DESIGN RECORD

CANADIAN-DEVELOPED MILITARY VEHICLES WORLD WAR II

VOLUME IV

SELF-PROPELLED M. T. CHASSIS

ISSUED BY
Army Engineering Design Branch
Department Of Munitions And Supply
Ottawa, Canada

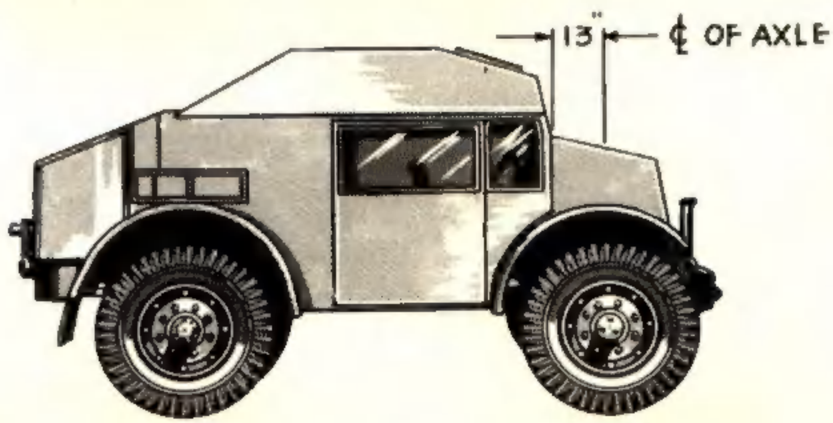

SELF-PROPELLED M.T. CHASSIS

CONTENTS

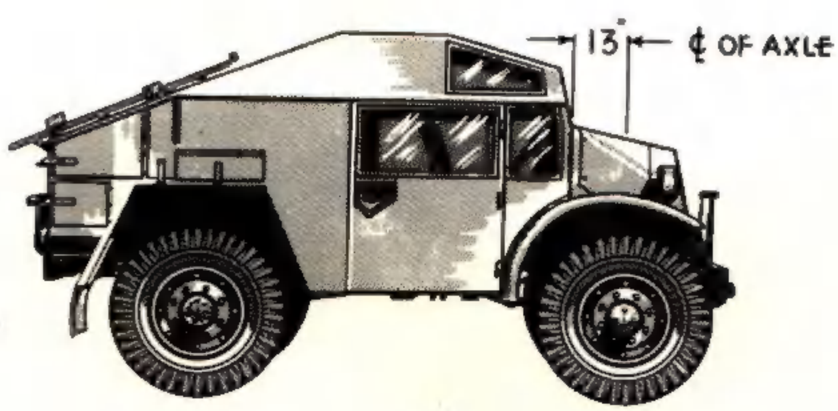
The policy stated for vehicle design at the beginning of the War was that it should conform to the British Army Standard. Therefore the Canadian Military Pattern Vehicles were developed from the dimensions of typical War Office vehicle. Aside from the fact that the majority of this class of vehicle had multi-wheel drive and were more ruggedly built, the chief characteristics in which they differed from Canadian commercial design were:- Semi-Cab over Engine; large single tires on heavy divided type wheels and right hand drive.

It is understood that the C.O.E. requirement, at least in the initial stages of the War, resulted from United Kingdom requirements for short turning circle and a minimum of overall length. Canadian vehicles, therefore, were developed along these lines and in wheelbases approximating the already established British Standard for any given size.

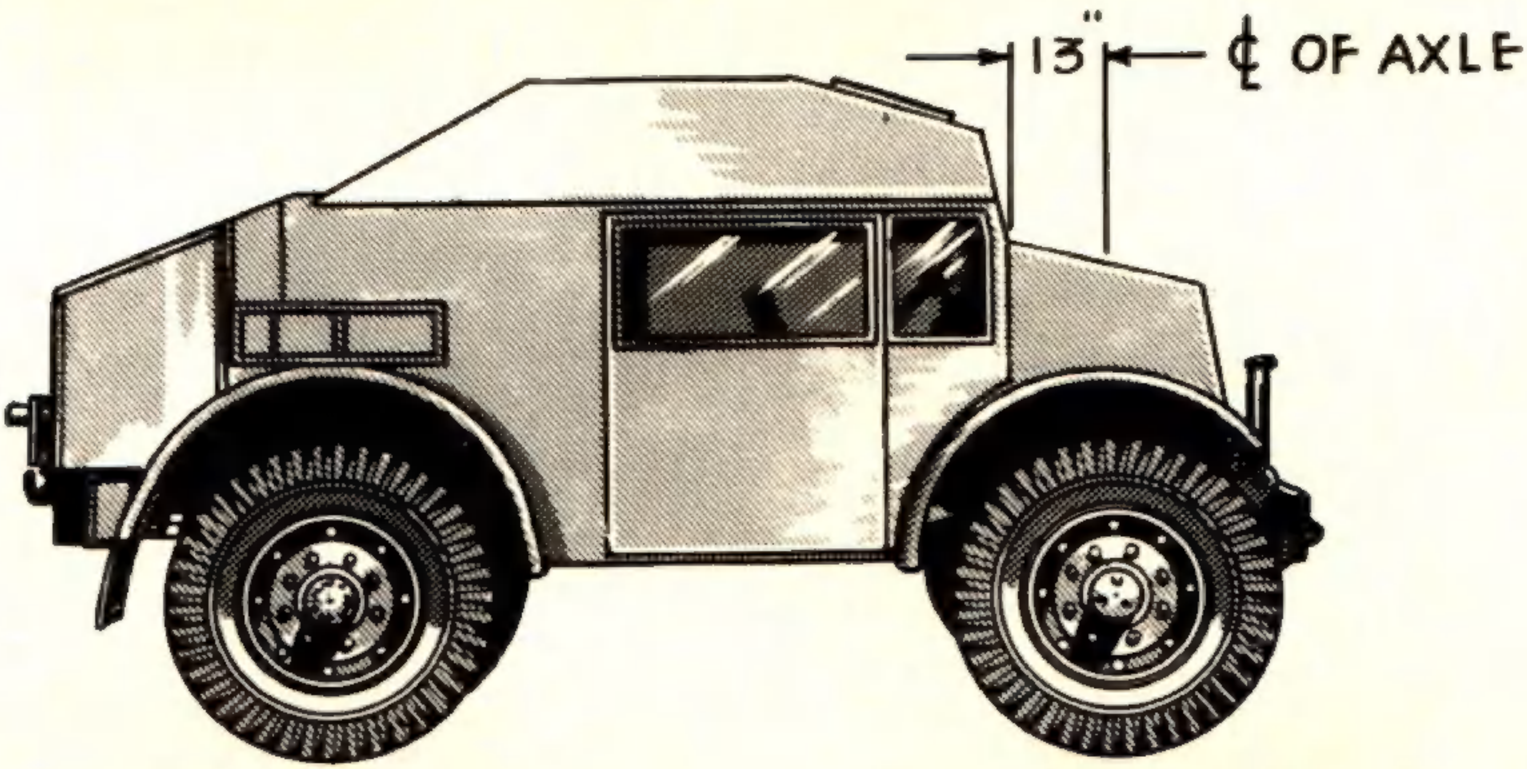
The acceptance of Semi-Cab over Engine Type as a definite requirement resulted in front axle loadings on Canadian Military Pattern Vehicles which were in excess of those experienced in Commercial Use. This feature was not fully appreciated and much effort was subsequently necessary to "heavy up" all front end components to compensate for this loading.

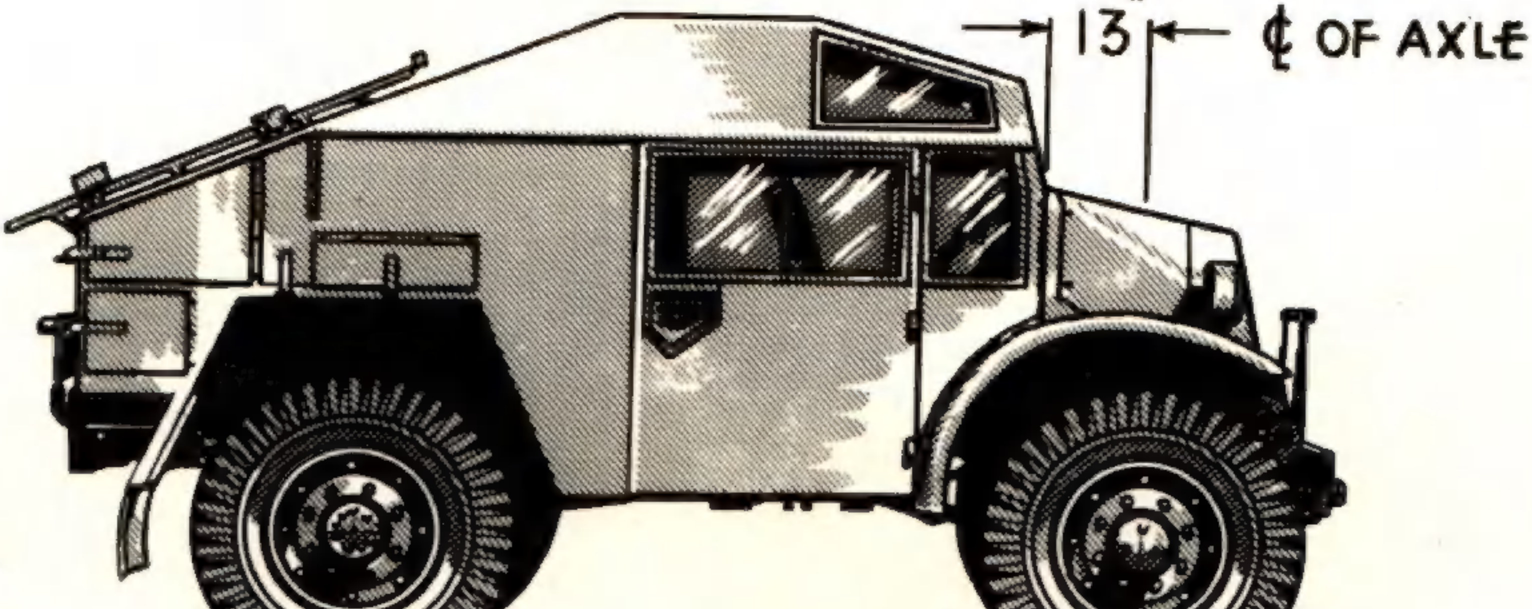


F.A. TRACTOR GUY 4 W.D. "QUADRANT"



F.A. TRACTOR 4X4 "101 W.B."


13"
℄ OF AXLE


13"
℄ OF AXLE

The Single Wheel and Tire used on any hub were considerably heavier and bulkier than commercial units. This excessive unsprung weight severely taxed the commercial axle components. The fact that front and rear tracks of single tired vehicles should coincide, laid a further requirement on the axle design.

Canadian Military Pattern Vehicles were developed from commercial components using basically two Power Plants, one a 6 cylinder in line engine, the other a V-8 engine, each of approximately 90 H.P. The ability of these engines to move vehicles in various gross weights ranging from 7000 pounds up to 16000 pounds was arranged by the use of various axle reduction and transfer case ratios. Under this arrangement, it is obvious that in a convoy, moving as one, and of various size vehicles, all the Power Plants could not be operating at the most economical speed.

In order to utilize to the full, the facilities which were available in industry, it was established as a proof practice that commercially proven components should be used wherever possible. In order to provide against the rigors of military use versus civilian use it was frequently the practice to use a component on military vehicles which was of a size heavier than the corresponding one which would have been used in commercial practice.

This plan was in general successful, as far as it applied to the basic component, but it was found necessary to make modifications to components in a very large number of instances. Subsequent pages which deal with the history regarding individual components tell their story in greater detail.

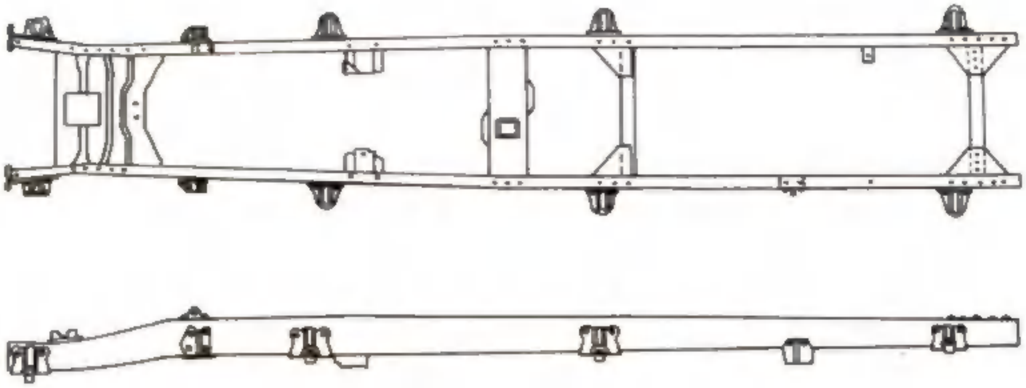
For consideration of the future it may now be stated that it is logical to use many proven commercial components but that the designer should anticipate the possibility of the necessity for some modifications to these assemblies.

TIRE & WHEEL ASSY.
8.25—20 (COMMERCIAL)
WT. 155 LBS.

W.D. TIRE & WHEEL ASSY.—10.50—20
WT. 237 LBS.

During the war a Weekly Progress Report was made by D.A.D. on projects in hand. This information has since been extracted and copied in grouped form for each project and it is suggested that this data be consulted for additional information, if required.

Comprehensive photographic files have also been developed. These include a binder containing positive prints. An envelope of negatives is filed under the same number.



FRAME

FRAMES:

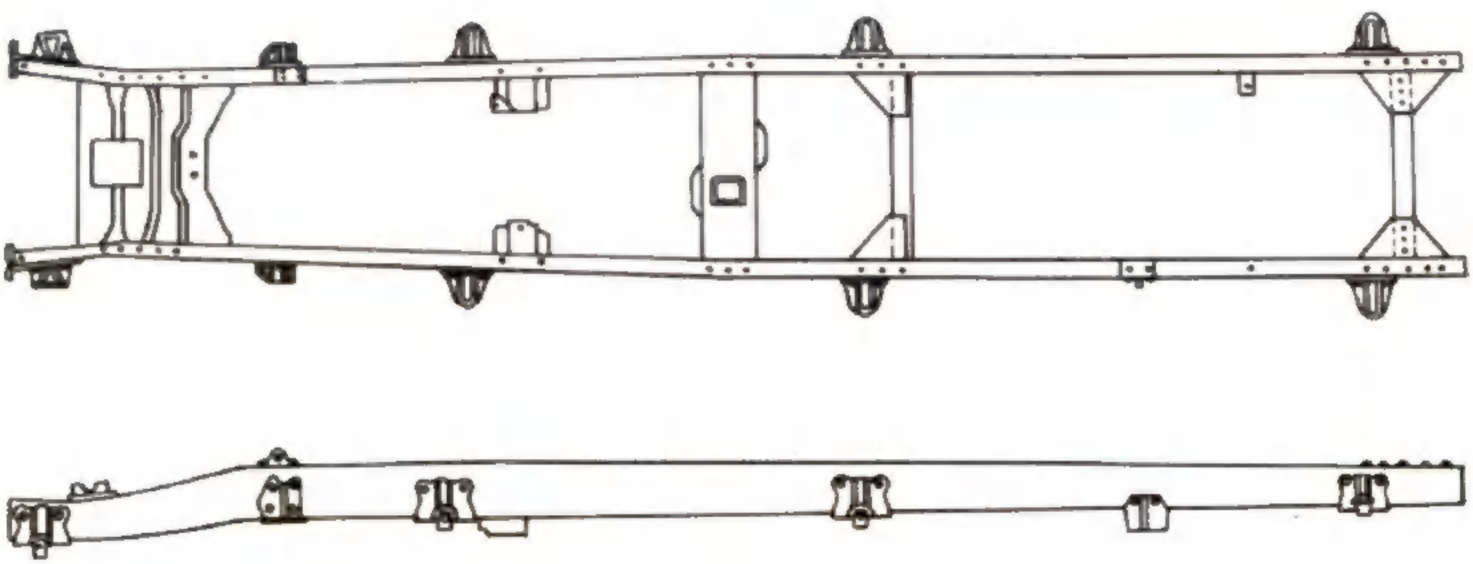
The basic frames on "B" vehicles have been adaptations of commercial components and consisted of channel members with suitable channel cross members. The frames for the lighter units on the short wheelbases have been relatively free of defects. However, frames on the 3-ton and gun tractor have required considerable reinforcement and modification depending on the particular model affected. The continuous build up in gross weight has aggravated points of severe stress. The ultimate requirement to furnish a spare pneumatic tire and wheel has resulted in the fact that frame lengths have had to be extended to compensate for the space absorbed.

The following are typical modifications found necessary.

1. Frame flanges have had to be vertically reinforced adjacent to axle bumper pads.
2. Frame webs at the forward end of the rear springs on 4 x 4's have been reinforced with inserts to prevent the spring hangers from flexing at this location.
3. With the provision of Cab Model 13, failures were experienced on the front supports with the tearing of the web at the anchor holes. Insert reinforcements were necessary at this point.
4. Fluid loads such as tankers and concentrated loads such as experienced in Portee, caused frame failures at that critical section to the rear of the cab, indicating that under more normal type of loading the factor of safety was minimum. Inserts, and, in one case, external reinforcing members were added to take care of such conditions.
5. On Winch equipped vehicles anchors for scotch [illegible]sers deformed the frame flanges where attached. Modifications were required to accommodate such highly stressed conditions.
6. On vehicles in which the body is bolted directly to the frame rail, modifications were found necessary in the method of attaching as the holes in the flanges of the frame rail became enlarged with subsequent failure at these points.
7. The installation of high bulky workshop bodies on the 6 x 6 units required reinforcing in the basic frame at the rear of the cab.

For the future designer the following suggestions are recorded:

1. It is axiomatic that with other things being equal the lower the frame height



of a chassis the lower the centre of gravity of the vehicle, and therefore the more stable the unit becomes. However, with a requirement of towing attachments whose location is controlled by the towed vehicle characteristics, low [redacted] levels may in [redacted] overall, add complications to body designs to accommodate such fitments as Tow Hooks etc. A compromise between high and low frame heights may have to be worked out.

2. Standard basic frame assemblies would [redacted] desirable between contractors furnishing chassis for one [redacted] design body.

3. The design of the frame should be based [redacted] the most extreme loading conditions on military establishment and/or projected establishments.

4. Consideration might be given to a vertically constant section channel frame from end to end [redacted] compared to the tapered and or kick up type of frame.

5. Experience has shown it is necessary to incorporate in frame rails a minimum number of openings or holes in either the top or bottom flange. Openings without rivets or tight bolts are particularly critical.

6. Production designs should incorporate features to enable transport by air with a minimum of disassembly and re-assembly.

7. 'Light Metal' frames might be considered [redacted] they have [redacted] successfully used commercially. The possible reduction in gross vehicle weight should not be overlooked.

<u>REFERENCES:</u>

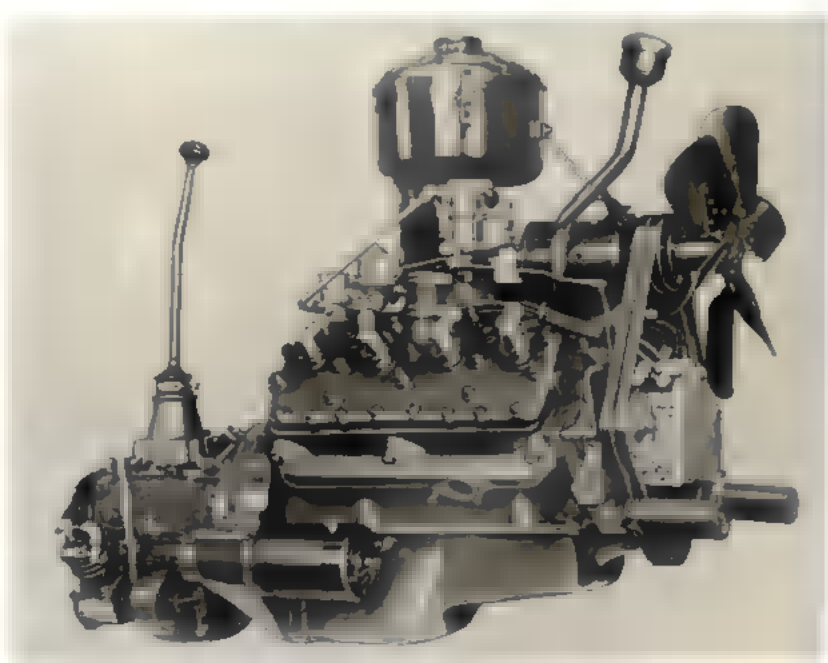
D.M.&S. File 73-F-4, 73-1-17.

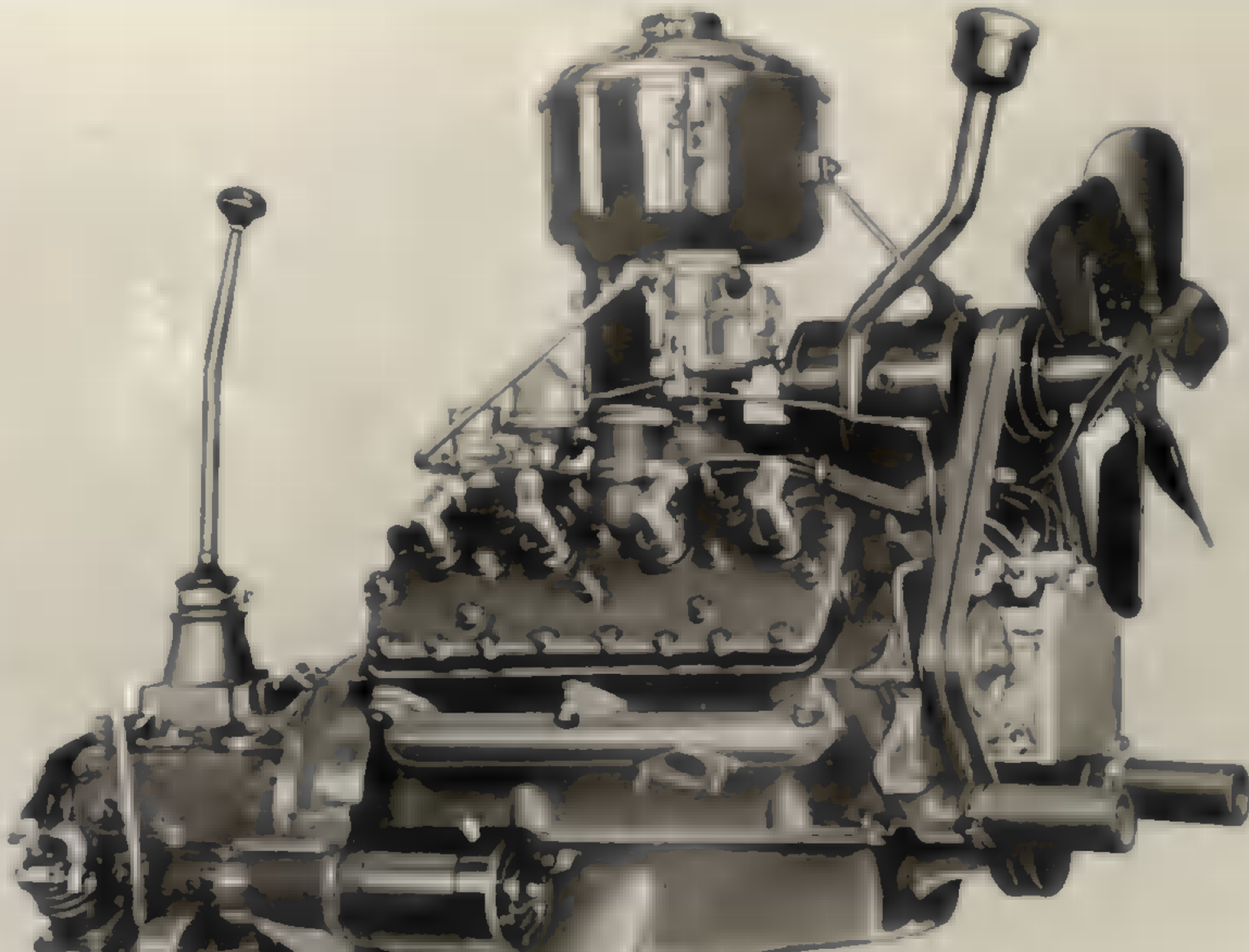
A.E.D.B. E.E. Test Reports Nos. E105, E212, E288.

[redacted]

1. The greater portion of C.M.P. Vehicles has been equipped with passenger car spark ignition Engines of approximately [redacted] H.P. These have been in two types, 216 and 239 cu. ins. displacement. These Engines have been satisfactory in the lighter chassis but [redacted] at the limit of their capacity with a gross load of 16,000 lbs.

2. On vehicles in excess of 16,000 lbs. gross, a heavy duty Engine of larger displacement, 270





cu. in. [redacted] used. Unfortunately, this Engine [redacted] not manufactured in Canada.

3. In standardizing [redacted] Engine size, it was necessary to compensate for the variety of loads by arranging the reduction ratios accordingly. This led to [redacted] high speed in the Engine of a slow speed heavily laden vehicle and therefore, [redacted] reduction in Engine Life related to vehicle miles [redacted] experienced.

4. Modifications to adapt commercial Engines to Military role included the following:

(a) Provision of large capacity Air Cleaner for Carburetor to reduce the necessity of frequent maintenance.

(b) Provision of Oil Filter.

(c) Provision of Sealed crankcase Ventilation to prevent ingress of dust, and to provide for positive ventilation at all speeds.

(d) Provision of Cold Starting including predilution.

(e) Provision of large capacity Drain Cocks [redacted] the cooling system for rapid draining to prevent freezing where Anti-Freeze is not available.

(f) Provision of sealed and flanged Carburetors to prevent ingress of dust.

(g) Provision of corrosion resisting components which [redacted] exposed to oxidation when immersed in salt water.

(h) Provision of special machined faces with glands and gaskets to prevent ingress of water to the working parts of [redacted] totally immersed engine.

5. For future design guidance it may be well to record the following points:

(a) Engines of 90 H.P., readily available at the moment, give a relatively poor power weight ratio on vehicles in excess of 15000 pounds gross for 4x4 units. For 6x6 units the power weight ratio, other things being equal, is still less satisfactory.

(b) Experience has shown that the field usefulness of engines, in M.T. vehicles, is largely governed by the availability of Engine Bearings [redacted] the adequacy of such bearings. Spare bearings [redacted] at times in short supply in World War II.

(c) Consideration should [redacted] given to the valves and valve seats with regard to their adequacy when used with highly leaded fuels.

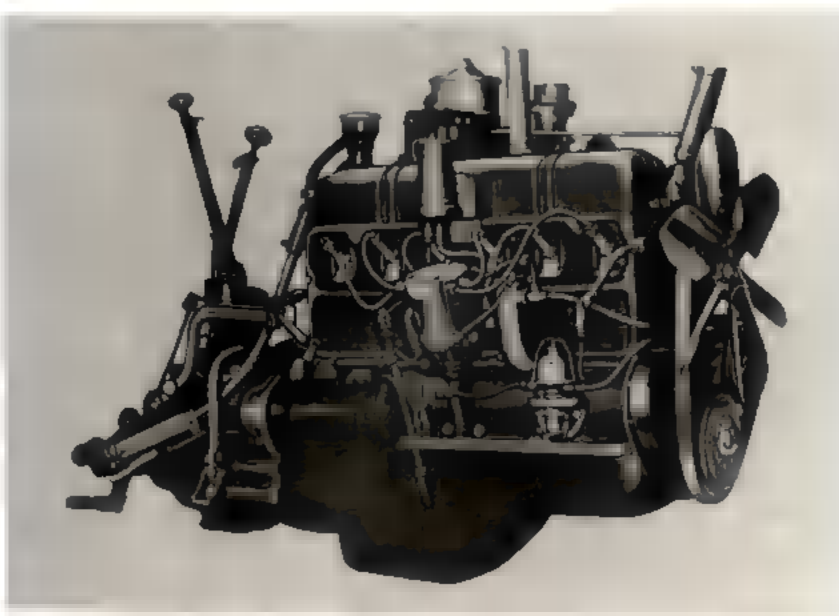
(d) Engine Lubricant Coolers would appear well worth consideration. Quite high oil temperatures have been [redacted] current design engines and may have been detrimental to bearing life.

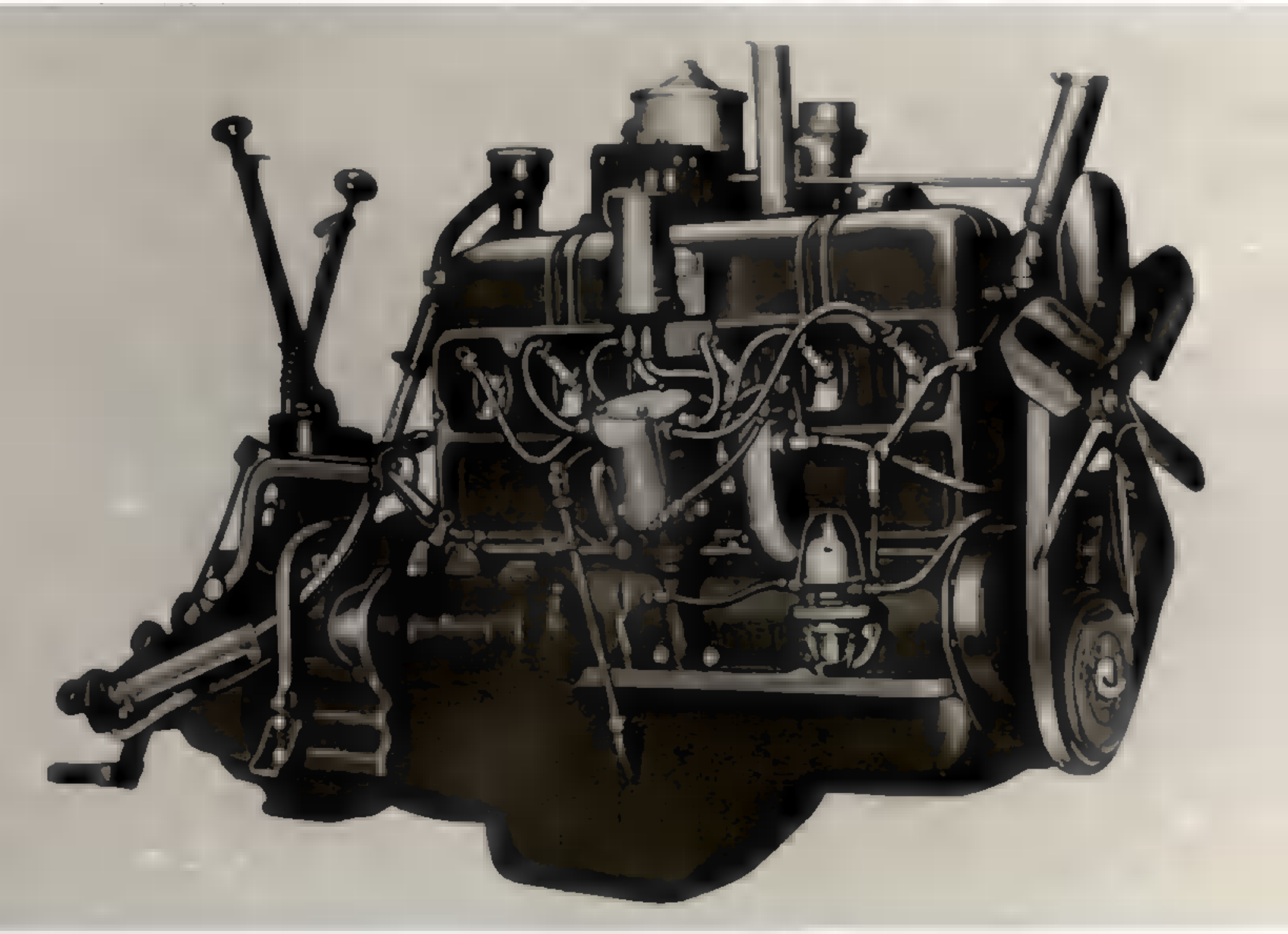
(e) Engine governors, to control the top engine speeds, would appear to warrant study when types not readily "unlocked" become available. Governors will not however eliminate high engine speeds when vehicles are operating down favourable grades.

REFEREN[redacted]:

D.M.&S. File 73-E-1.

A.E.D.B. E.E. Reports Nos. E79, E80, E109, E283, E287, E300, E379, E430, E498, E581.





TRANSMISSION

The Transmissions used behind the large volume engines were of the 4-speed forward, and 1 reverse, normal control commercial units. That used behind the larger engine was also 4-speed, but was of a capacity not usually manufactured in Canada and was therefore, an imported assembly. Each of the above designs were of proven commercial adequacy, but, as was to be expected, military use of [redacted] required modifications to be incorporated. These modifications were generally minor and include the following:

(a) The oil level and the quantity of oil required for lubrication was revised because of loss of oil through the shifter tower.

(b) Magnetic drain plugs [redacted] adopted by one manufacturer, to isolate metallic particles.

(c) The constant changing of gears in the heavy laden vehicles imposed service [redacted] beyond the normal commercial expectancy and slipping out of gear was experienced. Minor revisions were required to overcome such conditions, but were sometimes difficult to orient.

(d) Degrading of steel specifications lead to [redacted] difficulties and revised material specifications to agree with war emergency steel specifications were required.

(e) Bearing seals, retainers and shifting rod seals required modifications to provide reasonably water tight cases for Waders.

The ideal transmission is one with an infinite number of ratios and for the present and near future, this is approximated in the current "Fluid Flywheel", and/or "Torque Convertor" and/or the Hydromatic type Transmission. Unfortunately, the designs at present are limited in production, expensive in man-hours to produce, relatively tricky to maintain at efficient operation and, as well, are tailormade to suit [redacted] specific chassis both in the commercial truck variety or in the passenger car type. It is suggested that close contact be maintained with developments in this regard, and that periodically experimental units be subjected to military service.

REFERENCES

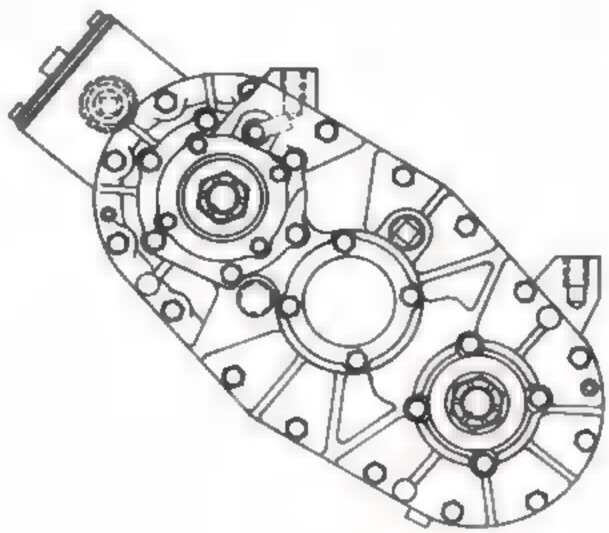
D.M.&S. File 73-T-3.

TRANSFER CASE

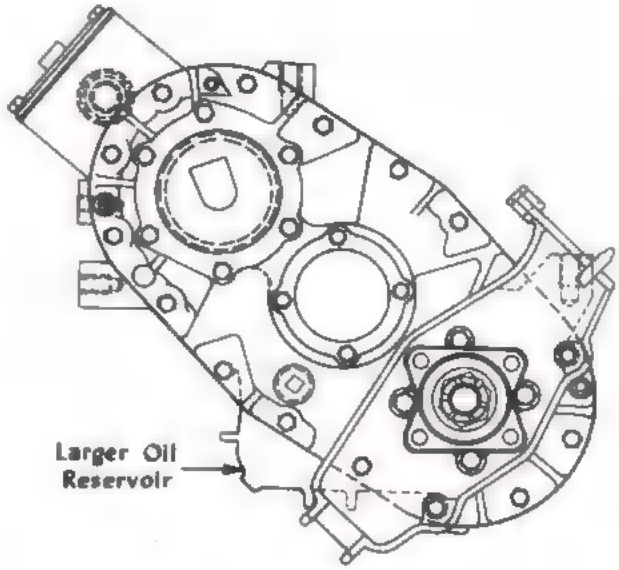
As in the case of trucks having front wheel drive which presented new problems to Canada, the Transfer Case, which is an associated component, also created [redacted] problems. The Canadian Cases [redacted] basically of [redacted] Design used in Commercial application in the U.S.A.

Our short experience during this War has taught several important lessons. High operating temperatures and a high noise level have been troublesome and it was concluded that operating temperatures are a function of lubricant level, speed, lubricant specifications, ambient temperatures and, the general design of the [redacted] itself, particularly with reference to its ability to withstand distortion and also the precision limits to which it has been manufactured - incidentally, these should be rather close.

It is also evident that the mounting of the Transfer Case and the Controls for changing ratios engaging Front Axle or P.T.O. are closely related, and this relationship must be accurately maintained. If the major axis of the present Case was more nearly horizontal, the problem of lubrication would have been somewhat alleviated, particularly with respect to the power take-off, since all other gears except the main shaft low ge[redacted] were stationary during P.T.O. operations, and since the oil level did not extend up to the rotating parts, there was only splash to lubricate them. Furthermore, a greater oil reservoir would be created without making [redacted] much, if any, head on the lower bearing seals. Placing the Transfer Case in this position will, of course, increase the belly clearance of the vehicle.



ORIGINAL TRANSFER CASE



REVISED TRANSFER CASE

However, this may be difficult to accomplish without having excessive drive line angles.

The Transfer Case gear ratios should be chosen to provide [redacted] nearly as possible equal increments between successive ratios from approximately 100:1 up to about 7:1 in terms of the present power plants and tire equipment.

[redacted] record of our experience with different drive combinations should be recorded. Two schools of thought exist mainly [redacted] follows:

(A) Those who prefer to have drive through the rear axle at all times and only through the front axle when traction conditions necessitate it, and

(B) Those preferring [redacted] type of compensator or third differential of the locking type in which the engine power is transmitted through both axles at all times.

The latter type may be preferred for the following reasons:

(a) Strictly from a design standpoint, the front axle declutch mechanism required by (A) is exposed more than an internal differential would be and the control linkage is subject to road hazards.

(b) Most Army trucks have [redacted] relatively high front axle loading and, from a control and safety standpoint, it is therefore felt that power should be transmitted to the front wheels to accept available increase traction.

(c) By actual test on [redacted] straight hard surfaced road, it was found that front tire tread wear was greater when the front wheels were running free than when power [redacted] being transmitted through them.

(d) While wheels drive at all times, there is less likelihood of the driver being stopped by poor traction through lack of judgment.

The likelihood of requiring the differential to be locked in the transfer [redacted] is reduced as compared with the present front axle declutch combinations, since all wheels would be driving at all times.

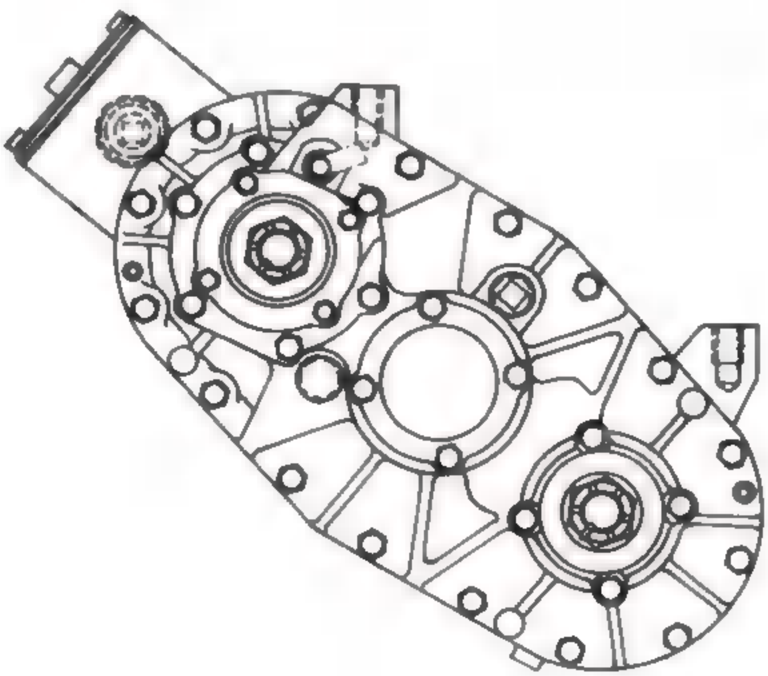
The current design of seals and seal faces were not all that could be desired, particularly from [redacted] standpoint of service life and also from a standpoint of sealing out [redacted] water during wading operations.

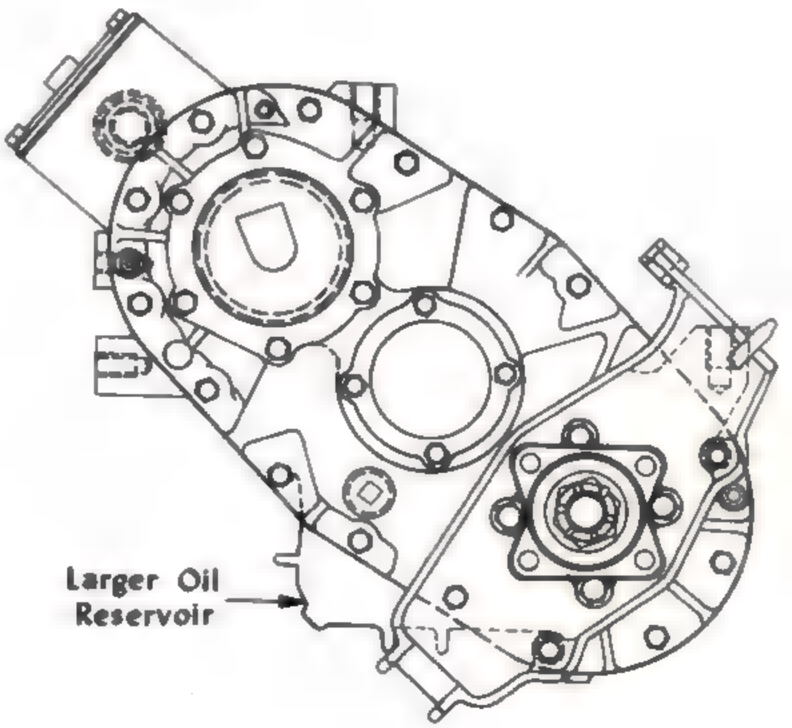
Insulated mountings of Transfer Cases would add greatly to the reduction in noise level but introduce problems in maintaining alignment.

<u>REFERENCES</u>

D.M.&S. File 73-T-3.

A.E.D.B. E.E. Reports Nos. E89, E280, E281, E468, E498, E506, E511.




Larger Oil
Reservoir

CHASSIS WINCH

This Section will deal only with the Winch suspended between [redacted] side rails [redacted] driven by the Take Off on the Transfer Case, with fairleads to allow winching forward or backward.

The [redacted] pull developed by this Winch [redacted] 11,000 pounds with [redacted] ratio of 6.2 to 1 in the Winch Drive Unit. The drive of the Winch consisted basically of [redacted] conventional [redacted] Axle Crown Gear, Pinion and Housing; the extended shaft of which carried [redacted] keyed horizontal Drum for spooling the Cable; the end of the shaft was supported in bearings designed to allow for the distortion in frame rails.

125 feet of 5/8" diameter cable [redacted] normally fitted [redacted] this Drum; the Drum could be driven to wind "in" or "out" and in addition could be held in [redacted] position by using [redacted] Hand Brake applied to the Pinion Shaft.

The experience indicated the following shortcomings in this design:

(a) The Winch was located relative to the Rear Axle at a constant distance because of short wheelbase Units, [redacted] the lead from the rear Sheave to [redacted] was relatively short causing mal-alignment of spooling of cable on Drum.

(b) The grooves on the Drum barrel [redacted] of questionable advantage.

(c) Routing of Cable to the forward end, under chassis, was inconvenient when Chassis becomes bogged down.

(d) Cable capacity required to meet later W.O. demands was not sufficient. These requirements [redacted] 200 to 250 ft. of cable.

(e) Pulling capacity for future F.A.T. was indicated [redacted] 90% of G.V.W.

Future action should determine:

(a) Whether Winching from both front and rear of vehicle is [redacted] firm definite necessity and whether Winching from one direction only is not equally satisfactory.

(b) The maximum Rope likely to be required with provision for same in Drum design.

(c) That consideration has been given to the [redacted] of small flexible Ropes with the aid of Blocks for heavy pulls as compared to single line straight pulls.

(d) Careful study be made to provide even "laying on" of Cable, either laden or unladen, whatever the location of the winch. Experimental Devices have been developed for Winches operating in various chassis positions.

(e) The Design of Winch will directly affect the clearance Chassis to Ground, either in approach, departure or belly dimension and this should be borne in mind.

[redacted]

D.M. & S. File 73-1-17

A.E.D.B. E.E. Reports Nos. E499, E519, E577, E613.

D.V.S.A. 6-439-E.

CLUTCH

The Clutches used have been of the single plate dry disc design of [redacted] heavy type in the size commercially applied to the subject engines.

Relatively minor modifications have been found necessary, however the indications [redacted] that Winches [redacted] become [redacted] requirement on all future vehicles in which [redacted] Clutch use will be increased to a degree and therefore life will presumably be reduced.

Experience on "sealed in" Clutch housings for wading [redacted] this time is not extensive and the performance resulting from this practice should be the subject of future observance in [redacted] far [redacted] normal operations are concerned.

REFERENCES

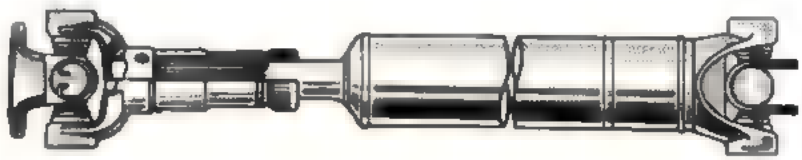
D.M. [redacted] S. File 73-E-1.

A.E.D.B. E.E. Reports Nos. E139, E293.

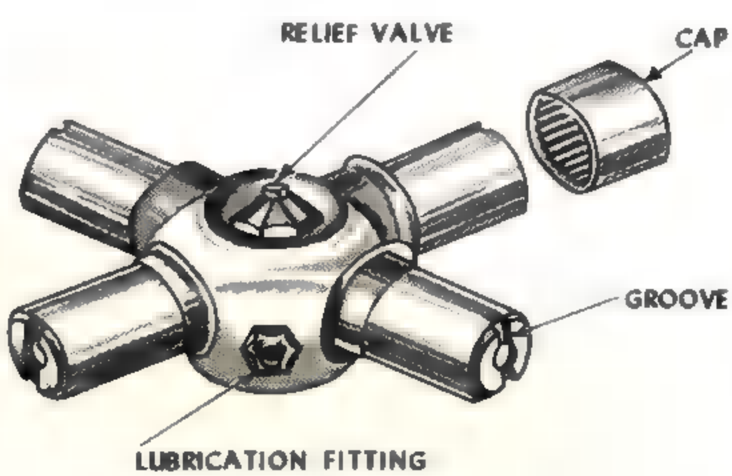
DRIVE LINE PROPELLER SHAFT AND UNIVERSAL JOINTS

Propeller Shafts [redacted] all wheeled drive vehicles [redacted] of the balanced tubular type fitted with conventional Hook type needle bearing Universal Joints. On the longer wheel-base 4x4's, [redacted] on 6x6, intermediate support bearings [redacted] provided, the former bearing being self aligning. All Propeller Shafts [redacted] of the exposed type [redacted] differentiated from the enclosed or torque tube type.

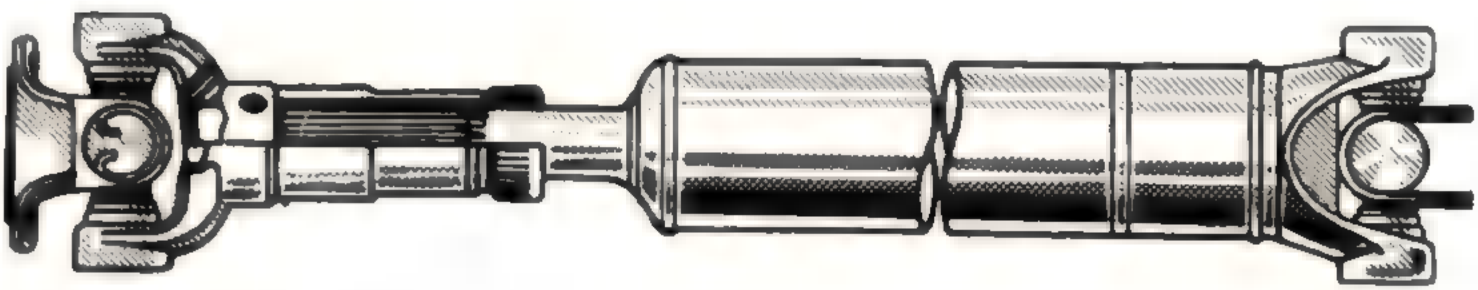
Early in production it became evident that the degree of articulation and torque involved created stresses beyond the capacity of the designs. Greater angular capacity, longer and [redacted] rugged slip splines, larger needle bearing assemblies and heavier tube section were all incorporated. Further short-comings were found in the sealing against grit and water on the slip joints [redacted] in the lubrication of the needle bearings. Slingers [redacted] provided and lubricant pressures of needle bearings increased. The latter [redacted] accomplished by increasing the blow-off pressure of the relief valve and redesigning the lubrication grooves.

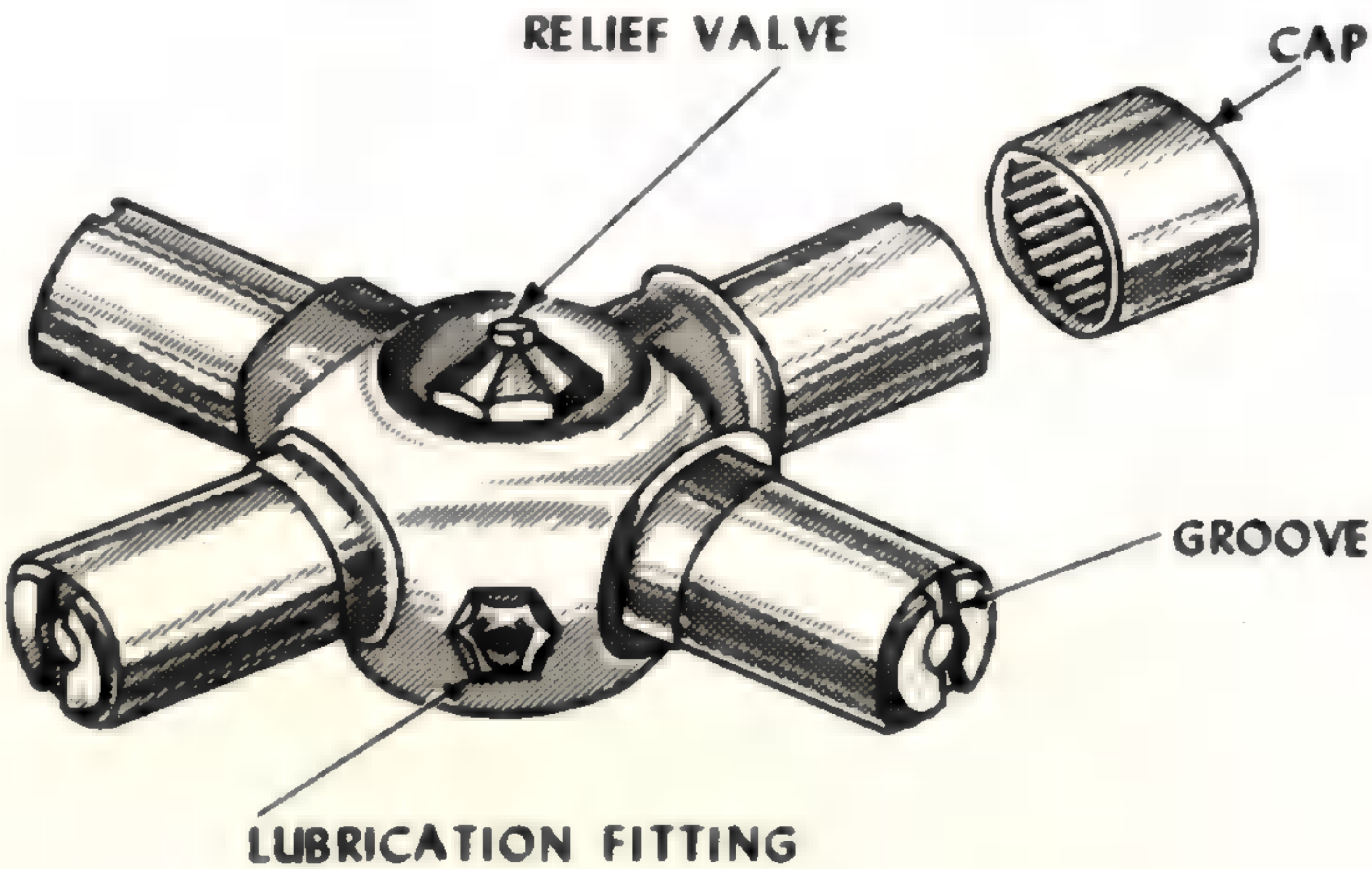


REAR PROPELLOR SHAFT



UNIVERSAL JOINT JOURNAL




RELIEF VALVE
CAP
GROOVE
LUBRICATION FITTING

Mal-adjustment of [redacted] two 'U' bolt type clip Universal Joints resulted in brinneling of the spiders in certain locations. On the short shaft between the transmission and transfer case, these [redacted] replaced by [redacted] four-bolt flanged-yoke type.

[redacted] attaching nuts of both 'U'-clips [redacted] flange bolts tended to loosen unless particular service attention [redacted] provided.

For future designs surplus angularity, travel, and capacity should [redacted] provided, and nuts should be of the non-back-off type. Further consideration should also be given to improving the lubrication of needle bearings such [redacted] providing a separate grease fitting for each bearing.

REFERENCES:

D.M.&S. File 73-T-3

A.E.D.B. E.E. Report E-284

COOLING SYSTEM

The engine Cooling System of [redacted] Vehicles [redacted] a combination of liquid and air of commercial design. The liquid coolant was circulated by [redacted] or more pumps on the motor through a radiator of either ribbed cellular or tube and fin type. The air [redacted] circulated by a fan mounted adjacent to the radiator and routed past [redacted] engine proper. In order to allow liquid coolant to reach temperatures in excess of 212°F, without vapourizing, sealed cooling systems [redacted] provided to allow pressures of 3 to [redacted] lbs./sq. in.

Because CMP Vehicles were of the COE Type, and due to frame distortion consequent of the high articulation, and further [redacted] a result of weather conditions experienced in Service, the following modifications were [redacted] during the production of vehicles:

(a) Fan Shrouds to control the air flow.

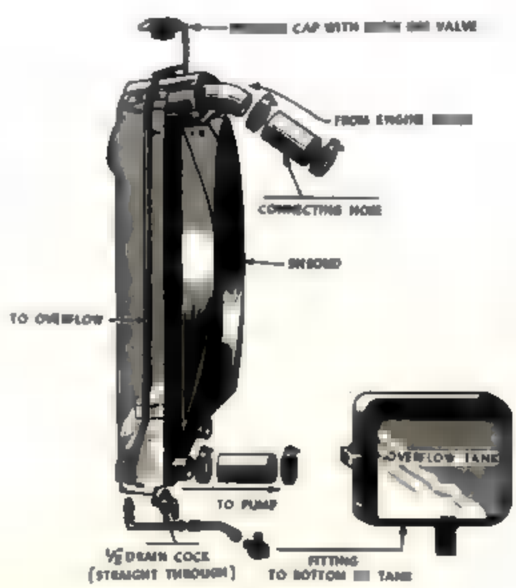
(b) Liquid Coolant capacity maintained by provision of Overflow Reservoirs.

(c) Redesign [redacted] reinforcing of radiator attaching means.

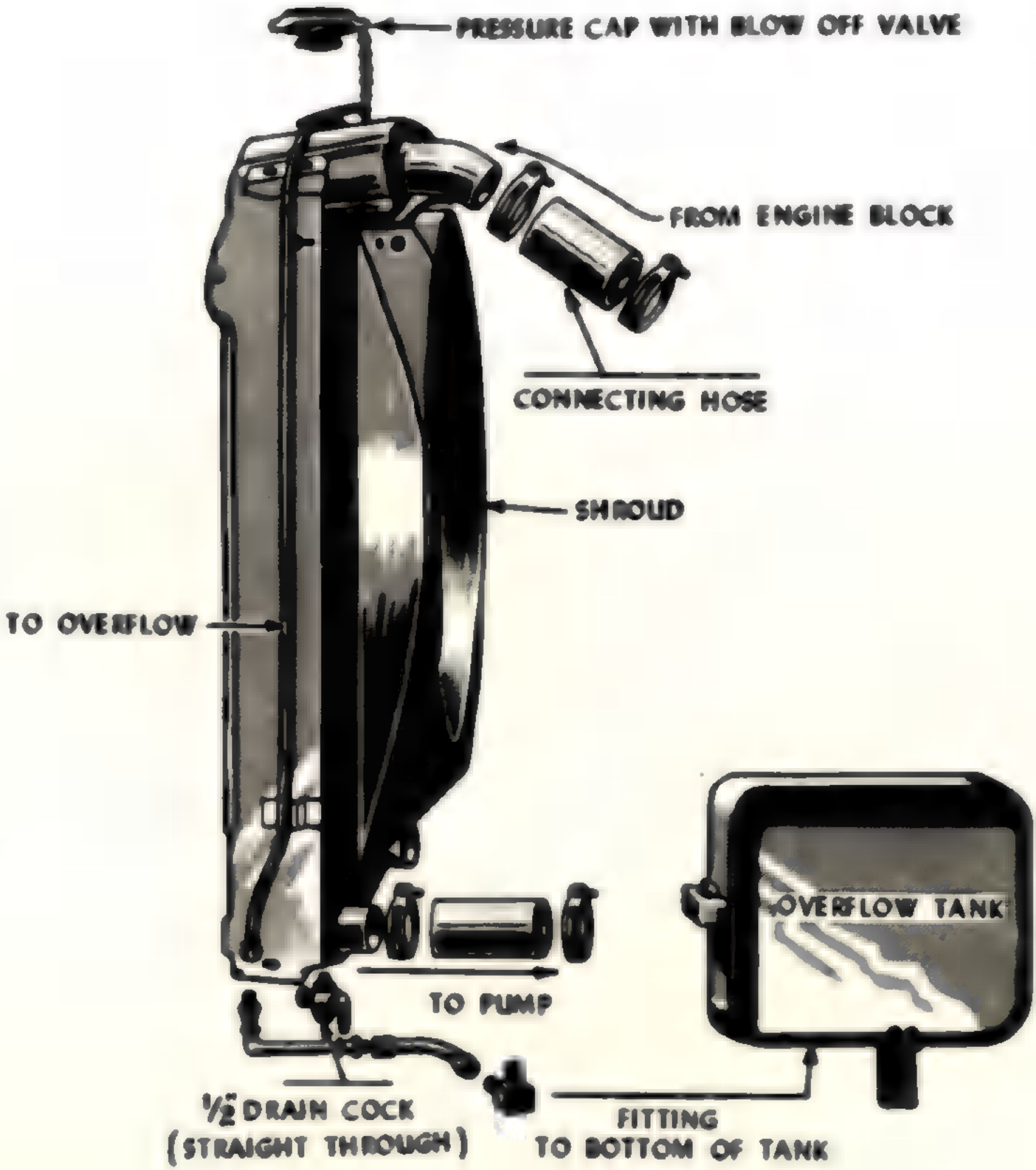
(d) Provision of Thermostats.

(e) Increase in the number, size and type of Drain Cocks to facilitate speedy drainage in freezing temperatures where adequate anti-freezes were not available.

[redacted] to the necessity of reducing the use of Tin, numerous other radiator soldering materials [redacted] investigated, [redacted] most [redacted]sful of which [redacted] Silver Solder applied [redacted] the cellular core only. The Tin content of the Standard Solder [redacted] considerably reduced and a portion of the radiator failures ex-



RADIATOR AND [redacted] TANK



RADIATOR AND OVERFLOW TANK

perienced was possibly due to this modification.

[redacted]

D.M.AS. File 75-C-7

A.E.D.B. E.E. Reports Nos. E286, E296.

FUEL SYSTEM

All C.M.P. Vehicles [redacted] fitted with two Fuel Tanks of the non-bullet proof type and [redacted] built of corrosive resistant steel. They [redacted] suspended one on either side of the chassis frame side rails, usually mounted adjacent to the back of the cab, interconnected with [redacted] draw-off line fitted with [redacted] three-way Valve allowing the [redacted] of either Tank independently.

Between the Three-way Valve and Fuel Pump [redacted] Fuel Filter [redacted] provided. From this point, the line led to a mechanically driven Fuel Pump of the diaphragm type and thence to the Carburetor.

Early Fuel Tanks were found to be inadequate in capacity, subject to foreign material entering, slow in filling, difficult to clean out, and [redacted] Draw-Off Line subject to plugging. During production, the capacity of the Tanks was increased on certain models and Screens provided in the Filler Necks as well [redacted] a Vent Pipe to increase the rate of filling.

A pilot Tank was developed which included the following features:

(a) Larger Filler Neck.

(b) Increased diameter Draw-Off Tube.

(c) Large Cleanout Opening.

(d) [redacted] rugged Top, to bear a man's weight.

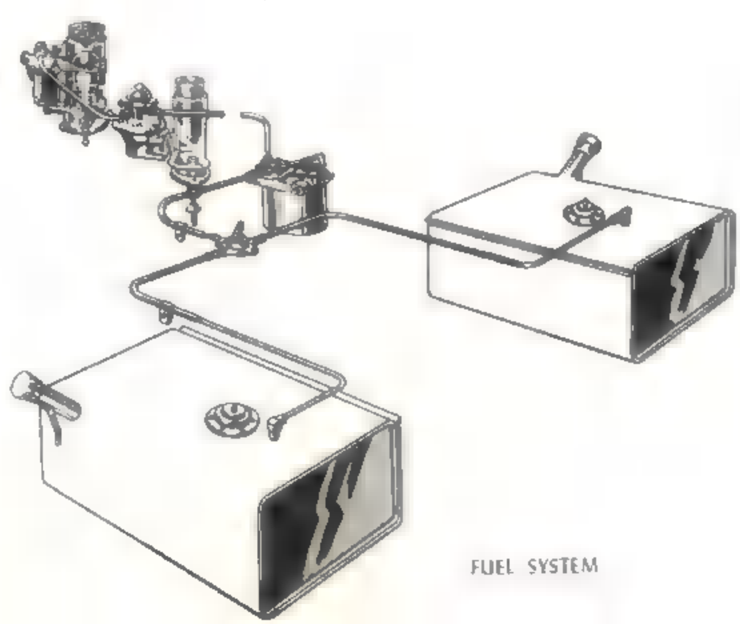
(e) Large Sump with Drain Plug in bottom.

(f) Facilities for guiding sludge away from the Draw-Off Tube.

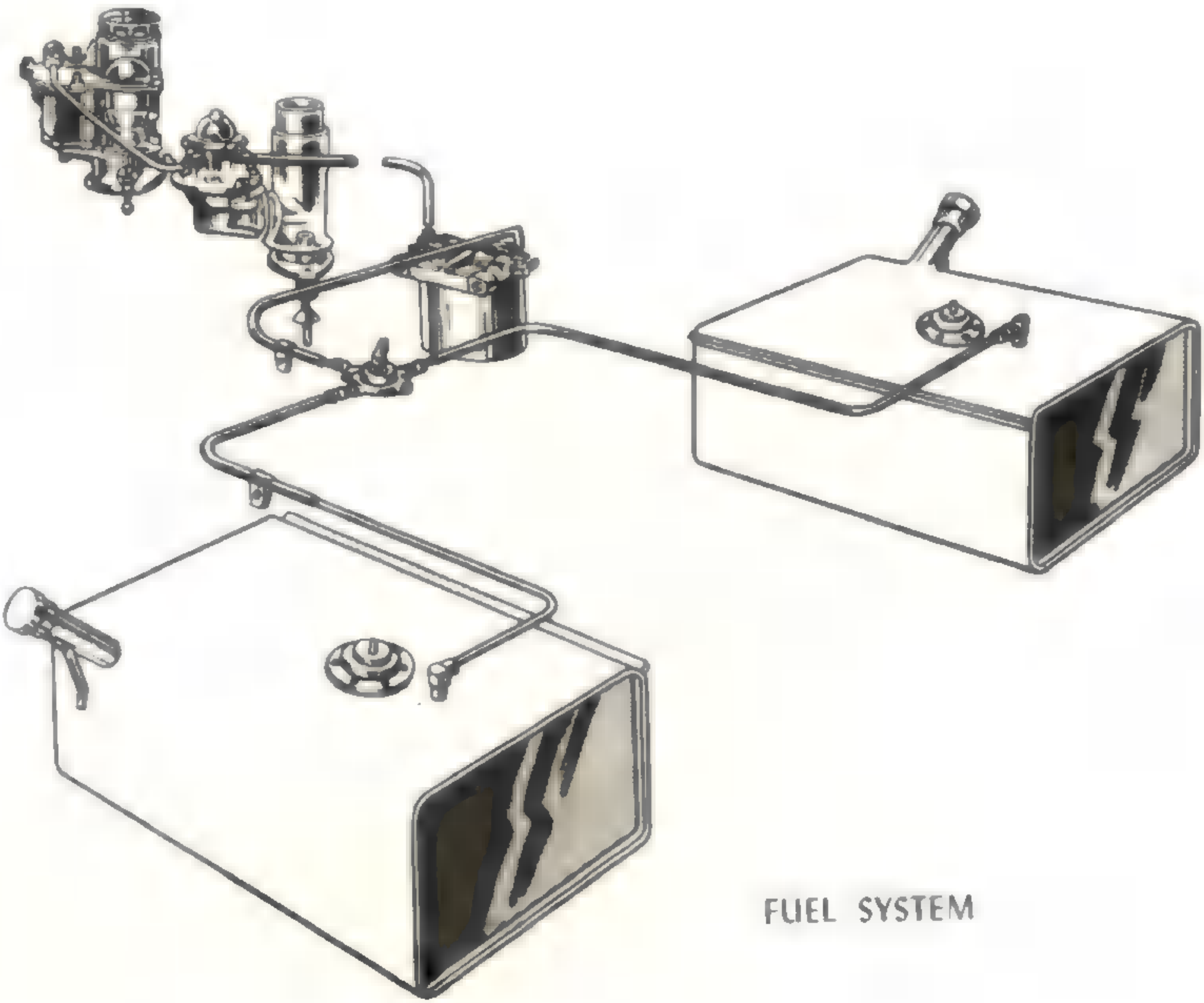
Unfortunately, this Tank never reached production, but is illustrated on the following page.

It [redacted] found that it would be very difficult to increase the capacity of the Tanks without sacrificing belly clearance and/or interfering with body and cab design on G.S. Vehicles. The Users demand for vehicle fuel capacity continued to increase until 450 miles without refill was specified. Future vehicle fuel capacity should be based on this requirement.

With the types of Fuel available in certain areas large deposits of gum reduced the capacity of the Feed Lines until the flow [redacted] such that plugging occurred. Flexible Fuel Line sections were found necessary to reduce breakage due to vibration.

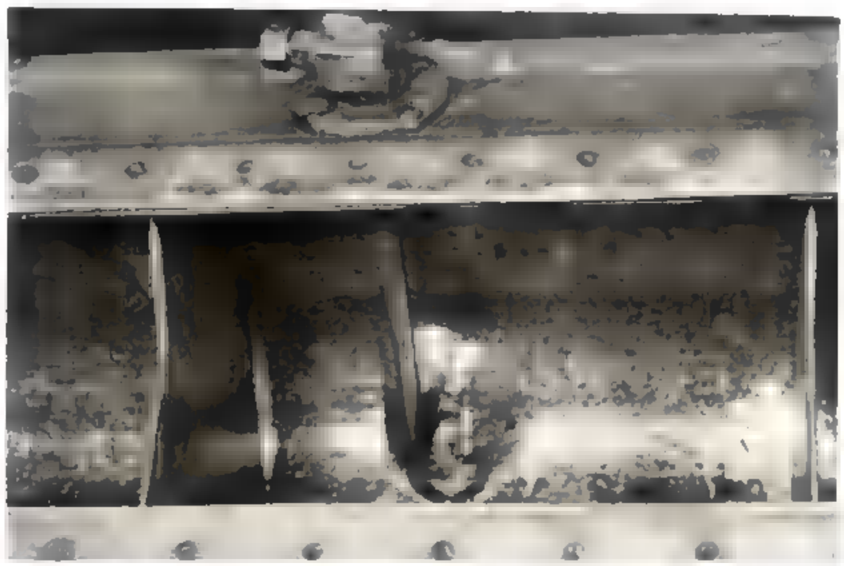


FUEL SYSTEM



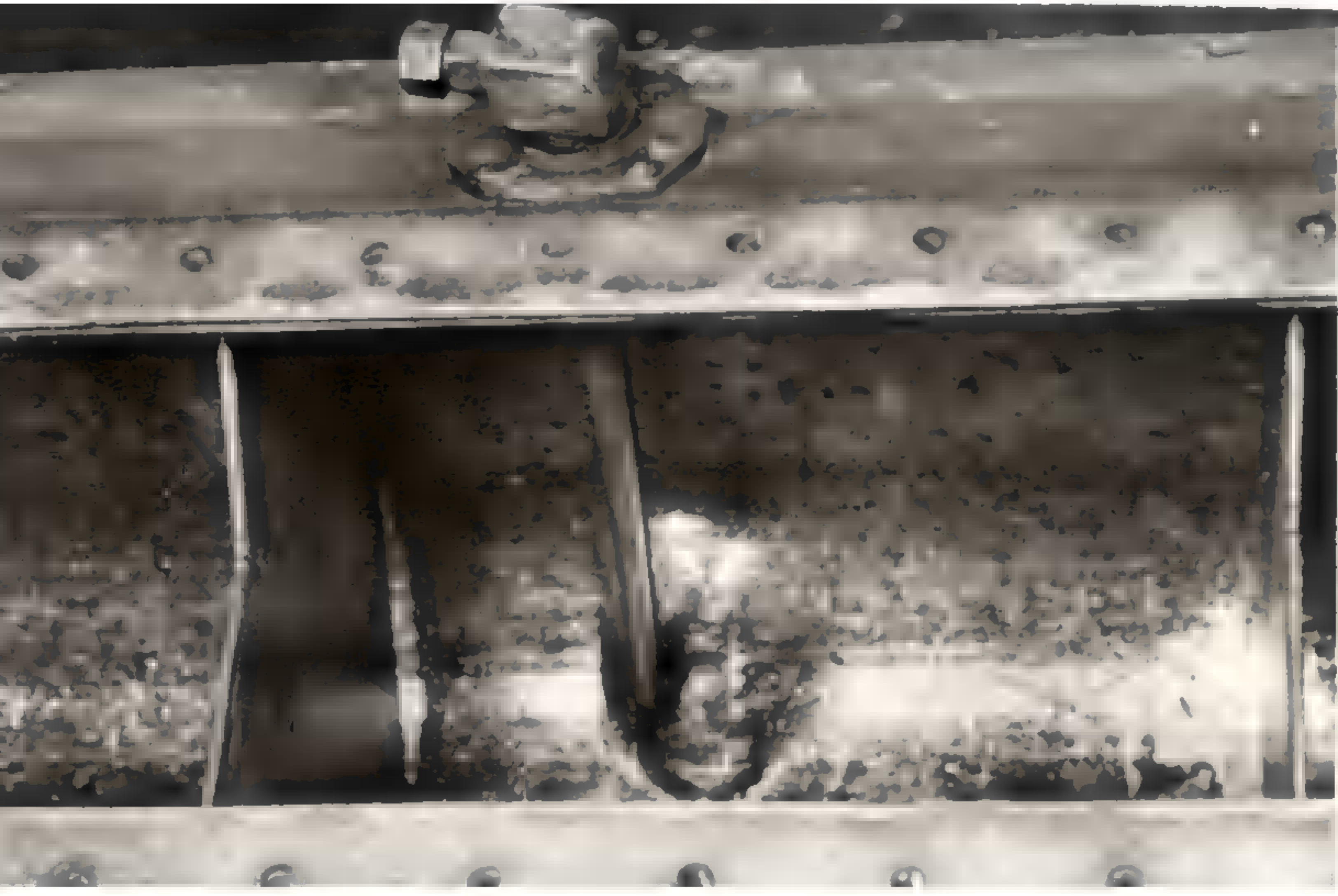
FUEL SYSTEM

PILOT TANK PLAN VIEW



PILOT TANK INTERNAL VIEW

PILOT TANK BOTTOM VIEW



The Fuel Filter was generally satisfactory in performance but on certain models was inaccessible and suffered from lack of proper maintenance. This condition [redacted] subsequently corrected.

The basic difficulty with the Fuel Pump was with its Diaphram which was required to pump, at extreme low and high temperatures, fuel with alcohol admixtures or normal fuels. [redacted] Diaphram designed to take care of all these conditions was never developed.

Vapour Lock was experienced in areas such as India where high altitudes occur. The most successful cure [redacted] the provision of a Pusher Pump located adjacent to the Fuel Tank. A Fuel Pump Hand Primer [redacted] incorporated to alleviate Vapour Lock, facilitate filling Carburetor for Cold Starting and clearing blocked Fuel Lines between Pump and Carburetor.

Carburetors were of the Down-Draft Type to suit the characteristics of the various engines. Continued efforts were made to better the Fuel Economy without sacrificing Engine Performance. Subsequently Carburetors [redacted] fitted with Mounting Flanges and seal to prevent the ingress of Water and Dust.

REFERENCES:

D.M.&S. File 73-F-1

A.E.D.B. E.E. Report E-516

BATTERIES

The first vehicles built for Army orders were fitted with the [redacted] Battery as supplied in the individual model truck for commercial production. Shortly after production started steps were taken to equip vehicles with Batteries which were physically interchangeable from [redacted] make of vehicle to the other [redacted] that any Battery fitted to a Motor Transport vehicle would fit into the Battery Hanger of any other vehicle. This arrangement necessitated that Ford change the pole positions of their Batteries and, in certain models, change the physical dimensions [redacted] that all their M.T. vehicles would be fitted with the same Battery.

With the exception of the Universal Carrier, which adopted the same size Battery [redacted] fitted to the English counterpart, all Armoured vehicles built by the Motor Vehicle Manufacturers used the [redacted] Battery as supplied for M.T. vehicles and used two in series where a 12-volt system was required.

This policy [redacted] continued until cold starting became an important factor. For desert operation the Battery requirement for M.T. Vehicles was not severe [redacted] the starting torque requirement was low and the S.A.E.-2L battery supplied [redacted] adequate. However, for low temperature operation the available starting torque became an important factor, also for Armoured Wireless Set carrying vehicles it [redacted] found that the S.A.E.-2L capacity was too low for the conditions under which the vehicles operated.

As explained in the Articising Section the original solution to the cold starting problem was to apply heat to the Battery and, subsequently, for operation in temperatures below minus 20° F, it was found advisable to keep the Battery warm to ensure satisfactory starting. The first approach to this problem was to apply heat to an insulated Battery during vehicle operation. The insulation delayed cooling of the Battery so that during an overnight stand the temperature would be maintained at the point where adequate starting torque would be available. It [redacted] also determined that with vehicles fitted with voltage regulators, it [redacted] necessary to raise the battery temperature to above 40°F above zero so that it could be adequately charged.

A later development for cold weather operation was the multi plate Battery. It was found that by building [redacted] battery with thin separators, thus bringing the plates closer together, the internal resistance [redacted] lowered and better starting torque at low temperatures was obtained. During the Summer of 1942, Experimental Batteries [redacted] built using 23 plates per cell, these were tested in vehicle operation at Camp Shilo in the Winter of 1942-43. Subsequently they [redacted] tested under laboratory conditions in the Cold Rooms of the Ford Motor Company in comparison with standard vehicle equipment Batteries. The results of these tests [redacted] covered in [redacted] report entitled "Report [redacted] Investigations of Lead Acid Type Storage Battery for Operation at Low Temperatures."

Following the tests the results were discussed at a meeting of the S.A.E.-U.S. War Engineering Board's Battery Committee to secure the advice of the best Battery experts [redacted] this Continent. The minutes of this meeting [redacted] included [redacted] part of the above mentioned report.

Some doubt was expressed [redacted] to whether the thin wood separators would give reasonable life under actual vehicle operating conditions. Before an opportunity was available to test the Batteries adequately, under actual operating conditions, an order was received for vehicles for operation in areas of minus 15°F where no standby heat [redacted] to be provided. A meeting was held with the Canadian Battery Manufacturers to decide on the type of Battery to be supplied for this order. A compromise [redacted] agreed upon of [redacted] 21 plate per cell Battery which, it was estimated, would give the starting torque required and would, at the [redacted] time, provide separators of sufficient thickness to give reasonable life. Subsequent laboratory tests showed that the 21 plate would give the torque required at minus 20°F (see Presto-O-Lite and Exide reports) and tests in vehicles operating on Tire Tests at Normoyle, Texas, indicated that the Battery life was better than the smaller capacity standard equipment Battery and equal to [redacted] 17 plate unit of the [redacted] ampere hour capacity. For the report on these tests refer to Experimental Report E-297, entitled "Report [redacted] Low Temperature Batteries (DMS-21 and similar Batteries) in Life Tests Under Normal Truck Use."

Specification O.A. 121 [redacted] written to cover the design and performance requirements of the 21 plate Battery which was designated D.M.S.-21.

In Armoured vehicles carrying wireless sets, it [redacted] found that the standard equipment M.T. 6-volt Batteries did not give the proper balance between the charging capacity and the battery load. When satisfactory test reports on the D.M.S.-21 became available it was decided to specify this type to replace the standard battery, identified [redacted] D.N.D., to secure the advantage of its larger capacity and its better low temperature characteristics.

The Department of National Defence [redacted] desirous of using a battery in which all replacable parts were interchangeable, this to facilitate the repair of batteries. For this reason, they wished to standardize, for use in Canada, on the D.M.S.-21 type as its specification [redacted] written to [redacted] that all replaceable parts would be interchangeable irrespective of the manufacturer. However, due to the additional labor and parts involved in producing the D.M.S.-21 over standard types, and the tremendous demand for both original equipment and replacement batteries, production facilities did not permit such [redacted] move to be made.

Commercial practice followed by the suppliers of both Ford and General Motors [redacted] to use [redacted] asphalt composition container. This practice was followed for Military vehicles and had considerable production advantage [redacted] these containers could be produced several times more rapidly than rubber containers.

However, Cold Room tests indicated that, where the container was subjected to extremes of heat and cold, the rubber container [redacted] much more satisfactory. For this reason, the rubber container [redacted] specified for all vehicles where the Battery was located under the hood, and for all vehicles fitted with Arctic equipment where it was subject to rapid changes in temperature.

There [redacted] a considerable divergence of policy with regards to batteries between that followed by U.S. and that followed by the British and Canadian Armies. U.S. practice [redacted] to use [redacted] dry charged Battery with porous rubber separators for export shipment. Upon arrival at destination this Battery could be put into immediate service at 75% of its capacity by adding the proper electrolyte. On the other hand batteries supplied to the British and Canadian Armies were fabricated using wood separators and [redacted] these had to be shipped in the moist state they were shipped dry, uncharged, [redacted] on arrival at destination required 40 to 60 hours charging to put them into serviceable condition. This latter arrangement, of course, required the provision of adequate charging facilities.

The U.S. rubber separator Battery demanded the supply of natural rubber, which by 1944 [redacted] in short supply and substitutions were tested, microporous glass [redacted] adopted on an [redacted] ergency basis although its S.A.E. Life Cycles were considerably lower than with the rubber.

It should be noted that the Batteries built with rubber separators lose less capacity due to storage than do those with wooden separators, and that after they have been stored for an extended period their low temperature characteristics [redacted] better.

For operation in areas in which the temperatures [redacted] similar to those encountered in Canada, the S.A.E.-2L Battery supplied [redacted] original equipment does not have adequate capacity to provide any factor of safety during Winter operation. [redacted] larger capacity Battery and particularly one with better low temperature chacteristics such as the D.M.S.-21 should be provided.

Summarization of the batteries supplied in vehicles built by Canadian Motor Vehicle Manufacturers is given on Battery Chart F-42-S.P.

REFERENCES:

File	-	73-1-4
E.E. Report	-	E.279
Specification	-	O.A. 121

BLACKOUT LIGHTING

All Canadian Military Pattern Vehicles [redacted] fitted, in the factory, with a lighting arrangement which enabled the vehicles to be operated in areas where "Blackout" existed.

The function of Blackout Equipment on vehicles was to -

(a) Screen the lights from enemy observations, particularly aerial.

(b) Reduce the amount of and direct light projected from the various lamps to best advantage, thus reducing the amount of reflected light around the vehicles.

The first C.M.P. Vehicles built were fitted with standard commercial lighting, i.e. two Headlamps of the replacable Bulb type, with upper and lower beams, Parking, Tail, Stop and direct Instrument Lamps. Separate switches [redacted] provided for each of the following; Instrument Light, Tail Light and Stop Light so that they each could be turned off when the Headlights were on.

The first type Blackout Equipment consisted of a Blackout Shield assembled between the Lens and the Lens retaining Rim of the Headlamps. In addition, the lower halves of the Headlamp Reflectors were painted Black. A shield was also supplied for the Tail Lamp Lens, the Tail Lamp License opening and the Stop Lamp. This shield had a 1/4" Dia. hole located in its centre. As in the original installation separate switches were provided so that the Tail, Stop and Instrument Lights could be turned off when the Head Lights were on.

In March 1941, the first issue of Specification O.A. 62 covering Blackout Equipment was released. This is[redacted] specified the following features:

(a) Parking Bulbs removed.

(b) Right Headlamp - fitted with a Double Contact, Double Filament prefocussed type Bulb having two 6 Watt Filaments. A metal mask [redacted] fitted on the outside of the Lens with 1/8 ins. Dia. hole located in its centre. The lower half of the reflector [redacted] painted Black.

(c) Left Headlamp - fitted with a Double Contact, Double Filament prefocussed type Bulb having one 6 and one 36 Watt Filament, the 36 Watt being the "high" beam. A mask and hood were installed in accordance with D.N.D. Drawing E-11012 and the lower half of the reflector was painted Black.

(e) The Indirect Instrument Lamp was arranged on an independent circuit.

(f) A Sub-Lamp, fitted with a 6 C.P. Bulb [redacted] mounted [redacted] the rear cross member to direct light onto the Rear Axle "Pot". The lamp [redacted] on [redacted] separate circuit controlled by [redacted] Dash Switch.

(g) Two Tail Lamps of the Hubbolite Type were supplied, one on each side of the vehicle, fitted with [redacted] Watt Bulbs and with removable metal masks having 1/4 in. Dia. hole in their centre. These lamps [redacted] in [redacted] separate circuit controlled by a Dash Switch.

(h) No Stop Lamp was supplied but the Stop Lamp Switch was connected to the Tail Lights to light them if the brakes [redacted] applied and they were not otherwise lighted.

(i) Green Reflectors were set in the Front Bumper, 2 ins. from the outside ends of the Bumper, to indicate the approximate width of the vehicle.

Various modifications were subsequently incorporated into production which resulted in lighting arrangement [redacted] indicated in the following.

(a) Wiring was provided for two Headlamps but only the Left Hand was connected.

(b) The Headlamp [redacted] fitted with [redacted] single Filament 36 Watt Bulb only.

(c) Side Lamps were provided on each Front Fender fitted with [redacted] C.P. Bulbs and with a Lens and Masking Disc so that the light was visible at 300 yards, on [redacted] clear dark night.

(d) Bulb in Sub-Lamp was [redacted] C.P.

(e) Tail Lamps were fitted with a 3 C.P. Bulb and Lens and Masking Disc with one 1/4 in. Dia. hole so that they would be visible from 100 to 300 yards, on [redacted] clear dark night.

(f) A Stop Lamp fitted with a 3 C.P. Bulb was mounted on the [redacted] bracket as the Right Hand Lamp.

(g) To provide flexibility, five Toggle Switches were provided to control the circuits as follows:

(i) Switch to operate Tail Light only

(ii) Switch to operate Tail and Side Lights.

(iii) Switch to operate Tail, Side and Head Light.

(iv) Switch to operate Instrument Light.

(v) Switch to Isolate Stop Light, which is normally lighted when brakes are applied.

(h) Reflectors in the Bumpers [redacted] deleted.

As conditions in theatres of [redacted] changed there was [redacted] demand for improved lighting. This resulted in [redacted] major revision to Specification O.A. 62 issued 3rd October, 1944, which stipulated the following changes to be incorporated into production 2nd January, 1945. -

(a) Two Headlamps [redacted] provided, fitted with 32-21 Candle Power, prefocussed Double Contact Type Bulbs and with [redacted] Mask which could [redacted] rotated to provide [redacted] essentially clear lens. For British Army Orders the 32 C.P. Filament only was energized but provision was [redacted] in the wiring so that for Canadian Army Orders both Filaments would be energized and connection made to a Dimmer Switch.

(b) The Mask on the Sidelamps were deleted and it was specified that the Lens will be of Semi-Transparent material such that the light will be visible at 650 - 700 yards on [redacted] clear dark night.

(c) The circuits were provided with a series of six Toggle Switches which enabled the following lighting arrangements to be made:

(i) Switch to operate Tail Lights only

(ii) Switch to operate Tail and Side Lights

(iii) Switch to operate Tail, Side and Headlights

(iv) Switch to operate Instrument Lights

(v) Switch to Isolate Stop Light

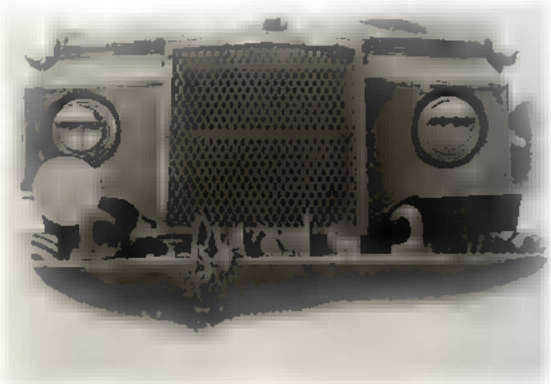
(vi) Switch to Isolate Right Hand Headlight.

Subsequently [redacted] a result of air superiority, Headlamp Masks were deleted, leaving two clear Lens.

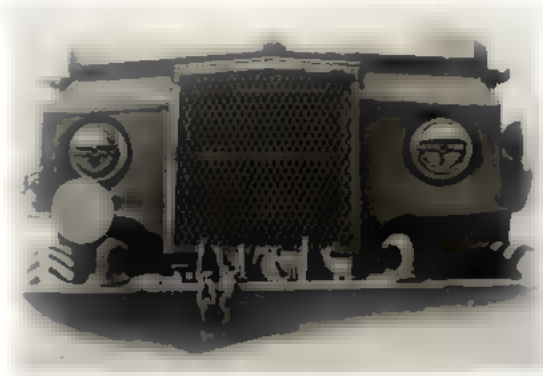
REFERENCE

D.M.&S. File 73-1-4

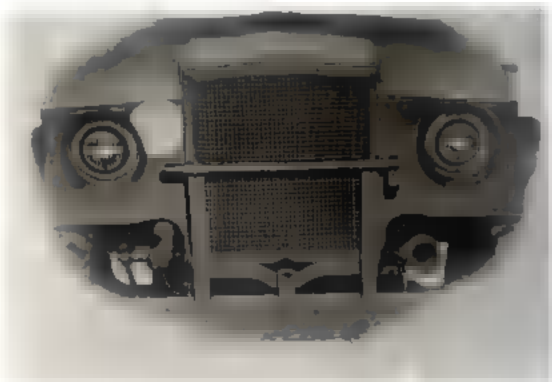
D.M.&S. Spec. O.A. 62



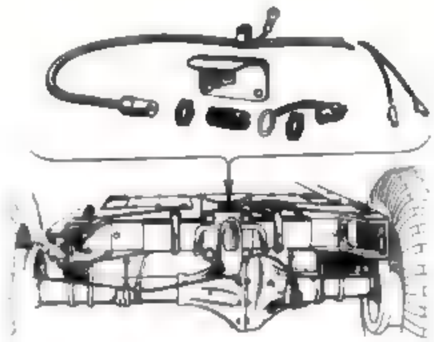
MASK IN BLACKOUT POSITION



[redacted] IN CLEAR BEAM POSITION



TOTALLY CLEAR [redacted]



SOCKET [redacted] TRAILER CONNECTION

ELECTRICAL SYSTEM

The electrical systems of C.M.P. 'B' Vehicles embraced both 6 and 12 volt types; [redacted] majority being in the 6 volt category. Because most of the engines used in Military Pattern Vehicles [redacted] modifications of existing domestic units employing 6 volts, this terminal voltage [redacted] retained from [redacted] manufacturing convenience standpoint.

However, extensive subsequent tests proved a 12 volt system to [redacted] much more efficient than 6 volt, especially in cold weather.

Also, in vehicles fitted for wireless installation, 12 volts was used to match the wireless terminal voltage.

In all cases, [redacted] one wire system was used with the vehicle chassis serving as the common return. This applied to both negative and positive grounded systems.

The following is a description of the various units comprising a representative system:-

Battery - 17 plates, 100 ampere hour capacity. See further details [redacted] Battery Development Page 15 - 16.

Generator - Two pole shunt wound with external control of both voltage and current. 32-34 ampere capacity.

Starter - Four pole series wound with Bendix drive or over-running clutch.

Ignition - High tension spark coil and distributor operated directly from Cam Shaft. Spark plugs were of conventional design.

Horn - Diaphragm type actuated by [redacted] vibrating armature.

Instruments - A Standard 'zero' centre ammeter [redacted] used. Fuel, Temperature and Oil pressure gauges were of the two unit type. The dash element consisted of a calibrated milliammeter actuated by a potentiometer representing the tank or engine element [redacted] the control.

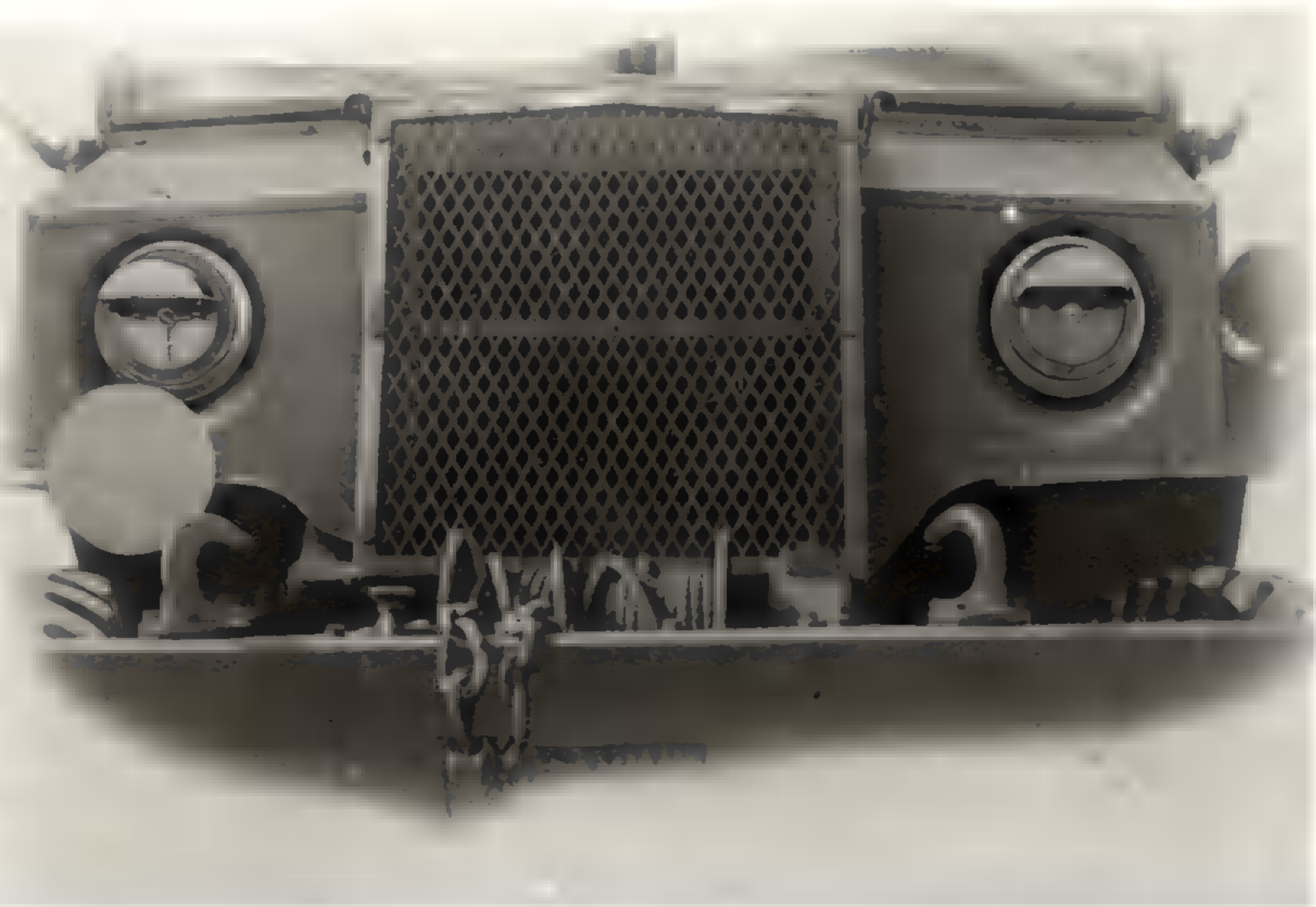
[redacted]

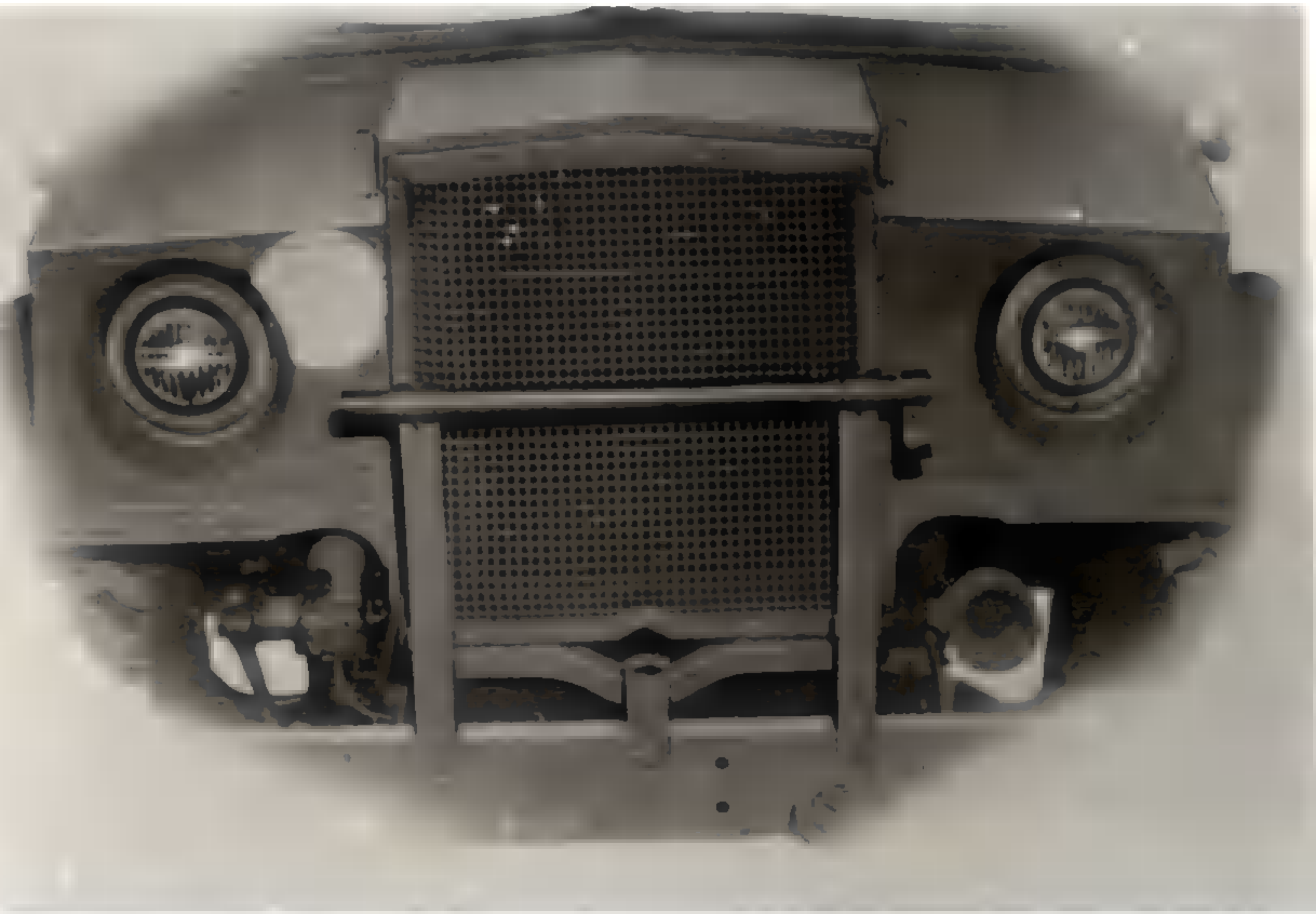
D.M.&S. Specification O.A. 65

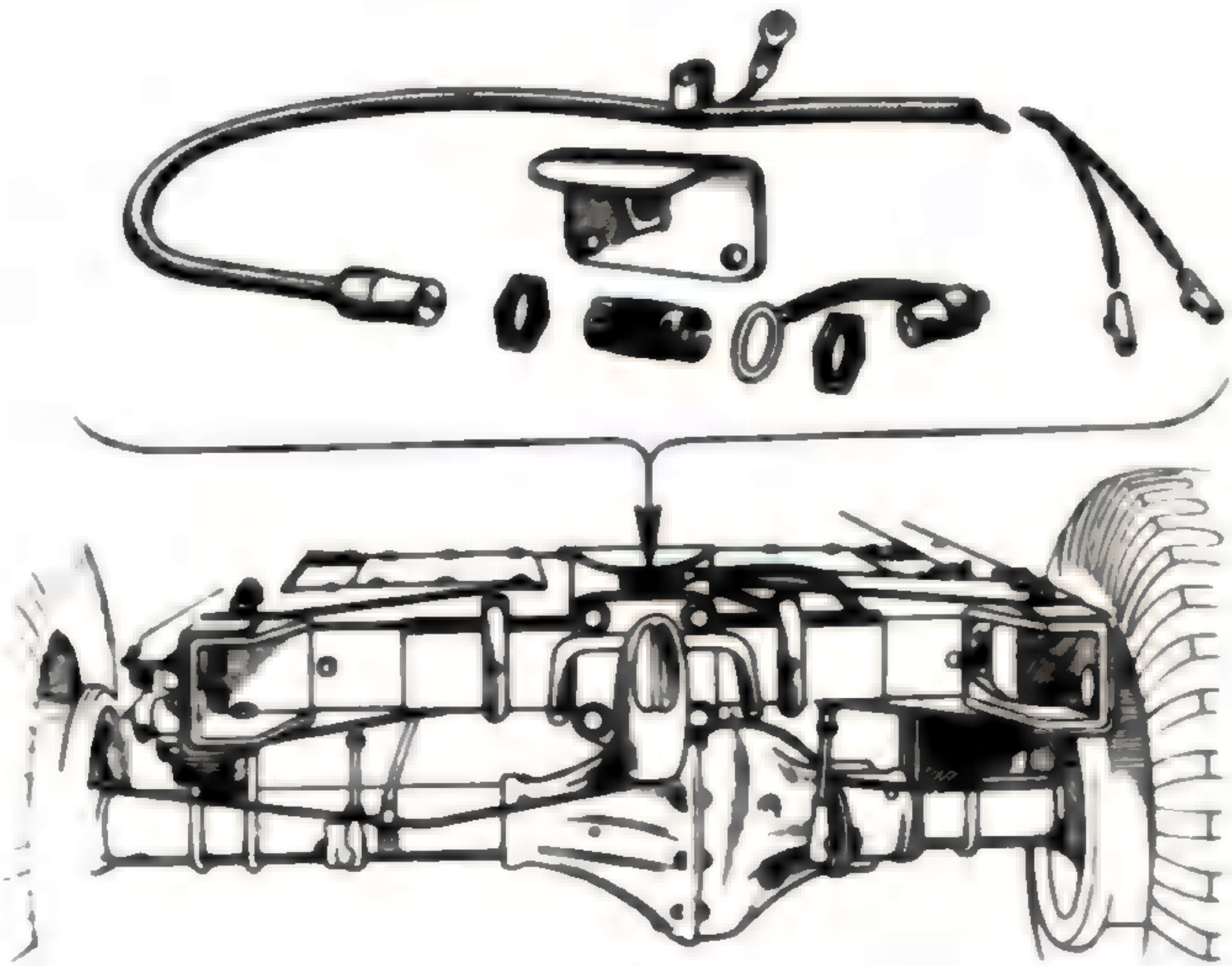
D.M.&S. File 73-1-4

D.M.&S. File 73-W2-1

D.M.&S. File 73-W2-2







RADIO INTERFERENCE SUPPRESSION

All Canadian production military vehicles were suppressed to prevent radiation of interference affecting the reception of wireless signals. These vehicles fell into two categories;- those that did not carry wireless at anytime and those fitted with or equipped for wireless installations. The methods used for the two classes differed considerably; on non-wireless vehicles the system [redacted] relatively simple whereas for wireless carrying vehicles it [redacted] more elaborate and comprehensive and included complete shielding or screening of all interfering components.

For convenience in testing of production vehicles, [redacted] "Screened Room" was used in order to exclude all atmospheric and extraneous noises. Later it [redacted] found however that the screened room results could not be completely relied upon. The reflecting characteristics of the Room would change from day to day, also, the room proper exhibited reflective properties which tended to cause incorrect findings and resulted in vehicle rejections which otherwise would test satisfactorily in open country. It was found that when [redacted] vehicle passed approval in the room, it could invariably be accepted [redacted] being satisfactory. However, when the interference [redacted] such [redacted] to constitute basis for rejection of [redacted] vehicle, the unit was [redacted]ver condemned until confirming tests in [redacted] substantially noise free area in open country were carried out.

The following is typical of the suppression components and their location, fitted to [redacted] non wireless vehicle:

<u>High Tension Cables</u> - 10,000 Ohm suppressors were inserted in each spark plug lead at the spark plug end and one in the lead between coil and distributor at the distributor end.

<u>Generator</u> - The output terminal was by-passed by a 1 mfd. metal encased condenser at the regulator.

<u>Electrical Gauges</u> - Fuel, oil pressure and temperature gauges were each by-passed by a 0.1 mfd. condenser at the tank or engine element.

<u>Ignition Switch</u> - The "cold" terminal of the ignition switch was by-passed by [redacted] 0.5 mfd. condenser.

<u>Bonding</u> - An average of ten bond straps were used throughout any vehicle, located between engine and chassis and between adjacent metal panels, to provide an electrical path of low resistance. These reduced to unity the radio frequency potential component existing throughout the vehicle, thereby preventing re-radiation.

Likewise for wireless carrying vehicles the following procedure was used:

<u>High Tension Ignition Circuit</u> - All high tension cables from spark plugs to distributor and from coil to distributor were enclosed in flexible metal conduit. These terminated at one end into metal cannisters enclosing each spark plug and, at the other end into [redacted] cast aluminum box enclosing the distributor.

<u>Generator</u> - The generator output [redacted] fed through [redacted] filter, which consisted of [redacted] shielded choke coil suitably by-passed by [redacted] condenser and effective at the interfering frequency. The connecting cables were enclosed in metal conduit terminating at the voltage regulator.

<u>Voltage Regulator</u> - The voltage regulator was housed in a cast aluminum enclosure along with the ignition coil but each was isolated from the other by [redacted] partition.

<u>Electrical Gauges</u> - Same [redacted] for non-wireless vehicles.

<u>Bonding</u> - Same as for non-wireless vehicles.

<u>REFERENCES</u>

D.M.&S. File 73-W-2-1

D.M.&S. File 73-W-2-2

Specification OS 19A and OS 33.

SPRINGS AND SHOCK ABSORBERS

C.M.P. "B" Vehicles have been equipped with laminated springs set at four points on the chassis with the long axis of the springs approximately parallel with the long axis of the vehicle. On 4x4 chassis [redacted] Shock Absorber has been provided with each spring; on 6x4 and 6x6 vehicle [redacted] springs have not been [redacted] equipped; on 4x4 the rear springs have been of the Hotchkiss drive type.

The basic springs have been adaptations of commercial installation and again it has been evident that military units require [redacted] than ordinary commercial ruggedness. Probably no other component has been the subject of more failure, criticism, study, test and redesign than the vehicle springs.

The improvements made during production may be listed [redacted] follows:

(1) The capacity of Springs was increased, without changing widths and lengths, to support the heavier vehicle components, i.e. larger cabs, longer and deeper bodies, additional military equipment, and other more robust chassis components.

(2) Auxiliary Springs were added to rear assemblies.

(3) Double wrapped eyes and/or cast eyes were incorporated to counteract the twisting of springs due to articulation.

(4) Nibs were added to align leaves and relieve centre bolt failures.

(5) Main and second leaves of most springs have been shot blasted to improve the effective life: on front springs of one make all leaves have been shot blasted.

(6) On front springs of heavily loaded units such as 6x6 workshops [redacted] trunnion type end eye has been applied to the springs to relieve the excessive twisting of the main leaves.

The shock absorbers have been of two commercial types; one the piston and lever, the other the cylindrical [redacted] and lever: each of the double acting principle accepting load [redacted] both normal and rebound motion of the chassis. These [redacted] enlarged in capacity during the Army Production Programme to accept the greater loads.

Future action is suggested as follows:

(1) Determine whether independent suspension [redacted] front wheels improves the articulation and stability sufficiently to adopt it [redacted] wheeled front drive axles by providing pilot units of heavy laden type.

(2) Bearing in mind the complication of mechanism likely to result from independent suspension, consideration be given to lateral front springs anchored by shackle on one end and free on the opposite. In this instance radius control rods must be provided to locate the front axle in position. This type design will probably be a fair compromise between current design and independent suspension. It will result in three point suspension on the chassis and should relieve much of the twisting and weaving stresses inherent [redacted] [redacted] result of current four point suspension.

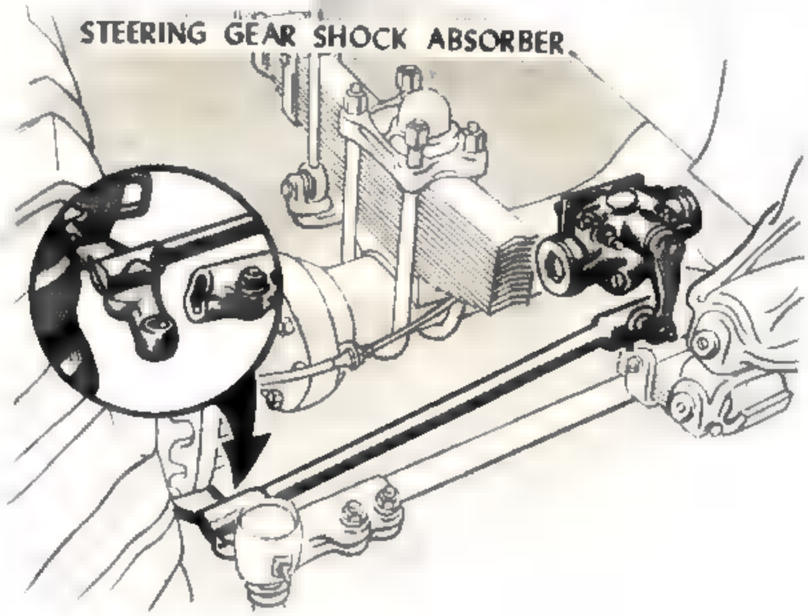
(3) Rear laminated springs of the "slip type" which will not be subject to torque [redacted] brake reaction. These reactions to be provided for by radius rods [redacted] now fitted on 6x6 rear assemblies.

(4) Solid Steel or Steel-Rubber type Torsion suspensions might be explored.

(5) Dependent on what system is found most expedient, suitable snubbing arrangements will have to be provided to evolve the most stable ride under [redacted] variety of conditions. It is felt that more satisfactory performance may be obtained if [redacted] specific vehicle has specific snubbers for it.

REFERENCES

D.M. [redacted] S. File	73-S-3
W.V.E.E. Report	M-2348
A.E.D.B. E.E. Reports Nos. E276, E291, E611.	



STEERING GEAR

At the outset, Steering Gears used were those from commercial design for vehicles of comparable rating. These gears were undersize for Military use and continued weaknesses [redacted] to light. Eventually modifications included:

1. Reinforcing the securing method of Gear to Chassis.
2. Enlarging the Steering Arm attaching Studs.
3. Enlarging the section of and the bearings in the Sector Shaft.
4. Increasing the section modulus of Mast Jacket.
5. On heavily loaded Front Axles [redacted] Steering Shock Absorber was found to be advantageous.
6. Flexible mounting on the cab Fire Wall [redacted] required to support Mast Jacket due to the movement of the Cab in relation to Chassis.
7. On Trunnion Mounted Gear, a Brace or Anchorage to the Gear was necessary in some cases to relieve the stresses in the Trunnion Cap.

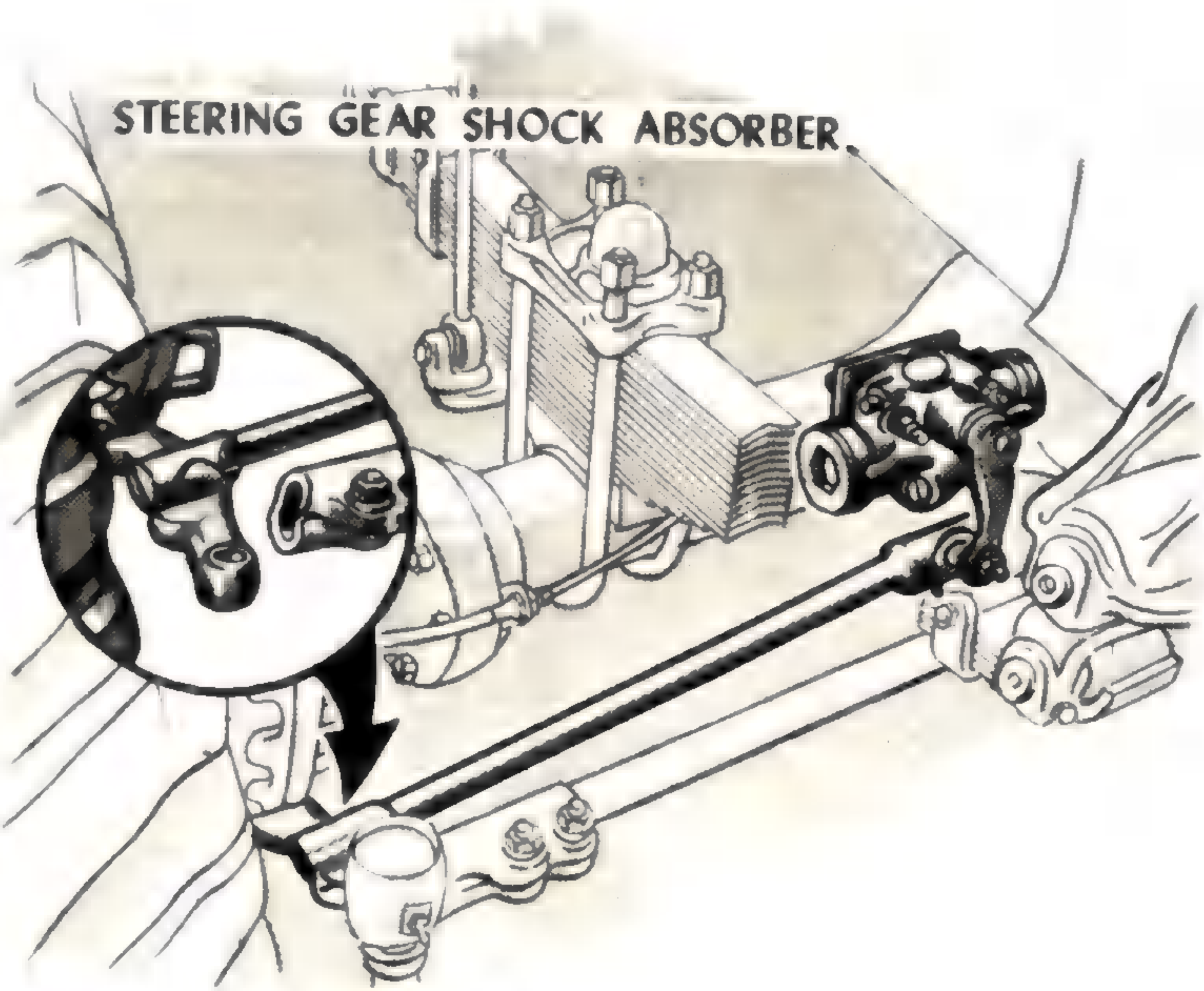
Future action on vehicles of new design should bear in mind that:

1. Steering Gears for cross country operation must be, for an equal size vehicle, heavier and more robust than acceptable commercial equipment. This condition needs further emphasizing when heavy Military Wheels, Tires and Axles are to be used.
2. For "Waders", [redacted] design which requires [redacted] minimum of field application of water proofing material is desirable.
3. For Airportable, easily lowered Steering Gears with special universals and/or column brackets would be advantageous.
4. The apparent limit for Manual steering is reached when the Front Axle Loading approximates 10,000 lbs. Therefore for loads in excess of this figure, Mechanical Aids must be considered.

REFERENCES

D.M.&S. File 73-S-1.

A.E.D.B. E.E. Reports Nos. E105, E139.


STEERING GEAR SHOCK ABSORBER

BRAKES:

Service Brakes have been of the internal two shoe expanding Hydraulic type applied on all hubs of C.M.P. vehicles. The front and rear brakes have been adjusted in size and/or pressures in an approximate relation to the proportion of loads carried by axles. The application of commercial brakes has been relatively satisfactory [redacted] C.M.P. vehicles.

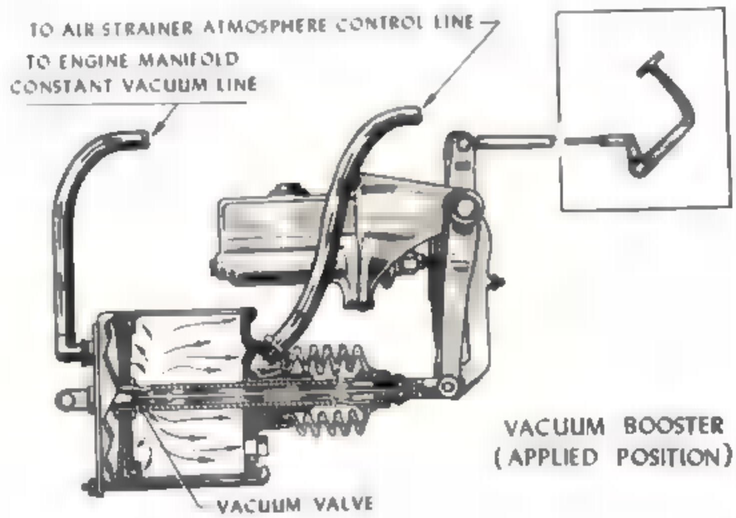
The brake drum and brake assembly have been semi-sealed [redacted] in commercial [redacted] which resulted in considerable mud and foreign material becoming lodged in the assembly, possibly causing early brake lining wear under adverse conditions. The size has been based [redacted] requirement of 25 sq. ins. of lining for each thousand pounds of gross vehicle weight.

To relieve driver fatigue and provide greater braking effort on 3-ton vehicles, mechanical assistance has been provided in the form of [redacted] vacuum Booster for each vehicle.

present designs in all kinds of Service operations.

3. Extensive tests to completely seal brakes to prove the satisfaction of same.
4. A complete study of the brakes on towed vehicles, guns, trailers, etc., should be made and a minimum of different varieties of applications should be standardized. Currently, the variety can be - (a) Overrunning; (b) Single vacuum controlled; (c) Dual Vacuum controlled; (d) Single air pressure controlled; (e) Dual air pressure controlled; (f) Electric brake; (g) Mechanical hand lanyard controlled.

(a) Overrunning - An automatic application of the brake occurs, due to [redacted] floating drawbar engaging linkage to the brakes. Such a trailer may be towed by any suitable vehicle without special apparatus on towing vehicle.



VACUUM BOOSTER
(APPLIED POSITION)

It [redacted] determined that for Hydraulic Brakes to operate successfully on both tropical and frigid operations they required special piston cup expanders and [redacted] Hydraulic fluid capable of use in both temperatures.

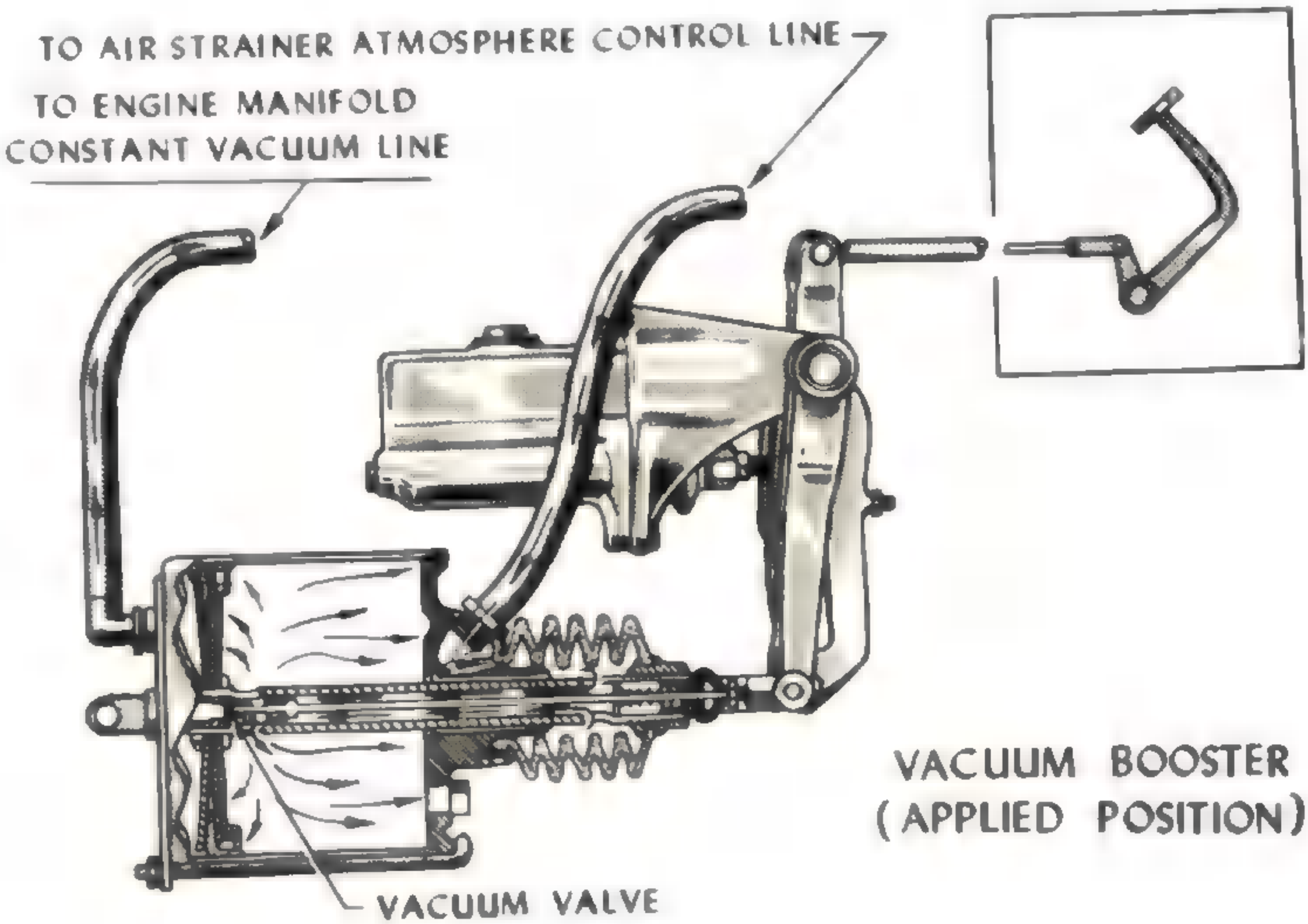
For future consideration the following might [redacted] considered.

1. Maximum protection against fractured and/or torn flexible hose lines in the form of guards and/or safety valves.
2. Extensive road tests to prove that open or exposed brake assemblies [redacted] more satisfactory, or are not [redacted] satisfactory as

It cannot be easily arranged to operate equally well on all surfaces under varying loads or at various speeds.

(b) Single Vacuum - The towed vehicle brakes may be operated by vacuum line connected into the towing vehicle brake system. Requires special fittings on towing vehicle and suffers from the inability to synchronize towing and towed vehicle brakes.

(c) Dual Vacuum - This is similar to a degree to (b) except two lines are



VACUUM BOOSTER
(APPLIED POSITION)

required and has the advantage of being synchronized, and in addition may be arranged to automatically apply towed vehicle brakes if [redacted] break-away occurs. Additional fittings are required on the towing vehicle to operate such brakes. It is relatively inexpensive.

(d) Single air pressure controlled brakes operate towed vehicle brakes by pressure operated cylinders fitted to suitable linkage on towing vehicle brake system. It is positive and may be graduated in the degree of application. However, it requires an air compressor and apparatus on towing vehicle and suffers from the fact it cannot be synchonized with towed vehicle brakes.

(e) <u>Dual air pressure</u> is similar to a degree to (d) but requires an additional line. It may be synchronized, but is relatively expensive. Its reliability is excellent.

(f) <u>Electric Brakes</u> have been used, using towing vehicle electrical system for actuation, and consist of magnets suitably applied to the wheels of towed vehicle. It requires fittings on towed vehicle, is reasonably priced, but suffers from early corrosion in wet operations.

(g) Hand operation of towed vehicle brakes consists of hand tugging [redacted] line from towing vehicle which is connected to linkage of brakes on Towed vehicle. This is inadequate in many respects.

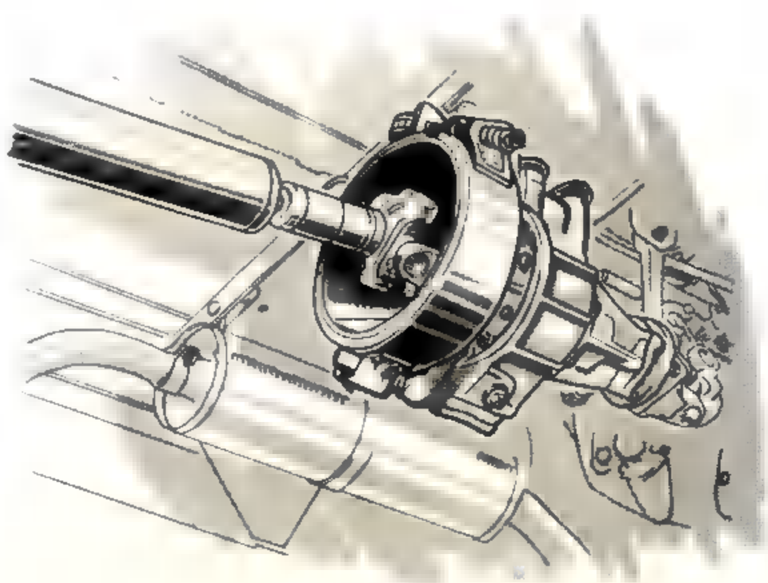
5. The decision should be made [redacted] the [redacted] of applying trailed vehicle brakes, i.e. by inclusion in tractor service brake foot pedal linkage, and/or provision of separate hand valve either column [redacted] dash mounted. Lack of standardization currently practised must result in service and operational confusion. As [redacted] result of (4) above, adequate planning [redacted] tractor brake design could be made.

<u>Hand Brakes</u> - North American civilian interpretation of Hand Brakes is that they must be used only [redacted] a Parking Brake once the vehicle is stopped. The British War Office interpretation of the Hand Brake is that it be used as an Emergency Service Brake, and this latter interpretation has crept into the Canadian Army thinking.

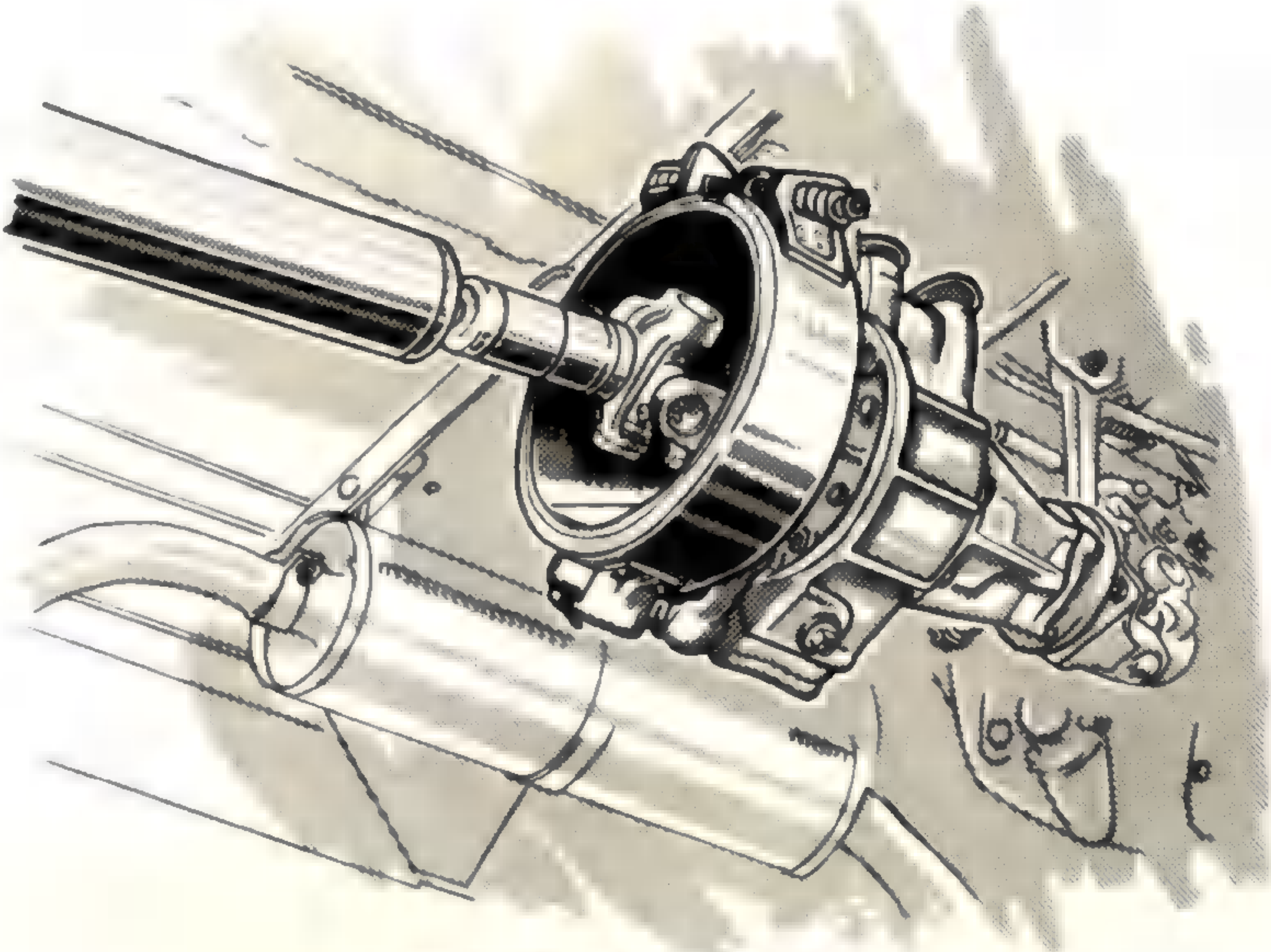
Hand Brakes on Canadian produced vehicles have been similar to those used commercially on the North American Continent, and therefore have been the subject of criticism. They have been of two types.

(a) Cable operated actuating the two rear wheel service brake shoes.

(b) Propeller shaft external contracting type located at the rear of the trans-



PROPELLER SHAFT HAND BRAKE



PROPELLER SHAFT HAND BRAKE

for case on 4x4, 6x6 and 6x4 vehicles and at the rear of the transmission on 4x2 vehicles. Lining material was fabric.

The former suffered deficiencies due to

(a) Cable Stretches.

(b) Seizure due to corrosion.

(c) Inoperative at low temperatures in the conduit due to solidifying of the lubricant.

(d) Difficult to keep in adjustment.

The weaknesses of the latter have been

(a) Insufficient brake lining area resulting in short periods between adjustments due to rapid wear caused by the high degree of heat generated under continuous application.

(b) Fading quickly under continuous application.

In order to improve the overall efficiency of Hand Brakes on any newly designed vehicle, consideration should be given to the following

(a) Metallic type of lining on Propeller shaft brakes.

(b) Application of Internal Expanding type shoes rather than External Contracting on Propeller Shaft Brakes.

(c) Disc type of "True Stop" Brakes bearing in mind the sacrifice of Belly clearance if too large a Disc is used.

REFERENCES

D.V.&S. File 73-B-4.

A.E.D.B. T.E. Reports Nos. E307, E479, E485, E583, E594.

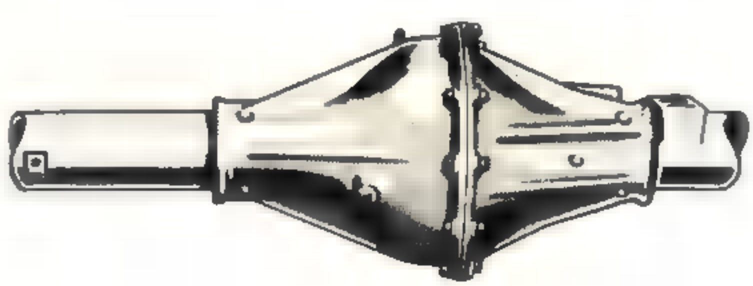
AXLES - Front.

The Front Axles of 4x4 C. M. P. Vehicles have been adaptations of proven commercial spiral bevel gear full floating type axle. Differential assemblies on the Front and Rear Axle of any one vehicle size were interchangeable. The housings were either split and/or banjo type with the pinion entrance to the housing at approximately the horizontal centre line of the axle shafts. The outer ends of the housings have been flanged to which were attached the cast spherical shaped "egg cup" members, which contained the Universal Joint.

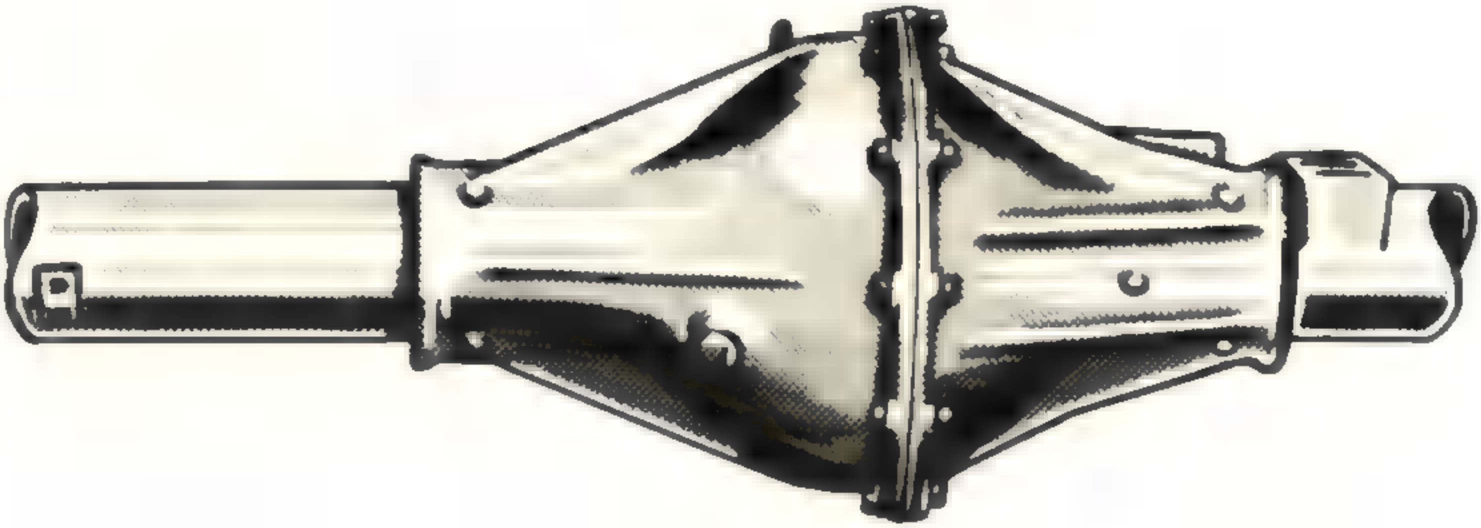
Front Driving Axles were built in alternative tracks and in optional ratios, dependent on the role and class of vehicle. The largest volume Axle, that used in 3-ton and 15-Cwt., was adapted to either role by changing the ratio and the size of Steering End Universal Joint.

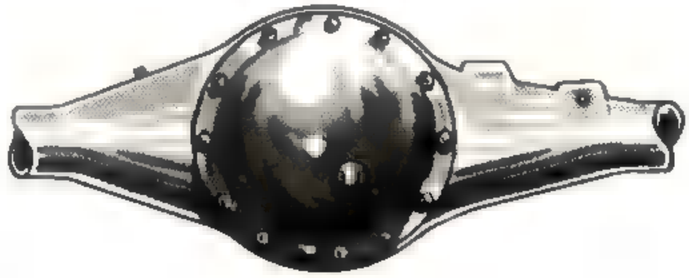
Use of such axles brought forth the following results:

(a) Full appreciation of the Military Requirements of a vehicle dictates that axle capacity must have 25% greater safety factor than similar commercial application for a given ratio.



AXLE "SPLIT TYPE"





AXLE "BANJO TYPE"

(b) Cast steel steering end assemblies and [redacted] cups require vigilant manufacturing inspection to provide consistently satisfactory components.

(c) Bevel drive axle housings are not economical in the vertical space required, and therefore road clearance is sacrificed.

(d) "Inverted" full floating hub and steering end result in abnormal bearing applications and difficult wheel bearing adjustment and service.

(e) An Axle Housing whose dimensions limit the number of alternative differential ratios which may be applied to it, is not suitable for use in a multi-role chassis.

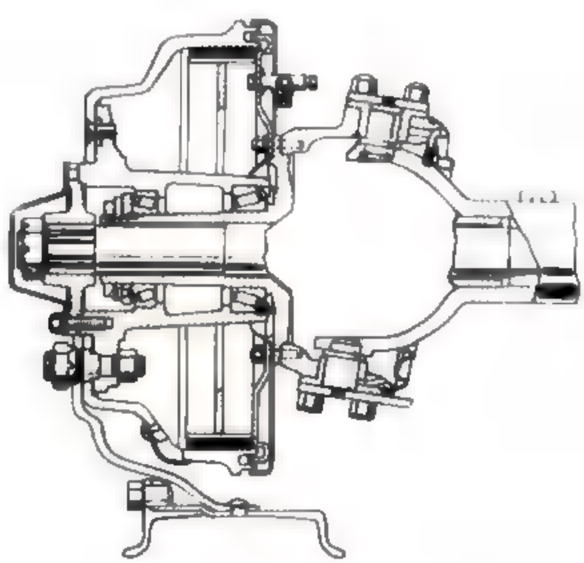
(f) Sacrifice of steering lock angle to favour an undersized Universal Joint is not advisable.

(g) Large Section Heavy Treaded Military Tires impose stresses on Axle components beyond normal stresses as experienced in commercial applications.

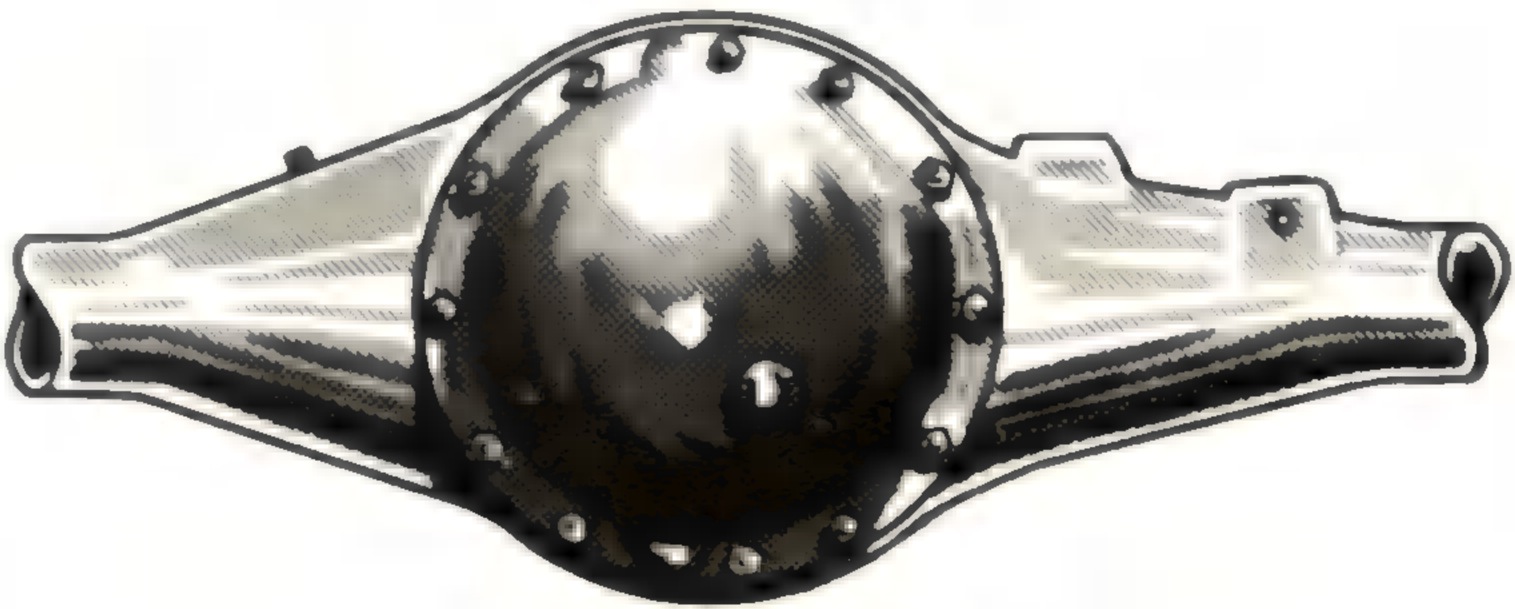
(h) Steering Arm Studs required reinforcement in material and size.

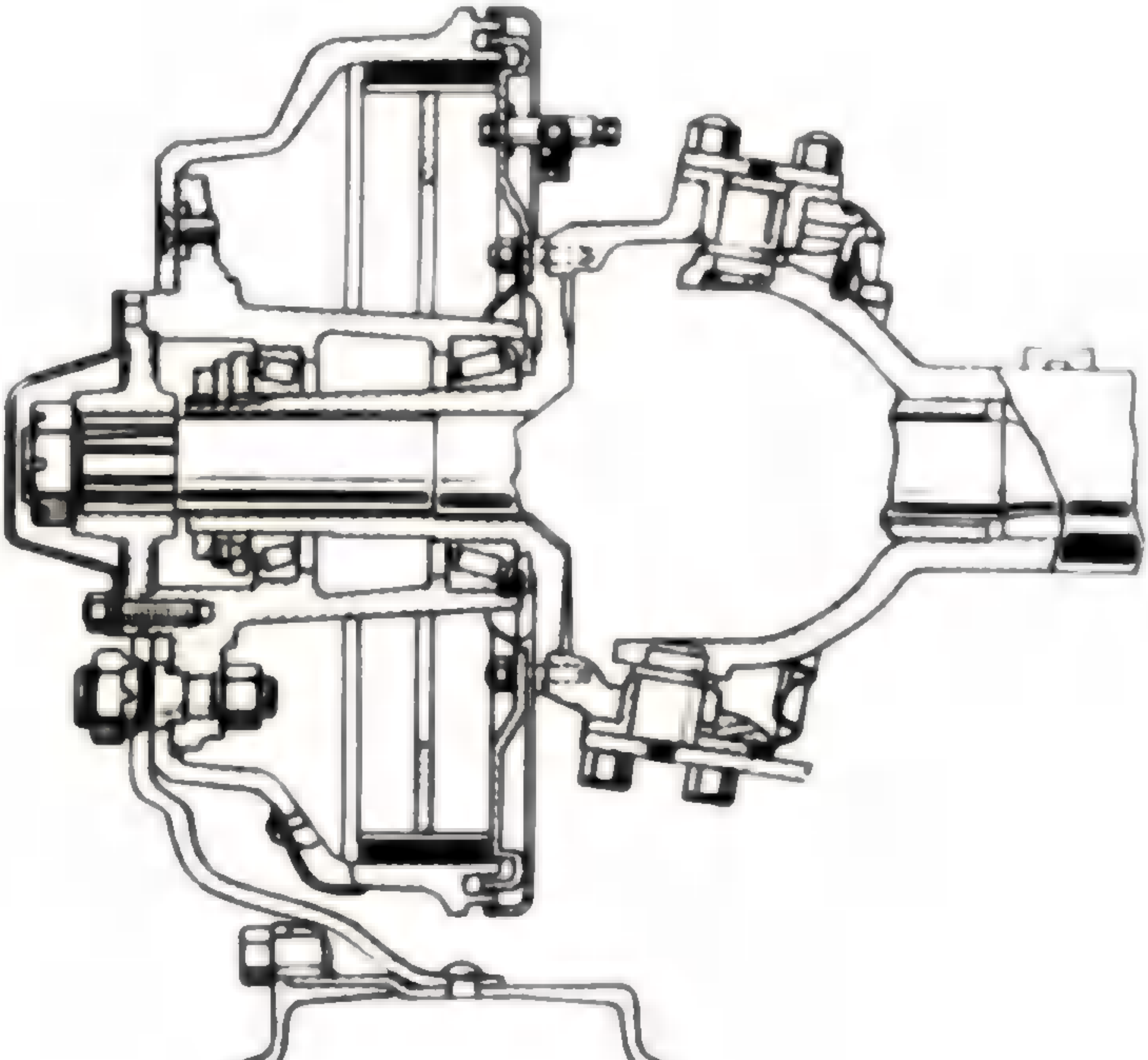
(i) Steering Tie Rods were subject to failure due to flexing and to damage through interference with obstructions such as stumps.

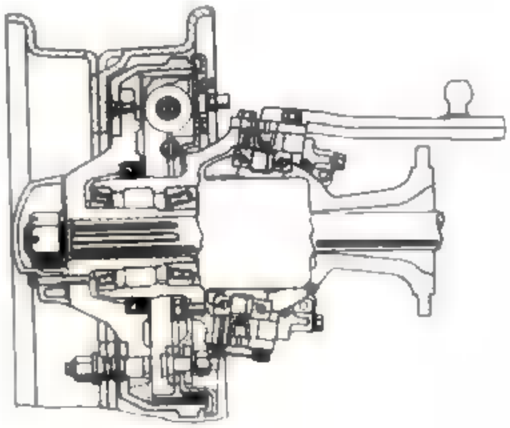
(j) Lubricant level and lubrication of Egg Cups, Wheel Hubs, etc., were difficult to control and special provision in the form of fittings, level control



FRONT AXLE HUB—STANDARD TYPE







FRONT AXLE HUB—INVERTED TYPE

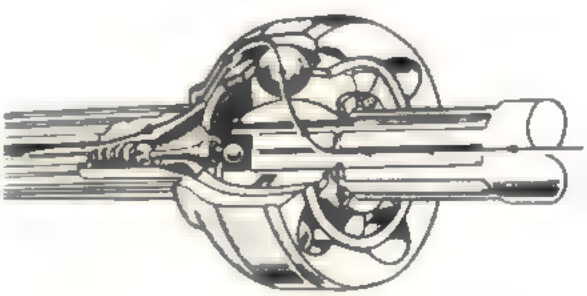
and pressure relief openings were provided.

(k) In using the "Inverted" type of hub and in order to eliminate bearing race spin, spacers of various types were used between inner and outer hub bearing. Ultimately, hardened forged spacers of tailored length were used in production, and a standard length spacer and soft shims in a variety of thicknesses were provided in service. Very high forces were encountered in this construction, and heavy wheel nut and special washer [redacted] required to maintain the required tightness in the assembly. This assembly is unsatisfactory generally, and should be discouraged on future designs.

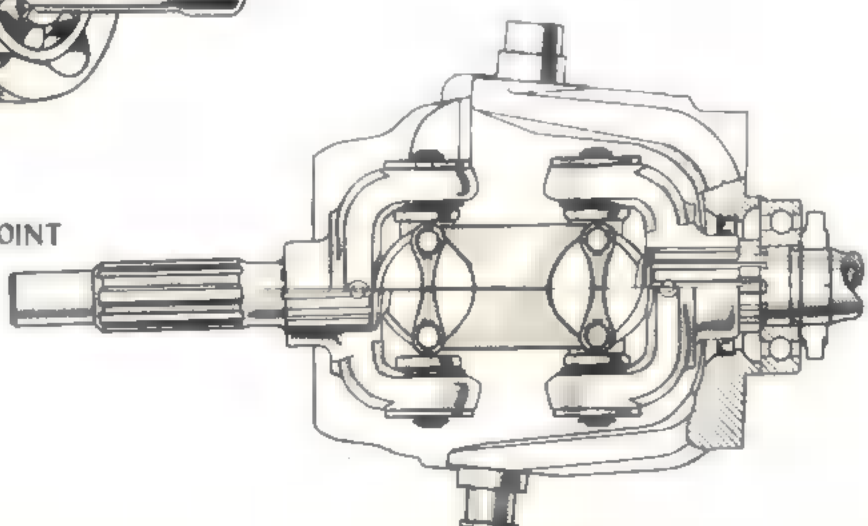
For future action the following steps are suggested:

(a) Full and extensive trials to prove the necessity of "Constant Velocity" Universal Joints on Front Driving Axles, and to determine if they are superior to Cardan Type.

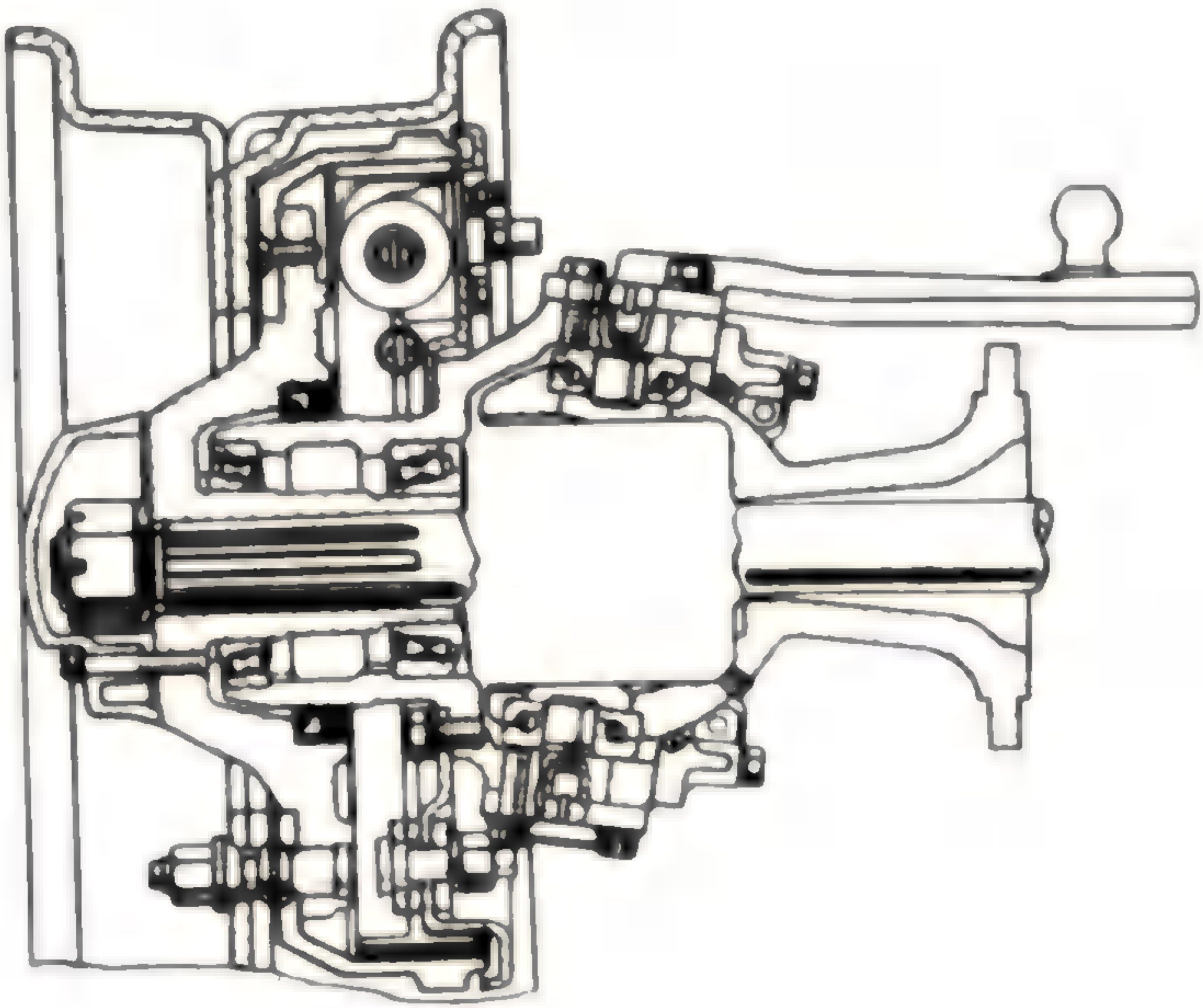
(b) Trials to prove the necessity of "closing in" of Cardan type of universal. Some foreign vehicles have been produced with open type Cardan Joints.

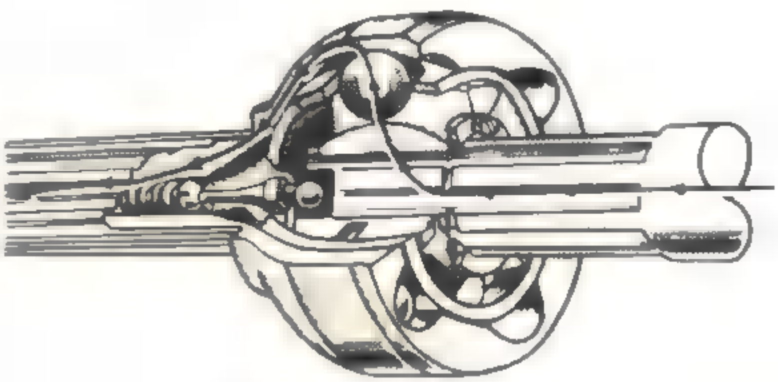


RZEPPA JOINT

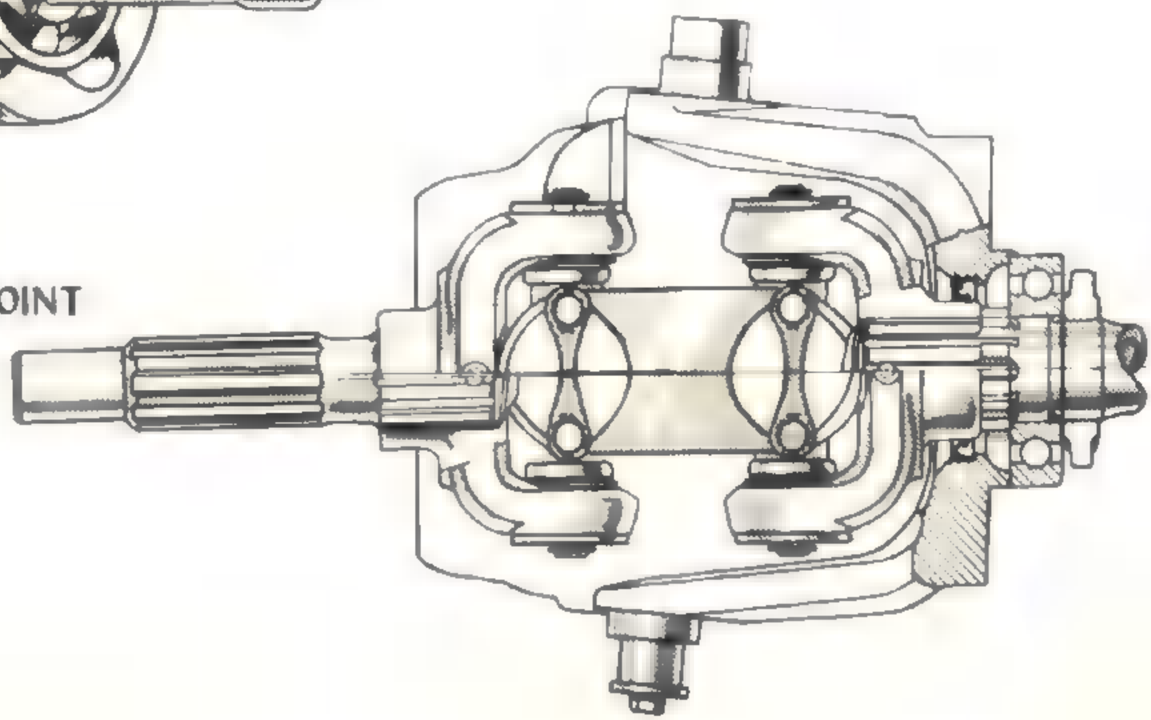


CARDAN (OPEN TYPE)
UNIVERSAL JOINT





RZEPPA JOINT



UNIVERSAL JOINT—"BENDIX"

(c) Application of a normal type of hub assembly (opposite to Inverted Type) to the axle housing of,

1. Double Reduction Axle - Side Mounted Pinion
2. Double Reduction Axle - Top Mounted Pinion
3. 2-Speed Axle

and thus follow current future tendencies in axle design, and record the advantages in each type.

(d) Axles whose track will provide adequate clearance in designated Air Craft without removal when "Air Portable" vehicles [redacted] stowed in the Air Craft should be provided on future vehicles of any [redacted] size.

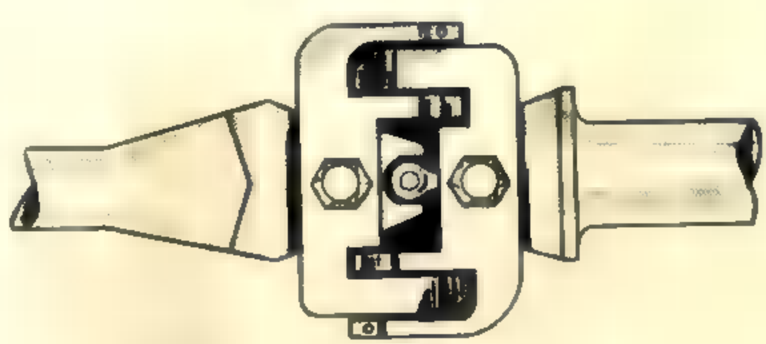
(e) The size, track, etc., of the Axle in (c) will be subject to the type of vehicle under consideration i.e., C.O.E. or Conventional, as well [redacted] to the load directly imposed on it.

(f) A Paper Study, and possible [redacted] few samples made, incorporating Independent Suspension on Steering Ends, rather than the Conventional Rigid Axle.

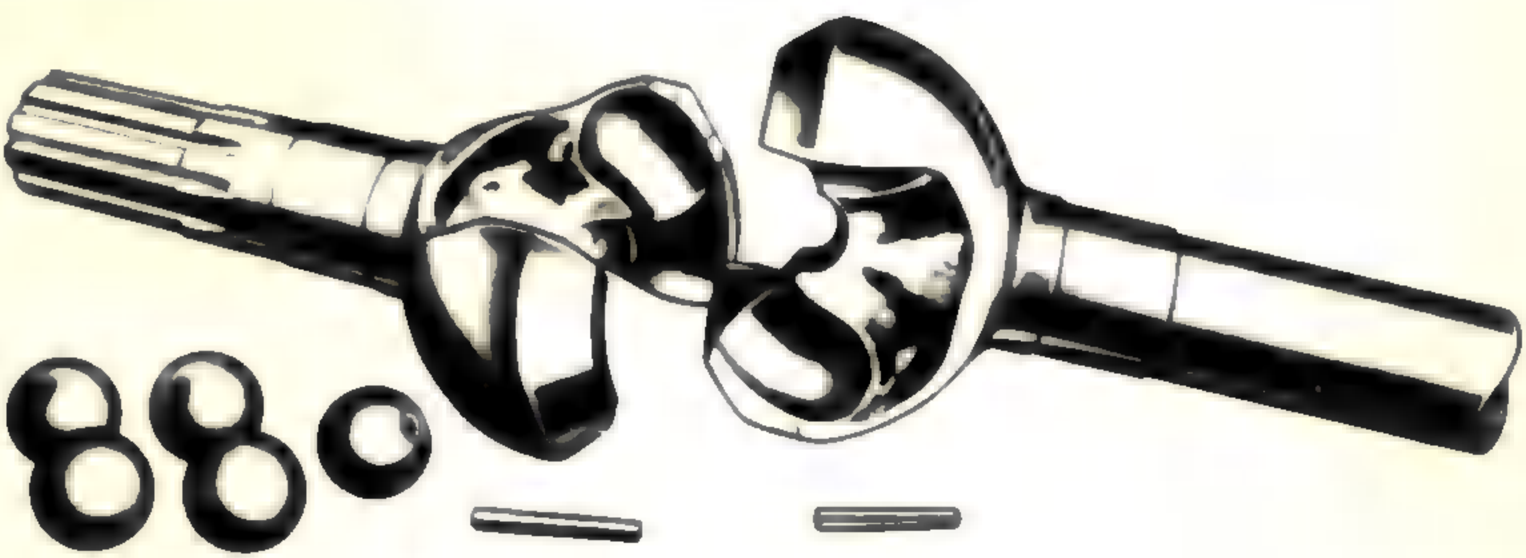
REFERENCES:

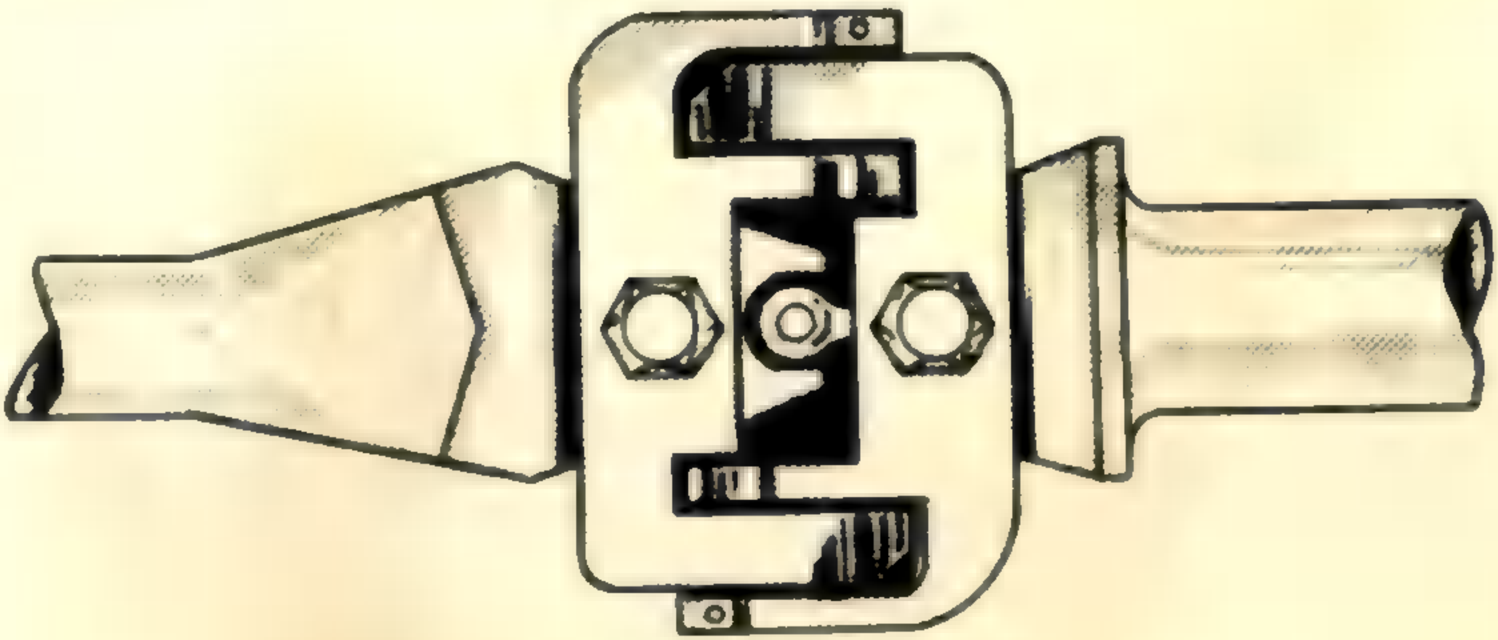
D.M. & S. File 73-A-1

A.E.D.B. E.E. Reports Nos. E105, E139, E152, E295, E543.



UNIVERSAL JOINT OPEN HOOK TYPE





FRONT AXLE STEERING ENDS ON FRONT WHEEL DRIVE ARMY TRUCKS

Immediately after the war [redacted] declared, the Ford Motor Company of Canada were charged with the responsibility of developing [redacted] 4 x 4 truck for Army use. Obviously, they had had very little experience in this field and it is doubtful if many, or for that matter, any Canadians had appreciable experience in it. Consequently, they went to the Marmom-Harrington Company, Indianapolis, who in peace time supplied conversion material to convert Standard Ford [redacted] x 2 trucks into [redacted] x 4 models for various commercial peace time usage, such as for [redacted] plough. The Marmom-Harrington Company had converted Ford trucks, using standard commercial wheels, tires, and Bendix-Weiss constant velocity joints having [redacted] spherical diameter of [redacted] 5/8". As a result of their experience with this combination, they unhesitantly recommend to Ford of Canada that they use these joints for the Army vehicles.

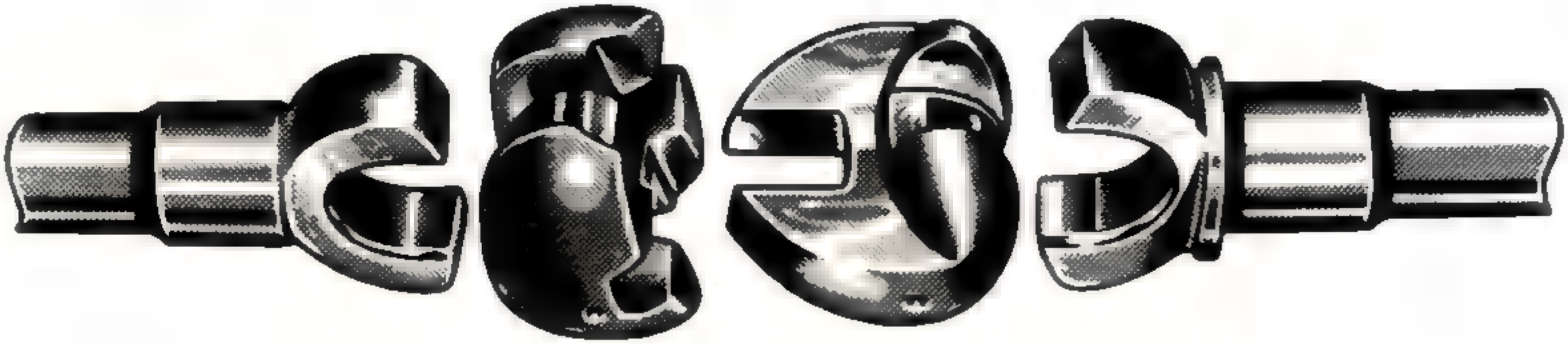
The performance of early Canadian front wheel drive Army truck vehicles in the field soon demonstrated that these joints [redacted] unsuitable. After considerable investigation it [redacted] proved that input torque from the engine was not the most critical condition to be met by the front axle joint, but rather the slip torque which is [redacted] function of the rolling radius of the front tires and the imposed load upon them. Again, since Army vehicles were basically of [redacted] cab-over-engine range and type which places larger percentage of the chassis and cab weight [redacted] the front axle, and [redacted] much of the body extends farther forward with relation to [redacted] axle than is the [redacted] in the Conventional truck, the possibility of getting some considerable amount of the payload [redacted] the front axle is greater. Another point is the fact that with the combination of Army wheels and tires which [redacted] considerably heavier than the commercial components, additional stresses were imposed upon the axle components which possibly were [redacted] factor in joint performance.

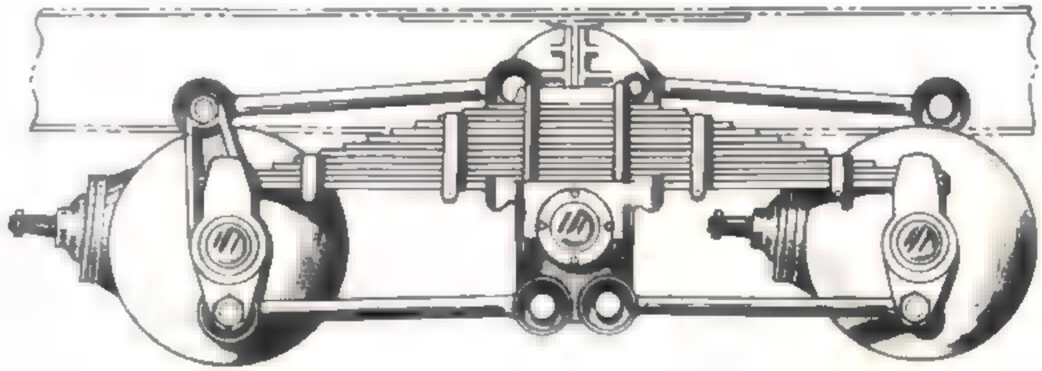
Bendix-Weiss and Rzeppa joints [redacted] chosen by General Motors and Ford respectively, and were subsequently tooled for in their plants in the sizes which experience showed would stand up [redacted] the difficult service and heavy loadings involved with Army trucks. Joints of both the above makes having [redacted] spherical diameter of 6" were specified for all vehicles having 20" wheels, and 5" Bendix-Weiss joints and 4 7/8 Rzeppa joints were specified for vehicles having 16" diameter wheels.

Due to Bendix-Weiss and Rzeppa joints having been tooled for and our related design having been stablized, it was not considered desirable to make any further changes during this war.

"The Tracta" constant veolocity joint offers certain advantages [redacted] compared with the Rzeppa and Bendix-Weiss joints and, in all probability, would have been adopted for Canadian front wheel drive vehicles had we known sufficient about it [redacted] the time that the other joints were adopted. It is simple to manufacture and requires no internal or difficult grinding, and from [redacted] service reliability standpoint has given a very good account of itself where used in vehicles produced both in the United States and the United Kingdom for this war.

UNIVERSAL JOINT—"TRACTA"





ALL DRIVE BOGIE

AXLES - Rear

All of the C.M.P. Vehicles utilize axles of similar design, of the full floating spiral bevel type. Both Ford and G.M. Rear Axles are of the standard commercial type but of heavier construction. With one exception, none other than spiral bevel gear has been developed for use on C.M.P. Vehicles.

Difficulties or weaknesses have not been serious in the Rear Axles of any of these vehicles and no basic changes have been necessitated or made. Some criticism has been evoked due to the low housing clearance provided, this particularly on the 15-Cwt., with small diameter tires, where the same housing is used as on the 3-Ton, thus reducing the clearance obtained with the 3-Ton by approximately 3½".

It is doubtful if the interchangeability feature of 15-Cwt. and 3-Ton Axles offsets the heavy weight penalty against the 15-Cwt.

Considerable attention has been given to Breathers on the housing. These are considered essential due to the requirements of wading. These have been made to emit air only, however, for wading, Breather Tubes must be above the required water level, due to temperature changes within the housing.

For future design, it is suggested that Double Reduction, Hypoid or Worm and Wheel be considered to reduce the size of the Housing Bowl. Also an endeavour should be made to reduce the weight of the Assembly without sacrificing strength.

A vehicle of the 6x6 type as well, was produced in Canada on which the Rear Bogie was mounted on Trunnions attached to the Chassis Frame Members. Drive and Brake reaction were transmitted through parallelogram radius rods and the springs were of the inverted semi-elliptic floating type.

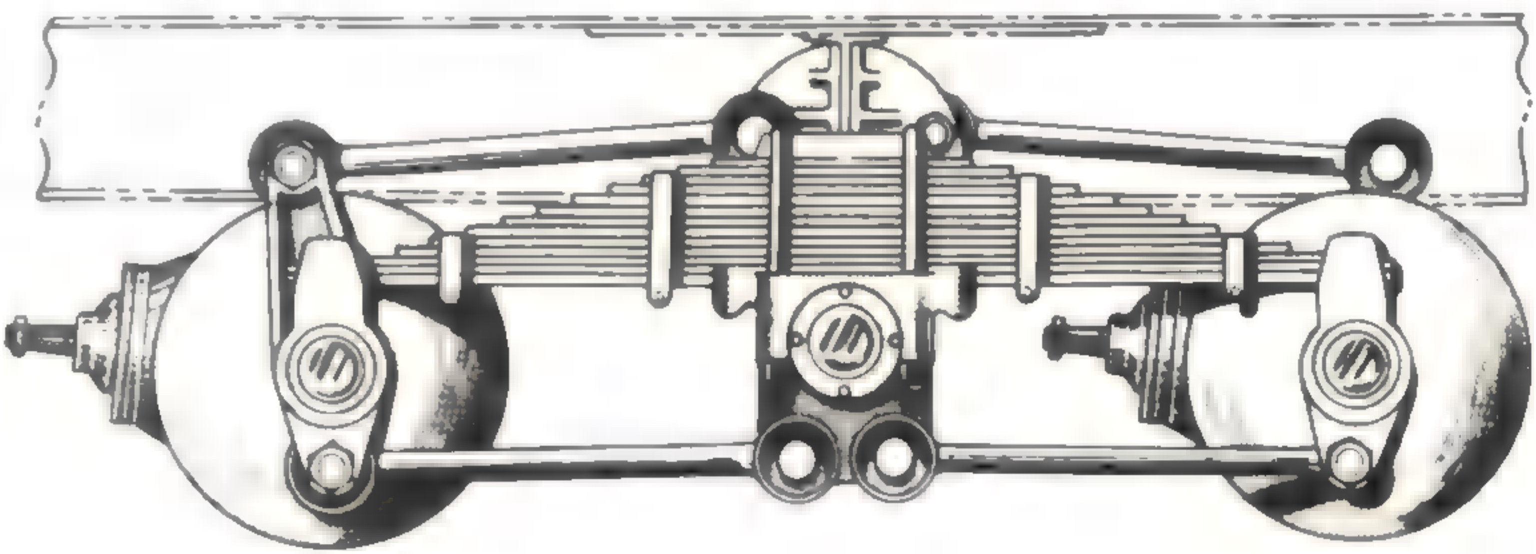
The Axle Housings and Driving Components are basically to 3-Ton C.M.P. Axle design, with each differential assembly having its own Propeller Shaft unit, thus the Transfer Case requires two rear out-put shafts to drive same. In the present design therefore, the Transfer Case Power Take Off is not available.

A 6x4 Vehicle has also been produced in which the Rear Bogie Suspension is similar to that used on the 6x6. In the case of the 6x4 the Rear Axle of the Bogie is a trailing Axle.

REFERENCES:-

D.M.&S. File 73-A-1.

A.E.D.B. E.E. Reports Nos. E90, E183, E543.



POWER TIRE PUMP

On the assumption that tire pressures should [redacted] maintained at the proper pressure [redacted] power tire pump has been provided to facilitate this [redacted] vehicles fitted with 10.50 - 16 and larger tires where the quantity of air required is such that [redacted] pumping would be difficult. It can be used for other vehicles not [redacted] equipped also. This pump [redacted] single cylinder air cooled compressor, manually engaged, operated by and lubricated with the vehicle transmission.

Difficulty [redacted] experienced in maintaining seals between transmission and pump due to the vibration inherent in [redacted] single cylinder unit. The location being low and vulnerable to road splash, dust, ice, etc., excessive wear [redacted] experienced. An air cleaner [redacted] subsequently provided on the intake side of the pump.

While the design of pump, its location etc., was based on the British counterpart, it is felt on future vehicles that the following points should be considered in [redacted] designs.

1. Self-contained lubricant facilities and not therefore subject to foreign material collected in lubricant by driving unit.
2. Driven from [redacted] engine auxiliary shaft and engaged by manual effort when desired, thus being at a higher level it would be less vulnerable to road splash.
3. Rotary type pumps are available for air actuated brakes; this type may warrant consideration.
4. The capacity of pump should not be less than 7.75 cu. ft. per minute to inflate [redacted] 10.50-20 size tire in [redacted] minutes maximum.

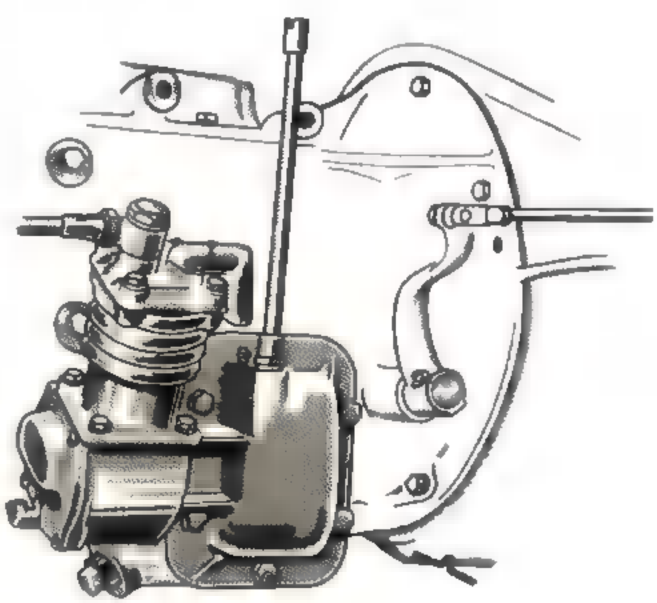
REFERENCES:

D.M.S. - File 73 - T - 3,
W.V.E.E. - Report No. H-2311,
A.E.D.B. E.E. Reports Nos. E96, E174,
D.V.S.A.6 Report E526.

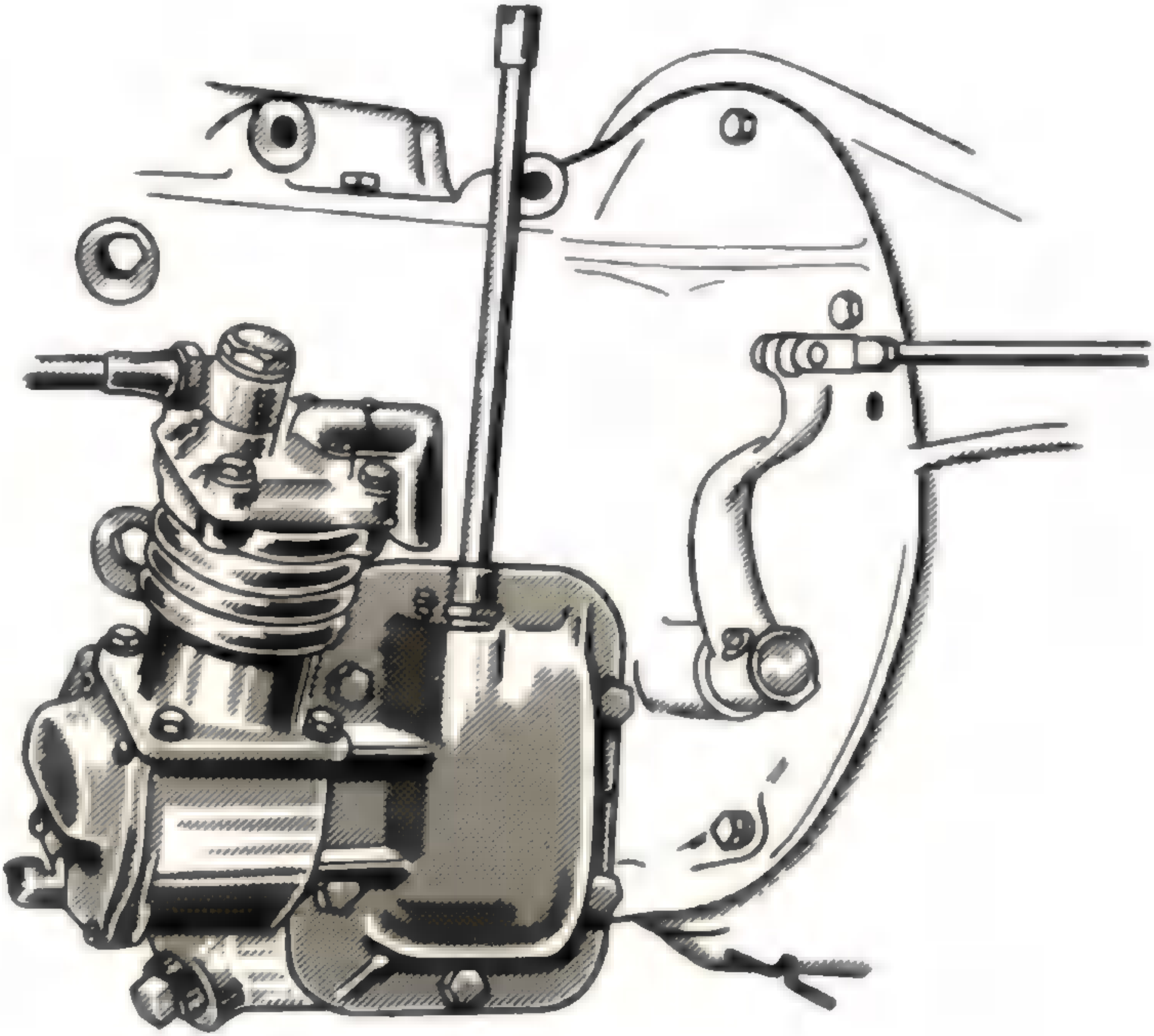
SPECIAL DEVELOPMENT

At the later stages of the war, designs for altering tire pressures of vehicles on the [redacted] were developed in U.K. [redacted] U.S.A. These designs allowed the driver to inflate and deflate the tires, and [redacted] used principally [redacted] amphibious vehicles.

The reader is referred to British drawings of Terrapin II and to U.S. War Department Manual TM 9-802 for further study. It is to be noted that on the former the air supply reaches the hub from inside the hull of the vehicle through the axle shaft. In the latter case, it is routed through flexible [redacted] from the chassis to the outer hub cap.



POWER TIRE PUMP



POWER TIRE PUMP

TOOLS AND EQUIPMENT

At [redacted] outset of production, Vehicle Tools were provided in a Metal container, the variety and type being based on War Office Tools [redacted] Equipment Tables. These Tables required Tools in [redacted] of comparable commercial provision. Vehicles equipped with Winch required additional equipment in the form of Scotches, Tackle Blocks, Hawsers, etc.

Subsequently, Maintenance programmes required for British Vehicles that the Driver perform the "Sixteen Task System", and a similar system [redacted] developed for Canadian Army maintenance. This divided the Driver maintenance of vehicles into definite Tasks for any one servicing, with the object that all points requiring maintenance [redacted] covered in [redacted] specific length of time in [redacted] routine orderly manner. The Tasks were such that Vehicle Tools were supplemented to [redacted] considerable degree.

[redacted] following points on Equipment and Tools might well be considered for future vehicles.

1. Wheel Jacks of the mechanical type should be replaced with telescopic hydraulic design in suitable capacities, for operation in high and low ambient temperatures. Current designs and manufacturing capacity of Jacks [redacted] found inadequate.
2. Tow Ropes with Spliced Eyes should be replaced by Ropes fitted with Clamp Type Sockets. The former are extravagant in rope and require skilled personnel for repair while the latter is economical in both regards.
3. Vehicle Chains for 4 x 4's, for tractive effort only, [redacted] subject to much investigation. It became apparent that standard Commercial Ladder Type Chains were as satisfactory under all types of operation, i.e. mud, snow, ice, slush etc., [redacted] any other design developed.

   Variations in tire dimensions between makes and lack of close manufacturing tolerances [redacted] Chains resulted in periodic mal-fit. Future Chains should be designed to suit the variations experienced in Tire details and should be built to rigid limits.
4. Vehicle "Overall Wrap-Around" Floatation and Traction Devices for Multi-wheel vehicles at [redacted] present time, leave much to be desired in design. Prime requirements should be minimum weight; maximum floatation; good adhesion; [redacted] of application; minimum stowage space while not in use; [redacted] of adjustment; reasonable life expectancy; minimum of tire damage.
5. Some Combination Wrenches desirable for M.T. Vehicles have [redacted] commercial counterpart. The provision of Tooling to make available Combination Wrenches would appear sound, as by this the overall quantity of M.T. Tools would be reduced.
6. Lubricant dispensing Tools need to be simple, of ample capacity, suitable for dispensing lubricant in cold weather, and readily handled by [redacted] man.
7. Tire Gauges [redacted] future vehicles should be of Dual Chuck Type and record in Increments suitable for all pressures required, thus making it applicable to Single or Dual Tires; Pneumatic or R.F. type.

REFERENCES:

D.M.S. File	73-T-1
D.M.S. File	73-1-7
D.M.S. File	73-1-17
A.E.D.B. Specification	O.A. 258
A.E.D.B. E.E. Report,	E.71 - Mitchell Chains.
A.E.D.B. E.E. Report,	E.84 Kennedy - Kemp Tracks on Diamond T Tank Transporter.
A.E.D.B. E.E. Report,	E.90 Budd Wheel Snatch Block.
A.E.D.B. E.E. Report,	E.98 Vehicle Tool Kits applied to Task System of Maintenance.
A.E.D.B. E.E. Report,	E.110 "Uni" Lubricating Gun.
A.E.D.B. E.E. Report,	E.140 #932 Walker 5-Ton Hydraulic Jack.
A.E.D.B. E.E. Report,	E.169 Standard Spliced Eye Cable Vs. Malleable Socket - Open & Closed End Type Cable.
A.E.D.B. E.E. Report,	E.175 Auto Specialties Jack #148D.
A.E.D.B. E.E. Report,	E.176 Canadian Army Standard Tire Chains vs. U.S. Army Light Weight Chains, 9.00x16 - 10.50x16.
A.E.D.B. E.E. Report,	E.194 Walker Jack 5 Ton Hydraulic #932.
A.E.D.B. E.E. Report,	E.204, E.233, E.304 - Tire Chains.
A.E.D.B. E.E. Report,	E.389 5-Ton Mechanical Chassis Jack Model 168 D.B.
A.E.D.B. E.E. Report,	E.392 Safe Line Wire Rope Clamps.
A.E.D.B. E.E. Report,	E.411 Auto Specialities 5-Ton Ratchet Jack.
A.E.D.B. E.E. Report,	E.453 Tire Chains, Endless Type, Parsons "Oriam" Type.
A.E.D.B. E.E. Report,	E.457 Drivers' Tasks 1st Echelon [redacted] (Chev.15-Cwt. 3-Ton 4x4)

ARCTICIZING

"Arcticizing" in its broad sense, [redacted] related to vehicles, [redacted] be defined as the [redacted]plication of equipment to vehicles which will enable them to be operated in [redacted] where the temperature is consistently below zero °F.

The experience of commercial operators in sub-zero areas [redacted] of limited value only as, normally, commercial operators have available to them adequate shelter and auxiliary devices such [redacted] electric immersion heaters, which are not available in military operation. In addition, it is highly desirable in military operation, that each vehicle be individually self sufficient. It is further true in military operation that for reasons of supply fuel and lubricants may not be the most desirable from [redacted] low temperature operational standpoint. For reasons of security in military operations it is highly desirable that the vehicles can be started instantly and that any "aids" used be of the type which will not be revealing to the enemy.

The following will deal with the steps which were taken to facilitate starting operation of the vehicle from the standpoint of low temperature only. Problems of snow-traversing which are usually encountered in the same areas [redacted] not discussed here.

The first technical effort that was made, on any scale, by any Government, to determine the requirements of sub-zero operation, was the trials carried out by Army Engineering Design Branch at Kapuskasing, Ontario, in January, February and March, 1942. Representative vehicles of both Canadian and U.S. manufacture [redacted] tested, some with special devices to aid starting, and [redacted] result of this investigation certain basic requirements were developed. These tests [redacted] observed by Canadian, U.S. and British Army Representatives and the results recorded in [redacted] 96 page report entitled "Report on Wheeled Vehicle and Universal Carrier Cold Test Trials conducted at Kapuskasing, Ontario, February 1942".

The conclusions arrived at were as follows:

> "Pending completion of further detailed tests in the Cold Rooms of the various motor vehicle manufacturers, final conclusions cannot be drawn, but the following is indicated from the tests made at Kapuskasing: these tests, plus commercial experience show that with proper precautions and equipment, vehicles can be operated in temperatures as low as minus 50°F."

For Starting

1. Vehicles in good condition with a fully charged battery and crankcase oil of suitable viscosity will start satisfactorily with minumum ambient temperatures of minus 20°F. without any special equipment.
2. Where temperatures below minus 20°F. are ordinarily experienced, special equipment and precautions have to be taken for starting.

   The items to be considered are:

   (a) A Dole Primer or some similar means is required to ensure that sufficient gasoline will be available in the engine intake manifold to give a correct mixture for starting.
   (b) Sufficient battery capacity for starting can only be ensured by maintaining the electrolyte temperature above minus 15°F.
   (c) The crankcase oil (10W) must be diluted unless the engine compartment is shrouded and the area underneath the shroud heated.
3. To start motorcycles or one cylinder gasoline engines at temperatures below minus 10°F., it is necessary to apply heat to the intake system and cylinder heads.

For Running

1. For operation at temperatures below minus 30°F. the lubricant used in the transmission, transfer case, differentials and steering gear must have a viscosity as low as S.A.E. 80 gear oil plus 10% Kerosene.
2. The greases at present available [redacted] not suitable for applying through the lubricant guns and pressure fittings under low temperature conditions, and pending further development, fluid lubricants will have to be used. There is no indication that bearings packed with the normally recommended grease will give any trouble.
3. When it is necessary to dilute the crank[redacted] oil, gasoline is [redacted] more satisfactory dilutuent than kerosene. Gasoline evaporates off in one to two hours operation requiring the addition of [redacted] further quantity

at the end of [redacted] day's run. The mixture of kerosene and oil gives [redacted] oil consumption greater than normal. Approximately half as much gasoline is required as kerosene for the same viscosity reduction, gasoline evaporates faster leaving the straight mineral oil for better lubrication and reduced oil consumption. Generally gasoline is more readily available than kerosene.

Due to the limited time available at Kapuskasing, it was not possible to develop adequate equipment to facilitate sub-zero operation, and an extensive programme of testing was carried out at the Cold Rooms of the motor vehicle manufacturers and with the co-operation of their Engineering Staffs.

In the early part of 1942, [redacted] order was received for 4,000 vehicles fitted with equipment for operation at temperature of minus 40°F.

In the light of experience gained at Kapuskasing, [redacted] in the Cold Rooms at that time, [redacted] specification [redacted] developed (O.A.99) covering the special arrangements to be made and the equipment to be fitted on the vehicles for this order. Reference to this specification, also to pages F1-1 to F1-7 of [redacted] Canadian Military Pattern Data Book, and to the special Maintenance Manual and Spare Parts List No. RT1C-C1 will give the details of the special features. Briefly these were -

1. Special Lubricants.
2. Special Fuel Pump Diaphragm.
3. Fuel Primers fitted to Intake Manifolds.
4. Crankcase Oil Diluters.
5. Insulated Battery Boxes.
6. Under Chassis Heaters and Shrouds.
7. Special Body Heaters.

In addition to the above, Specification O.A. 15 [redacted] written to cover the supply of special equipment for fitment to [redacted] small number of Air Compressor Trailers.

It [redacted] realized that certain features of this equipment, particularly the heaters, were not the most desirable and that further work was necessary.

This work proceeded along three lines -

1. [redacted] co-operative programme with U.S. Ordnance and the Society of Automotive Engineers Cold Starting Committee.
2. Further development work with the Motor Vehicle Manufacturers [redacted] the Petroleum Industry.
3. Further test work, with newly developed "aids", at Camp Shilo, Manitoba in the winter of 1942 - 1943.

This test work was carried out in conjunction with the Canadian Army and in co-operation with the U.S. Army who operated [redacted] Cold Weather Detachment at Camp Shilo at the [redacted] time.

The results of the vehicle phase of these tests were recorded in Part IX of the Department of National Defence Report on the Camp Shilo Tests.

From this test work, it was determined that sub-zero operation could be divided into two phases -

1. That in which the lowest anticipated temperature would be minus 20°F.
2. That in which the temperatures are commonly below minus 20°F. and may frequently be below minus 40°F.

Following the Shilo tests, orders were received from the British Army for vehicles for operation in areas in which the lowest anticipated temperature was minus 20°F. and from the Russian Army for vehicles to operate in areas where minus 40°F. was common.

1. <u>Minus 20°F.</u>

For operation in these areas it was determined that the most important item [redacted] [redacted] battery which would provide sufficient torque to start the engine with the battery electrolyte temperature and engine oil, etc., at minus 20°F.

Following the test work at Shilo, where an experimental 23 plate (per cell) 6-volt battery was tested in vehicles, further tests were carried out in the Cold Room and the tests recorded in [redacted] report entitled "Report on Investigations of Lead Acid Type Storage Battery for Operation at Low Temperatures". In consultation with the Battery Industry, it [redacted] determined that a 21 plate battery would give the starting torque required and would be better than the 23 plate battery from [redacted] durability standpoint. Subsequently, laboratory tests were made and life tests in Canadian vehicles operating on Tire Tests at Normoyle, Texas. [redacted] results of these tests were recorded in report E-279 entitled "Report on Low Temperature Batteries (DMS-21 and similar batteries) in Life Tests under Normal Truck Use". Following these tests Specification O.A. 121 [redacted] compiled to cover the 21 plate battery.

In addition to the battery phase of [redacted] equipment other items such [redacted] Cab Heaters, Cran [redacted] Oil Diluters [redacted] developed and Specification O.A.199 [redacted] written covering the equipment to be fitted to vehicles for use in these [redacted]eas.

Reference to the equipment in more detail will [redacted] found on pages F1-9 to F1-13 of the Canadian Military Pattern Data Book and to the Spare Parts Lists and Maintenance Manuals referred to therein.

2. Minus 40°F.

In areas where the temperature will frequently drop below minus 40°F, and particularly where the fuel available in military operations [redacted] not be the best from a starting standpoint, heat to the engine is essential. Heat to the engine reduces the viscosity of the engine oil and consequently [redacted] cranking of the engine easier and it also aids in volatilizing the fuel thus facilitating starting.

With the knowledge acquired from the test work and from the experience on the equipment tested at Shilo, [redacted] specification was written (O.A.111) covering the equipment to be fitted on Canadian Military Pattern Vehicles for shipment to Russia. Reference to pages F1-15 to F1-21 inclusive of the Canadian Military Pattern Data Book and to the Maintenance Manuals listed therein will give additional detail of the equipment fitted to Canadian Military Pattern Vehicles for this order.

In addition to the above, Specification O.A. 115 was written to cover equipment fitted to Air Compressors and Specification O.A.131 to cover equipment fitted to the Diamond T Chassis. This latter was based on a U.S. Ordn[redacted] Kit developed for this chassis of U.S. manufacture.

Summary of Developments.

There has been considerable controversy [redacted] to the equipment which is required for Arctic operation both in the extent required and also in its application. Even in areas where the temperature of minus 40°F. is [redacted] the number of hours at, or below, this temperature are relatively few. However, the following basic facts [redacted] generally acknowledged -

1. That to secure adequate starting torque from the lea[redacted] acid type storage battery its temperature must not be below minus 20°F.

2. That the internal resistance of the lead-acid type storage battery increases as the temperature [redacted] down and that in vehicles equipped with voltage regulators, it is necessary at least at the time of writing, to raise its temperature above 40°F. above zero to enable it to be fully charged.

3. That to [redacted] starting of [redacted] engine, particularly with the low vapour pressure gasolines which may only be available, heat to the engine is necessary in areas where the temperature is commonly below minus 20°F.

It is generally considered that Combat and Reconnaissance vehicles should be self sufficient and should be so equipped that they can be started within thirty minutes. Such a requirement can [redacted] met either by -

1. "Standby" heaters

This type of heater should be of the type which can burn the [redacted] fuel that is used for the engine. If this fuel is used there is [redacted] certain fire hazard and the possibility of the heater "going-out". It has the advantage of enabling the vehicle to be instantly started, when the heater works properly.

These heaters can be of two types -

(a) Under chassis heater used in conjunction with [redacted] shroud over the vehicle or engine compartment. This type has the advantage of being easily adaptable to any vehicle with a minimum of preparation and can be so arranged to keep the battery warm [redacted] well [redacted] other components such [redacted] transmissions etc.

(b) [redacted] heater "built-in" to the engine. These can be arranged [redacted] that a minimum amount of fuel is required to maintain the engine temperature at the proper point by thermo-syphoning the engine coolant. The battery can also be heated with this arrangement. This type has the disadvantage of requiring considerable "plumbing" and is difficult to install.

Other vehicles can be heated from "Slave-Vehicles" fitted with high capacity heaters and a bank of batteries. These heaters can be used to direct heat at the components of vehicles. This heat together with the torque capacity available from the batteries from the Slave-

Vehicle will enable a formation to start a convoy of vehicles. It has the disadvantage of being time-consuming but [redacted] advantage of requiring the minimum amount of equipment.

[redacted] equipment to any vehicle complicates its servicing and should be avoided where possible.

Dilution of the engine oil to lower its viscosity and to facilitate starting is necessary where [redacted] heat to the engine is provided and is an additional safeguard even when heat is provided. It [redacted] been proven that in most engines, dilution has [redacted] ill effect [redacted] wear. However, in [redacted] engines, usually the low production types, there is considerable distortion in the engine at low temperatures and diluting the engine oil does not aid in starting. Diluting the engine oil with gasoline has been found to be preferable to the [redacted] of kerosene [redacted] it evaporates faster resulting in lower oil consumption and closer control of the amount of dilution.

When [redacted] diluter is used our experience has indicated it should be as simple in operation as possible and in this respect, the "Can" type specified in O.A.199 is preferred to the more complicated types specified in O.A.99 and O.A. 111.

Where no heat to the battery is available, it has been found that a multi-plate battery has better starting characteristics at low temperatures than one of the [redacted] size with fewer plates per cell. As the battery assembly does not lend itself to quick heating unless "Stand-by" heating is provided, [redacted] multi-plate battery (See Specification O.A.121) should be provided. In any event, heat should be provided to the battery during operation to raise its temperature sufficiently [redacted] that it will accept [redacted] charge. Where the battery container is subjected to extreme changes in temperature, and particularly where this is rapid, cracking of [redacted] container may result. The rubber container has been found more satisfactory from this standpoint than the composition.

Armoured vehicles have normally been fitted with 12-volt systems whereas Transport vehicles have been fitted with 6-volt. From [redacted] starting standpoint, the 12-volt is markedly superior at low temperatures and any vehicle designed specifically for low temperature operation should be so equipped.

Diesel engines have been found to be much more difficult to start than gasoline engines and unless flame "primers" [redacted] fitted, heat to the engines is [redacted] necessity below minus 10°F. to ensure good starting.

One of the greatest difficulties has been to secure adequate space heaters for vehicle bodies. Self contained spark ignited gasoline heaters have been fitted but have been unsatisfactory from [redacted] maintenance standpoint. The reaction of personnel on [redacted] Cold Weather Test at Prince Albert, Saskatchewan in 1945 [redacted] that a radiant type heater is the most acceptable, one which the personnel can "sit-around" and see, [redacted] well as feel, the fire.

Fuels, lubricating oils and greases [redacted] of the greatest importance in low temperature operation and particularly at temperatures below minus 20°F.

For good starting at temperatures below zero, the Reid vapour pressure of gasoline should be 12# minimum. Diesel fuel should have a cloud point 10°F. lower than the lowest anticipated temperatures.

Lubricating oils must have [redacted] pour point, or be diluted to give a pour point, lower than the lowest anticipated temperature. This is [redacted] requirement not only for lubrication of the vehicle components but also so that the lubricants can be dispensed.

Greases should be of the type that will not channel at low temperatures and that can be dispensed with available equipment. (See Part IX of Shilo Report for further details).

REFERENCES

A.E.D.B. Cold Weather Trials, Camp Shilo, Manitoba, 1942 - 1943, Part IX.

A.E.D.B. Cold Weather Trials, Kapuskasing, 1942.

A.E.D.B. "Report on Investigations of Lead Acid Type Storage Battery Operation at Low Temperatures".

Canadian Military Pattern Data Book.

Maintenance Manual & Spare Parts List No. RT1C-C1.

A.E.D.B., E.E. Report E-279

Specification O.A. [redacted]

Specification O.A. 15

Specification O.A. 121

Specification O.A. 199

Specification O.A. 111

Specification O.A. 115

Specification O.A. 131

AIRPORTABLE

With the increase in the scope of the campaign in the Far East which includes transfer of vehicles to remote areas, the requirement for vehicles to be made Airportable arose.

In July, 1944, D.A.C. were charged with making the design changes necessary to enable a 3-Ton C.M.P. G.S. chassis and cab, to be loaded into a Dakota C-47 Aircraft. Two mock-ups of [redacted] Dakota fuselage were built, one in Windsor and [redacted] in Oshawa. Preliminary trials of planned modifications to the chassis were conducted in these mock-ups.

Numerous methods of loading were developed, but eventually instructions were received to use the British method of chassis and cab dismantling and loading. Design [redacted] finalized using Army Air-Borne Transport Development Centre Report No. A.400 [redacted] the basis. Vehicles modified [redacted] per this report, were successfully loaded in actual Dakota Aircraft and the necessary design changes were released to production at both of the motor companies that manufacture C.M.P. Type vehicles.

It appears certain that, in future military operations, air transport will become increasingly necessary. In the future design of military vehicles this should, therefore, be borne in mind. [redacted] study of the aircraft to be used [redacted] a vehicle transport should be undertaken before any airportable vehicle design is finalised. The current C-47 Dakota transport places very strict limits [redacted] weights of vehicles. In all 3-Ton C.M.P. Vehicles manufactured in Canada, it is necessary to remove both the front and rear axle assemblies. This is because the axle length is greater than the usable width of the aircraft. If aircraft widths are not increased, axle lengths should be decreased sufficiently to allow them to remain in place when the vehicle is loaded in the aircraft.

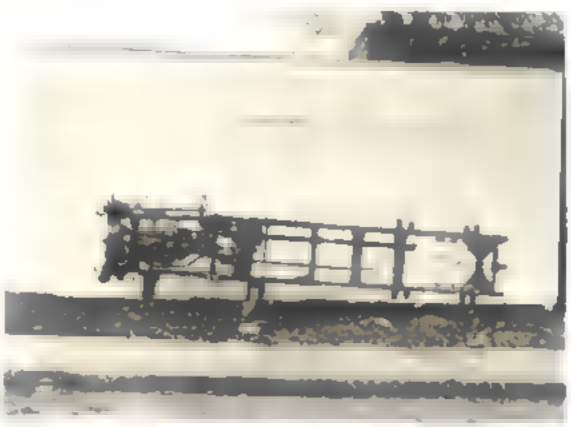
REFERENCES

D.M.&S. File 73-V-43

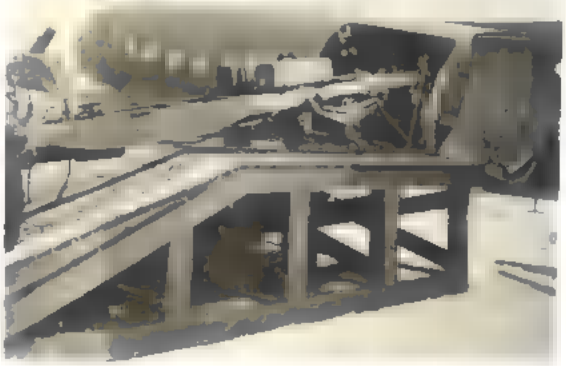
D.M.&S. File 73-V-44

D.M.&S. File 73-V-46

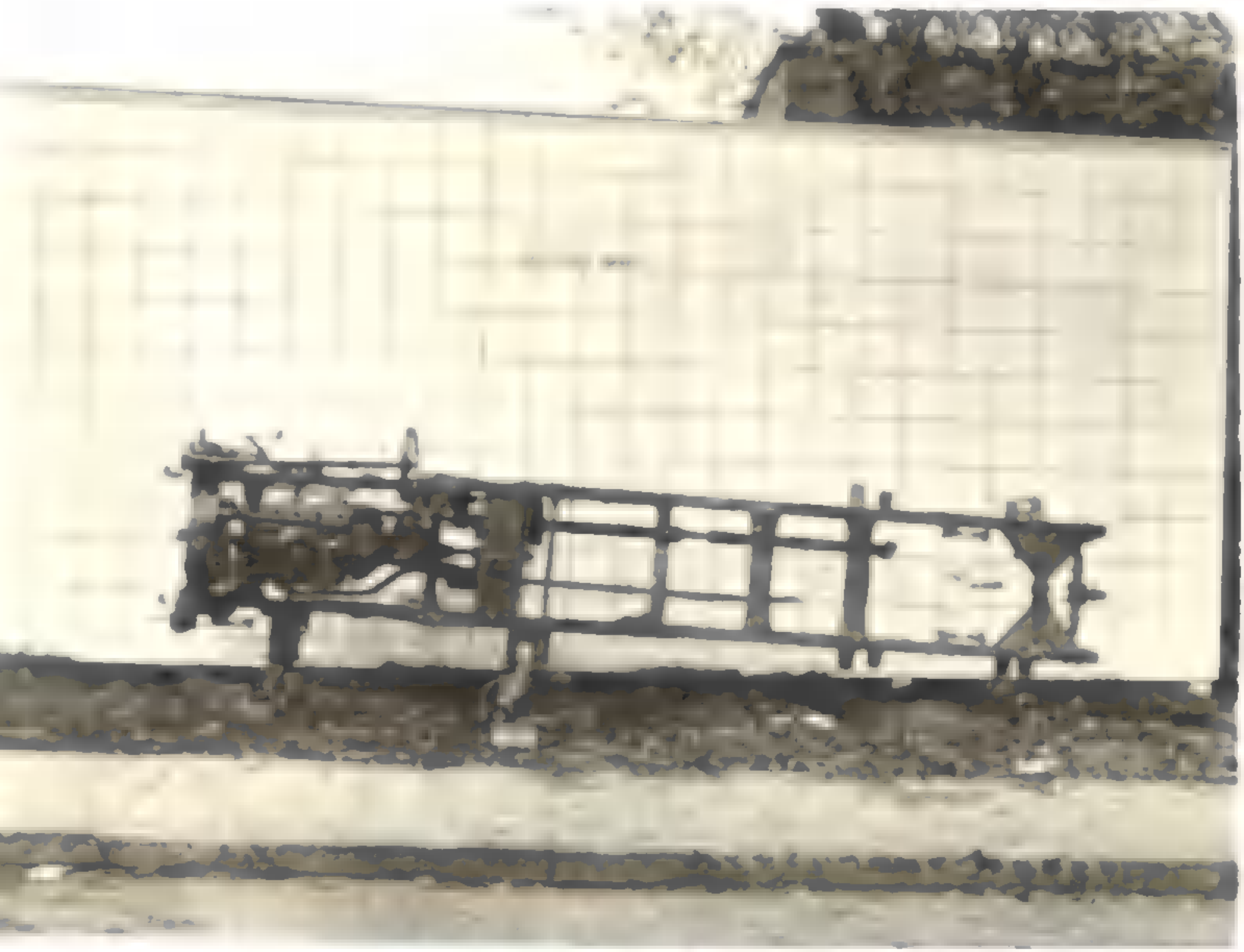
A.A.T.D.C. Report No. A.400

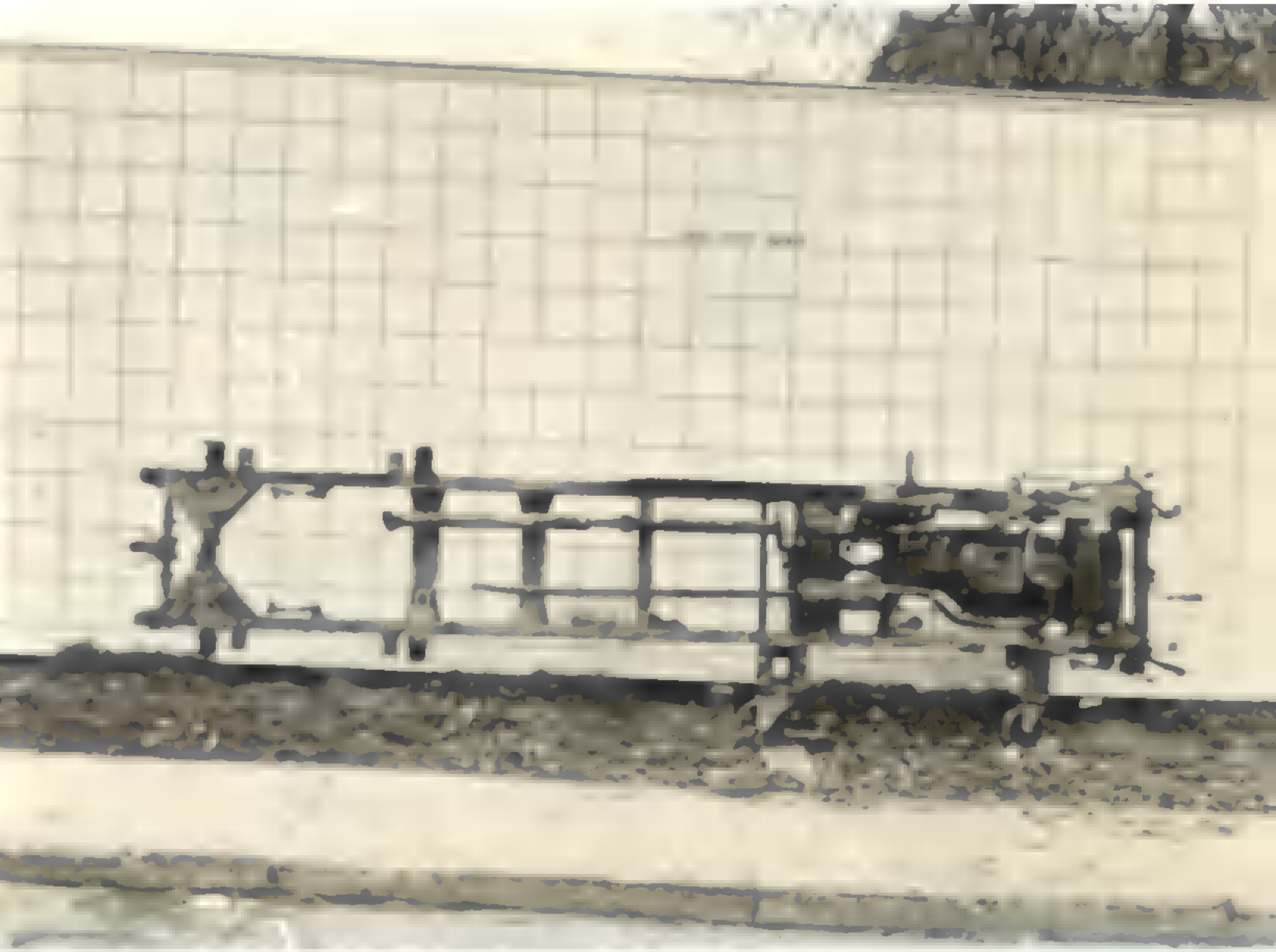


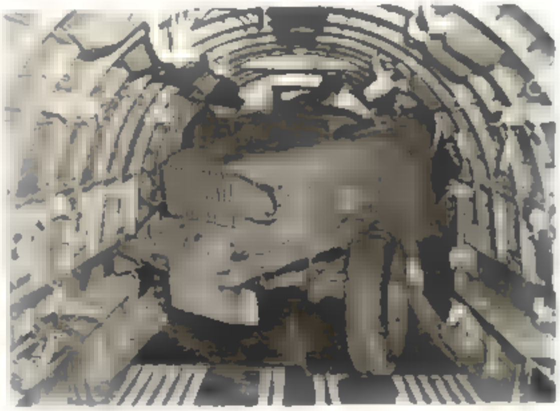

EXPERIMENTAL SIDE TILTING - 3 TON 4x4 NOT ADOPTED



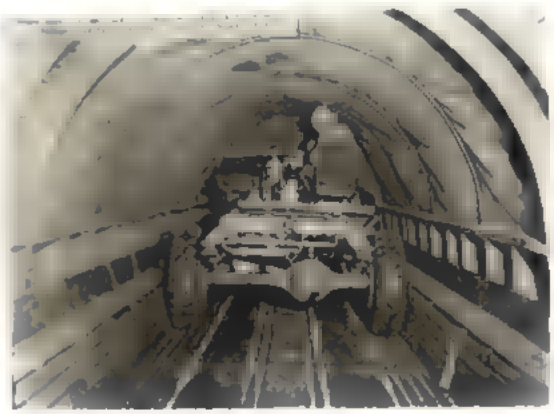

EXPERIMENTAL REAR LOADING [redacted] TON 4x4 NOT ADOPTED



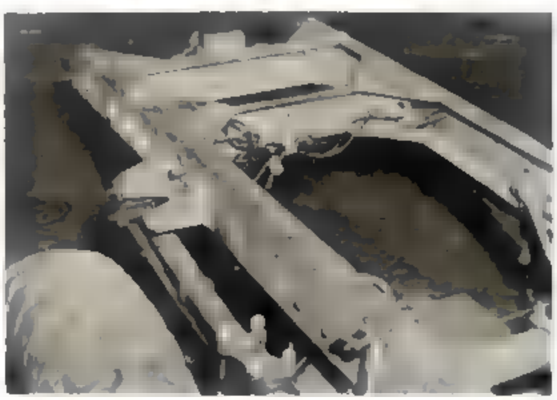




PRODUCTION DODGE 3/4 TON APT - 98" W.B.



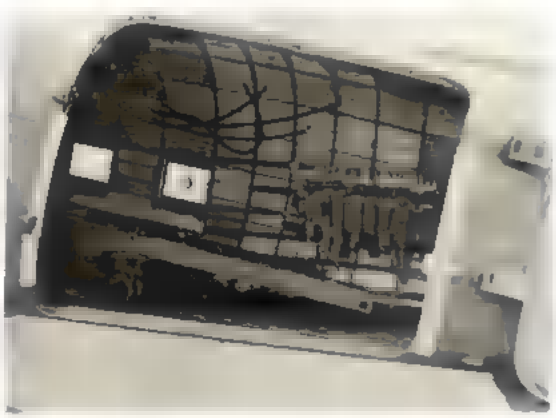
PILOT [redacted] 15 CWT. APT - 101" W.B.



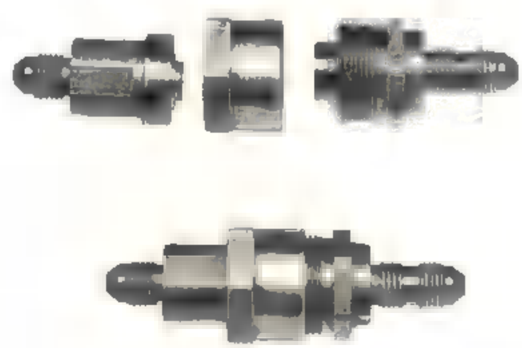
RIGHT REAR [redacted] SPLICE

STRIPPED CHASSIS ON CASTERS

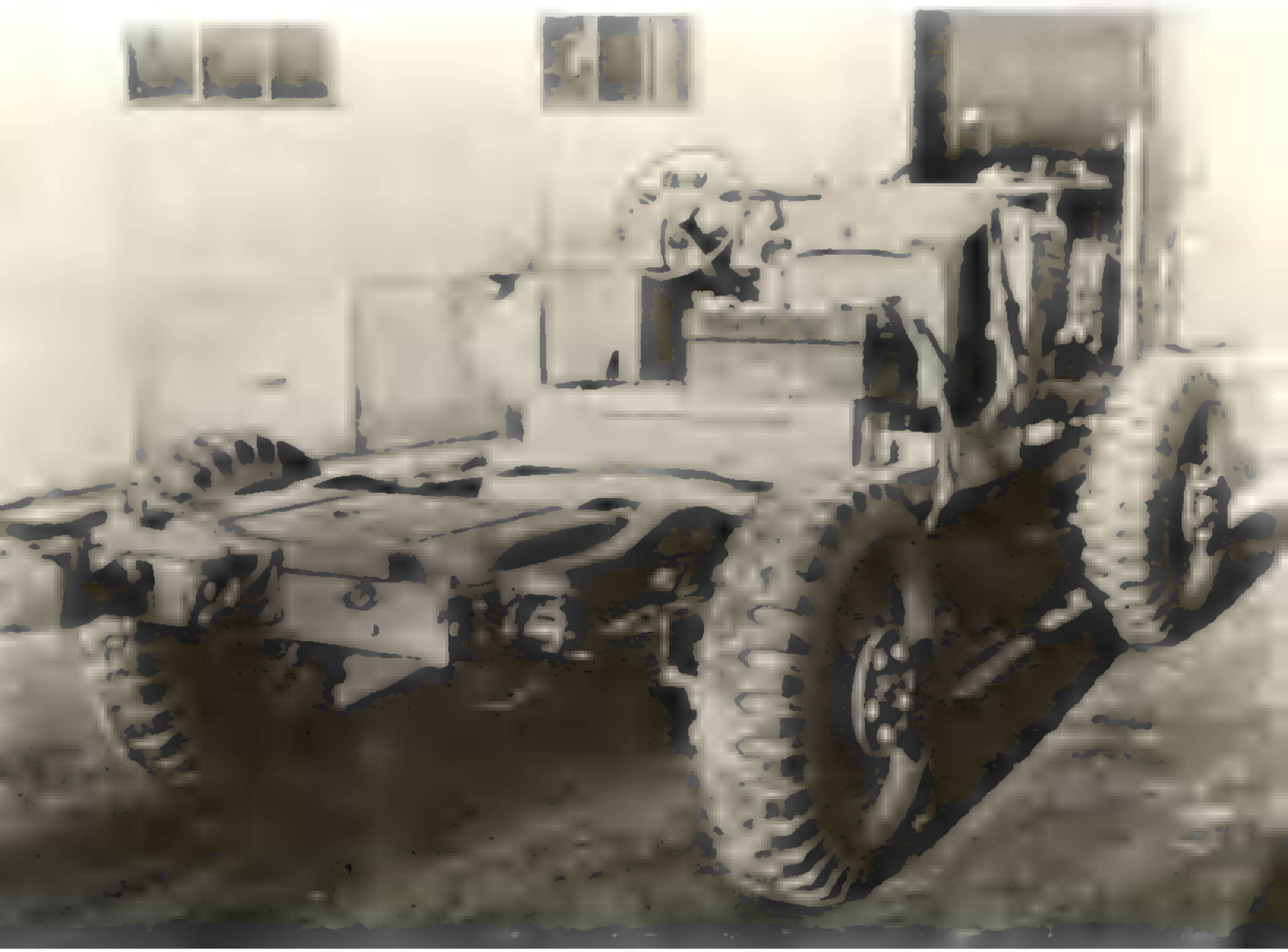
P R O D U C T I O N   3   T O N   4 x 4   1 5 8" W. B.

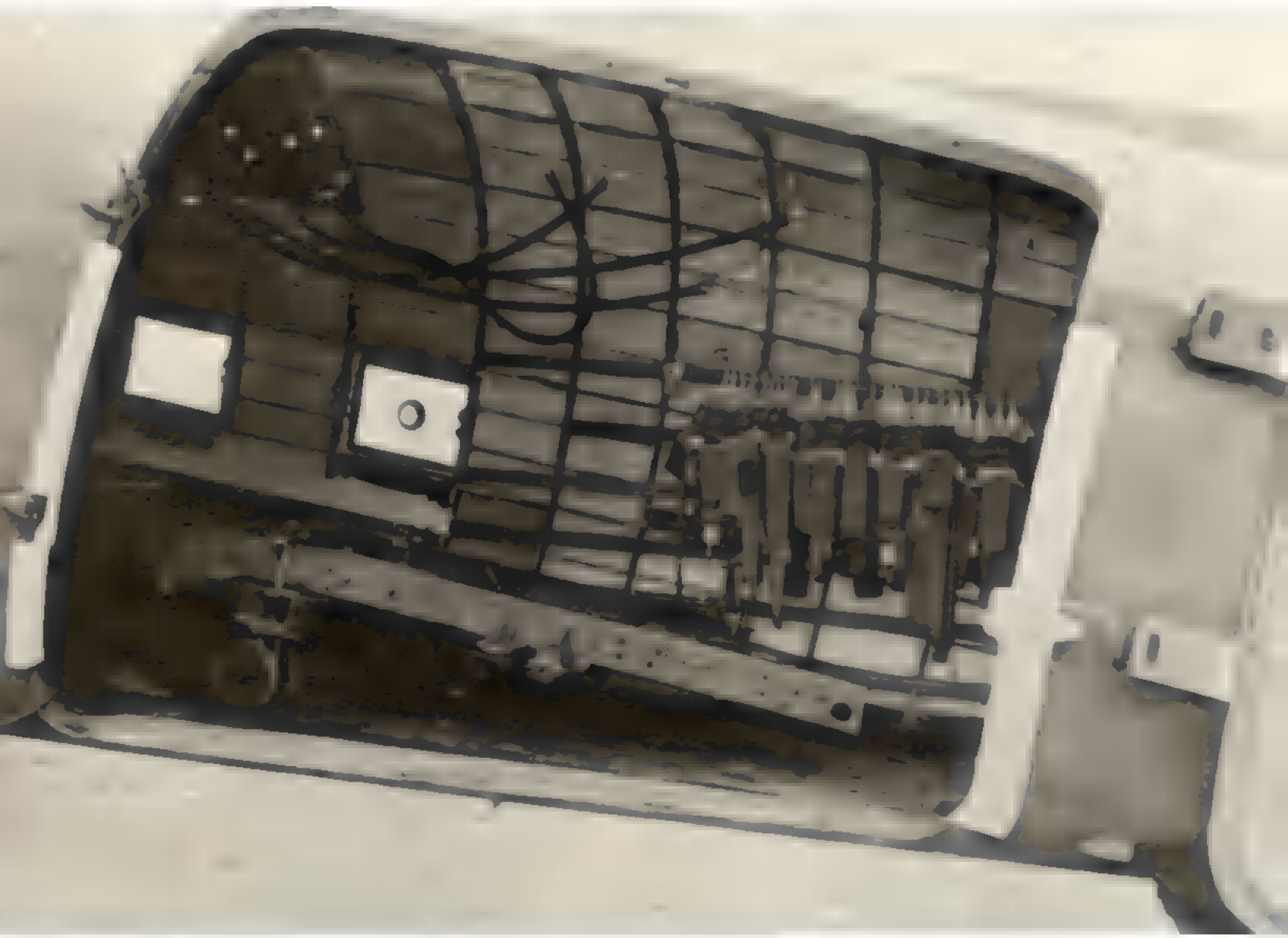


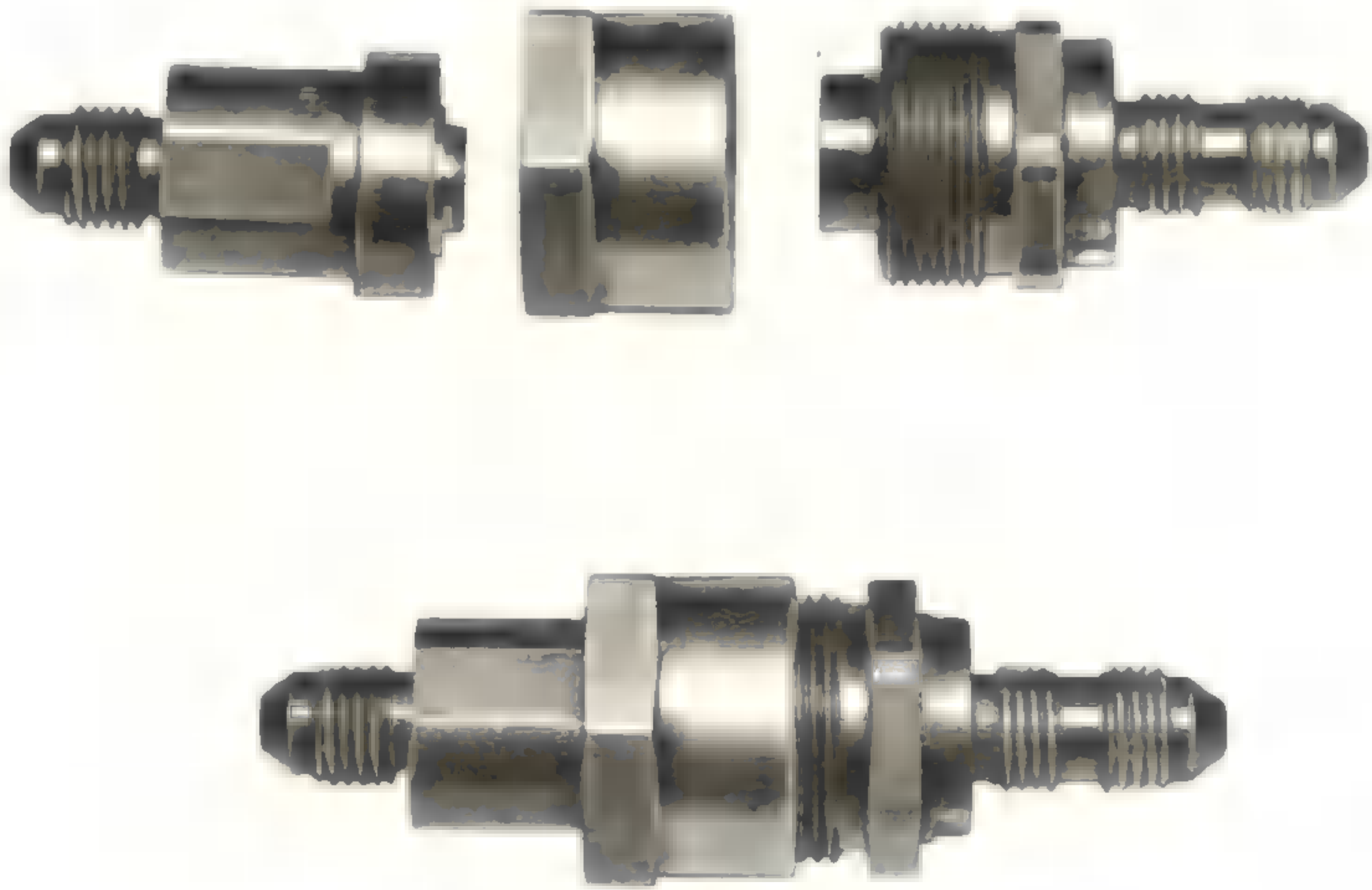
STOWING 3 TON 4x4 158" W.B. IN DAKOTA
SHOWING DOOR [redacted] GUARDS



SELF SHUT-OFF HYDRAULIC [redacted] LINE COUPLING
FOR FLEXIBLE LINES OF AXLES OF 3 [redacted]







TROPICPROOFING

Operations of M.T. Vehicles in Tropical areas brought forward the requirement to provide, on certain affected parts, [redacted] protection against corrosion, fungus and animal growth, not commonly specified for like operations when carried out in temperate zones.

[redacted] facilities of National Research Laboratories, Ottawa, were used to conduct tests in developing the steps necessary to protect [redacted] vehicle components. The conditions of tests in a Fungus Chamber were 28 days duration, at [redacted] Temperature of 95°F. plus or minus 3°, Humidity 95 to 100% Relative. Several types of Mould Spores were dusted on the various surfaces during this test to insure contamination.

Particular attention [redacted] given to electrical equipment such as Switch Backs, Distributor Rotors and Caps, Condensor End Caps and Terminal Junctions.

The only detrimental effect on these units insofar [redacted] electrical characteristics are concerned, is that the mould growth retains moisture to [redacted] greater degree than normal, but there is [redacted] evidence that failures, in the low voltages of 6 and 12, [redacted] due to Fungus Growth.

Cotton Braiding, Low Tension Wiring and Harness were treated with "Coraseal" dip and at the end of 100 days in the Test Chamber, no evidence of Fungus Growth appeared. "Coraseal" is [redacted] solution made of Salicylanilide naphtha and certain waxes. The dipping is from 3 to [redacted] minutes, after which the Assembly may be air dried at temperatures below 200°F. The [redacted] content provides [redacted] high water—repellant film.

Material such [redacted] Cotton, Duck, Rope, Webbing, Hair, Thread, and Felt being subject to Fungus Growth and Rot were found to be protected by the [redacted] of Copper naphthanate solution. The [redacted] material has been used to protect the Wood components of other portions of the vehicle apart from the Chassis.

REFERENCE

D.M.&S. File 73-1-221.

WADE-PROOFING

[redacted] request [redacted] received from British Ministry of Supply, T.T.2., to change the design of Canadian 'B' Vehicles in production so that with a minimum of preparation by the drivers or in workshops, the vehicle would be capable of wading in 5 feet of Sea Water, with an additional 18 inch wave, for six minutes.

The original request specified that all vehicles having single tire equipment rather than duals were to be wadeproofed. However, later this requirement [redacted] changed to include only all wheel drive vehicles since other types would not be suitable as spearhead vehicles for establishing beach heads. The ultimate requirement [redacted] applied to all wheel drive Single tired vehicles only.

The specific requirement details [redacted] follows -

(a) The vehicle design must be such that it will wade in Sea water five feet deep, with 18 inch waves in addition, for six minutes. At the end of a six minute wade, the maximum ingress of water into the steering gear housing, master cylinder, transfer case, transmission, rear axle, front axle, engine oil pan, winch housing and brake booster cylinder shall not exceed [redacted] amount representing reasonable seepage.

(b) All vital parts and assemblies pertaining to the ignition, induction, generating and starting systems which may thereby be contacted by Sea water shall be treated to prevent abnormal corrosion. They shall not show signs of corrosion at the end of [redacted] 100 hour Salt spray test.

(c) Their design shall [redacted] such that, prior to [redacted] wade, all points requiring supplementary treatment over and above those which are permanently fitted to the vehicle in production, shall be readily accessible in order that such treatment may be carried out with reasonable facility, without the aid of special tools and within [redacted] minimum of time, by the operator.

(d) All such material and components required to be fitted to the vehicle by the operator to enable it to perform [redacted] minimum of [redacted] wade, shall form a part of the vehicle equipment and shall be identified as such and suitably stowed in the vehicle.

(e) The vehicle design shall be such that immediately after [redacted] wade it will be capable of operating under average beach-head conditions for five miles [redacted] one hour without any servicing and without impairing the subsequent performance of any component of the vehicle.

(f) The design shall be such that after [redacted] wade, it will be capable of conversion to normal operating condition within [redacted] minimum of time and with [redacted] minimum of servicing.

In the early development stages it became obvious that the fuel induction, high tension electrical and hydraulic brake systems of the vehicles had to be made watertight when wading in water of approximately three feet or [redacted] in depth.

In less vital components such [redacted] axles, transfer case, transmissions, steering gear boxes and front axle universal joint housings, etc., [redacted] negligible quantity of water seepage [redacted] accepted due to the limitations of commercially available seals, although full [redacted] made of special materials and designs whenever possible, and in the preparation of seal tracks.

Another very important point, particularly from [redacted] maintenance and durability standpoint, was the corrosion resistance which must be provided on many surfaces to extend the life of seals as much as possible, also to prevent rapid deterioration generally which would affect reliability in many components.

A problem arose in regard to corrosion in the brake drums and adjacent brake parts, and unfortunately, despite the research and development work in this connection, [redacted] not extensive enough to specify any change in current construction which would alleviate this condition.

AFFECTED ASSEMBLIES

Generator - The generator [redacted] basically the same as the standard unit but with added insulation treatments to resist water and with improved corrosion resistance of metal components. Brush holders, terminals, and terminal nuts were made of brass and stainless steel [redacted] used for brush springs and pins.

Starting Motor - Two types were used - On engines where it [redacted] found advisable to seal the flywheel housing, [redacted] sealed starter was used to complete the sealing. An open type [redacted] used on the Dodge engine which operated with an open flywheel housing. Both types were treated for protection from water and corrosion.

Spark Plug - Ford and Dodge engines [redacted] fitted with [redacted] conventional 14 [redacted] plug in [redacted] 3 piece metal enclosure with 10,000 Ohm suppressors built in. Because of the physical limitations of the Chevrolet cylinder head, [redacted] modified aircraft type with suppressor built in had to be employed. With this type of plug considerable difficulty was experienced in preventing the suppressor from opening, thereby causing high resistance in the plug circuit.

Ignition Distributor - Ford and Chevrolet used standard distributors housed in a cast aluminum enclosure with packing gland type outlets thus sealing the terminals against ingress of water. Atmospheric venting [redacted] by tubing to a point above the 6'6" requirement.

The Dodge distributor represented a new design which was inherently sealed, with packing gland type H.T. outlets and vented to the atmosphere by tubing.

Ignition Coil - The Coils used on Dodge and Chevrolet were redesigned to provide inherent sealing. Terminal outlets were of the packing gland type.

Ford used [redacted] standard coil housed in [redacted] cast aluminum enclosure with packing gland type outlets. The enclosure was vented to the atmosphere by tubing.

Voltage Regulators - Standard regulators were used. Ford and G.M. employed watertight and vented enclosures. The Dodge regulator was sealed and exposed parts made corrosion resistant.

Instruments and Switches - All instruments [redacted] sealed and the backs were treated with a fungicidal varnish. The speedometer sealing was completed by [redacted] synthetic sheath over the metal conduit.

Electrical switches were basically standard with improved sealing between case and back and with [redacted] rubber boot added at toggle lever.

Head and Running lamps [redacted] made corrosion resistant by the addition of plating and provision of adequate holes for drainage.

Carburetor - This unit was watertight and dust proof with intake to accept the flanged type Air Cleaner. Zinc cast parts were made corrosion resistant by di-chromate treatment and plating.

Fuel Pump - Basically the [redacted] as a standard pump except that the vent hole was deleted and the priming lever shaft sealed.

Fuel Tanks - Standard, except that sealed caps were used and filler necks vented.

Clutch Housing - Both General Motors and Ford vehicles employed sealed clutch housings. In addition, the clutch hub was "Lubrited". Retention of oil in porous surface resulting from Lubrite's phosphate coating prevented seizing and binding of clutch on splines of clutch main drive shaft. Housing was vented. Satisfactory operation of the Dodge was obtained with an open clutch housing. Exposed parts were adequately protected by plating.

Transmission - This unit was redesigned in order to seal shifter shaft rails by Welsh plugs. The gear shift lever tower was sealed by a rubber boot. Two element Synthetic Seals were used at the drive flange, and flanges and Shifter Shafts were "Lubrited". The Dodge vehicle used [redacted] Standard Transmission with standard venting.

Transfer Case - This unit was essentially the same as a standard transfer case, and was remotely vented. Double seals were added to outgoing shafts. Dodge remained un-modified.

Axles, Front and Rear - These units were assembled with improved two element seals throughout. All joints and threads were sealed with Permatex. Pinion flange [redacted] "Lubrited". Remote venting employed. Dodge vehicle used a standard unit with standard venting.

Steering Gear - Seals were added to Mast Jacket above the worm, and the horn wire exit sealed.

Brake Master Cylinder - Sealed and remotely vented.

Brake Booster Cylinder - Permatex Sealing Compound was used at the bellows and studs to help prevent ingress of water into the cylinder. Unit was remotely vented.

Venting on Chevrolet and Ford

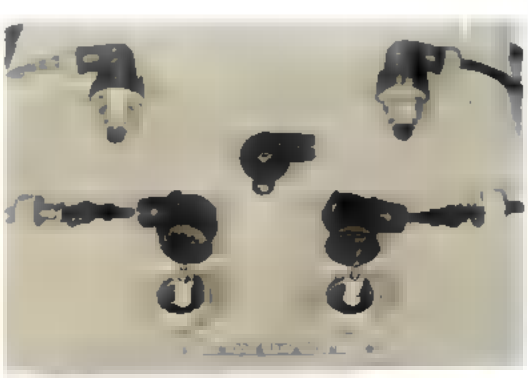
To ensure satisfactory operation of the vehicle while wading, a number of components required to be vented to the atmosphere. Units requiring ventilation with air cleaners attached to intake pipes to ensure clean air entering the system, were -

1. Front and rear axle differential housing
2. Transfer case
3. Hydraulic brake master cylinder
4. Transmission operated tire pump crankcase
5. Intake of transmission tire pump
6. Vacuum power brake cylinder
7. Clutch housing
8. Fuel tanks
9. Distributor
10. Generator regulator
11. Ignition coil
12. Circuit breaker
13. Carburetor
14. Engine crankcase.

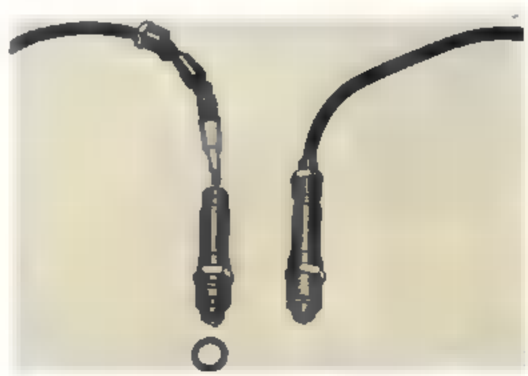
[illegible]:

D.M.&S. File 73-1-120.

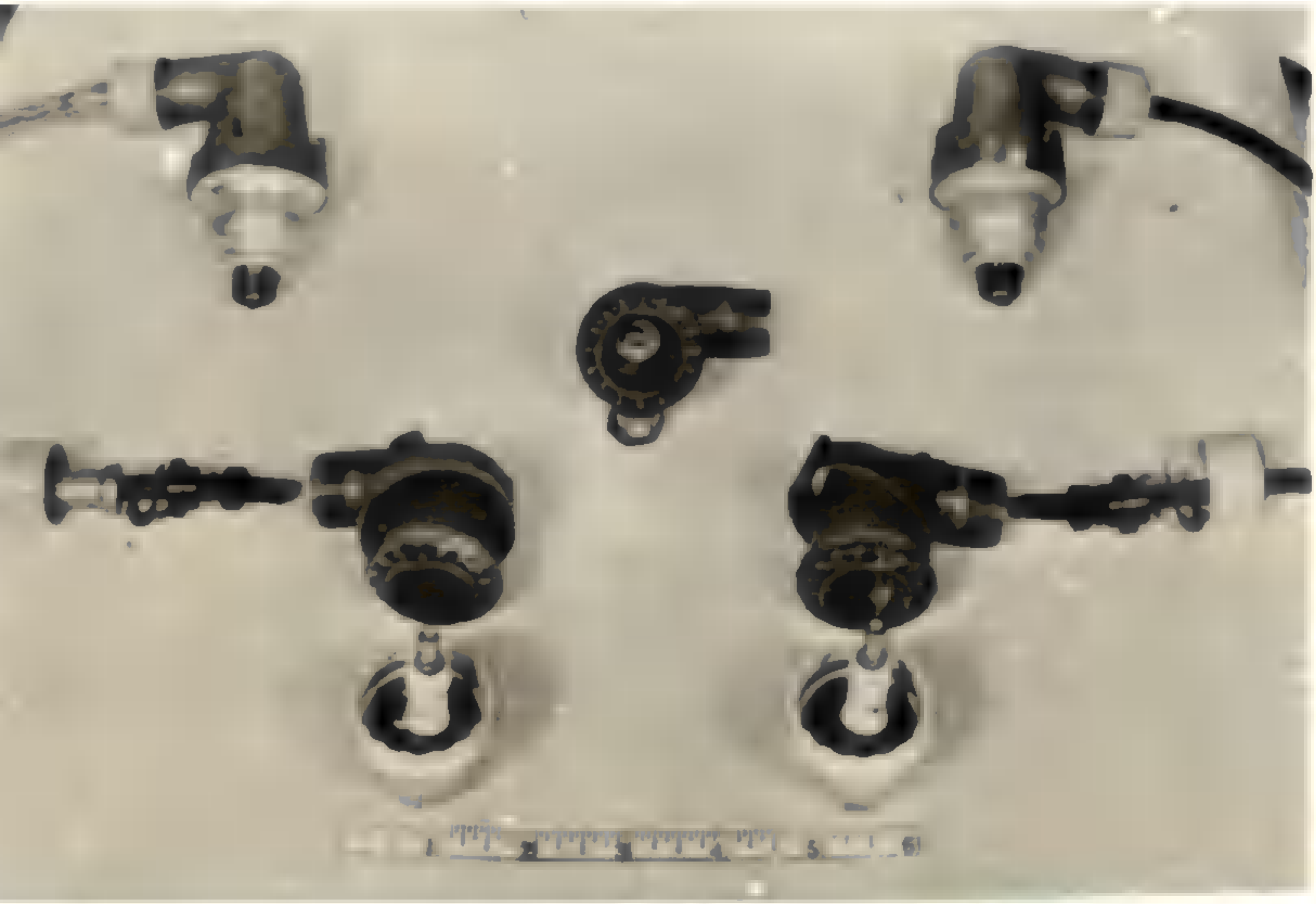
A.E.D.B. Report - Sea Wading Trials Comox B. . August 1945.



ENCLOSED SPARK PLUG



MODIFIED AIRCRAFT PLUG



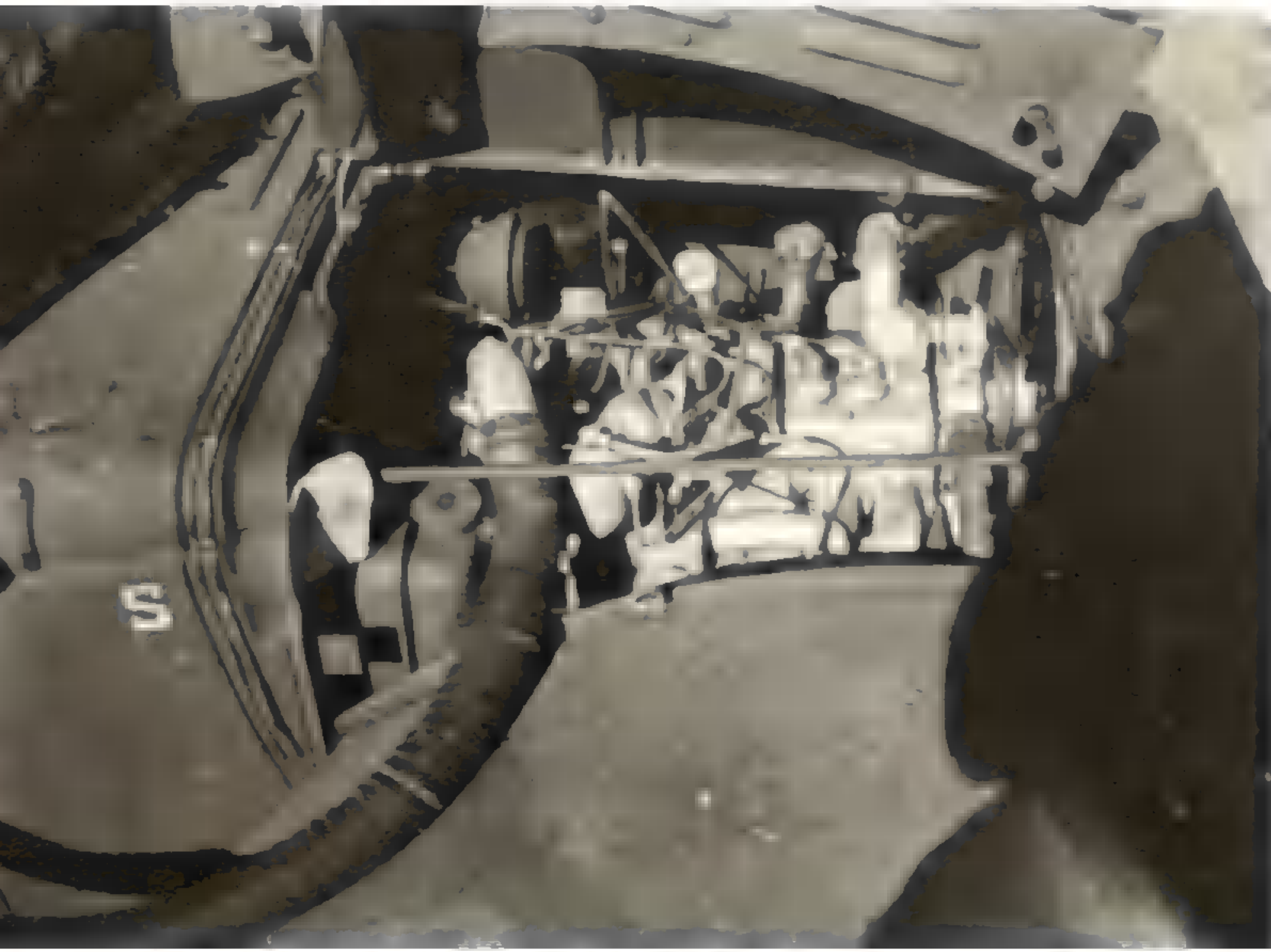
DODGE ENGINE

VENTING ARRANGEMENT

SEA WADE - 3 TON 4x4 FORD

SEA WADE - 3 TON 4x4 CHEVROLET

SEA WADE - 3/4 TON 4x4 DODGE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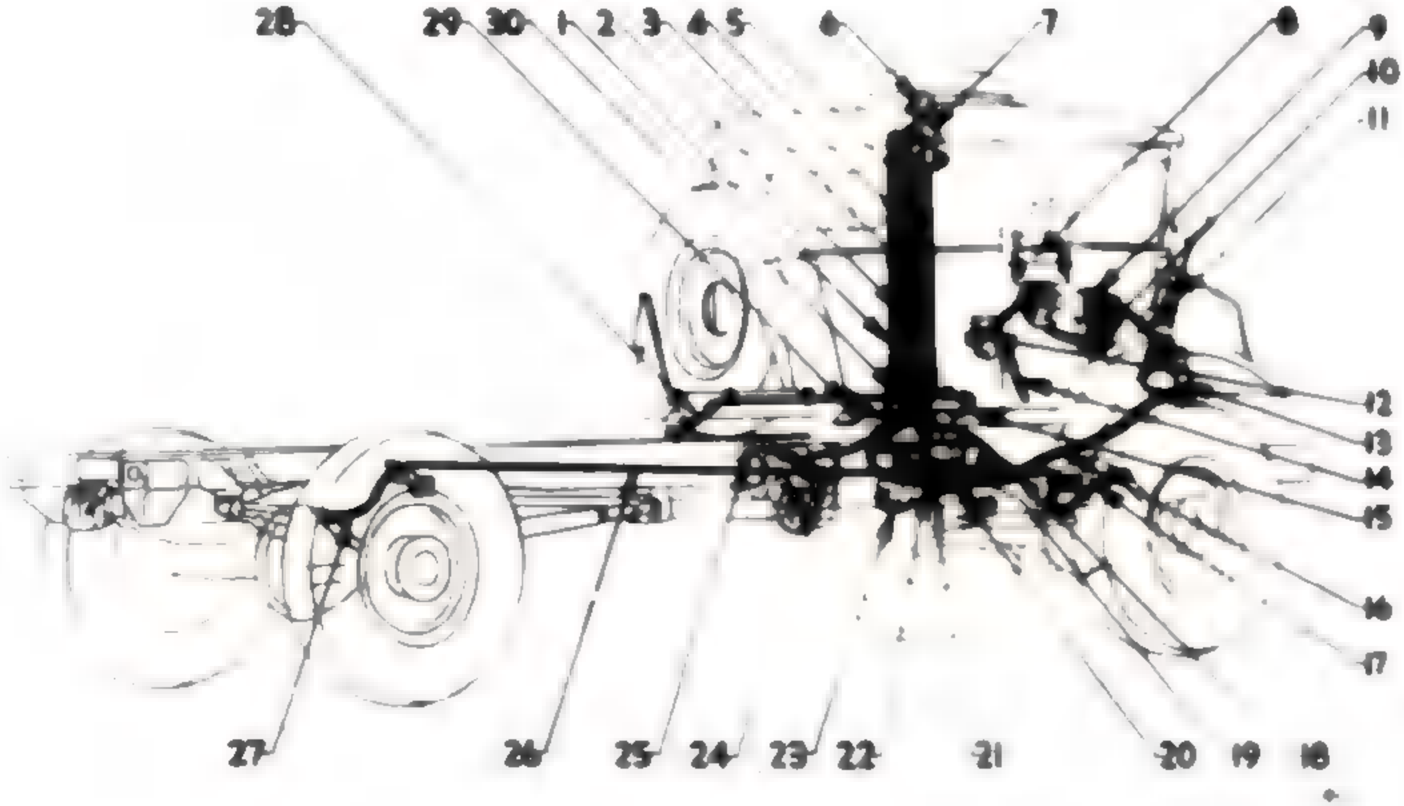

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FIELD COMMENTS ON CANADIAN WHEELED 'B' VEHICLES

[redacted] following comments [redacted] recorded in 1 Canadian Field Research Section, ADM, HQ, Canadian Forces in the Netherlands - Report No. 66 - dated August 12, 1945. The source of information includes Infantry, Artillery, Armoured, R.C.E.M.E., R.C.A.S.C., R.C.E., R.C.O.C., R.C.C.S., R.C.A.M.C., and Dental.

Q. Are chains required for all driving wheels of Arty Tractors which [redacted] equipped with winches?

A. Chains [redacted] required on all driving wheels of Arty Tractors even though they [redacted] equipped with winches. Frequently, even with full chains, breakdown assist[redacted] is needed to help [redacted] gun and tractor in bad ground.

Q. Is the pay load capacity of the lorry 3-ton 4x4 GS sufficient [redacted] is the tendency in the field to overload these vehicles?

A. The pay load capacity of the lorry 3-ton 4x4 GS is considered to be sufficient for its purpose and there is seldom if ever any good reason to overload these vehicles other than lack of adequate transport or indifference, neither of which is the fault of the vehicle. Mounted on [redacted] 4-ton vehicle would solve the majority of problems in loading 1098 actual requirements, ease the driver problem and generally be [redacted] acceptable under up to date conditions and operational demands in the field. Should Canadian firms be unable to produce [redacted] ton lorry 6x6 in large numbers, heaviest 3-ton or over Std Veh 6x6 is recommended.

Q. Is there a requirement for semi-trailer load carriers in preference to the present [redacted] and 10-ton [redacted] Lorries for long road hauls?

A. Semi-trailers are suitable for use only under favourable road conditions and in L of C areas. In excessive hilly or mountainous country they are inclined to cause considerable delay and holdups on vital traffic routes, except for heavy tractor-semi-trailers of recovery design, having 6x6 and in some cases 4x4 drive of the tractor vehicle. It is questionable whether semi-trailer load carriers would be warranted [redacted] additional equipment to the recommended 4-ton and existing 10-ton load carriers, although there is certainly a place for them in rear echelons.

Q. Should all vehicles of 3-ton capacity and up be on [redacted] 6x6 chassis in preference to the 4x4?

A. It is recommended that all vehicles of 3-ton and greater capacity be on [redacted] 6x6 chassis in preference to 4x4.

Q. Should overall chains be provided for all 6 whld vehicles with the exception of load carriers?

A. Overall chains should be provided for all 6 whld vehicles, including load carriers, providing all wheels [redacted] driving wheels.

Q. Have frame failures [redacted] the [redacted] of the cab been frequent and if so, under what conditions of load and service?

A. Frame failures at the rear of cab on lorry 3-ton, 4x4, 158" Ford are frequent in rough, stony country and on bad roads full of holes where, particularly during night operations, the front end of [redacted] loaded vehicle drops into [redacted] chuckhole, light shell crater, or equivalent rise. The frame and centre crossbar buckle, damaging vehicle to the extent that transmission is thrown out of alignment and vehicle will not stay in [redacted], or gears cannot be changed or vehicle will not stay in [redacted] out of four wheel drive.

Q. Show preference of winch location by underlining preferred and crossing out least preferred of the following types:-

Centrally mounted between frame side rails, [redacted] on Canadian Gun Tractors.
Back of cab above frame as on F.W.D. - M.A.T.
Forward mounted, [redacted] U.S. Army 2½ ton 6x6.

A. Preference of winch location for other than recovery vehicles [redacted] to be for forward mounted unit, but having fairleads [redacted] that winch operates front [redacted] rear. For recovery vehicles winch requires both front and rear fairleads, is considered best centrally mounted as at present. For gun tractors [redacted] for recovery vehicles.

Q. Is [redacted] winch considered necessary on all vehicles? (See No 2 Para [redacted] and [redacted] Para 3).

A. The advantage of having [redacted] winch on all GS vehicles is considered out of proportion to the additional expense involved, it would be seldom if [redacted] used under normal conditions, is not considered necessary. It would, however, be [redacted] advantage to have [redacted] winch and power take-off unit complete with accessories designed for mounting in the field [redacted] that it could be installed as required by REME, RE's, Arty, etc., as the case may be under special conditions. In the majority of cases, however, breakdown vehicles [redacted] generally readily available for this purpose.

Q. Are grooved barrels of winch drum considered advantageous compared with non-grooved?

A. Grooved barrels are not considered [redacted] necessary advantage. Size of cable used may vary if proper size not available. A strong level-wind mechanism is desirable to prevent strand falls, binding and crushing of cable.

Q. Current wire rope loops are spliced, would mechanical replaceable splice fittings be preferred?

A. Mechanical replacement splice fittings [redacted] very desirable for wire rope loops. In the field, when [redacted] loop pulls apart or cable breaks, it is not generally possible to splice the cable due to lack of tools, knowledge and time.

Q. In your opinion, did the fact that, on vehicles with the conventional semi-sealed brake assemblies, the entrance of water and grit seriously reduce the life of brake linings, drums, etc.

A. The entrance of water and grit into semi-sealed brake assemblies of conventional type on GS vehicles did not materially reduce the life of brake linings and drums. Such life reduction [redacted] hardly noticeable if at all in [redacted] Europe or in Italy under excessive heat and dust conditions. Some thought was given to this matter in North Africa, but wear was negligible to the point where it was considered unnecessary to alter latest designs.

Q. [redacted] Vehicle Drive Tools actually used in the field, outside the workshops?

A. Vehicle drivers tools [redacted] used constantly for repair and maintenance work done outside of workshop, and are a most necessary part of the vehicle equipment. The average driver is most insistent [redacted] having [redacted] full set of tools before he will move.

Q. Is design of War Department Equipment such as picks, shovels, etc., furnished by vehicle manufacturer considered satisfactory in general?

A. Design of picks, shovels, vehicle tools, chains, etc., [redacted] furnished with vehicles are quite satisfactory. All are regularly and often used. It is suggested, however, that consideration might be given to increase iss[redacted] of tire repair kits for each vehicle to carry. Foot operation tire pumps [redacted]ve proven most satisfactory type. Each vehicle should have spare tire valves [redacted] valve caps.

Q. [redacted] the present C.M.P. storage battery sufficient capacity to give reasonable service from both starting and charge period standpoints?

A. Experience has shown that the most suitable battery from both starting and charging period standpoints, for standard use, is [redacted] 120 amp hour heavy duty six volt battery.

Q. Is 12 volt electrical system desirable? If so, on what type of vehicles?

A. Yes. On all armoured vehicles [redacted] the 12 vol[redacted] system could be used for the wireless equipment if required. A 12 volt system is much more dependable than 6 volt, carries [redacted] long term power.

Signals and RCEME Telecomm: Recommendation for 12 volt ignition system for all vehicles in which wireless equipments (types W/T19, W/T 22, etc) are mounted so that truck generator may be used to charge 12 volt batteries used for operating equipment and lights, (example Heavy Utility Wireless).

Q. Uniformity of tire types is desirable for all "B" vehicles. With that thought in mind would you favour, from your experience, standardization on;

directional chevron type tires
non-directional lug type tires
conventional highway type tires?

A. Cases of excessive wear are frequent on directional chevron type tires. Conventional highway type tires are not considered suitable for field conditions [redacted] active service. The non-directional cross-lug type tire is considered to be the most suitable all-round tire which could be standardized for all purposes. It has worn well.

Q. Was the bonding and suppression of motorcycles, wireless and non-wireless carrying trucks satisfactory on Canadian-made vehicles and vehicles of other makes? How much servicing was necessary to keep vehicles adequately suppressed?

A. Bonding and suppression in Canadian-made vehicles [redacted] very satisfactory.

Q. Is the present vehicle fuel tank capacity sufficient? If not state recommended increase.

A. Present fuel tank capacities are considered satisfactory.

Q. Would dual wheels be of any advantage over single wheels in the various types of terrain encountered in operations? If so, what types of vehicles should be [redacted] equipped?

A. Dual wheels for standard GS vehicles [redacted] not considered to be of any particular advantage. In very soft, muddy ground the vehicle will sink or dig in as quickly with duals [redacted] with singles. Special dual wheel mountings could be made for [redacted] in desert or dry sand conditions if sufficient to warrant same. The standard single heavy duty Canadian tire and wheel as used on GS vehicles has proven satisfactory for most terrains. The heavy single [redacted]l appears to have stood up better in the field than the double wheels which are generally lighter in construction. Recovery vehicles, etc. with special heavy dual wheels and greater overall width should, in view of their work, continue with dual wheels as at present.

Q. On winching heavy loads beyond capacity of vehicle winch, would additional snatch blocks be acceptable as alternative to [redacted] greater capacity winch to meet such conditions?

A. Present snatch block equipment is [redacted] sidered adequate. Present winch capacities are considered sufficient. Complaints against winch, although on the light capacity, [redacted] generally due to improper use of winch or vehicle. In future designs, winches and cables should be made to balance maximum power and capabilities of the vehicle.

Q. [redacted] you use Hand Brake as:-

Parking Brake
Service Brake
Parking and Service

A. Hand brakes are used in practically all [redacted] [redacted] parking or holding brake, or when upgrade halts in hot climates where engines [redacted] inclined to stall.

Q. Are spring centre bolts subject to excessive failure?

Do Chevrolet or Ford spring centre bolts fail more often?

A. Spring centre bolt failures [redacted] not frequent in GS vehicles. Chevrolet fail more often than Ford; believed [redacted] result of spring U-bolts not being kept tight.

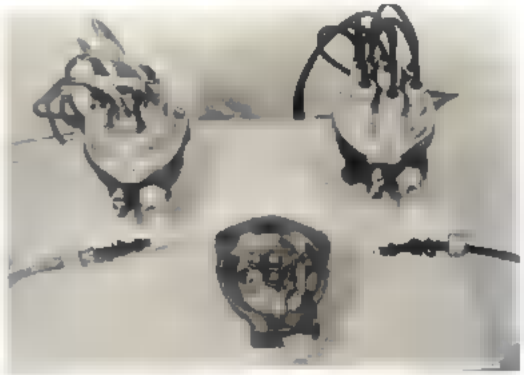
Q. Is present transfer case satisfactory? Has the percentage of burnt-out cases, due to overheating, been great?

A. No, but transfer case bearing failures has been frequent. In some cases caused by the frequent loosening of both the supporting bolts and the case bolts. A cast case with an improved mounting, would lengthen the life. Over heating has sometimes been caused by inferior lubricants, but mostly through loose bearings or poor bearing adjustment.

RCEME: It is recommended that [redacted] type of transfer [redacted] with an overriding gear such as the Marmon Harrington be adopted on all types of GS vehicles in order to eliminate the under friction caused by fight between front and [redacted] wheels in four wheel drive, resulting from varying conditions such [redacted] tyre pressures, overloading, types of ground, traction slippage, etc.

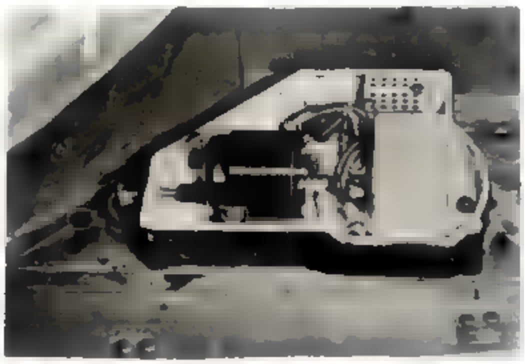
Q. Have serious weaknesses been discovered in vehicles or components which could have been revealed by special testing methods?

A. The majority of serious weaknesses, found in all wheeled vehicles, [redacted] corrected by Defect Reports and subsequent modifications, later by production. (See separate reports of various vehicles and defects attached.) More rugged tests over longer periods to assimilate field conditions by field [redacted] are recommended.



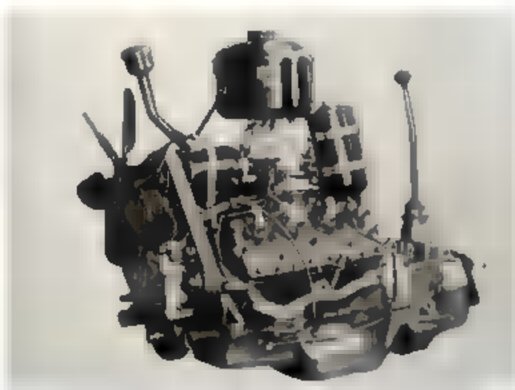
SEALED DISTRIBUTOR

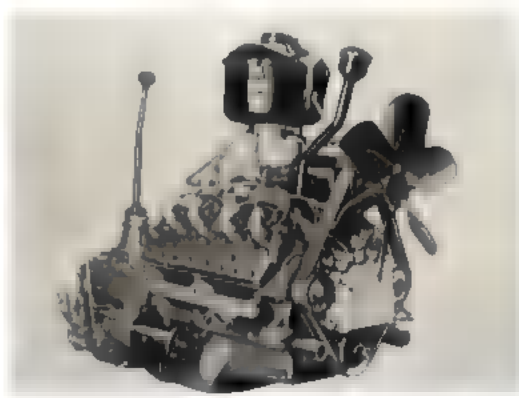
DISTRIBUTOR ENCLOSURE



COIL AND REGULATOR IN HOUSING

SEALED IGNITION COIL





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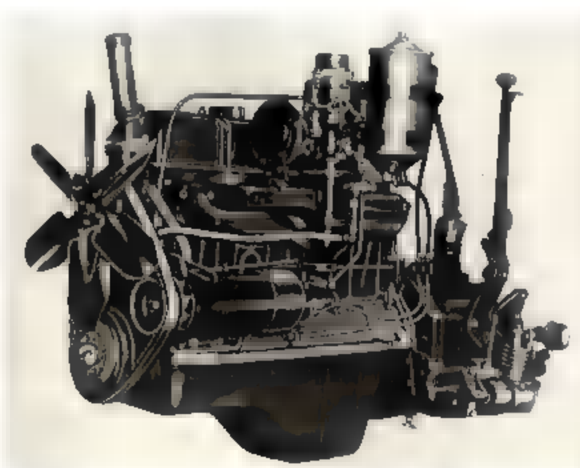
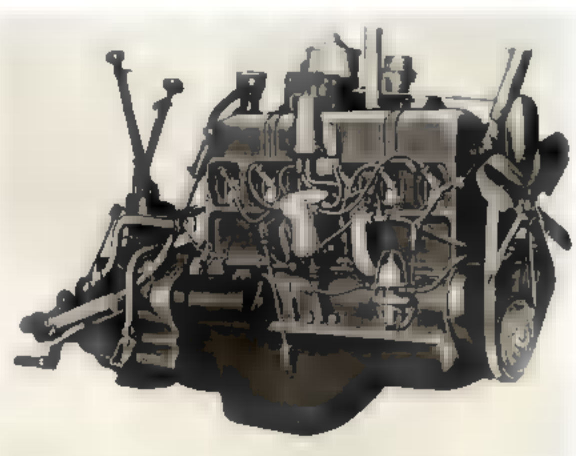
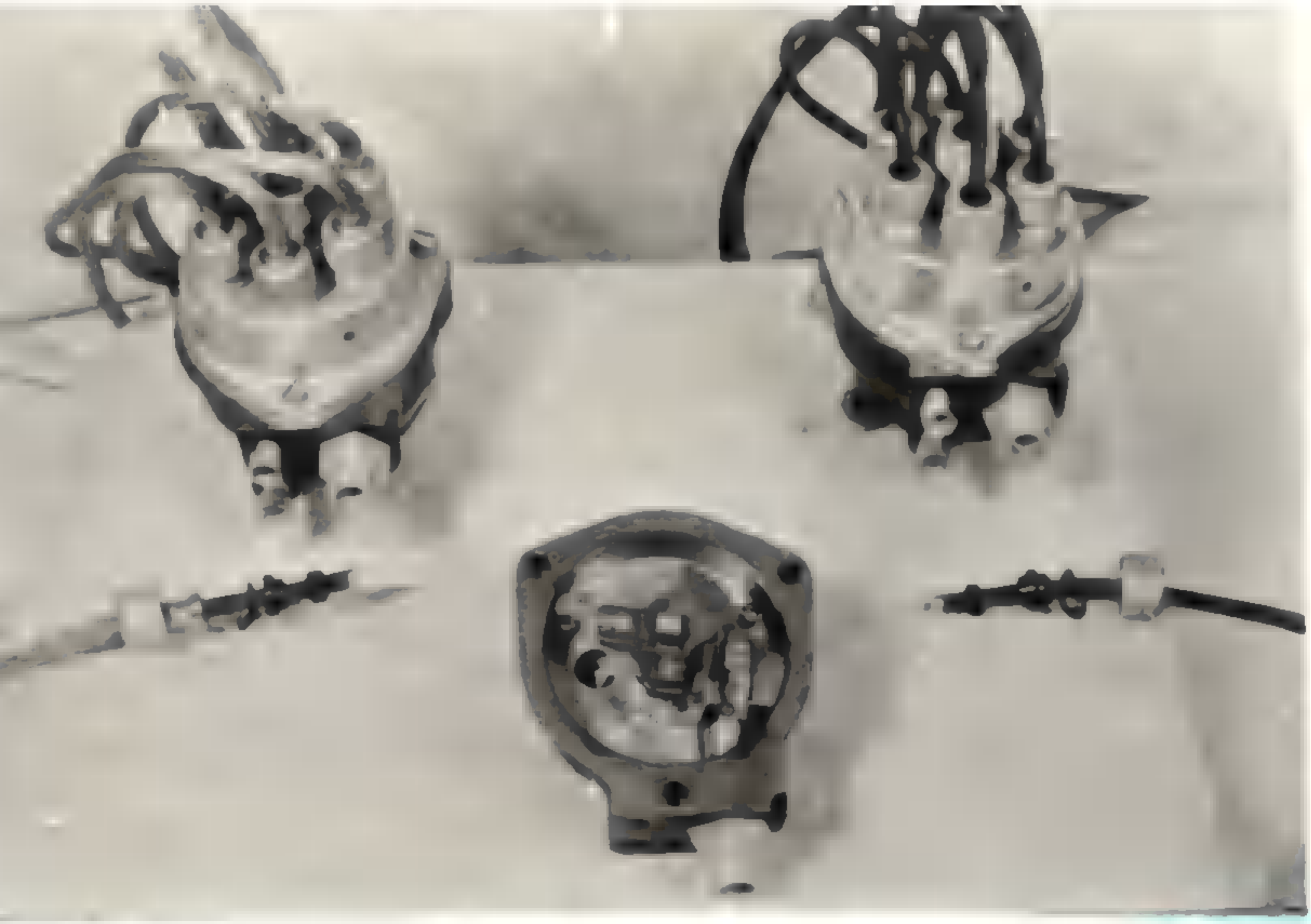
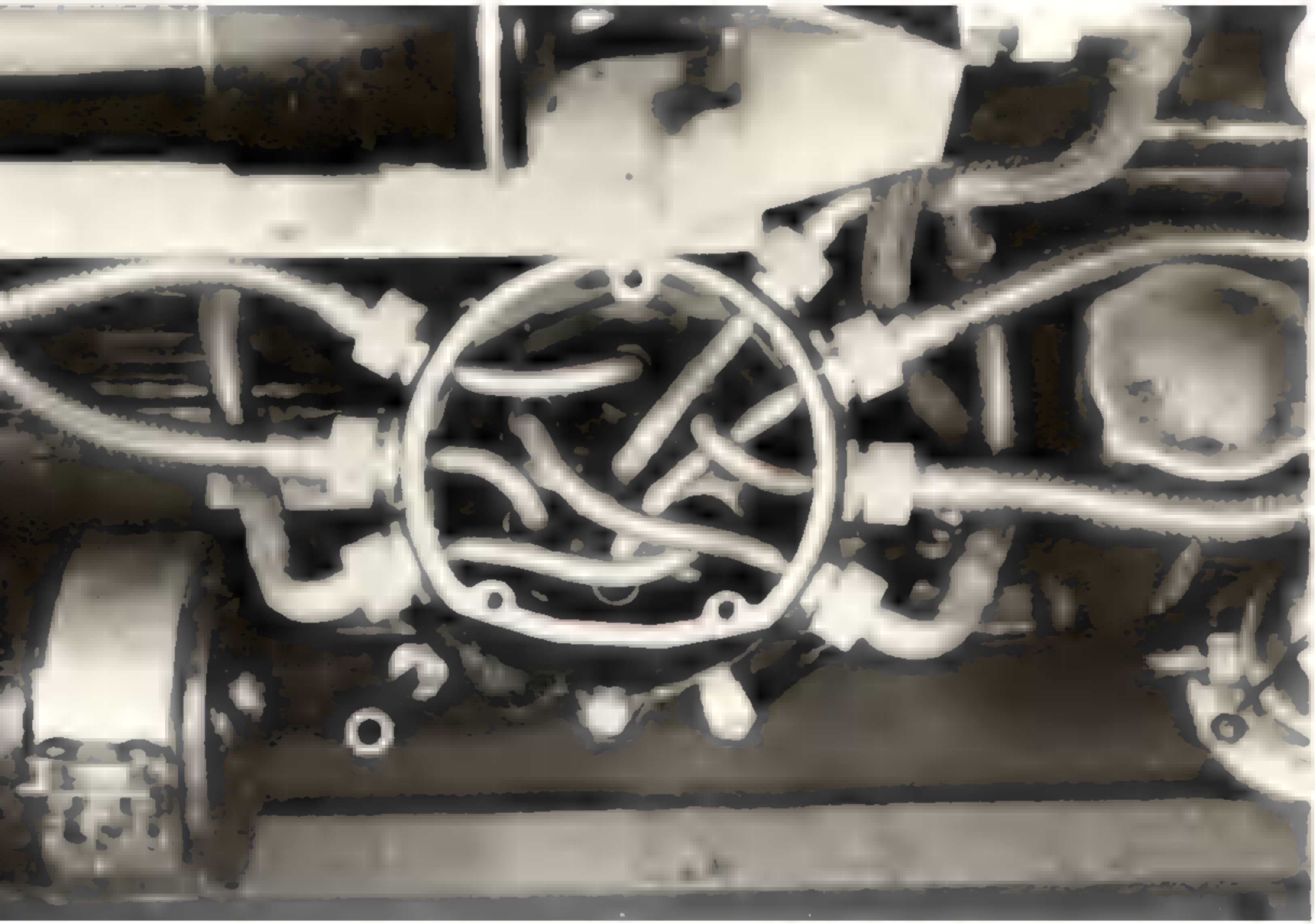
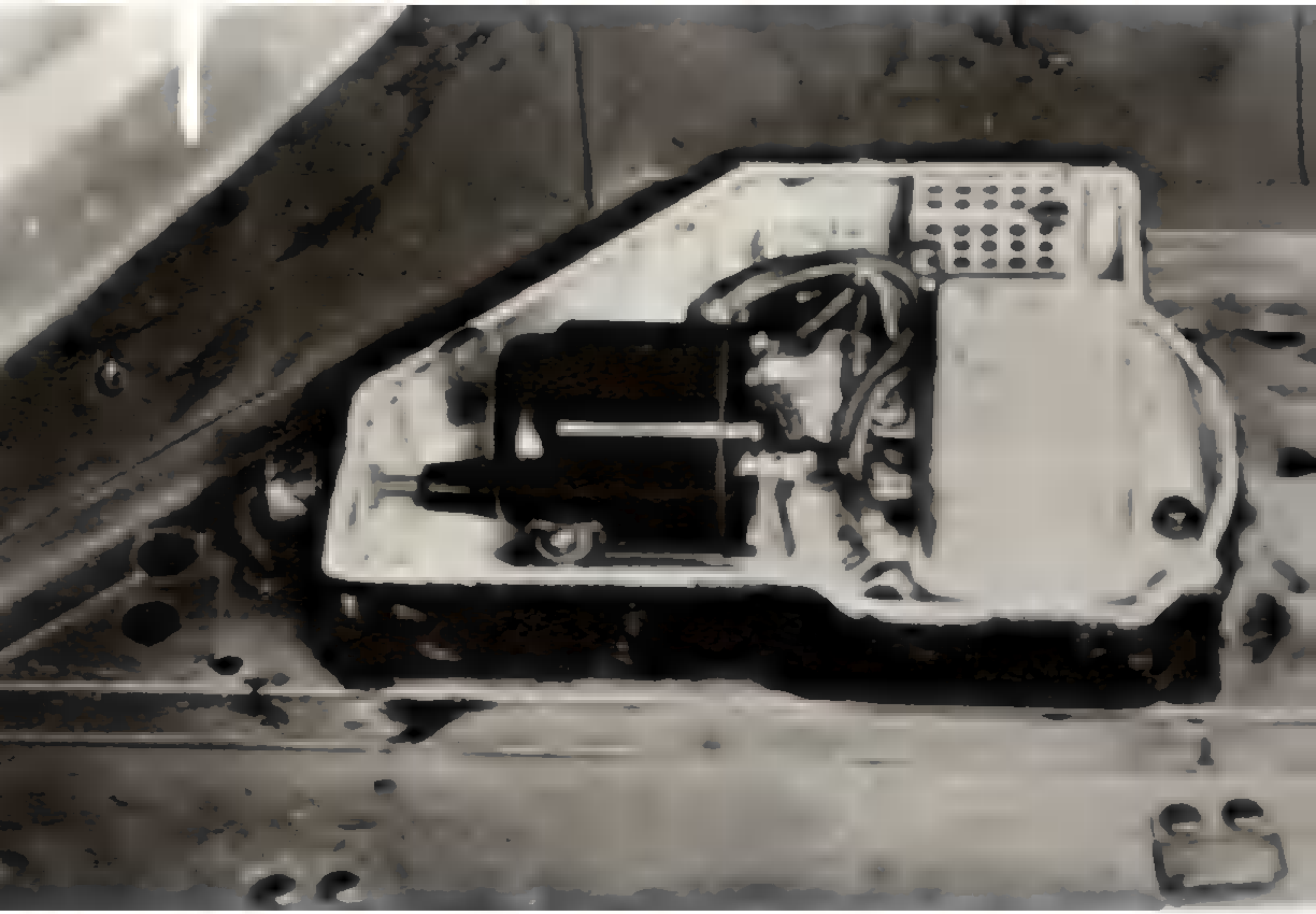


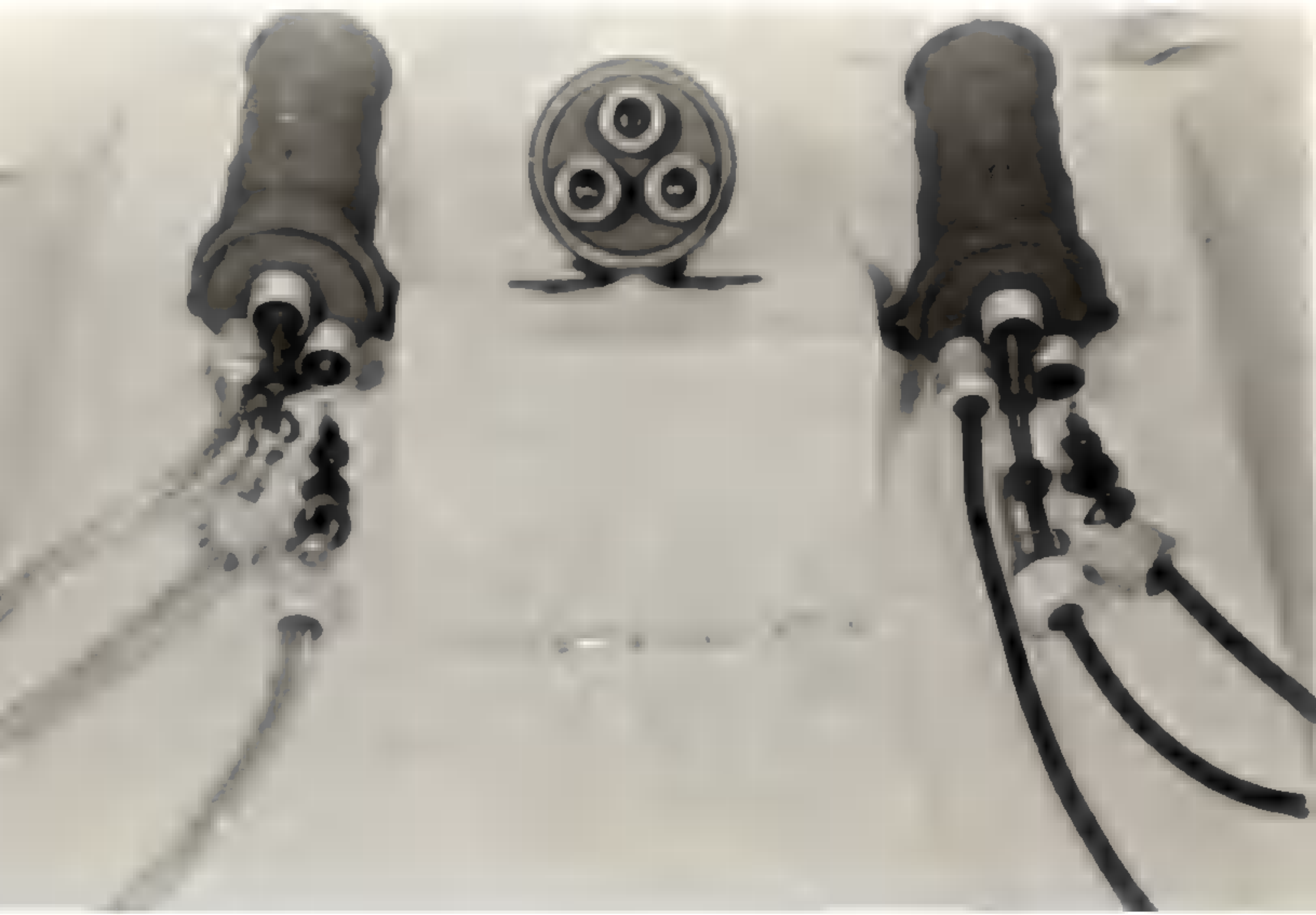


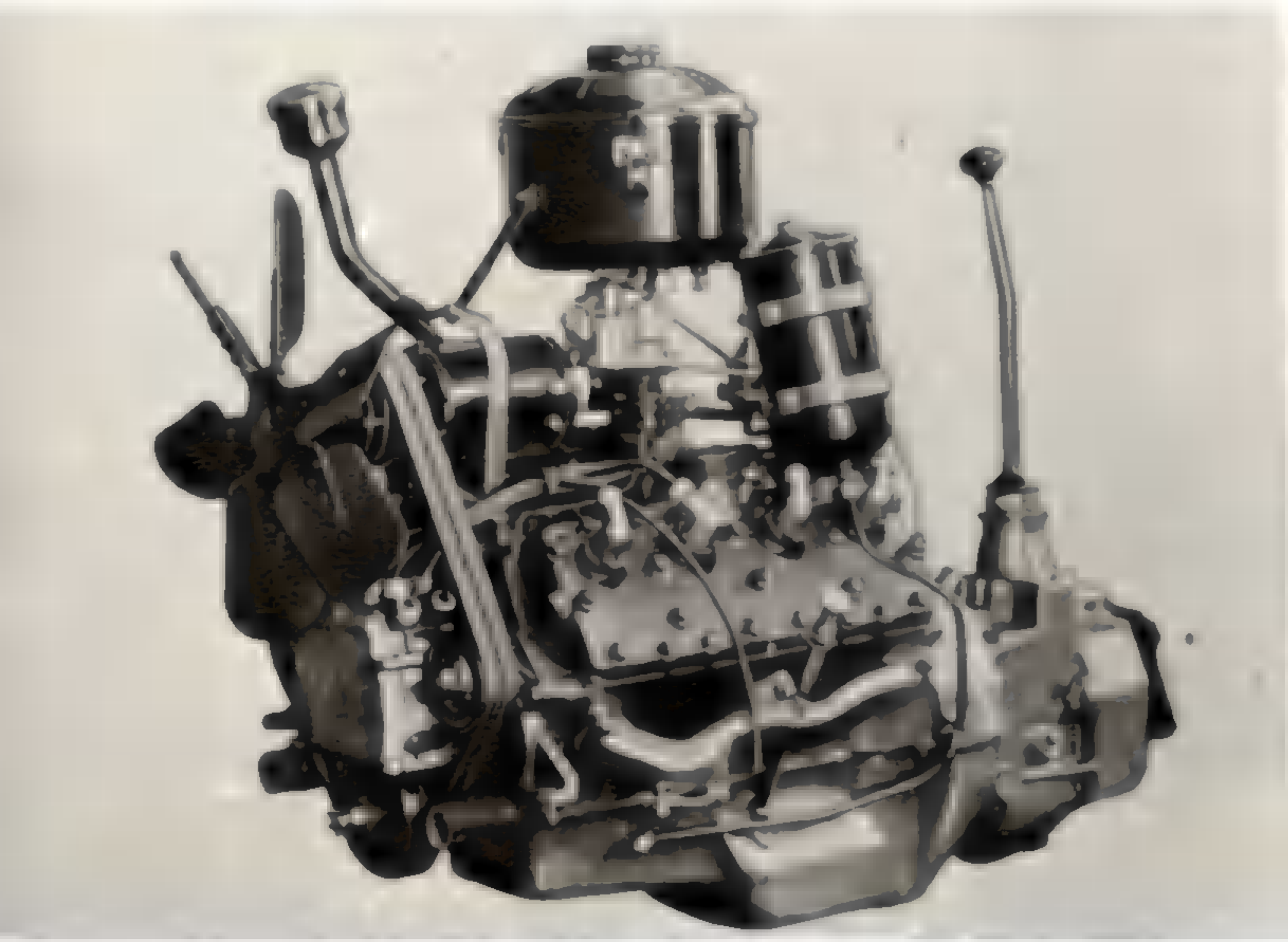
C H E V R O L E T E N G I N E

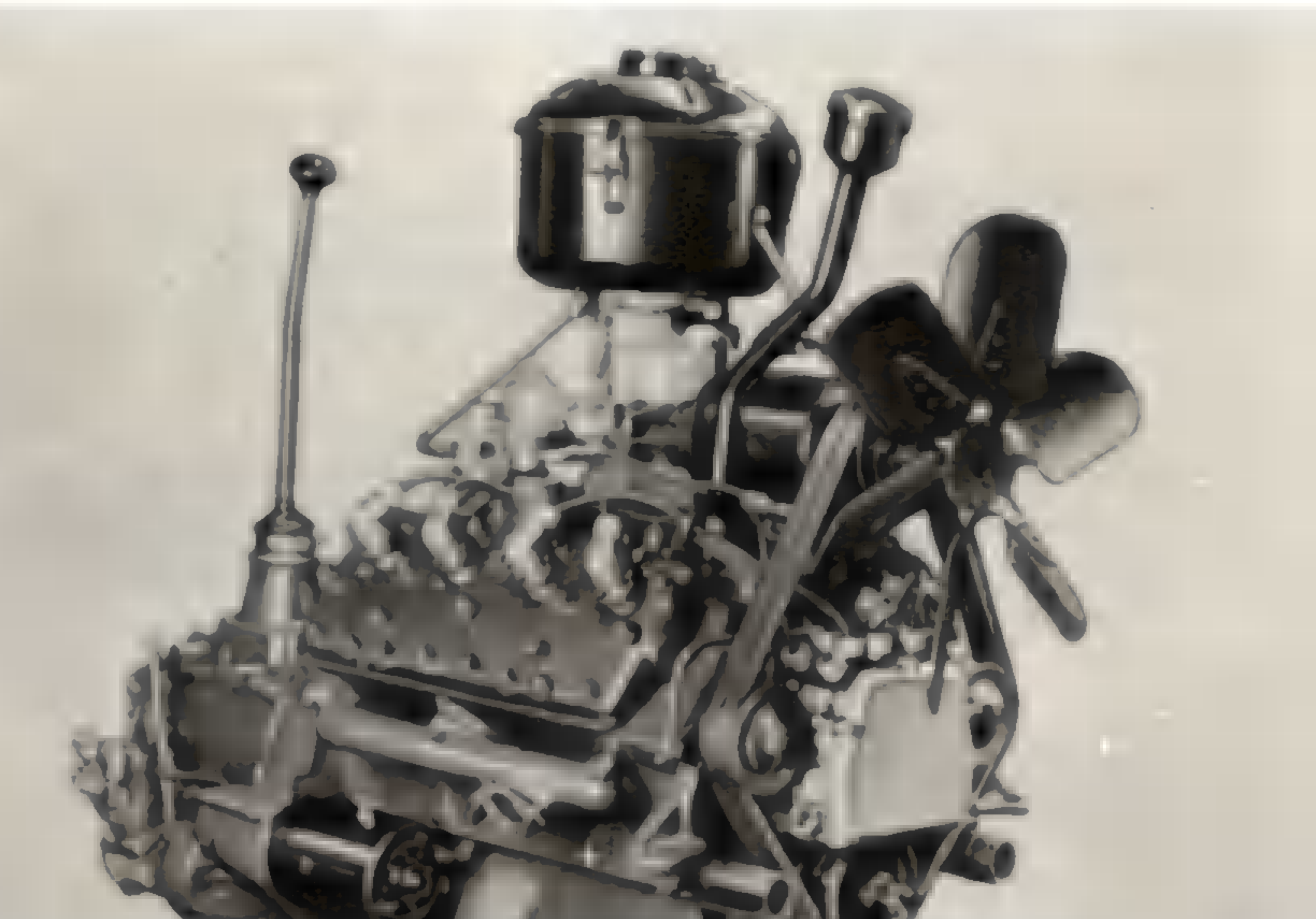


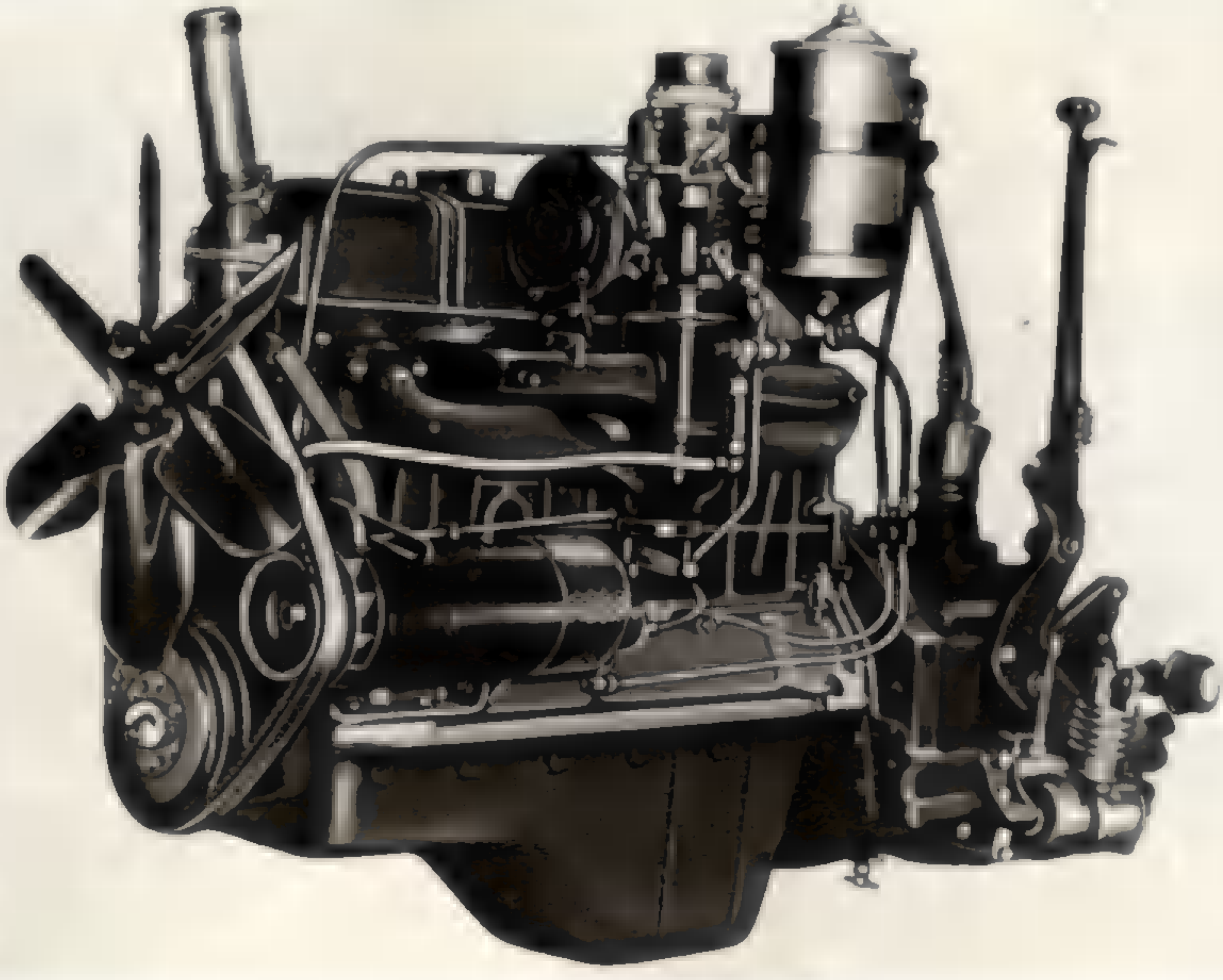


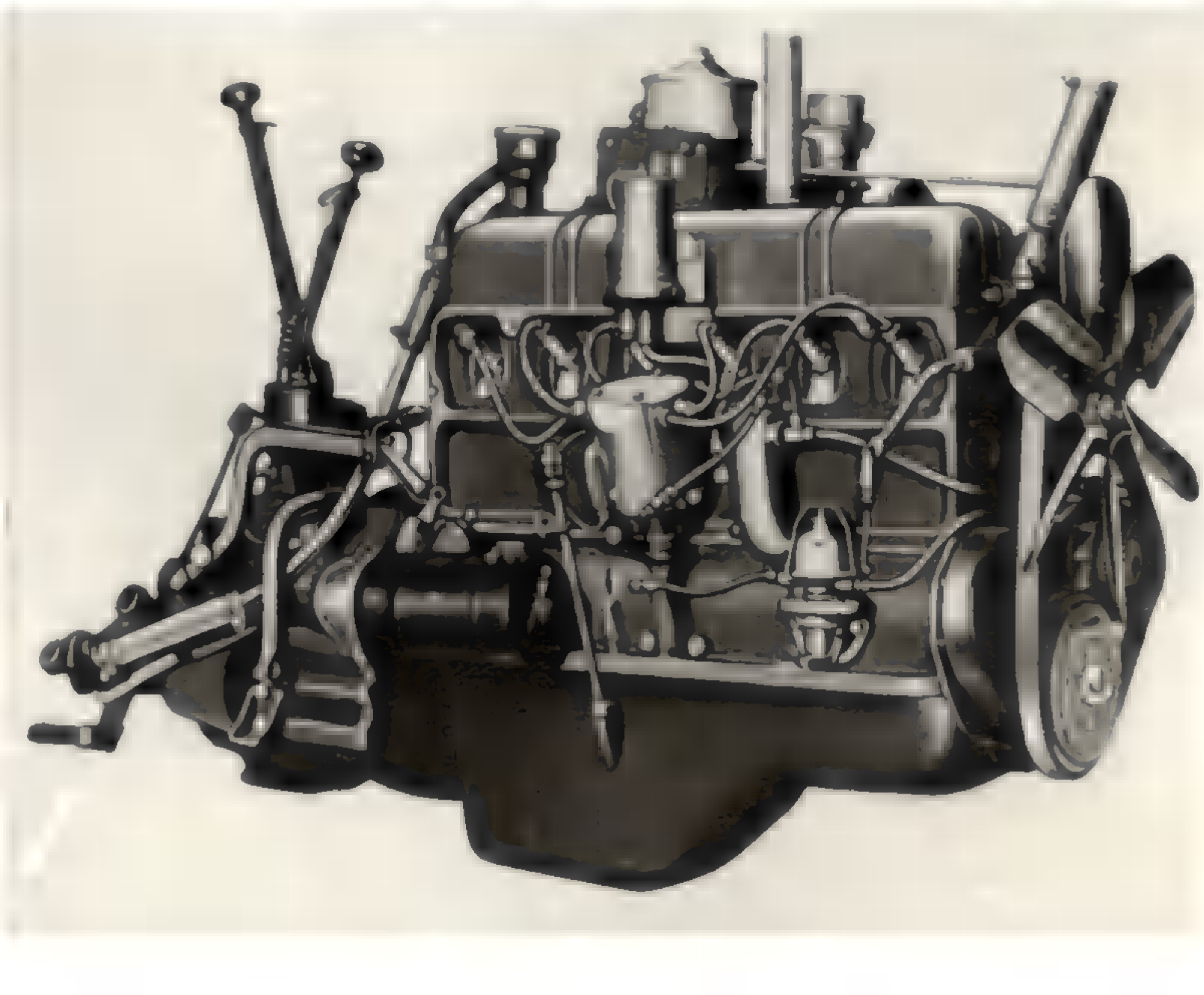












PERFORMANCE FORMULAE

The performance of [illegible] vehicle is generally considered to be its ability to [illegible] itself. For theoretical calculations it is considered to be operating over [illegible] dry hard surface road. Performance [illegible] be readily divided into two characteristics.

(a) ability to climb an inclined roadway.

(b) ability to maintain a certain speed in miles per hour on [illegible] level roadway.

Both (a) and (b) above, may be calculated providing certain data of the specific vehicle are known. Some of the data necessarily has been obtained thro' laboratory and/or practical test. Such items as wind resistance, reduction gear efficiency, engine horse power and torque fall in this class.

Industry has used for [illegible] years [illegible] number of formulae for determining the performance of wheeled vehicles. Army Engineering Design Branch modified these, and using the following formulae accurate theoretical results were determined for Canadian Military Pattern units. A very extensive test programme under Army Engineering Design Branch has confirmed the accuracy of the calculations from these modified formulae.

Therefore with [illegible] performance laid down by the user it has been possible to forecast on paper quite accurately the necessary power requirement and ratios to meet such performance when reasonable accuracy was maintained in estimating the dead weight and payload of the vehicle.

Gradeability.

G.A. is the ability of [illegible] vehicle to climb [illegible] inclined plane without losing speed and is expressed [illegible] the [illegible] gradient in any gear. It is [illegible] function of the following vehicle characteristics.

(1) T. - The Net Engine Torque usually expressed in pounds feet.

(2) G.R. - The overall reduction in speed of the driving shaft in relation to the Engine R.P.M. In C.M.P. vehicles this is [illegible] product of Axle Ratio, [illegible] Transmission Gear Ratio and the Transfer Case Ratio.

(3) R. - The Rolling Radius of the loaded Tire expressed in feet.

(4) [illegible].V.W. - The gross weight of the vehicle or vehicles moved by the unit. This is expressed in pounds.

(5) E. - The Mechanical Efficiency of the driven members of the vehicle, expressed [illegible] [illegible] proportion of unity, and varies from 0.75 to 0.90.

(6) F. - The coefficient of friction between the tires and road surface, usually expressed as [illegible] proportion of unity and accepted as 0.6 for pneumatic tires on dry hard surfaces.

(7) R.R. - The resistance to movement inherent in the revolving parts, expressed usually as pounds and accepted as 16 pounds for each 1,000 pounds of G.V.W. for C.M.P. 4x4 units. This is termed Rolling Resistance.

(8) G. The resistance due [illegible] Gravity and expressed in pounds relative to G.V.W. in 1,000 pound increments per each percent of gradient. 10 pounds is accepted as this factor.

$$\text{G.A. in } [illegible] = \left(\frac{T \times GR. \times E}{R} - \frac{GVW. \times RR.}{1000}\right) \frac{1000}{GVW. \times 10}$$

= Sine of the angle of incline to the horizontal multiplied by 100.

North American Railway practice is to express percentage grade [illegible] the tangent of the angle between gradient and horizontal multiplied by [illegible] Hundred.

[illegible] sample calculation on [illegible] 6x6 vehicle whose Gross Vehicle Weight is 21,465 pounds on 10.50 x 20 W.D. Tires (Rolling Radius equals 19.5 ins. or 1.625 feet) with an Axle Ratio of 7.17:1; Transmission Ratio of 5.0:1; Transfer Case (Auxiliary) Ratio of 2.60:1; and Engine whose Net Torque is 254 pounds feet at 1600 Engine R.P.M.

$$\text{G.A.} = \left(\frac{254 \times 7.17 \times 5.0 \times 2.60 \times 0.75}{1.625} - \frac{21465 \times 24}{1000}\right) \times \frac{1000}{21465 \; [illegible] \; 10}$$

= 48.5% expressed [illegible] the Sine of the angle.

= 56% expressed [illegible] the Tangent of the angle.

Actual trials showed that vehicle climbed 50% grade with reserve power but failed on 60%.

Similarly [redacted] the Transmission Ratios 3.5, 1.7 and 1:1; other grades would result. Likewise if alternative Transfer Case Ratios, Tires, etc., [redacted] used, other figures for GA. would be obtained.

The above is based [redacted] the adhesion of Tire to Road surface being greater than the ability of the Engine to spin the Driving Wheels.

__Tractive Effort.__

This is [redacted] function of the factors as listed under Gradeability, and is sometimes referred to [redacted] Rim Pull. It is in effect the pounds pull exerted between the Driving Tire and the Road Surface. The formula for expressing Tractive Effort in pounds is:

$$T.E. = \frac{T \times GR. \times E}{R.}$$

__Draw-Bar Pull.__

This is [redacted] function of Tractive Effort and Rolling Resistance and is limited by the Adhesion of Driving Tires to the Road Surface. It is expressed in pounds and may be arrived at [redacted] follows:

$$D.B.P. = T.E. - \frac{GVW. \times RR}{1000}$$

This must be less than the Product of the Load on the Driving Wheels when multiplied by 'F' the Coefficient of Friction between Tires and Road; if not the Wheels will spin and an inconstant Pull will result.

__Speed.__

V - Expressed in Miles Per Hour is [redacted] function of the following factors of any vehicle.

(1) R.P.M. - Revolutions per Minute of the Engine.

(2) T. - The Net Torque of the Engine in pounds feet.

(3) G.R. - The overall Gear Reduction.

(4) R. - The Rolling Radius of loaded Tire in feet.

(5) RR. - Rolling Resistance between vehicle and ground in pounds.

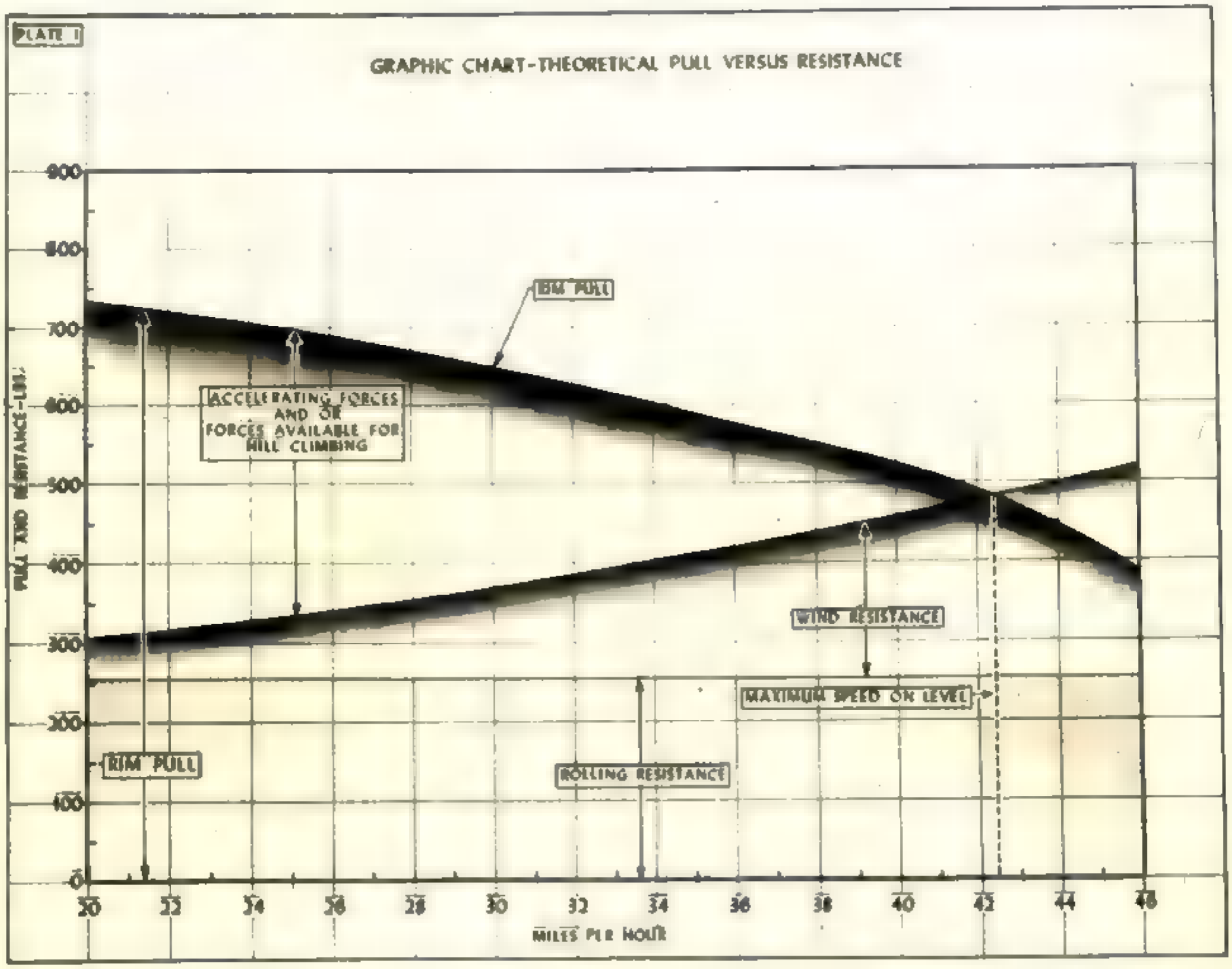
(6) WR. - Wind Resistance in pounds; [redacted] factor of Frontal Area, Velocity and degree of Streamline; which is usually considered unimportant up to Speeds of 40 M.P.H. for Streamlined Passenger Cars and up to 25 M.P.H. for Angular Military Vehicles. For C.M.P. Vehicles it [redacted] found that W.R. in pounds = $0.0025\ V^2$ multiplied by the projected Frontal Area in Square Feet.

To determine the normal Speed (not maximum) of any vehicle the following formula is used:

V (In Miles Per Hour) =

$$\frac{R.P.M. \times 60 \times \text{Rolling Circumference of Tire}}{GR. \times 5280}$$

For maximum Speed, where Wind Resistance becomes a factor, [redacted] Simple mathematical formula does not lend itself readily to solution. In such instances [redacted] graphic solution is most applicable and may be described [redacted] the intersection of the Net Rim Pull Curve at various speeds of the motor and the accumulated Curve representing Rolling Resistance plus Wind Resistance, each expressed in pounds. A sample graph appears on the next page. This shows [redacted] theoretical top speed of 42.4 M.P.H. Actual test vehicle gave 42.5 M.P.H.



The Rolling Resistance in pounds of the moving vehicle is considered constant and is represented on the graph by the rectangular shaded portion. Rolling resistance in this case is 256 pounds.

The Resistance in pounds caused by the speed of the vehicle through the air is termed 'wind resistance'. This forms a parabolic curve when plotted against speed. In this instance it is plotted adjacent to the Rolling Resistance and is that portion below middle curve and above the Rolling Resistance area.

The total resistance in pounds at the various speeds is shown at the middle curve and is the addition of Rolling Resistance and Wind Resistance.

The top curve is developed from the Torque of the Engine, and represents from the bottom of graph to this curve the actual Rim Pull at any vehicle speed.

The [redacted] to the left of the intersection of the curves represents the available Rim Pull for acceleration on the level, or forces available for climbing gradients. When the curves intersect the Rim Pull equals the Total Resistance and further acceleration is not available. This point is the maximum speed on a level surface, in the illustration it is 42.4 miles per hour.

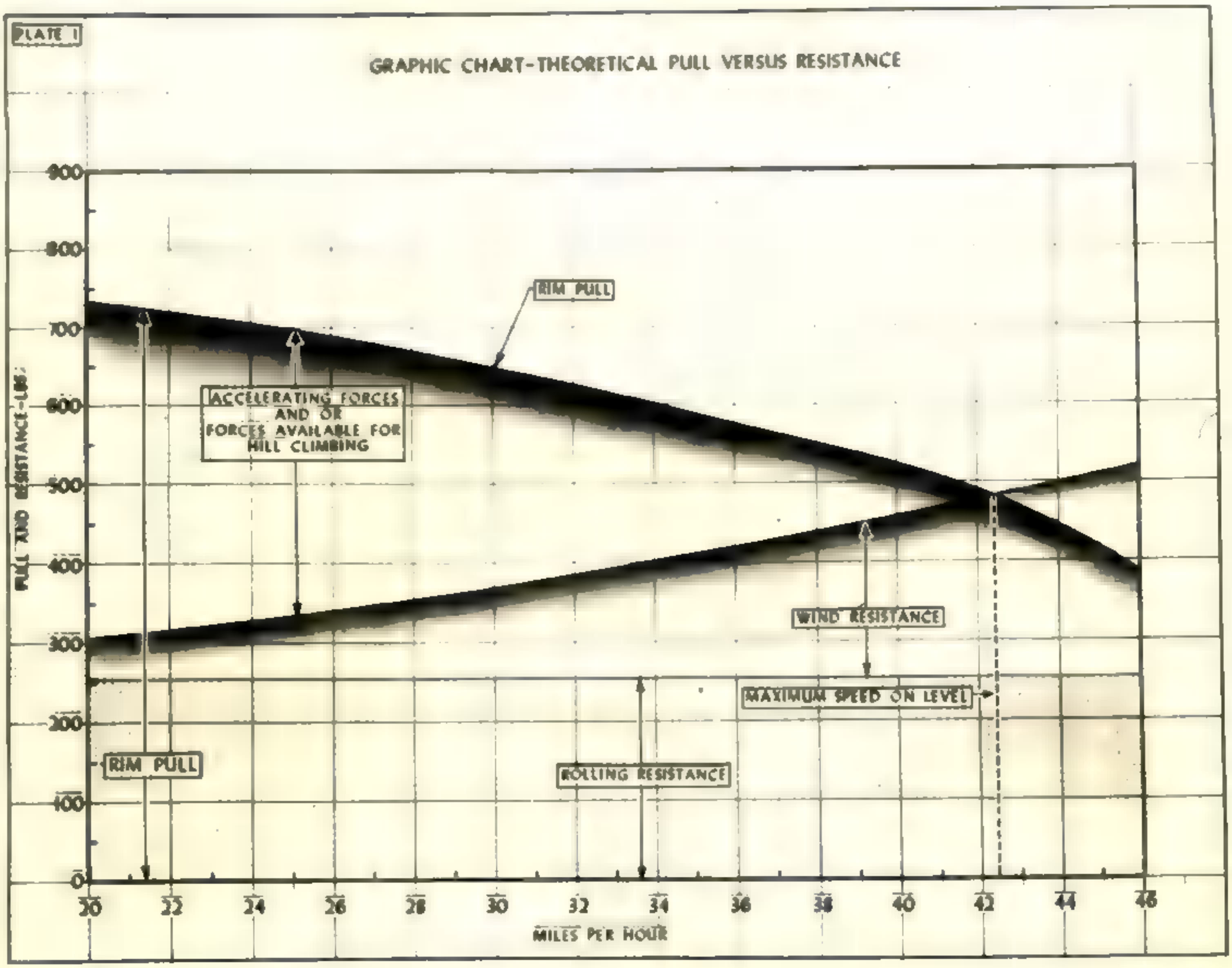


PLATE I
GRAPHIC CHART-THEORETICAL PULL VERSUS RESISTANCE
RIM PULL
ACCELERATING FORCES
AND OR
FORCES AVAILABLE FOR
HILL CLIMBING
WIND RESISTANCE
MAXIMUM SPEED ON LEVEL
RIM PULL
ROLLING RESISTANCE
PULL AND RESISTANCE-LBS.
900
800
700
600
500
400
300
200
100
0
20
22
24
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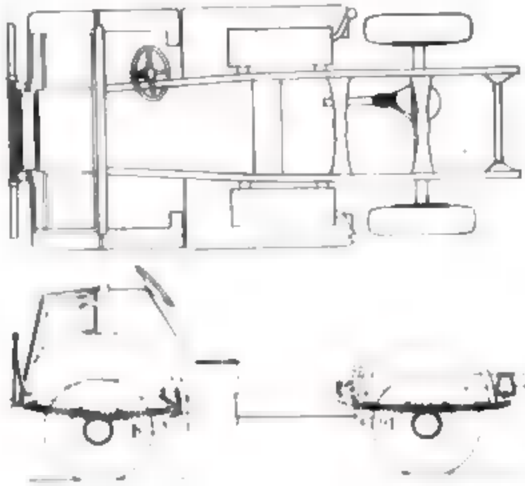
MILES PER HOUR

VEHICLE CHASSIS SPECIFICATION

HEAVY UTILITY [redacted] CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE: Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 650 lbs.

Permissible Max. Gross Weight 7500#.

WHEELBASE:- 101 ins.

Back of Cab to end of Frame, 88 ins.
Rear Axle to end of Frame, 29.5 ins.

TIRES:- 9.25 x 16 W.D. - 5.

TREAD:- Front, 62 ins.
Rear, 62 ins.

OVERALL LENGTH: 163 ins.
WIDTH: 79 ins.
HEIGHT: 90 ins.

[redacted] OF APPROACH:- 57°.

ANGLE OF DEPARTURE:- 53°.

TURNING CIRCLE:- L.H. 47 feet, 10 ins.
R.H. 47 feet, 4 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio 5.43:1. [redacted] ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating Spiral Bevel, Ratio 5.42:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 14 ins. by [redacted] ins. Rear 14 ins. by 2 ins. Lining Area 218 sq. ins.

Parking: External contracting, mechanical on Propeller Shaft. Size 9.5 ins. by [redacted] ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 22.6 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear 6.1%.

MAXIMUM SPEED:- 52 M.P.H. @ 3000 engine R.P.M.

CRUISING RANGE:- 375 Miles.

FORDING DEPTH:- [redacted] ins.

WADE PROOF:- Design Released, not produced.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 10.8 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- [redacted] Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet, 6 cylinder Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 @ 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type. Width 36 ins. Maximum Section Modulus 3.138 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 11, Length 45 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 10, Length 50 ins. Width 2.2 ins.

STEERING:- Right [redacted] Drive. Recirculating Ball Type. Ratio: 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1, 4th, 1:1. Transfer Case Single Speed. Ratio 1:1.

REFERENCE

CODE:- CSA.

MAINTENANCE MANUAL:- MB-C2.

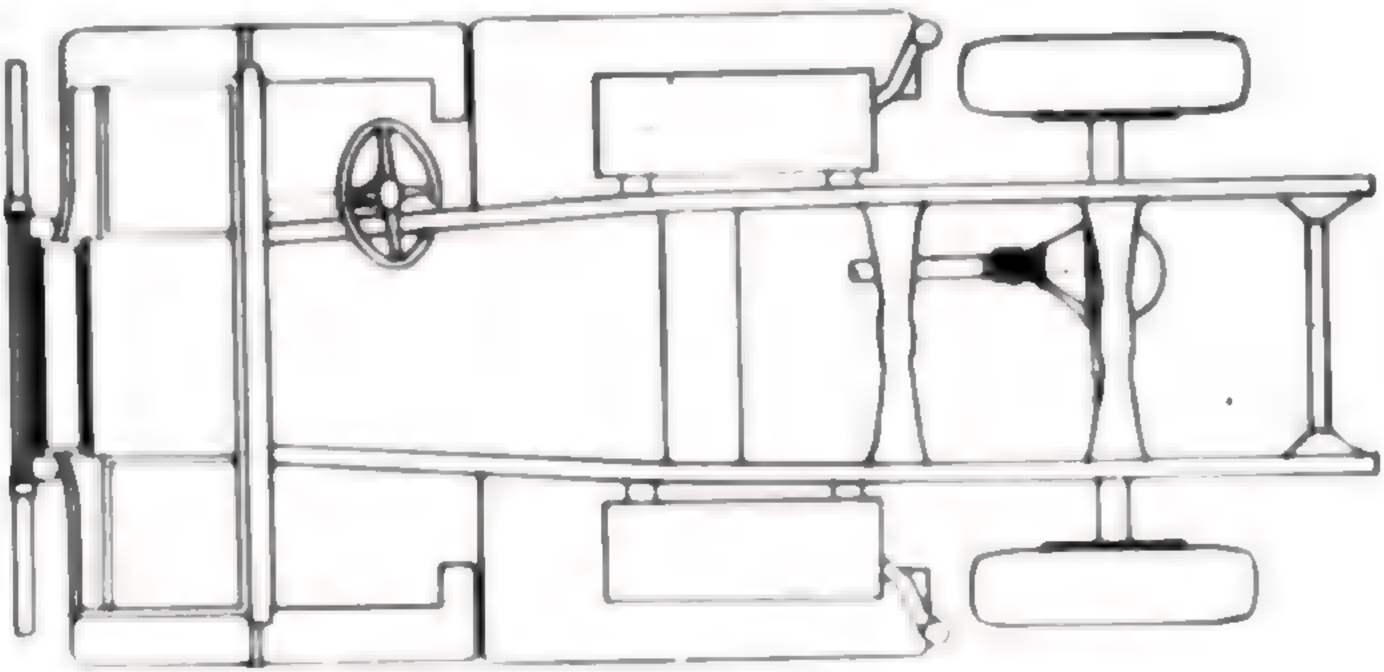
PARTS BOOK:- CSA-C3.

DRIVERS HAND BOOK:- CSA [redacted] (BRI.)
CSA HC1 (CAN.)

COST OF CHASSIS & CAB:- approx. 1850.00.

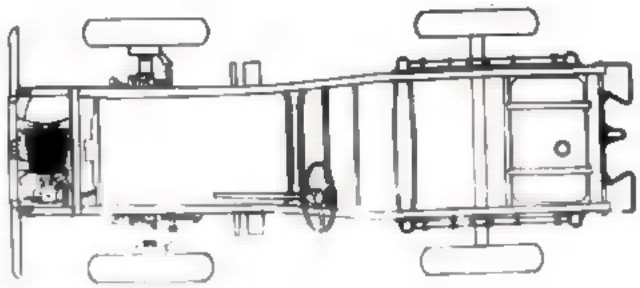
QUANTITY PRODUCED:- approx. 13,000.

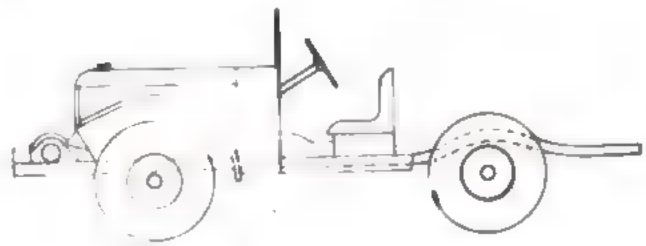
APPLICATIONS:- Personnel Carrier Staff Car, and Wireless, when Sedan Type Body fitted.



VEHICLE CHASSIS SPECIFICATION

3/4 TON 4x4 CHASSIS & [redacted]





CHASSIS MANUFACTURER:-

Chrysler Corporation of Canada, Limited.

TYPE:- Conventional, with Open Type Cab.

LOAD CARRYING CAPACITY:- 1680 lbs.

Permissible Max. Gross Weight 8000#.

WHEELBASE:- [redacted] ins.

Back of Cab to end of Frame, 95.2 ins.
Rear Axle to end of Frame, 35.2 ins.

TIRES:- 9.00 x 16. U.S. - 5.

TREAD:- Front, 64.8 ins.
Rear, 64.8 ins.

OVERALL LENGTH: 168.2 ins.
WIDTH: 77.8 ins.
HEIGHT: 80 ins.

[redacted] **OF APPROACH:-** 45°.

ANGLE OF DEPARTURE:- 29°.

TURNING CIRCLE:- L.H. 42 feet, 4 ins.
R.H. 42 feet, [redacted] ins.

AXLES: Front: Full Floating Hypoid. Ratio 5.83:1. 4.5 ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating Hypoid. Ratio 5.83:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 14 ins. by 1.8 ins. Rear 14 ins. by 1.8 ins. Lining Area 203 sq. ins.

Parking: External Contracting Mechanical [redacted] Propeller Shaft. Size 7.8 ins. by [redacted] ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 28.7 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear 7.0%.

MAXIMUM SPEED:- 50 Miles per hour.

CRUISING RANGE:- 260 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- In Production, for five feet.

AIRPORTABLE:- In Production.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Cellular Type. Capacity of System 14.2 Qts. Thermostat equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 12 Volt Single Wire System. Battery 200 A.H. Capacity. 6 Cell. Starter: Mechanical Shift. Generator 55 Amp. Capacity.

ENGINE MAKE:- Chrysler. [redacted] Cylinder L Head. Displacement 236 cu. ins. Max. B.H.P. 115 @ 3800 R.P.M. Max. Gross Torque 190 @ 1800 to 2200 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in.

FUEL SYSTEM:- One 25 gallon Fuel Tank. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Tapered Ladder with kick up over rear axle. Inner reinforcement. Width 40 ins. at rear.

SPRINGS:- Front: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 8, Length, 39 ins. Width 1.8 ins.

Rear: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 12, Length [redacted] ins. Width 1.8 ins.

STEERING:- Left Hand Drive. Worm and Sector Type. Ratio 23.2:1.

TRANSMISSION:- 4 Speeds forward, 1 [redacted]verse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1, Reverse 7.82:1. Single speed transfer case, Ratio 1:1.

REFERENCE

CODE:- D 3/4 APT. and D 3/4 APT/WP.

MAINTENANCE MANUAL:- 3/4 APT - D1.

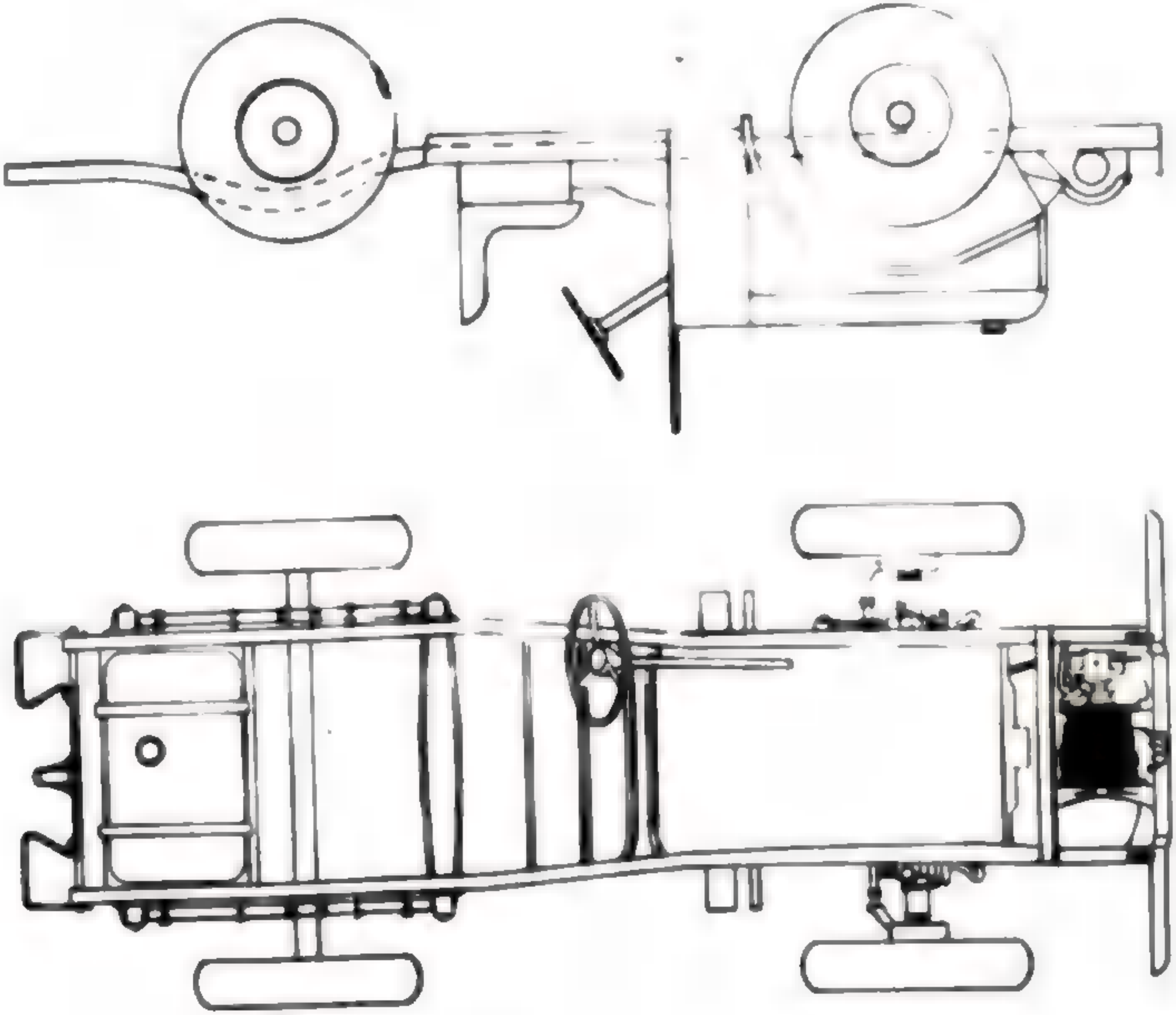
PARTS BOOK:- D 3/4 [redacted] - 01.

DRIVERS HAND BOOK:- D 3/4 APT-HB1, and D 3/4 APT/WP-HB1.

COST OF CHASSIS & CAB:- approx. 1600.00.

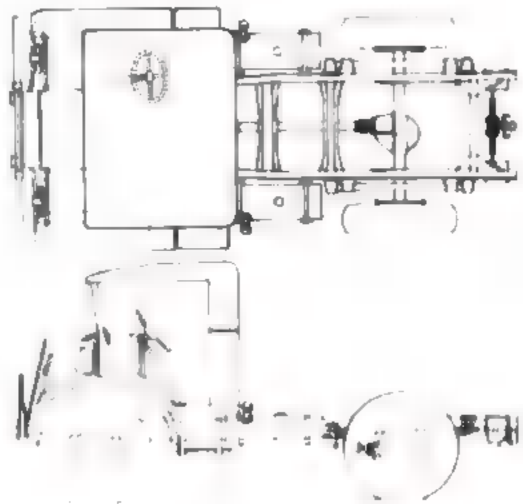
QUANTITY PRODUCED:- approx. 6500.

APPLICATIONS:- General Service.



VEHICLE CHASSIS SPECIFICATION

15 CWT 4X2 CHASSIS [illegible] CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 15 Cwt.

Permissible Max. Gross Weight 8500#.

WHEELBASE:- 101 ins.

Back of Cab to end of Frame, 98.5 ins.
Rear Axle to end of Frame, 36.5 ins.

TIRES:- 9.00 x 16 W.D. - 5.

TREAD:- Front, 64 ins.
Rear, 64 ins.

OVERALL LENGTH: 170 ins.
WIDTH: 86.5 ins.
HEIGHT: [illegible] ins.

ANGLE OF APPROACH:- 49°.

ANGLE OF DEPARTURE:- 33°.

TURNING CIRCLE:- L.H. 40 feet.
R.H. 40 feet.

AXLES:- Front: Reverse Elliot I Beam

Rear: Full Floating, Hypoid. Ratio, 6.16:1.

BRAKES:- Service: [illegible] Wheel internal expanding, Hydraulic. Front 14 ins. by [illegible] ins., Rear 14 ins. by [illegible] ins. Lining Area 231 sq. ins.

Parking: Cable operated on Rear Wheels. Size 14 ins. by [illegible] ins. Lining Area 115.5 ins.

PERFORMANCE

POWER/WEIGHT:- 20 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear 6.1%.

MAXIMUM SPEED:- 50 M.P.H. @ 3200 Engine R.P.M.

CRUISING RANGE:- 375 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- [illegible] requirement.

CLUTCH:- Single Plate Dry Disc, 10.8" Diameter.

COOLING SYSTEM:- Circulating liquid, Pressure type. Centrifugal [illegible] driven by V Belt from Crankshaft. Radiator: Ribbed cellular Type. Capacity of System [illegible] Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single [illegible] System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet. [illegible] cylinder, Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 [illegible] 3400 R.P.M. Max. Gross Torque: 170 [illegible] 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using [illegible] Pump, Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type. Width 36 ins. [illegible] Section Modulus 5.43 ins. cubed.

SPRINGS:- Front: Semi Elliptic, with Delco Shock Absorbers. No. of [illegible]ves 9, Length 40 ins. Width 2 ins.

Rear: Semi Elliptic, with Delco Shock Absorbers. No. of Leaves 13. Length 45 ins. Width 2.5 ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio 23.6:1. [illegible] ins. Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1 4th, 1:1. Reverse: 6.98:1.

REFERENCES

CODE:- C15

MAINTENANCE MANUAL:- MBC2

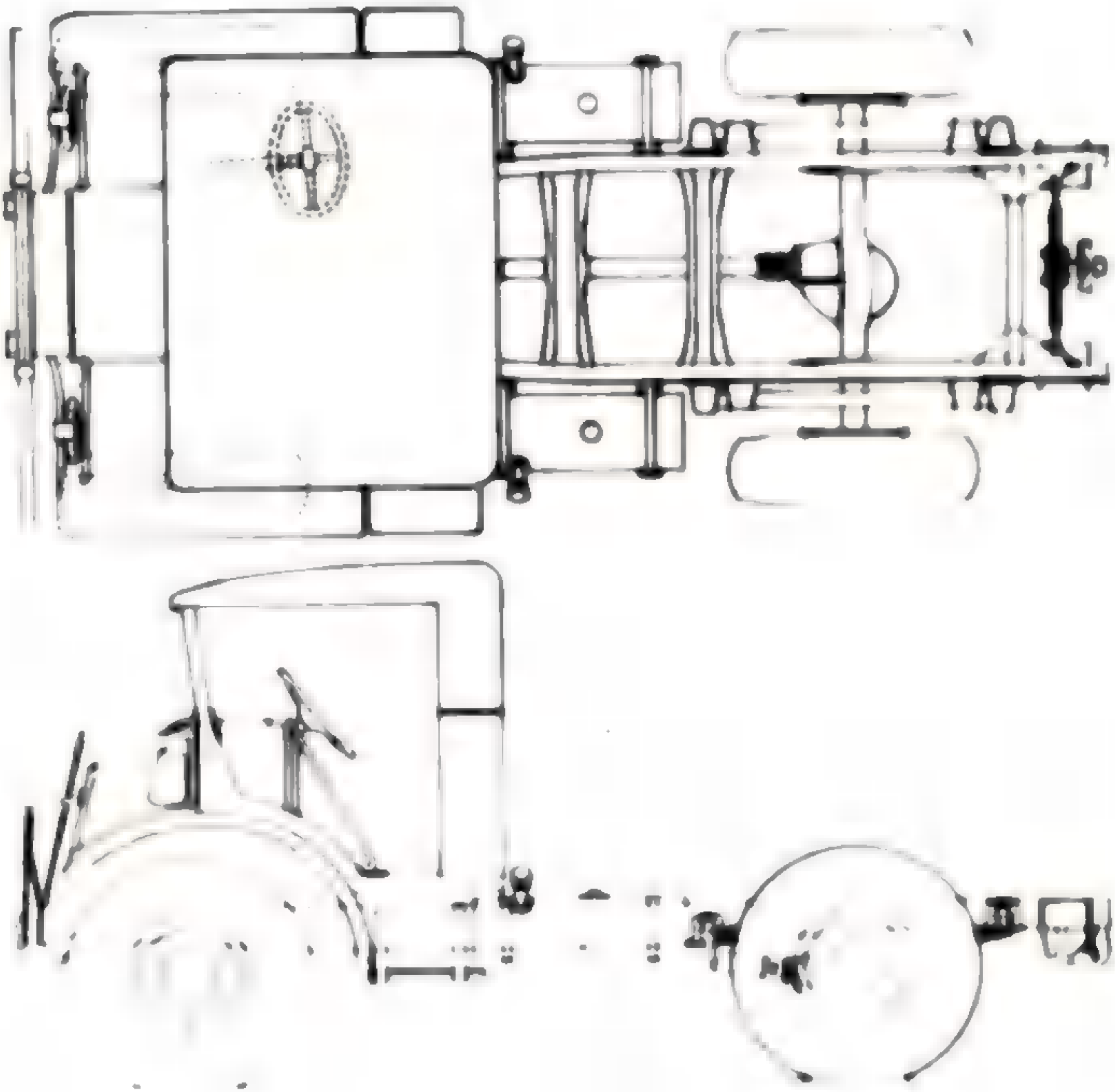
PARTS BOOK:- C15-02

DRIVERS HAND BOOK:- C15-HC1 (CAN.)
C15-HB1 (BRI.)

COST OF CHASSIS [illegible] CAB:- approx. 1400.00.

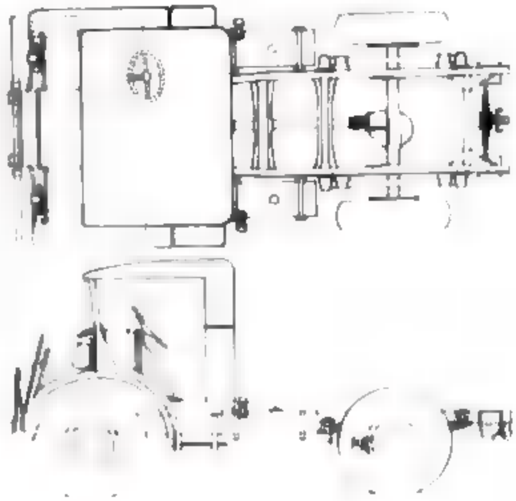
QUANTITY PRODUCED:- approx. 17,000.

APPLICATIONS:- General Service, Van, Cable Layer, Personnel, Anti Tank Tractor, Anti Aircraft.



VEHICLE CHASSIS SPECIFICATION

15-CWT. 4x2 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 15-Cwt.

Permissible Max. Gross Weight: 8500 lbs.

WHEELBASE:- 101.2 ins.

TIRES:- 9.00 x 16 W.D. - 5

TREAD:- Front, 67.5 ins.
Rear, 64.4 ins.

OVERALL LENGTH: 165.5 ins.
WIDTH: - 86 ins.
HEIGHT; 93 ins.

ANGLE OF APPROACH:- 47°.

ANGLE OF DEPARTURE:- 34°.

TURNING CIRCLE:- L.H. 43 feet, 6 ins.
R.H. 43 feet, [illegible] ins.

AXLES:- Front: Reverse Elliot I Beam.

Rear: Full Floating Spiral Bevel. Ratio: 6.67:1.

BRAKES:- Service: 4-Wheel internal expanding, Hydraulic. Front: 14 ins.by 2 ins. Rear: 15 ins. by 3.5 ins. Brake Lining Area: 303 sq. ins.

Parking: Cable operated on Rear Wheels.

CLUTCH: - Single Dry Disc. 11 inch Diameter.

COOLING SYSTEM:- Circulating liquid,pressure type. 2 centrifugal pumps driven by Double "V" Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System: 20 Qts Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss.Universal Joints: open type.

ELECTRICAL SYSTEM:- [illegible] Volt Single Wire System. Battery: 100 A.H. Capacity, 3 cell. Starter Bendix actuated. Generator: 33 Amp.Capacity.

ENGINE MAKE:- Ford, 6-Cylinder V-type, L Head. Displacement: 239 cu.ins.,Max.B.H.P. [redacted] @ 3600 R.P.M. Max.Gross Torque: 178 @ 1850 R.P.M. Lubrication: Full pressure from Gear Pump. Pressure, 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gal.Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder type. Width: 34 ins. Maximum Section Modulus 5.2 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 13. Length: 38 ins. Width: 2.2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 10.Length: 45 ins. Width: 2.5 ins.

STEERING:- Right Hand Drive, Worm and Roller. Ratio: 20.5:1. 18 in. Steering Wheel.

TRANSMISSION:- 4-Speeds Forward, 1 Reverse. Ratios: 1st,6.4:1. 2nd,3.09:1. 3rd,1.69:1. 4th, 1:1. Reverse: 7.82:1.

PERFORMANCE

POWER/WEIGHT:- 22.35 B.H.P.per short ton.

GRADEABILITY:- In 4th Gear: 6.95%.

MAXIMUM SPEED:- 50 miles per hour @ 3400 Engine R.P.M.

CRUISING RANGE:- 300 miles

FORDING DEPTH:- 24 ins.

[redacted] PROOF:- No requirement.

AIRPORTABLE:- [redacted] requirement.

REFERENCES

CODE: - F15.

MAINTENANCE MANUAL:- MB F1.

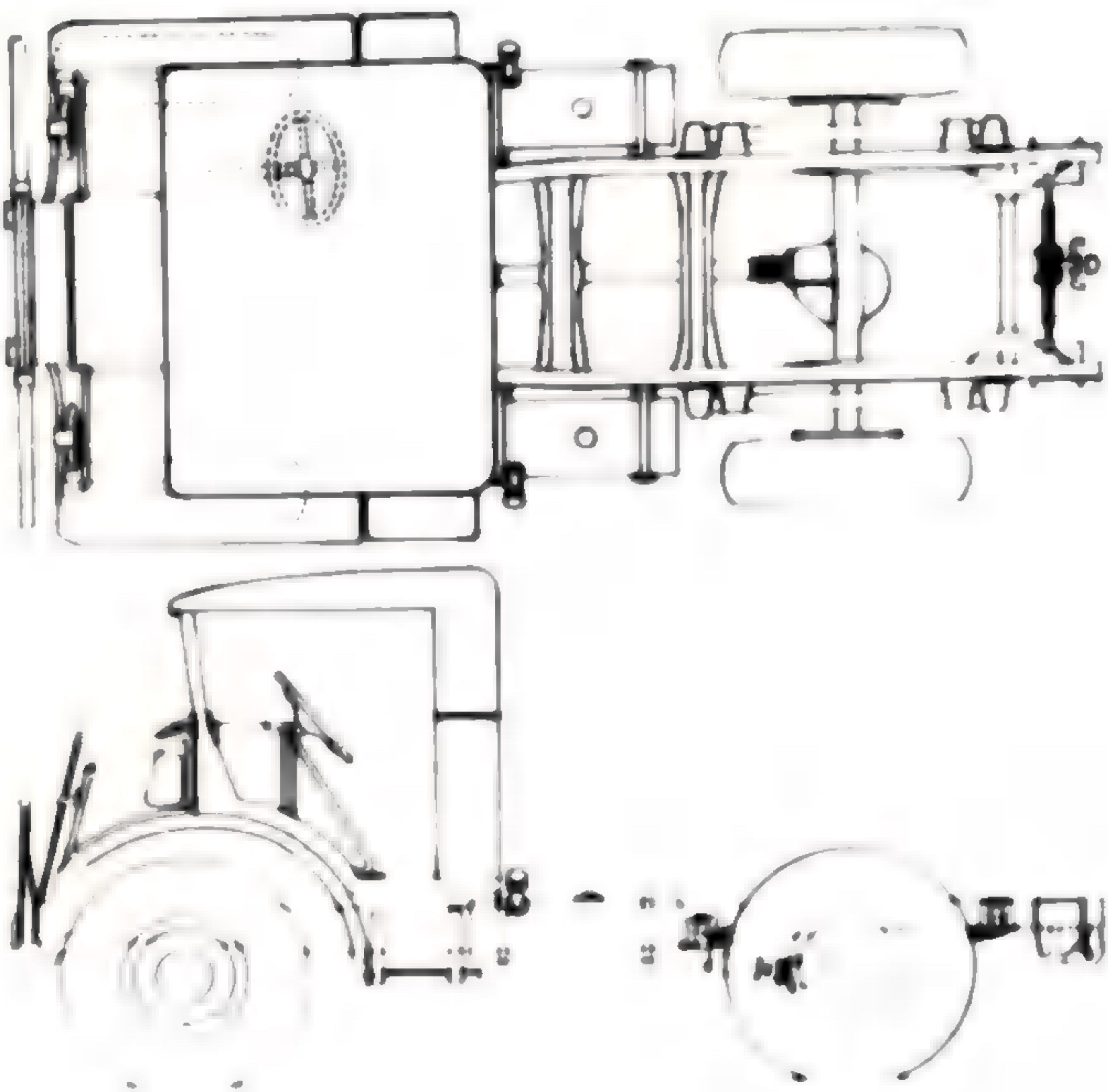
PARTS BOOK:- F15-01.

DRIVERS HAND BOOK:- F15-HC1 (Can.)
F15-HB1 (Bri.)

COST OF CHASSIS & CAB:- approx. 1400.00.

QUANTITY PRODUCED:- approx. 17,000.

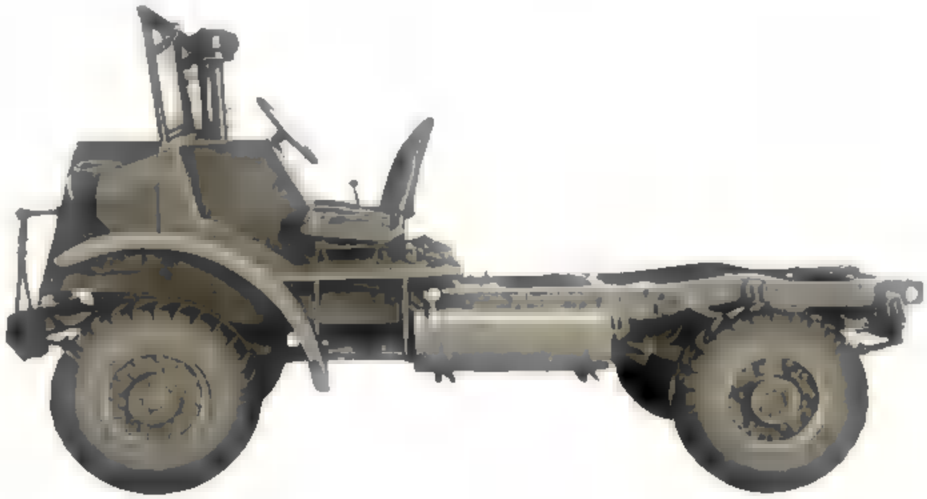
APPLICATIONS:- General Service, Van, Cable Layer, Personnel, Anti-Tank Tractor,Anti-Aircraft.



VEHICLE CHASSIS SPECIFICATION

CHEVROLET 15 CWT. 4x4 101" W.B.

AIRPORTABLE CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 2240 lbs.

WHEELBASE:- 101 ins.

TIRES:- 9.25 x 16 W.D. - 5.

TREAD:- Front, 62 ins.
Rear, 62 ins.

OVERALL LENGTH: 163 ins.
WIDTH:
HEIGHT:

ANGLE OF APPROACH:- 57°.

ANGLE OF DEPARTURE:- 45°.

TURNING CIRCLE:- L.H. 47 feet, 1 ins.
R.H. 47 feet, [redacted] ins.

AXLES:- Front: Full Floating Spiral Bevel. Ratio 6.17:1. 5 in. Bendix-Weiss Constant Velocity Joints.

Rear: Full Floating Spiral Bevel. Ratio 6.17:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 14 ins. by 2 ins. Rear 14 ins. x 2 ins. Lining Area 212 sq. ins.

Parking: External Contracting, mechanical [redacted] Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 21 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear 7%.

[redacted] **SPEED:-** 49 M.P.H. @ 2930 engine R.P.M.

CRUISING RANGE:- 375 Miles.

FORDING DEPTH:- 24 ins.

[redacted] **PROOF:-** Yes.

AIRPORTABLE:- Yes.

CLUTCH:- Single Plate Dry Disc, 10.8 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet, 6 cylinder Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 @ 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type. Width 36 ins. Maximum Section Modulus 3.138 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 11, Length 45 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 10, Length 50 ins. Width 2.2 ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio 23.6:1. 18 in. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd 3.48:1, 3rd, 1.7 1:1, 4th, 1:1. Transfer Case Single Speed. Ratio 1:1.

REFERENCE

CODE:- Nil.

MAINTENANCE MANUAL:- Nil.

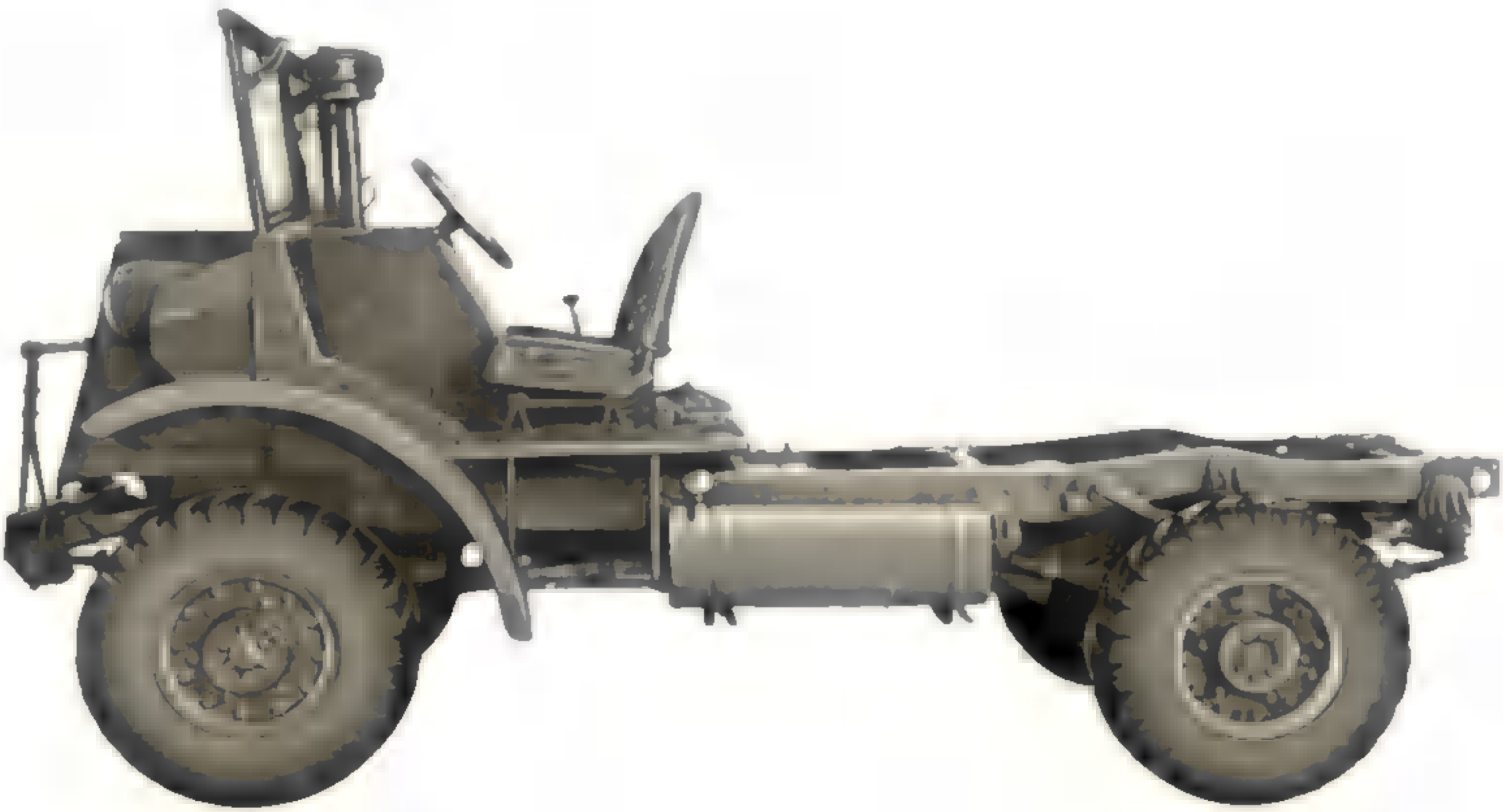
PARTS BOOK:- Nil.

DRIVERS HAND BOOK:- Nil.

COST OF CHASSIS & CAB:-

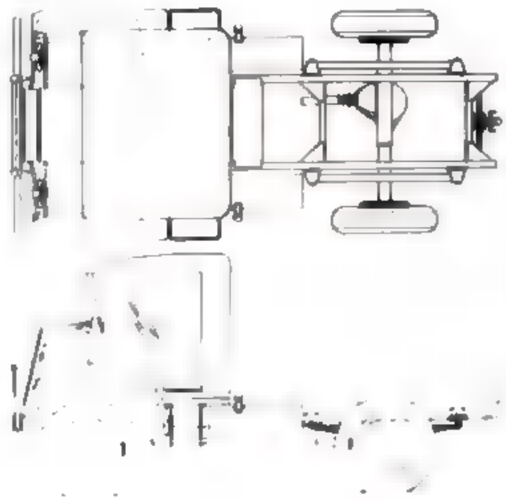
QUANTITY PRODUCED:- 2 Pilots.

APPLICATIONS:- Built [redacted] G.S. in Airportable Role.



VEHICLE CHASSIS SPECIFICATION

15 CWT. 4x4 CHASSIS [illegible] CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 20 Cwt.

Permissible Max. Gross Weight 10,000#.

WHEELBASE:- 101 ins.

Back of Cab to end of Frame. 91 ins.
Rear Axle to end of Frame. 38.2 ins.

TIRES:- 9.00 x 16 W.D. - 6.

TREAD:- Front, 70.5 ins.
Rear, 70.5 ins.

OVERALL LENGTH: 170 ins.
WIDTH: 86 ins.
HEIGHT: [illegible] ins.

ANGLE OF APPROACH:- 57°.

ANGLE OF DEPARTURE:- 40°.

TURNING CIRCLE:- L.H. 48 feet, 9 ins.
R.H. 49 feet, 8 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio 6.5:1. 5 ins. Bendix-Weiss Constant Velocity Joints.

Rear: Full Floating Spiral Bevel, Ratio 6.5:1.

BRAKES:- Service: 4 Wheel internal expanding Hydraulic. Front 14 ins. by [illegible] ins. Rear 15 ins. by 3.5ins. Lining Area 303 sq. in.

Parking: Cable operated on Rear Wheels. Lining Area 198 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 17 B.H.P. per Short Ton.

GRADEABILITY:- In 4th gear 4.9%.

MAXIMUM SPEED:- 50 M.P.H. @ 3300 engine R.P.M.

CRUISING RANGE:- 375 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- Design Released, not Produced.

AIRPORTABLE:- No Requirement.

CLUTCH:- Single Plate Dry Disc. 10.8" Diameter.

COOLING SYSTEM:- Circulating liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet. 6 Cylinder. Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 [illegible] 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, Using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type. Width [illegible] ins. Maximum Section Modulus 9.68 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 10. Length 40 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 12. Length 50 ins. Width 2.5 ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio: 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1, 4th, 1:1. Reverse: 6.98:1. Transfer Case Single Speed, Ratio 1:1.

REFERENCES

CODE:- C15A

MAINTENANCE MANUAL:- MBC-2

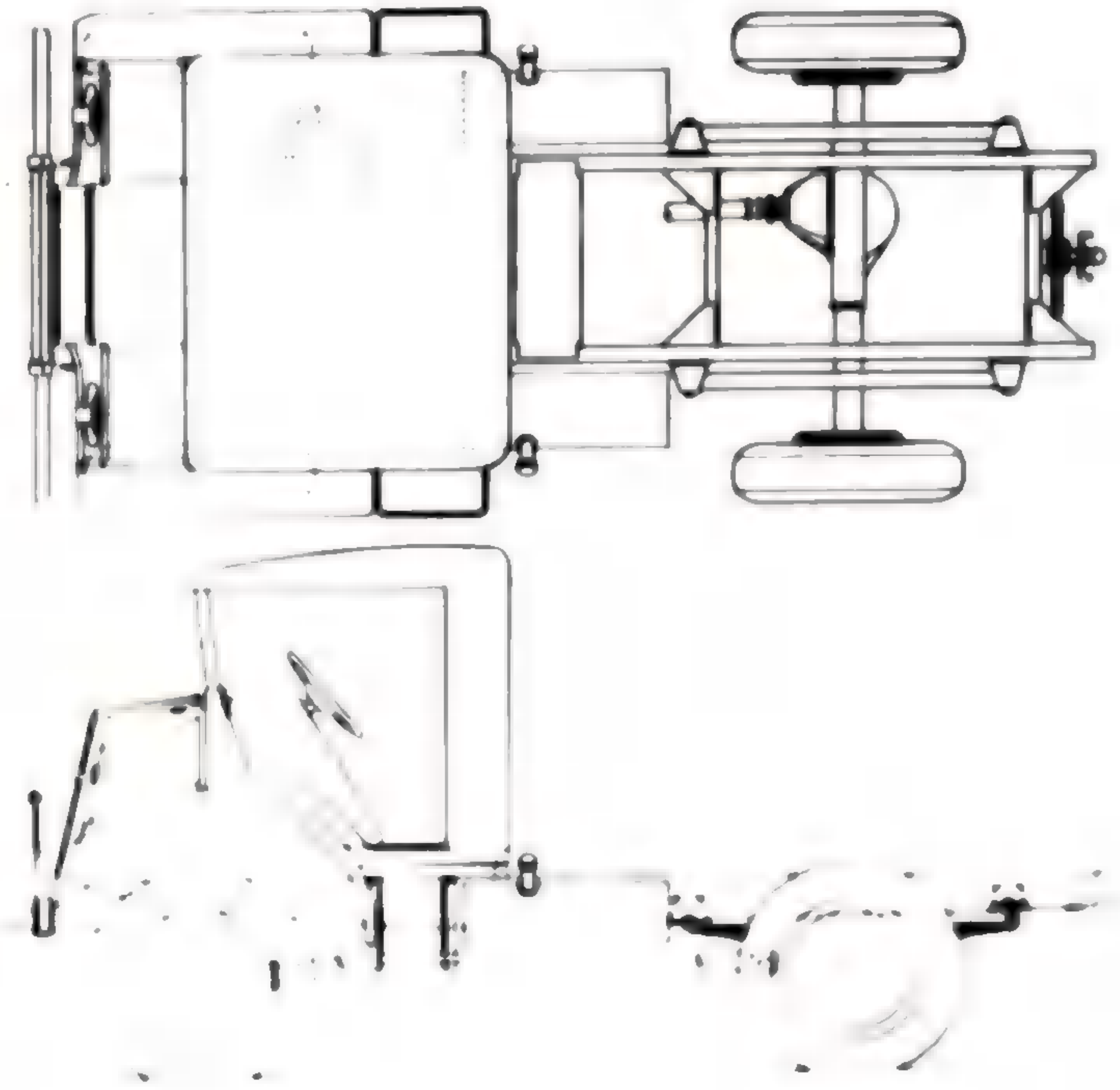
PARTS BOOK:- C15A-03

DRIVERS HAND BOOK:- C15A-HC1 (CAN.)
C15A-HB1 (BRI.)

COST OF CHASSIS & CAB:- approx. 1800.00.

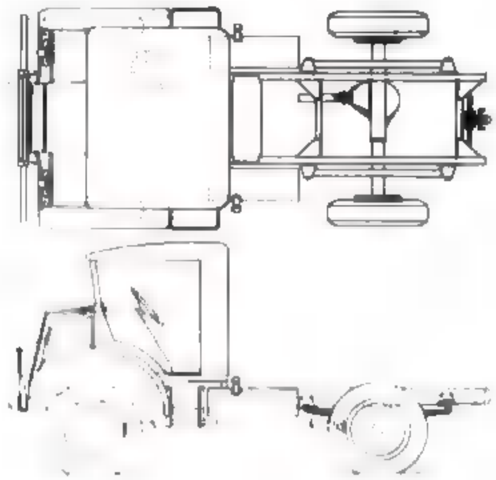
QUANTITY PRODUCED:- approx. 35,000.

APPLICATIONS:- General Service, Van, Office, Wireless, Cable Layer, Personnel, Water Tank, Anti Tank Tractor, Anti Aircraft.



VEHICLE CHASSIS SPECIFICATION

15-CWT. 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada,Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 20-Cwt.

Permissible Max.Gross Weight, 10000#.

WHEELBASE:- 101.2 ins.

Back of Cab to end of frame, 91 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 9.00 x 16 W.D. - 5.

TREAD:- Front: 69.8 ins.
Rear: 70.5 ins.

OVERALL LENGTH:- 168 ins.
WIDTH:- 96 ins.
HEIGHT:- 91 ins.

ANGLE OF APPROACH:- 55°.

ANGLE OF DEPARTURE:- 44°.

TURNING CIRCLE:- L.H. 50 feet.
R.H. 50 feet.

AXLES:- Front: Full Floating Spiral Bevel, 5 in. Rzeppa Constant Velocity Joints. Ratio: 6.5:1.

Rear: Full Floating Spiral Bevel. Ratio: 6.5:1.

BRAKES:- Service: 4-Wheel internal expanding Hydraulic. Front: 14 ins.by 2 ins. Rear: 15 ins. by 3.5 ins.Brake Lining Area : 303 sq. ins.

Parking:- Cable operated on Rear Wheels.

CLUTCH:- Single Dry Plate, 11 inch Diameter.

COOLING SYSTEM:- Circulating liquid,pressure type 2 centrifugal pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: open type.

ELECTRICAL SYSTEM:- [redacted] Volt Single Wire System. Battery: 100 A.H. Capacity: 3 cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford 8-Cylinder V-type L Head. Displacement: 239 cu.ins. Max.B.H.P.95 [redacted] 3600 R.P.M. [redacted]x.Gross Torque: 178 @ 1650 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure: 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gal.Fuel Tanks.Carburetor: D[redacted] Draft. Fuel Pump: Diaphragm type mechanically actuated.

FRAME:- Ladder type,Width: 34 ins. Maximum section Modulus 5.2 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 13. Lenght: 38 ins. Width: 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 10. Length: 45 ins. Width: 2.5 ins.

STEERING:- Right Hand Drive,Worm and Roller. Ratio: 20.5:1. 18 in. Steering Wheel.

TRANSMISSION:- 4-Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1. 2nd, 3.09:1. 3rd, 1.69:1. 4th, 1:1. Reverse: 7.82:1. Transfer Case: Single Speed. Ratio: 1:1

PERFORMANCE

POWER/WEIGHT:- 19 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear: 5.1%.

MAXIMUM SPEED:- 52 M.P.H. @ 3400 Engne R.P.M.

CRUISING RANGE:- [redacted] Miles.

[redacted] DEPTH:- [redacted] ins.

WADE PROOF:- Design Released, for 5 ft.

AIRPORTABLE:- [redacted] requirement.

REFERENCES

CODE:- F15A.

MAINTENANCE MANUAL:- MB-F1

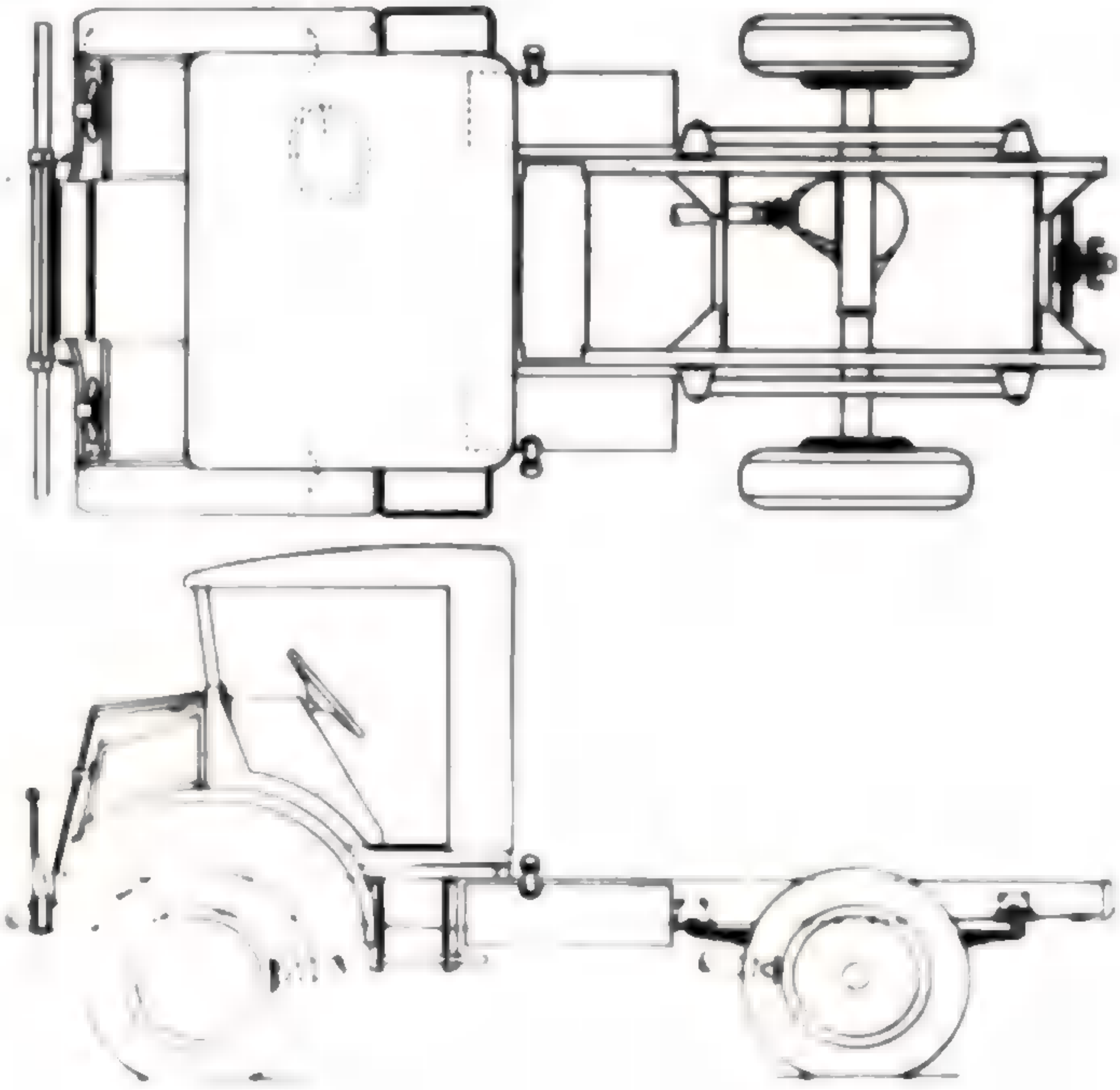
PARTS BOOK:- F15A-01.

DRIVERS HAND BOOK:-(F15A-HC1 (Can.)
(F15A-HB1 (Bri.)

COST OF CHASSIS & CAB:- approx. 1800.00

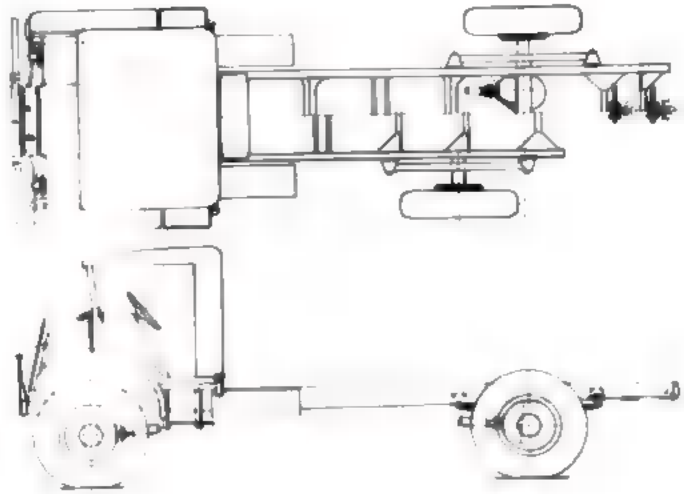
QUANTITY PRODUCED:- approx. 35,000.

APPLICATIONS:- General Service, Van, Cable Layer, Personnel, Anti-Tank Tractor,Anti-Aircraft, Machinery KL.



VEHICLE CHASSIS SPECIFICATION

30 CWT. 4x4 CHASSIS [redacted] CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 30 Cwt.

Permissible Max. Gross Weight 12600#.

WHEELBASE:- 134 ins.

Back of Cab to end of Frame, 1_4. ins.
Rear Axle to end of Frame, 3_. ins.

TIRES:- 10.50 x 16 W.D. - 5.

TREAD:- Front, 7_. ins.
Rear, 70.5 ins.

OVERALL LENGTH: 198 ins.
WIDTH: 86 ins.
HEIGHT: 87 ins.

ANGLE OF APPROACH:- 58°.

ANGLE OF DEPARTURE:- 38°.

TURNING CIRCLE:- L.H. 61 feet.
R.H. 62 feet, 1 in.

AXLES:- Front: Full Floating, Spiral Bevel, Ratio 7.16:1. 5 ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating, Spiral Bevel, Ratio 7.16:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 14 ins. by [redacted] ins. Rear 15 ins. by 3.5 ins. Lining Area 303 sq. ins.

Parking: External contracting, mechanical on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 13.5 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear, High Transfer Case 3.80%. Low Transfer Case 7.85%.

MAXIMUM SPEED:- 50 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 300 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- Design Released, not produced.

AIRPORTABLE: No requirement.

CLUTCH:- Single Plate Dry Disc, 10.8" Diameter.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet, [redacted] Cylinder, Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Maximum Gross Torque 170 [redacted] 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump, Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type, Width 34 ins. Maximum Section Modulus 9.68 ins. cubed.

SPRINGS:- Front: Semi-elliptic with Delco Shock Absorbers. No. of Leaves 10, Length 40 ins. Width 2 ins.

Rear: Semi-elliptic with Delco Shock Absorbers. No. of Leaves 12, Length 50 ins. Width 2.5 ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio 23.6:1. [redacted] ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1 4th, 1:1, Reverse: 6.98:1. Transfer Case 2 speed. Ratios: 1:1 and 1.87:1.

REFERENCES

CODE:- C30

MAINTENANCE MANUAL: MBC-2

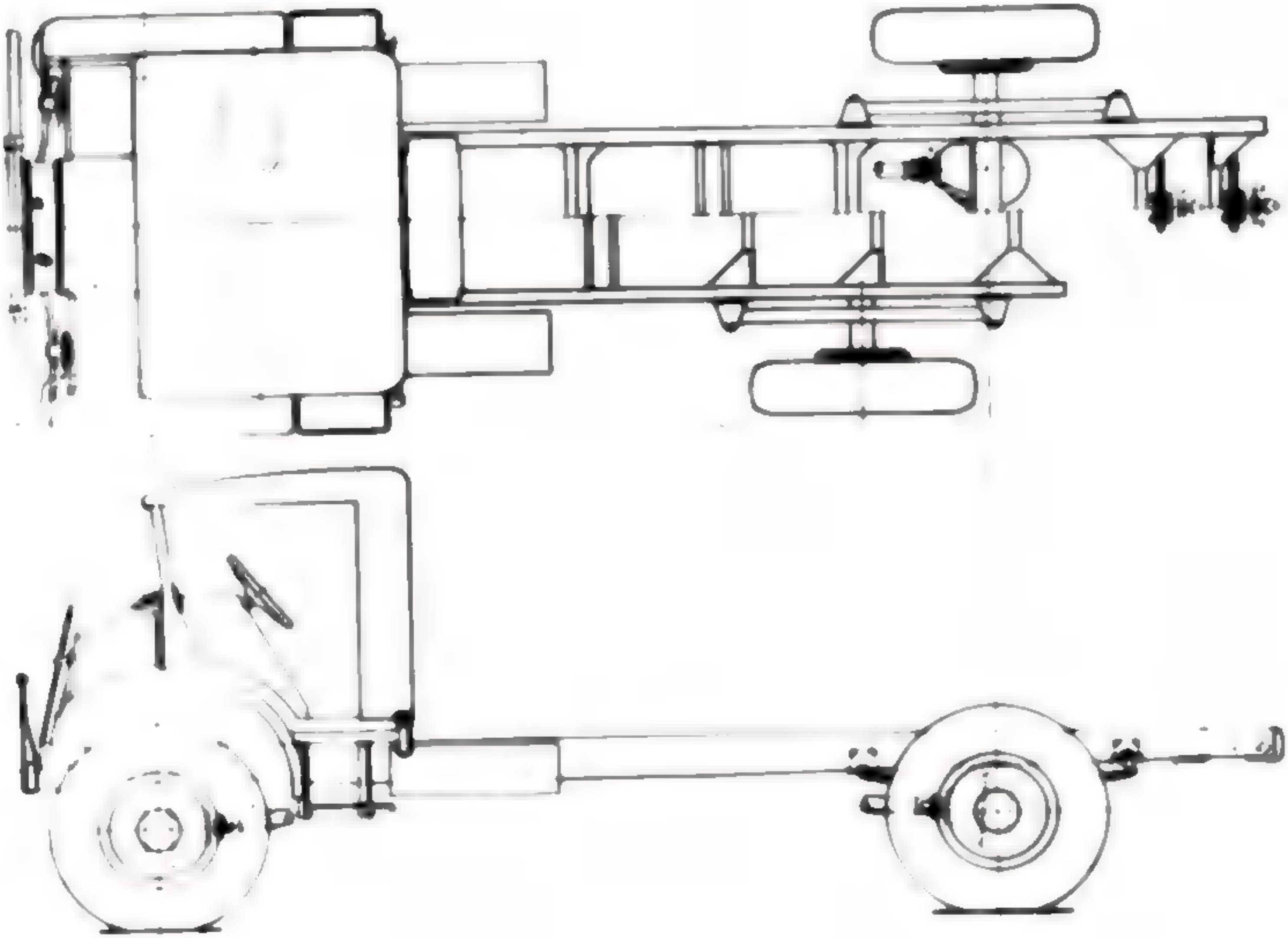
PARTS BOOK:- C30-02.

DRIVERS HAND BOOK:- C30 HB1 (BRI.)
C30 [redacted] (CAN.)

COST OF CHASSIS & CAB:- approx. 1800.00.

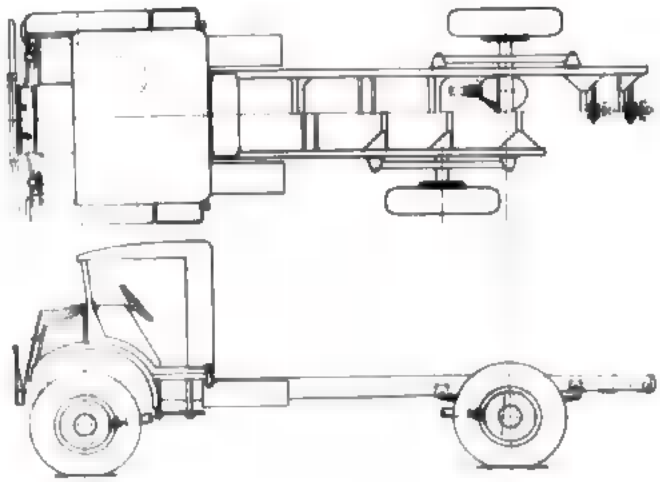
QUANTITY PRODUCED:- approx. 9,500.

APPLICATIONS:- General Service, Office, Cable Layer, Light Anti-Aircraft, Stores.



VEHICLE CHASSIS SPECIFICATION

30-CWT. 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 30-Cwt.

Permissible Max.Gross Weight, 12600#.

WHEELBASE:- 134.5 ins.

Back of Cab to end of Frame, 124.5 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 [illegible] 16 W.D. - 8.

TREAD:- Front, 69.8 ins.
Rear, 70.5 ins.

OVERALL LENGTH: - 198.8 ins.
WIDTH: - 82.8 ins.
HEIGHT: - 87 ins.

ANGLE OF APPROACH:- 50°.

ANGLE OF DEPARTURE:- 42°.

TURNING CIRCLE:- L.H. 70 feet, 6 ins.
R.H. 69 feet, 9 ins.

AXLES:- Front: Full Floating Spiral Bevel, 5 in. Rzeppa Constant Velocity Joints. Ratio: 7.16:1.

Rear: Full Floating Spiral Bevel. Ratio: 7.16:1.

BRAKES:- Service: 4-Wheel internal expanding Hydraulic. Front: 14 ins. by 2 ins. Rear: 15 ins. by 3.5 ins. Brake Lining Area: 303 sq. ins.

Parking: External contracting. Mechanical on Propellor Shaft. Size: 9.5 ins. by 3 ins. Lining Area: 88 sq. ins.

CLUTCH:- Single Dry Plate, 11 inch Diameter.

COOLING SYSTEM:- Circulating liquid, pressure type 2 centrifugal pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss: Universal Joints: open type.

ELECTRICAL SYSTEM:- [illegible] Volt Single Wire System. Battery: 100 A.H. Capacity: 3 cell. Starter: Bendix actuated. Generator: [illegible] Amp.Capacity.

ENGINE MAKE:- Ford 8-Cylinder V-type L Head. Displacement, 239 cu.ins. Max. B.H.P.95 @ 3600 R.P.M. Max. Gross Torque: 178 @ 1850 R.P.M. Lubrication: Full Pressure from Pump. Pressure, 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gal. Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm type mechanically actuated.

FRAME:- Ladder type with reinforcements. Width, 34 ins. Maximum section Modulus 5.2 inches cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 12. Length: [illegible] ins. Width: 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 10. Length: 45 ins. Width: 2.5 ins. Auxiliary: 7 Leaves.

STEERING:- Right Hand Drive, Worm and Roller. Ratio: 20.5:1. 18 inch Steering Wheel.

TRANSMISSION:- 4-Speeds Forward. 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse: 7.82:1. Transfer Case 2-Speed. Ratio: 1:1 and 1.87:1.

PERFORMANCE

POWER/WEIGHT: 15.05 B.H.P. per short ton.

GRADEABILITY:- In 4th [illegible]r: High Transfer Case, 3.9%. Low Transfer Case, 8.1%.

MAXIMUM SPEED:- 50 M.P.H.@ 3400 Engine R.P.M.

CRUISING RANGE:- 250 [illegible]les.

FORDING DEPTH:- 24 ins.

WADE PROOF:- Design Released, for 5 ft.

[illegible] No Requirement.

REFERENCES

CODE:- F30.

MAINTENANCE MANUAL:- MB-F1.

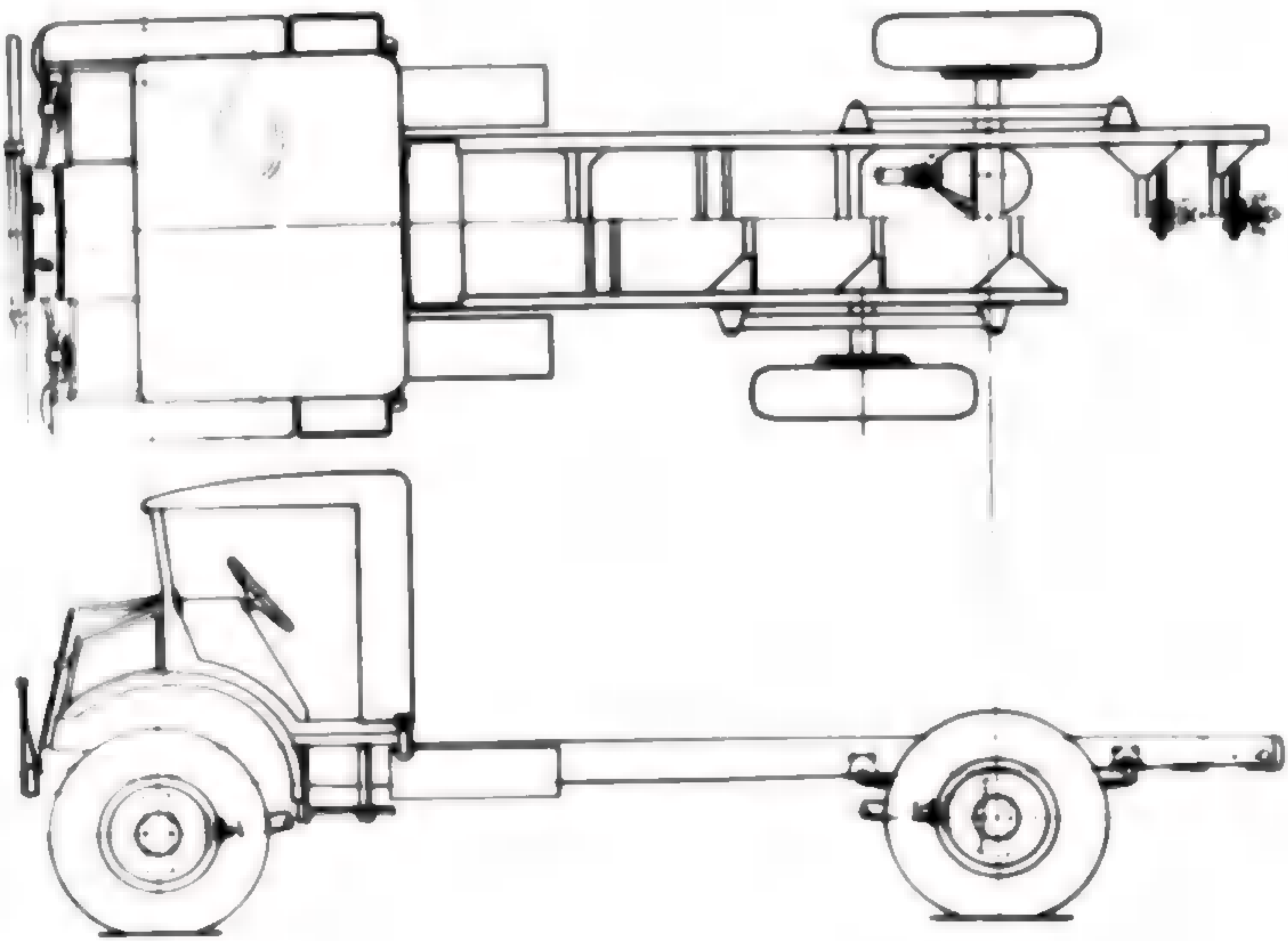
PARTS BOOK:- F30-01.

DRIVERS HAND BOOK:- (F30-HC1/F60S-HC1 (Can.)
(F30-HB1/F60S-HB1 (Bri.)

COST OF CHASSIS [illegible] CAB:- approx. 1800.00.

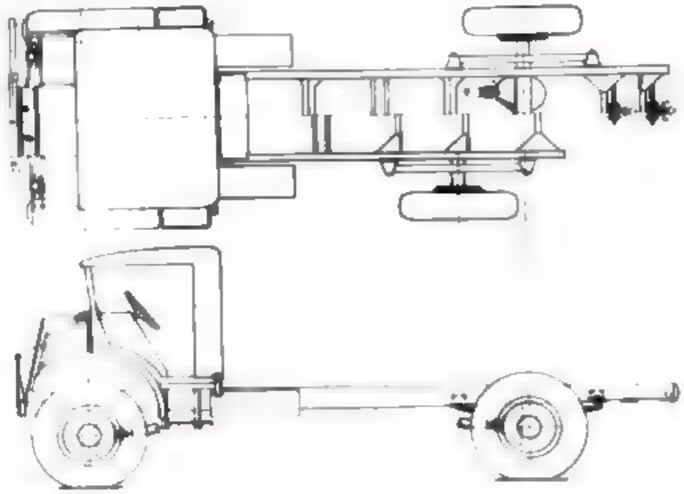
QUANTITY PRODUCED:- approx. 9,500.

APPLICATIONS:- General Service, Ambulance, Derrick, Light Antiaircraft, Winch



VEHICLE CHASSIS SPECIFICATION

30 CWT. 4x4 COMPRESSOR TRUCK, CHASSIS [redacted] CAB.



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 30 Cwt.

Permissible Max. Gross Weight 12000#.

WHEELBASE:- 101 ins.

Back of Cab to end of Frame, 91 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 16 W.D. - 5.

TREAD:- Front, 69.8 ins.
Rear, 70.5 ins.

OVERALL LENGTH: 168 ins.
WIDTH: [redacted] ins.
HEIGHT: 91 ins.

ANGLE OF APPROACH:- 60°.

ANGLE OF DEPARTURE:- 42°.

TURNING CIRCLE:- L.H. 50 feet.
R.H. 50 feet.

AXLES:- Front: Full Floating Spiral Bevel. Ratio 6.5:1. 5 ins. Rzeppa Constant Velocity Joints.

Rear: Full Floating Spiral Bevel. Ratio 6.5:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 14 ins. by 2 ins. Rear, 15 ins. by 3.5 ins. Lining Area 303 sq. ins.

Parking: Cable operated on Rear Wheels. Size 15 ins. by 3.5 ins. Lining Area 198 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 15.8 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 3.7%. Low Transfer Case 7.7%.

MAXIMUM SPEED:- 52 M.P.H. [redacted] 3200 Engine R.P.M.

CRUISING RANGE:- 300 Miles.

FORDING DEPTH:- 24 ins.

MADE PROOF:- In production for five feet.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. 2 Centrifugal Pumps driven by Double [redacted] Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 150 A.H. Capacity. 3 Cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford. 8 Cylinder V Type L Head. Displacement: 239 cu. ins. Max. B.H.P. [redacted] @ 3600 R.P.M. Max. Gross Torque 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 5.2 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 12, Length 38 ins. Width 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 10, Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Roller Type. Ratio 20.5:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1. Reverse 7.82:1. Transfer Case, 2 Speed. Ratios 1:1 and 1.87:1.

REFERENCE

CODE:- Nil. (Pilot Model)

MAINTENANCE MANUAL:- M.BF-1

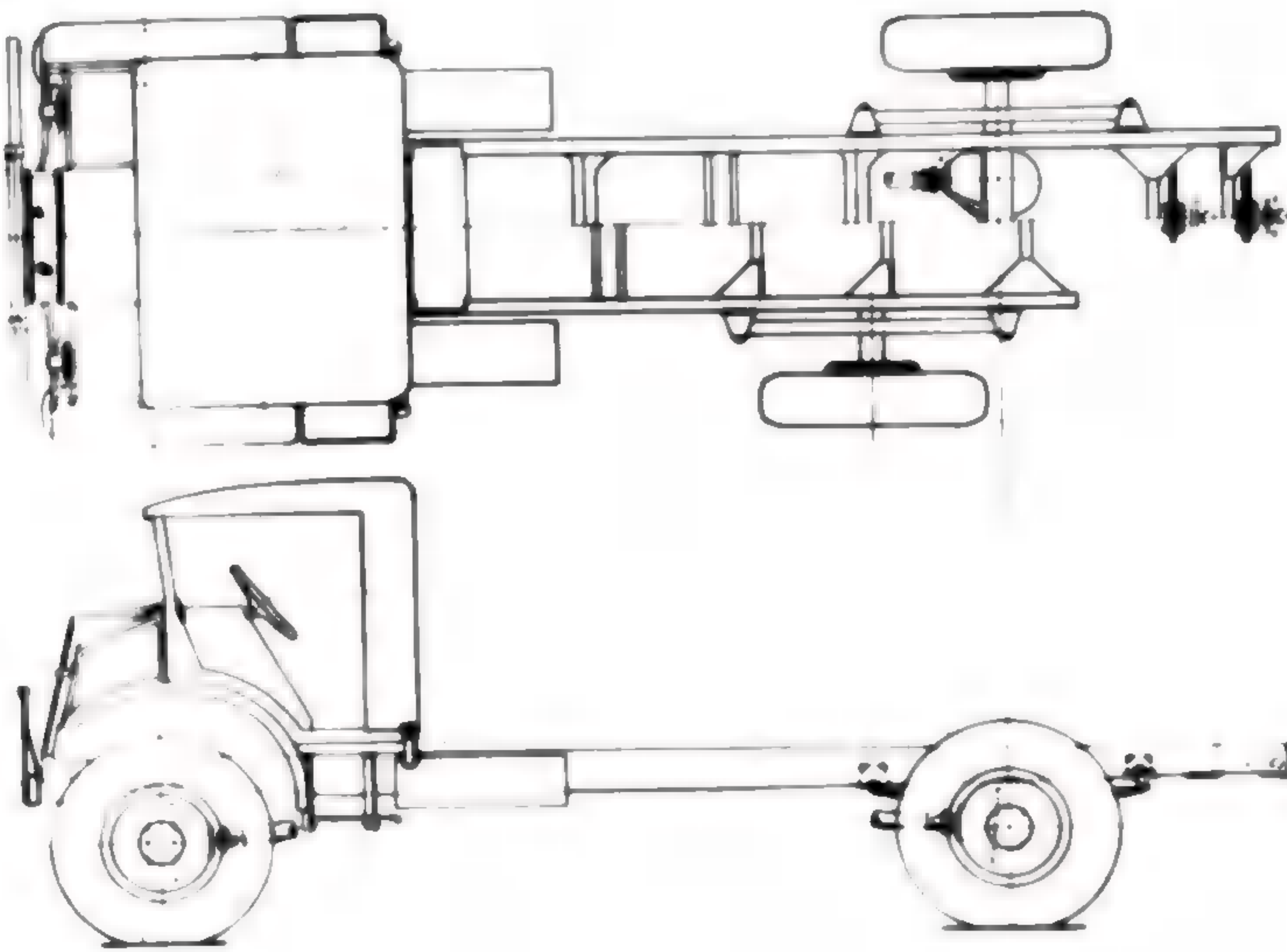
PARTS BOOK:- Nil.

DRIVERS HAND BOOK:- Nil.

COST OF CHASSIS & CAB:-

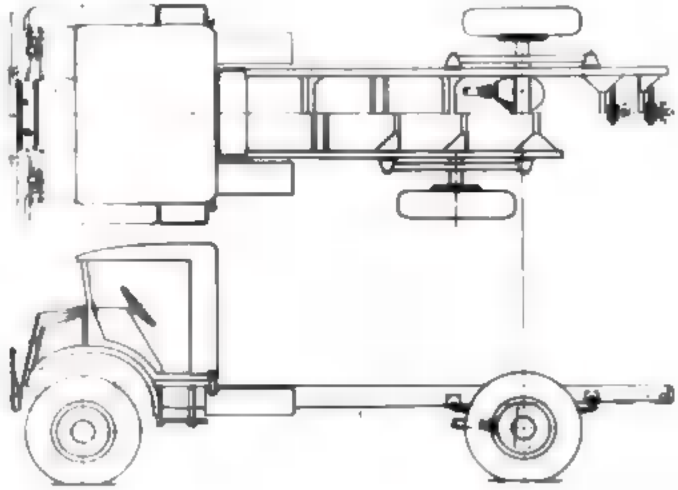
QUANTITY PRODUCED:- Pilot.

APPLICATIONS:- Air Compressor Truck.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 15500 #.

WHEELBASE:- 134.2 ins.

Back of Cab to end of Frame, 124.5 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 16 W.D. - 5.

TREAD:- Front, 71.9 ins.
Rear, 71.8 ins.

OVERALL LENGTH:- 200.6 ins.
WIDTH:- 81 ins.
HEIGHT:- 87 ins.

ANGLE OF APPROACH:- 68°

ANGLE OF DEPARTURE:- 46°

TURNING CIRCLE: L.H. 53 feet, 3 ins.
R.H. 54 feet, 1 in.

AXLES: Front: Tubular.

Rear: Full Floating, Eaton 2 speed. Ratios: 6.33:1 and 8.81:1.

BRAKES:- Service: 4-Wheel internal expanding, Hydraulic, with Vacuum Booster. Front, 14 ins. by 2 ins. Rear 15 ins. by 3.5 ins. Lining area 303 sq. ins.

Parking: External contracting, Mechanical, [illegible] Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 12.26 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear High Axle range 2.6%. Low Axle Range 3.9%.

MAXIMUM SPEED:- 50 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 200 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc. 11" Diameter.

COOLING SYSTEM:- Circulating liquid, pressure type. 2 centrifugal Pumps, driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of system: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: open type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 100 A.H. Capacity. [illegible] cell. Starter: Bendix actuated. Generator: 33 Amp. capacity.

ENGINE MAKE:- Ford 8-cylinder V Type, L Head, Displacement 239 cu. ins. Max. B.H.P. 95 @ 3600 R.P.M. Max. Gross Torque: 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure: 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks, Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder type with inner rail reinforcements. Width 34 ins. Maximum Section Modulus 7.75 ins. cubed.

SPRINGS:- Front: Semi-elliptic with Houdaille Shock Absorbers. No. of leaves: 13, Length 38 ins, Width 2 ins.

Rear: Semi-elliptic with Houdaille Shock Absorbers. No. of leaves: 10, Length 45 ins. Width 2.5 ins. Auxiliary: 7 Leaves.

STEERING:- Right Hand drive. Worm and Roller. Ratio 24.4:1, 18 inch Steering Wheel.

TRANSMISSION:- [illegible] speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, [illegible] rd, 1.69:1 4th, 1:1. Reverse, 7.82:1.

REFERENCES

CODE:- F602S

MAINTENANCE MANUAL:- SE 29C

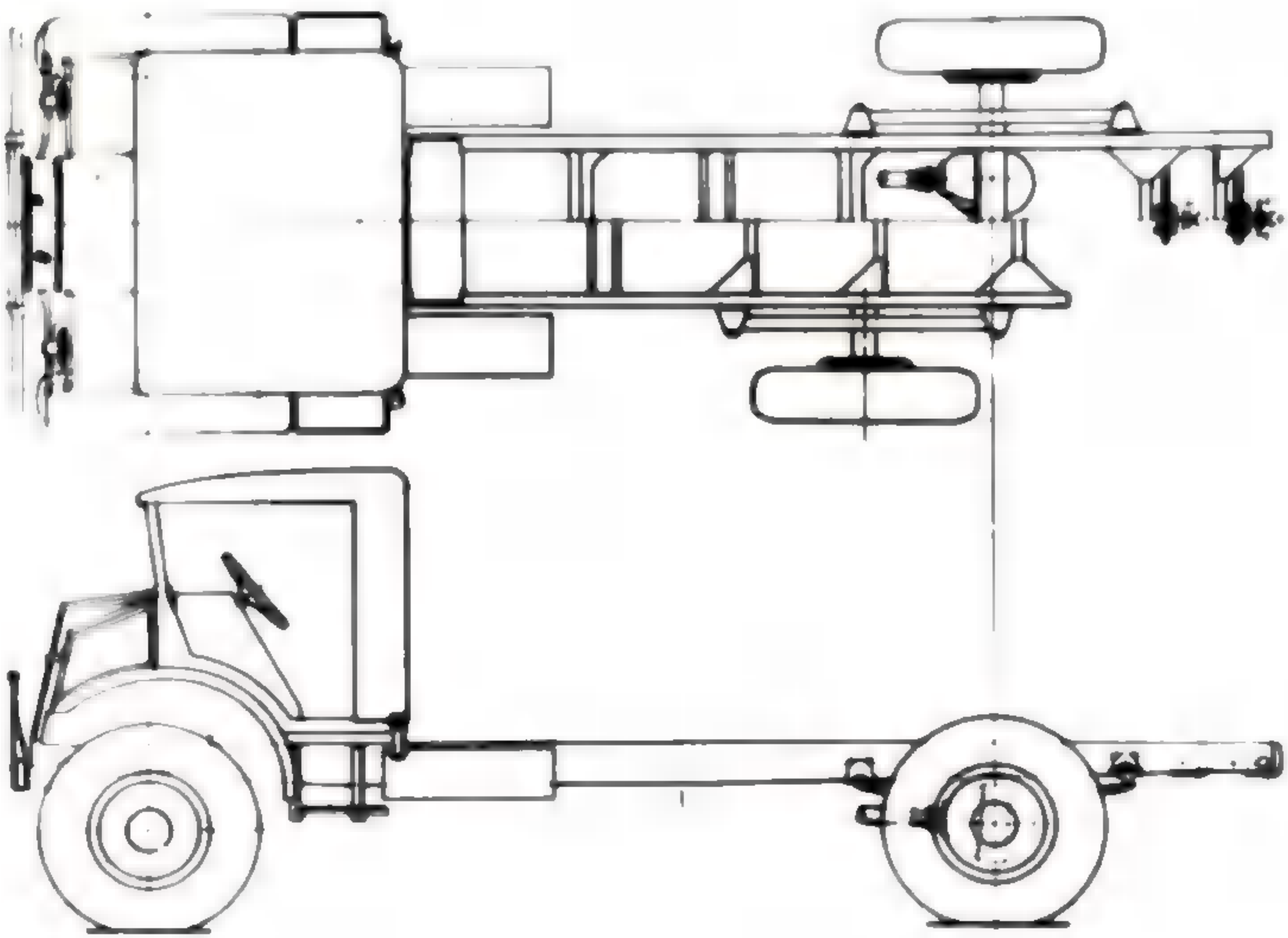
PARTS BOOK:- SE 201

INSTRUCTION BOOK:- SE 29B.

COST OF CHASSIS [illegible] CAB:- approx. 1900.00.

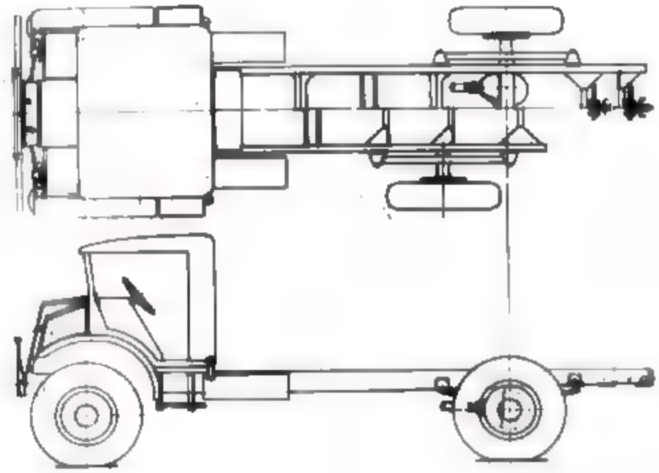
QUANTITY PRODUCED:- approx. 3000.

APPLICATIONS:- General Service.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS & [redacted]



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 15500#.

WHEELBASE:- 158.2 ins.

Back of Cab to end of Frame, 148.5 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 16 W.D. - 8.

TREAD:- Front, 71.9 ins.
Rear, 71.8 ins.

OVERALL LENGTH:- 224.6 ins.
WIDTH:- 81 ins.
HEIGHT:- 87 ins.

ANGLE OF APPROACH:- 58°.

ANGLE OF DEPARTURE:- 46°.

TURNING CIRCLE:- L.H. 63 feet
R.H. 63 feet, 3 ins.

AXLES:- Front: Tubular

Rear: Full Floating, Eaton 2 speed. Ratios: 6.33:1 and 8.81:1

BRAKES:- Service: [redacted]-Wheel, internal expanding, Hydraulic, with Vacuum Booster. Front, 14 ins. by [redacted] ins. Rear, 15 ins. by 3.5 ins. Brake lining [redacted] 303 sq. ins.

Parking: External contracting, Mechanical, [redacted] Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 12.25 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear, High Axle Range 2.6%. Low Axle Range 3.9%.

MAXIMUM SPEED:- 50 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 200 miles

FORDING DEPTH:- [redacted] ins.

MADE PROOF:- No requirement.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 11" Diameter

COOLING SYSTEM:- Circulating liquid, pressure type. 2 centrifugal pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of system: [redacted] qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal joints: open type.

ELECTRICAL SYSTEM:- 6 Volt, Single Wire System. Battery: 100 A.H. capacity. 3 cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford, 8 cylinder, V type, L head, Displacement, 239 cu. ins. Max. B.H.P. 95 [redacted] 3600 R.P.M. Max. Gross Torque: 176 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump, Pressure: [redacted] lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm type, mechanically actuated.

FRAME:- Ladder type with reinforcements. Width 34 ins. Maximum section Modulus 15.5 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of leaves: 13. Length 38 ins., Width [redacted] ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of leaves: 10. Length 45 ins., Width 2.5 ins. Auxiliary: 7 leaves.

STEERING:- Right Hand Drive, Worm and Roller. Ratio: 24.4:1. 18 inch Steering Wheel.

TRANSMISSION:- [redacted] Speeds Forward, 1 reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1, Reverse, 7.82:1.

REFERENCES

CODE:- F602L

MAINTENANCE MANUAL:- SE 29C

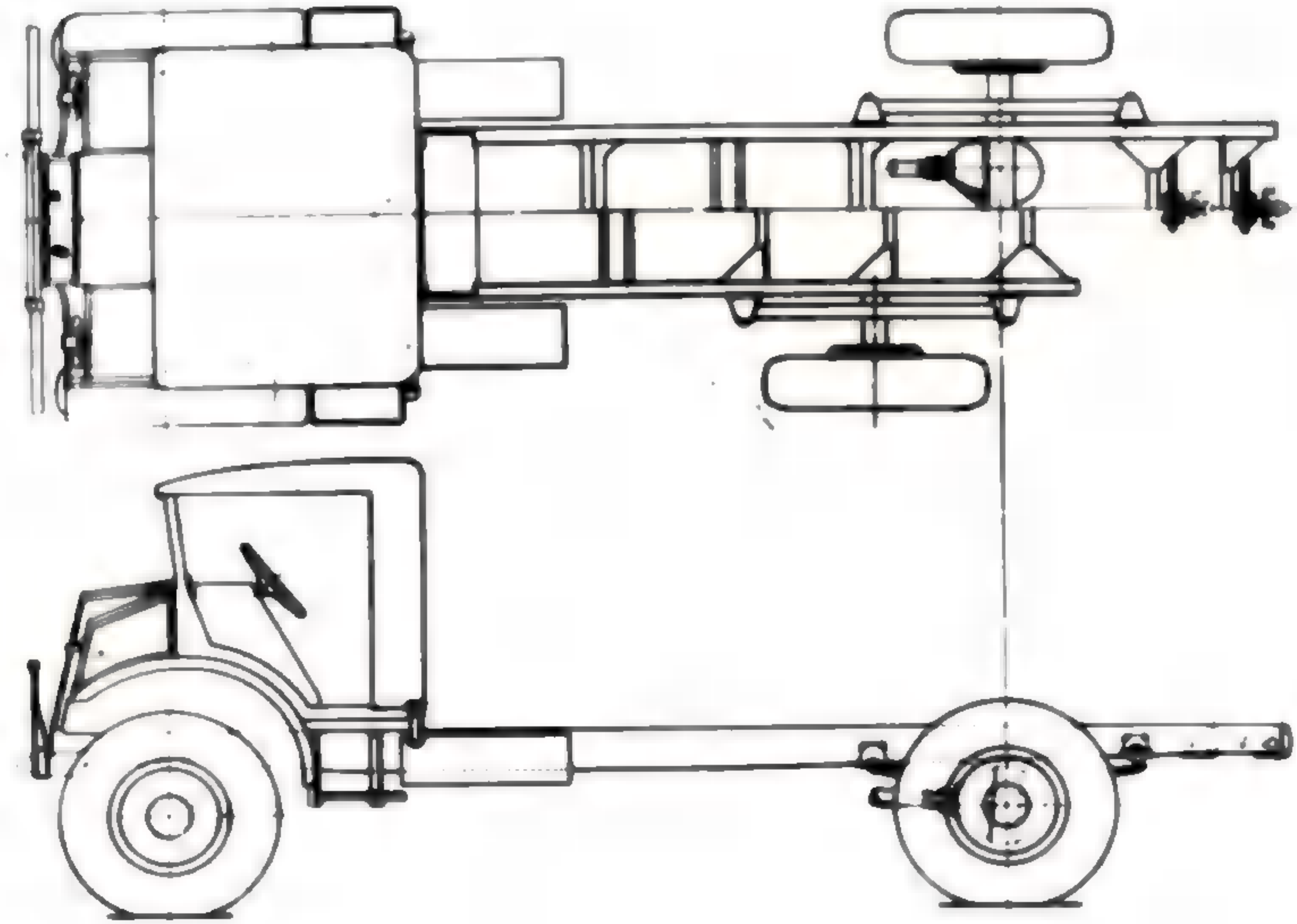
PARTS BOOK:- SE 201

INSTRUCTION BOOK:- SE [redacted]

COST OF CHASSIS [redacted] CAB:- approx. 1900.00.

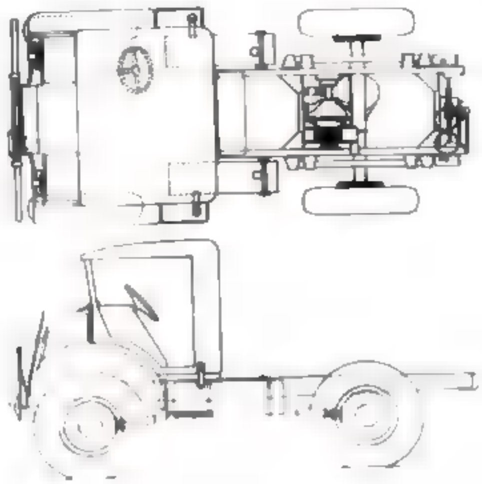
QUANTITY PRODUCED:- approx. 3000.

APPLICATIONS:- General Service.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 F.A.T. CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 2800 lbs.

Permissible Max. Gross Weight 13200#.

WHEELBASE:- 101 ins.

Back of Cab to end of Frame, 92 ins.
Rear Axle to end of Frame, 39.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 69 ins.
Rear, 69 ins.

OVERALL LENGTH: 167 ins.
WIDTH: [redacted] ins.
HEIGHT: 90 ins.

ANGLE OF APPROACH:- 62°.

ANGLE OF DEPARTURE:- 36°.

TURNING CIRCLE:- L.H. 43 feet, 8 ins.
R.H. 44 feet, 9 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio: 7.16:1. 6 ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating, Sprial Bevel, Ratio: 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 15 ins. by 3.5ins. Rear 15 ins. by 3.5 ins. Lining Area 396 sq. ins. Vacuum Booster equipped.

Parking: External contracting, mechanical, on Propeller Shaft. Size 9.5ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 12.9 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 3.0%. Low Transfer Case 6.5%.

MAXIMUM SPEED:- 55 M.P.H. @ 3400 engine R.P.M.

CRUISING RANGE:- 480 Miles.

FORDING DEPTH:- 24 ins.

[redacted] PROOF:- Design Released, not produced.

AIRPORTABLE: No requirement.

CLUTCH:- Single Plate Dry Disc, 10.8" Diameter.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open type.

ELECTRICAL SYSTEM:- [redacted] Volt Single Wire System. Battery 90 A.H. Capacity 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet. 6 cylinder Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 [redacted] 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 20 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 9.68 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves, 12, Length 40 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 12, Length 50 ins. Width 2.5 ins-Auxiliary 6 Leaves, 2 spacers.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio: 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1 4th, 1:1, Reverse 6.98:1. Transfer Case [redacted] speed. Ratios: 1:1 and 1.87:1.

REFERENCE

CODE:- CGT

MAINTENANCE MANUAL:- MBC-2

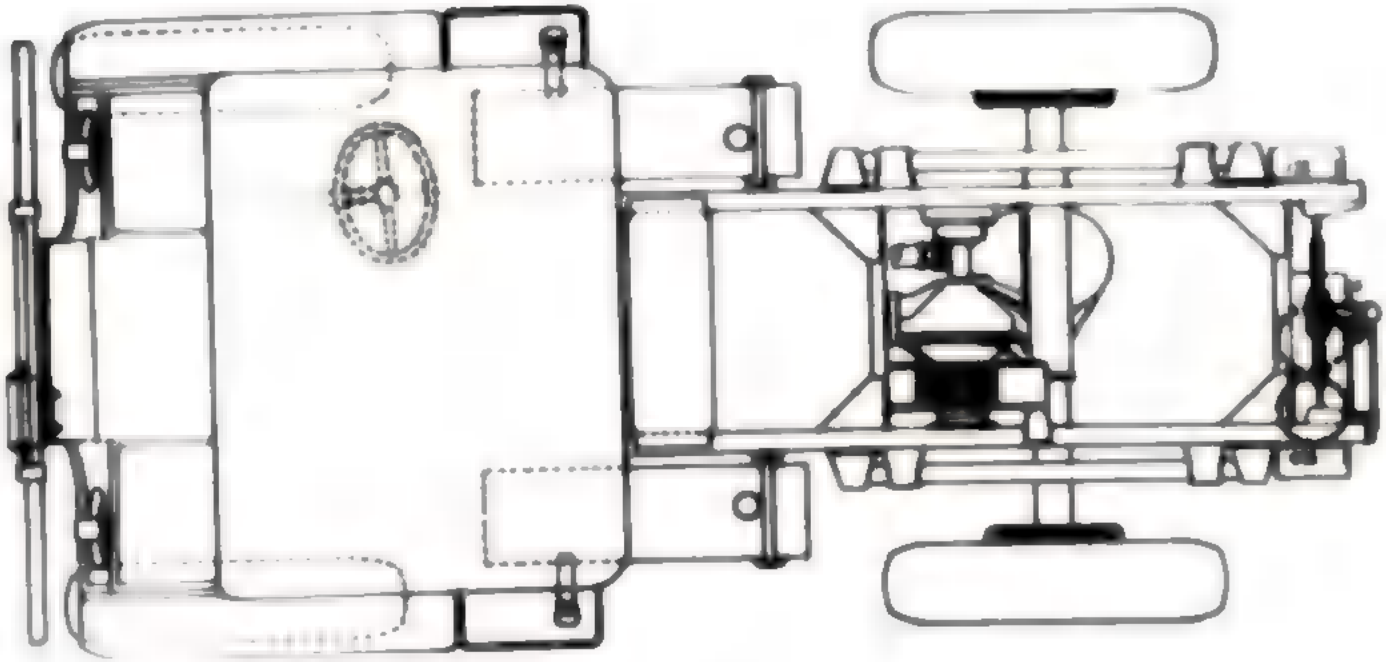
PARTS BOOK:- CGT-02

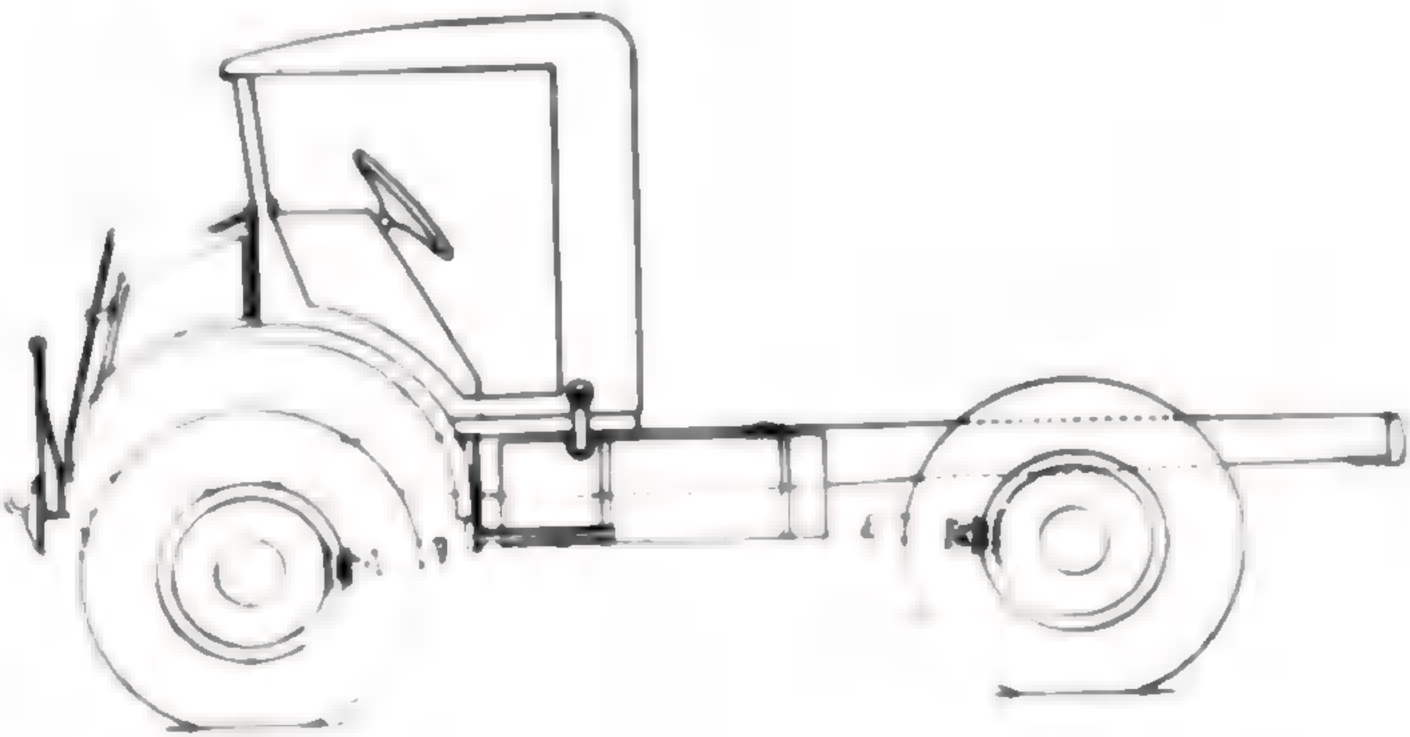
DRIVERS HAND BOOK:- CGT-HB1 (BRI.)
CGT-HC1 (CAN.)

COST OF CHASSIS & CAB:- approx. 2200.00.

QUANTITY PRODUCED:- approx. 11,000.

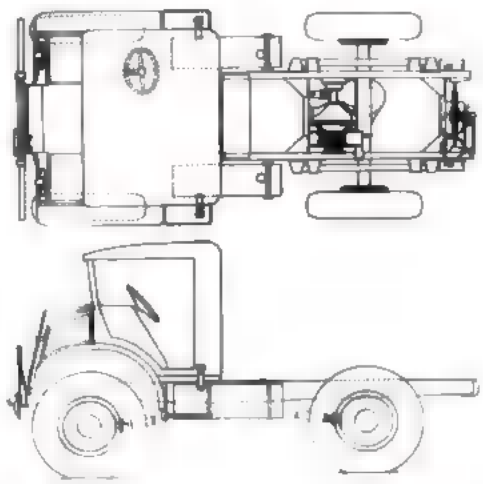
APPLICATIONS:- Field Artillery Tractor.





VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 F.A.T. CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:-

Permissible Max. Gross Weight 13200#.

WHEELBASE:- 101.2 ins.

Back of Cab to end of Frame, 95.5 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 70.2 ins.
Rear, 69.2 ins.

OVERALL LENGTH:- 167.5 ins.
WIDTH:- 83 ins.
HEIGHT:- 89 ins.

ANGLE OF APPROACH:- 68°

ANGLE OF DEPARTURE:- 44°

TURNING CIRCLE:- L.H. 43 feet, 3 ins.
R.H. 43 feet, 3 ins.

AXLES:- Front: Full Floating, Spiral Bevel. Ratio: 7.16:1. 6 ins. Rzeppa Constant Velocity Joints.

Rear: Full Floating, Spiral Bevel. Ratio: 7.16:1

BRAKES:- Service: 4-Wheel internal expanding, Hydraulic with Vacuum Booster. Front 15 ins. by 3.5 ins. Rear 15 ins. by 3.5 ins. Brake Lining Area 396 sq. ins.

Parking: External contracting, Mechanical, on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 86 sq. ins.

CLUTCH:- Single Plate Dry Disc. 11 ins. dia.

COOLING SYSTEM:- Circulating liquid, Pressure type. 2 Centrifugal Pumps driven by Double 'V'. Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System, 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 100 A.H. Capacity. 3 cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford, 8 cylinder V type, L Head. Displacement: 239 cu. ins. Max. B.H.P. [redacted] @ 3600 R.P.M. Max. Gross Torque: 178 @ 1800 R.P.M. Lubrication: Full pressure from Gear Pumps. Pressure, 60 lbs. per sq. in.

FUEL SYSTEM:- Two 30 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type. Width 34 ins. Maximum section Modulus 5.2 ins. cubed.

SPRINGS:- Front: Semi elliptic with Houdaille Shock Absorbers. No. of leaves 12. Length 39 ins. Width 2 inches.

Rear: Semi elliptic with Houdaille Shock Absorbers. No. of leaves 10. Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Roller. Ratio: 24.4:1.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse: 7.82:1. Transfer Case 2-Speed. Ratios: 1:1 and 1:87:1.

PERFORMANCE

POWER/WEIGHT:- 14.4 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear: High Transfer Case, 3.2%. Low Transfer Case 6.8%.

MAXIMUM SPEED:- 55 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 480 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- In Production, for [redacted] feet.

AIRPORTABLE:- No requirement.

REFERENCES

CODE:- FGT

MAINTENANCE MANUAL:- MB-P1.

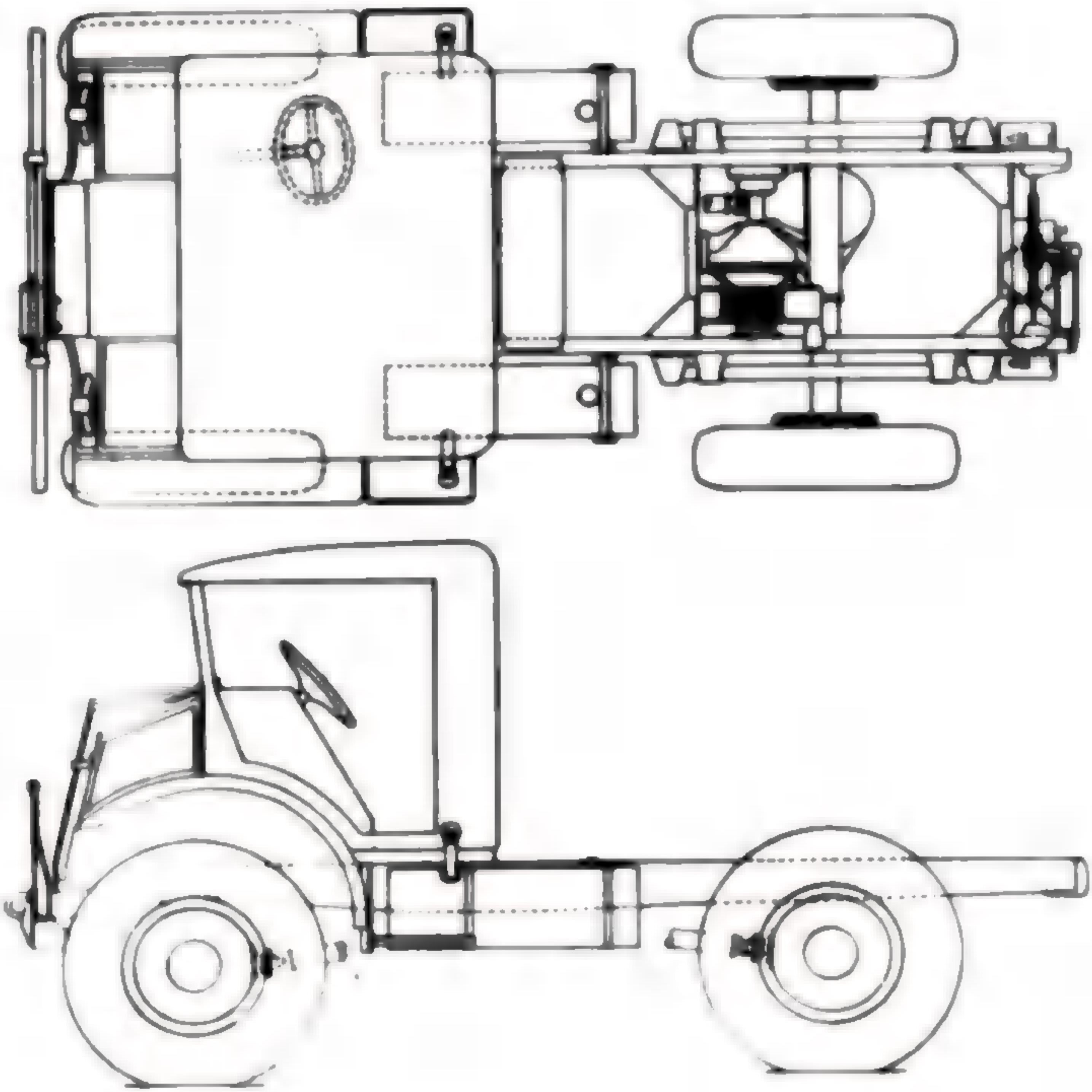
PARTS BOOK:- FGT-01

DRIVERS HAND BOOK:- FGT-HC1 (CAN.)
FGT-HB1. (BRI.)

COST OF CHASSIS & CAB:- approx. 2100.00.

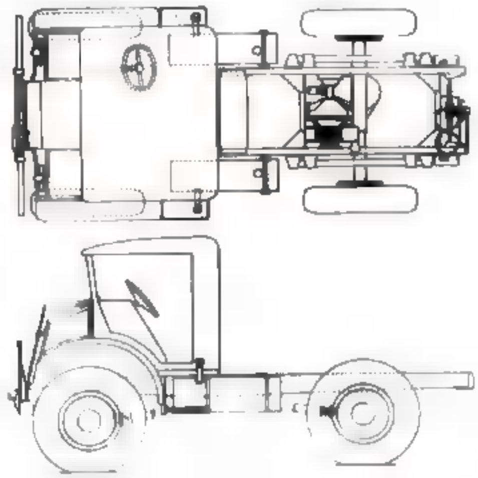
QUANTITY PRODUCED:- approx. 11,500.

APPLICATIONS:- Field Artillery Tractor.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 TRACTOR, CHASSIS [redacted] CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 9,800 lbs.

Permissible Max. Gross Weight of Train, 26,500 lbs.

WHEELBASE:- 115 ins.

Back of Cab to end of Frame, 67 ins.
Rear Axle to end of Frame, 29.1 ins.

TIRES:- 10.50 [redacted] 20 W.D. - 5.

TREAD:- Front, 70.2 ins.
Rear, 69.2 ins.

OVERALL LENGTH:- 170.5 ins.
WIDTH:- 84 ins.
HEIGHT:- 90.8 ins.

ANGLE OF APPROACH:- 61°.

ANGLE OF DEPARTURE:- 65°.

TURNING CIRCLE:- L.H. 53 feet.
R.H. 53 feet.

AXLES:- Front: Full Floating, Spiral Bevel. Ratio, 7.16:1. 6 ins. Rzeppa Constant Velocity Joints.

Rear: Full Floating, Spiral Bevel. Ratio, 7.16:1.

BRAKES:- Service: 4 Wheel Internal expanding, Hydraulic with Vacuum Booster. Front 15 ins. by 3.5 ins. Lining Area 396 sq. ins.

Parking: External contracting, Mechanical, on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT OF TRAIN:- 7.17 B.H.P. per short ton.

GRADEABILITY OF TRAIN:- In 4th gear High Transfer Case, .8%, Low Transfer Case, 2.6%.

MAXIMUM SPEED OF TRAIN:- 41 M.P.H.

CRUISING RANGE OF TRAIN:- 246 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- In production, for [redacted] feet.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc, 11" Diameter.

COOLING SYSTEM:- Circulating liquid, Pressure Type. 2 centrifugal Pumps driven by double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 100 A.H. Capacity. 3 cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford. 8 Cylinder V Type, L Head. Displacement: 239 cu. ins. Max. B.H.P. 95 @ 3600 R.P.M. Max. Gross Torque: 176 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure: 60 lbs. per sq. in.

FUEL SYSTEM:- Two 20.5 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME: - Ladder Type with inner reinforcement. Width 34 ins. Maximum section Modulus 7.75 ins. cubed.

SPRINGS:- Front: Semi-elliptic with Houdaille Shock Absorbers. No. of Leaves, 13, Length 38 ins. Width 2 ins.

Rear: Semi-elliptic with Houdaille Shock Absorbers. No. of Leaves, 12, Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Roller. Ratio, 24.4:1.

TRANSMISSION:- [redacted] speeds forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd 1.69:1 4th, 1:1. Reverse 7.82:1. Transfer Case, 2 speed. Ratios: 1:1 and 1.87:1.

REFERENCES:

CODE:- F60T.

MAINTENANCE MANUAL:- MBF1

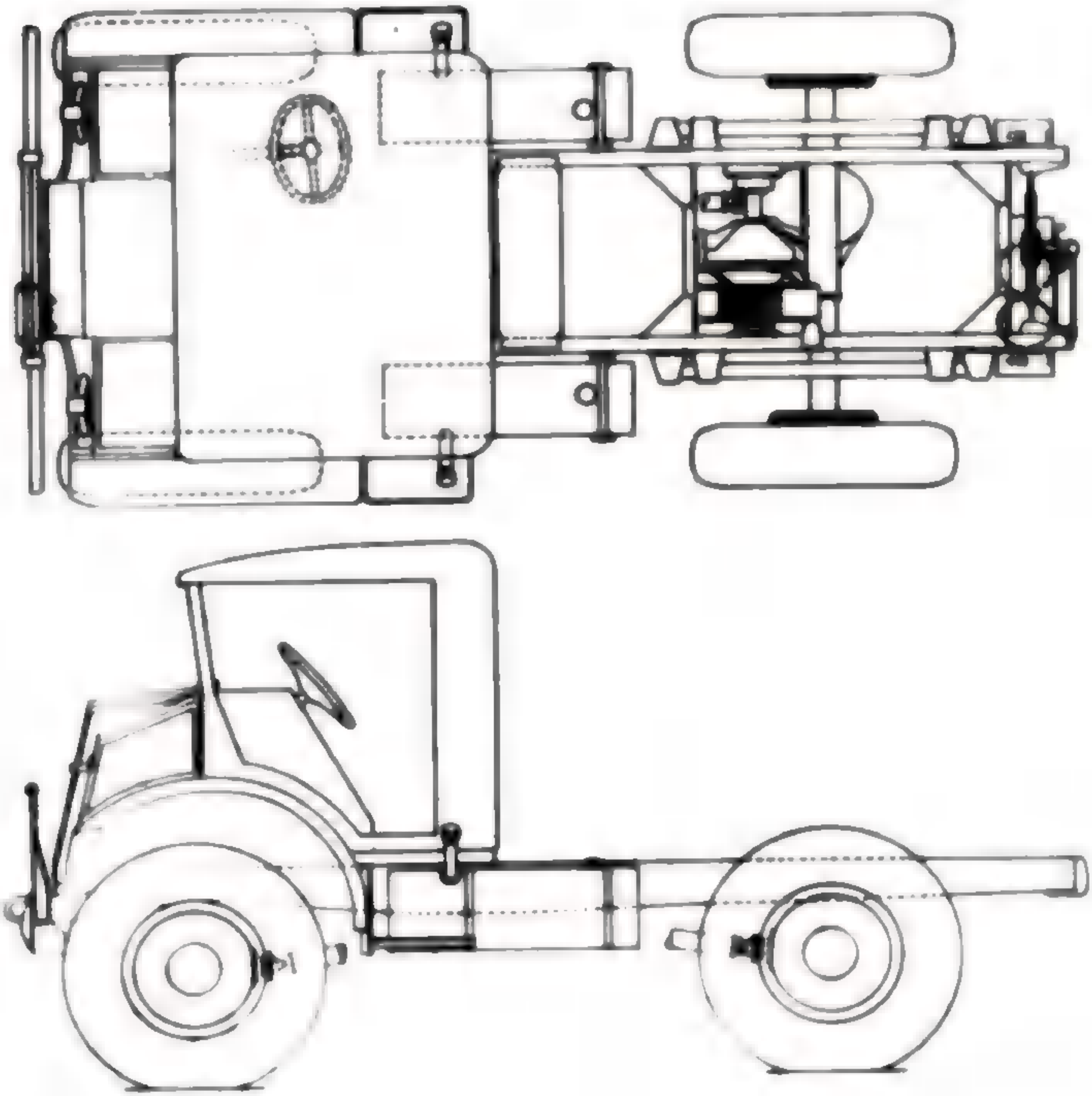
PARTS BOOK:- F60T-01.

DRIVERS HAND BOOK:- F60T-HC1 (CAN.)
F60T-HB1 (BRI.)

COST OF CHASSIS & CAB:- approx. 2200.00.

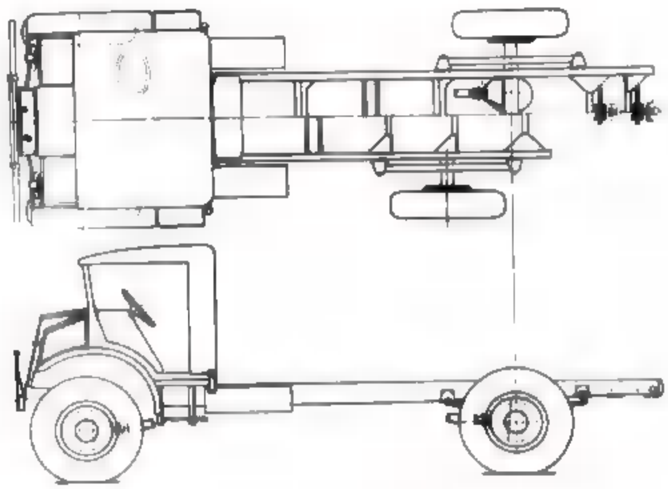
QUANTITY PRODUCED:- approx. 3000.

APPLICATIONS:- Tractor for [redacted] Ton Semi Trailer.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 16000#.

WHEELBASE:- 134 ins.

Back of Cab to end of Frame, 123.8 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 69 ins.
Rear, 69 ins.

OVERALL LENGTH: 202 ins.
WIDTH: 89 ins.
HEIGHT: 90 ins.

ANGLE OF APPROACH:- 65°.

ANGLE OF DEPARTURE:- 45°.

TURNING CIRCLE:- L.H. 56 feet.
R.H. 55 feet, 10 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio 7.16:1. ■ ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating Spiral Bevel, Ratio 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 15 ins. x 3.5 ins. Rear, 15 ins. by 3.5 ins. Lining Area 396 sq. ins. Vacuum Booster equipped.

Parking: External contracting, mechanical on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 68 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 10.6 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 2.25%. Low Transfer Case 5.11%.

MAXIMUM SPEED:- 55 M.P.H. @ 3400 engine R.P.M.

CRUISING RANGE:- 250 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- Design Released, not produced.

AIRPORTABLE:- No Requirement.

CLUTCH:- Single Plate Dry Disc, 10.8 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet. 6 cylinder Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 @ 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 9.68 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 11, Length 40 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 12, Length 50 ins. Width 2.5 ins. Auxiliary 6 Leaves, 2 Spacers.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio: 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1 4th, 1:1. Reverse 6.98:1. Transfer Case ■ Speed. Ratios: 1:1 and 1.87:1.

REFERENCE

CODE:- C60S

MAINTENANCE MANUAL:- MBC-2

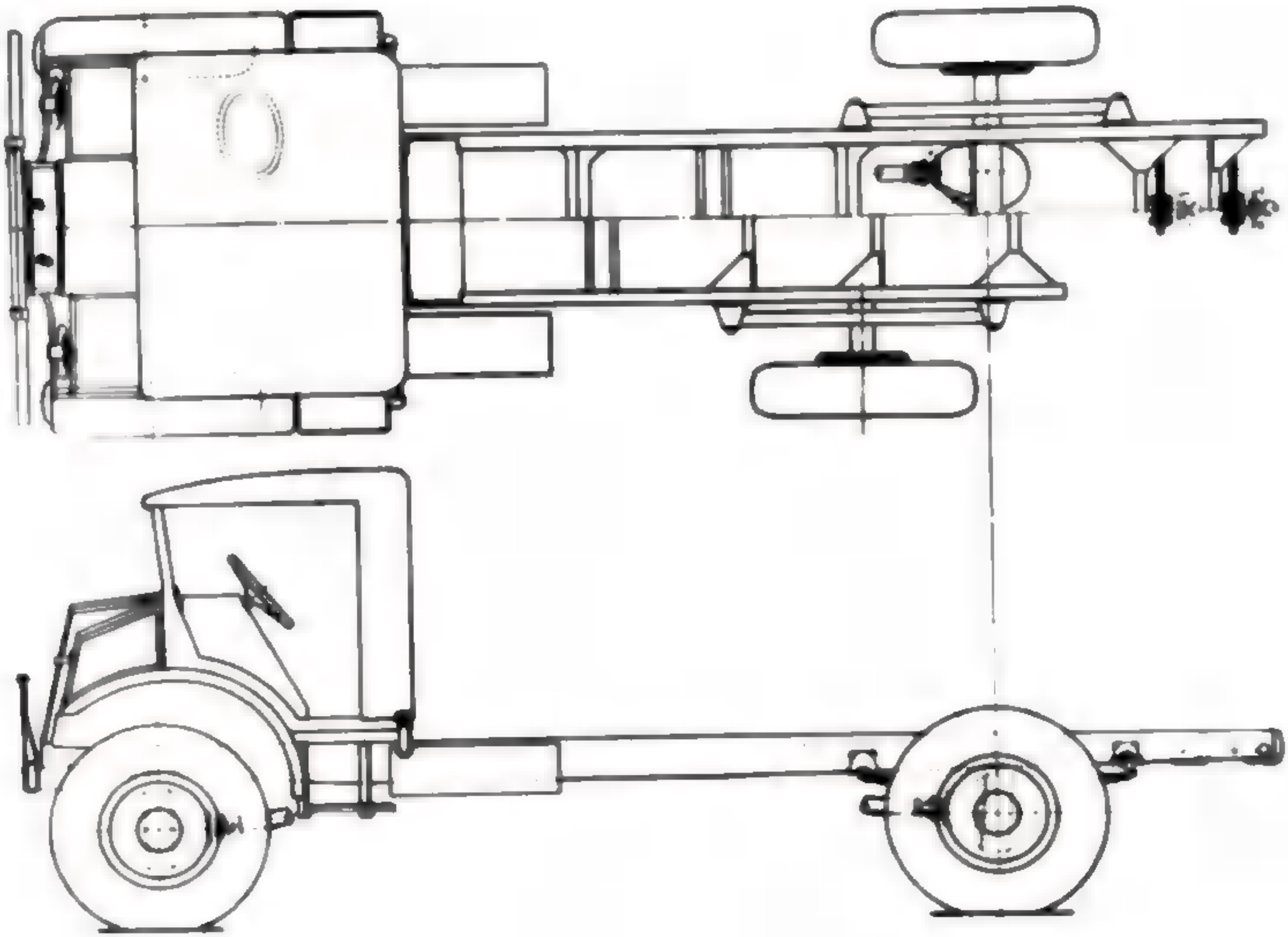
PARTS BOOK:- C60S-03.

DRIVERS HAND BOOK:- C60-HB1 (BRI.)
C60-HC1 (CAN.)

COST OF CHASSIS & CAB:- approx. 2100.00.

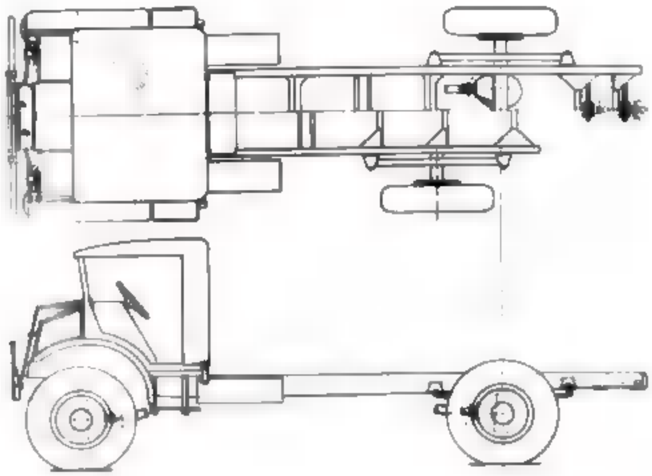
QUANTITY PRODUCED:- approx. 20,000.

APPLICATIONS:- General Service, Wireless, Stores, Dump, Signals Line Construction, Breakdown.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible max. Gross Weight 16000w.

WHEELBASE:- 134.5 ins.

Back of Cab to end of Frame, 124.5 ins.
Rear Axle to end of Frame, 52.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 70.2 ins.
Rear, 69.2 ins.

OVERALL LENGTH:- 200.5 ins.
WIDTH:- 92 ins.
HEIGHT:- 89 ins.

ANGLE OF APPROACH:- 68°

ANGLE OF DEPARTURE:- 44°

TURNING CIRCLE:- L.H. 51 feet, 5 ins.
R.H. [redacted] feet, 11 ins.

AXLES:- Front: Full Floating Spiral Bevel, 6 inch Rzeppa Constant Velocity Joints. Ratio: 7.16:1.

Rear: Full Floating Spiral Bevel. Ratio: 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic with Vacuum Booster. Front, 15 ins. by 3.5 ins. Rear, 15 ins. by 3.5 ins. Brake Lining Area, 396 sq. ins.

Parking: External Contracting, Mechanical, on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 11.9 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 2.4%. Low Transfer Case 5.4%.

MAXIMUM SPEED:- 55 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 200 miles.

FORDING DEPTH:- 24 ins.

[redacted] PROOF:- In Production, for 5 feet.

AIRPORTABLE:- No Requirement.

CLUTCH:- Single Plate Dry Disc. 11 ins. Diameter.

COOLING SYSTEM:- Circulating liquid, Pressure Type. 2 Centrifugal Pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss, Universal Joints: open type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 120 A.H. Capacity: 3 cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford 8-cylinder V-type L Head. Displacement, 239 cu. ins. Max. B.H.P. 95 @ 3600 R.P.M. Max. Gross Torque: 178 [redacted] 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure, 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gal. Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm type, mechanically actuated.

FRAME:- Ladder Type with reinforcements. Max. Section Modulus 11.3 ins. cubed. Width 34 ins.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of leaves 12. Length 3- ins. Width [redacted] ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of leaves 10. Length 45 ins. Width 2.5 ins. Auxiliary 7 leaves.

STEERING:- Right Hand Drive. Worm and Roller. Ratio: 24.4:1.

TRANSMISSION:- 4 speeds forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1. Reverse 7.82:1, Transfer Case [redacted] speed, Ratios 1:1 and 1.87:1.

REFERENCES

CODE:- F60S

MAINTENANCE MANUAL:- MBF1

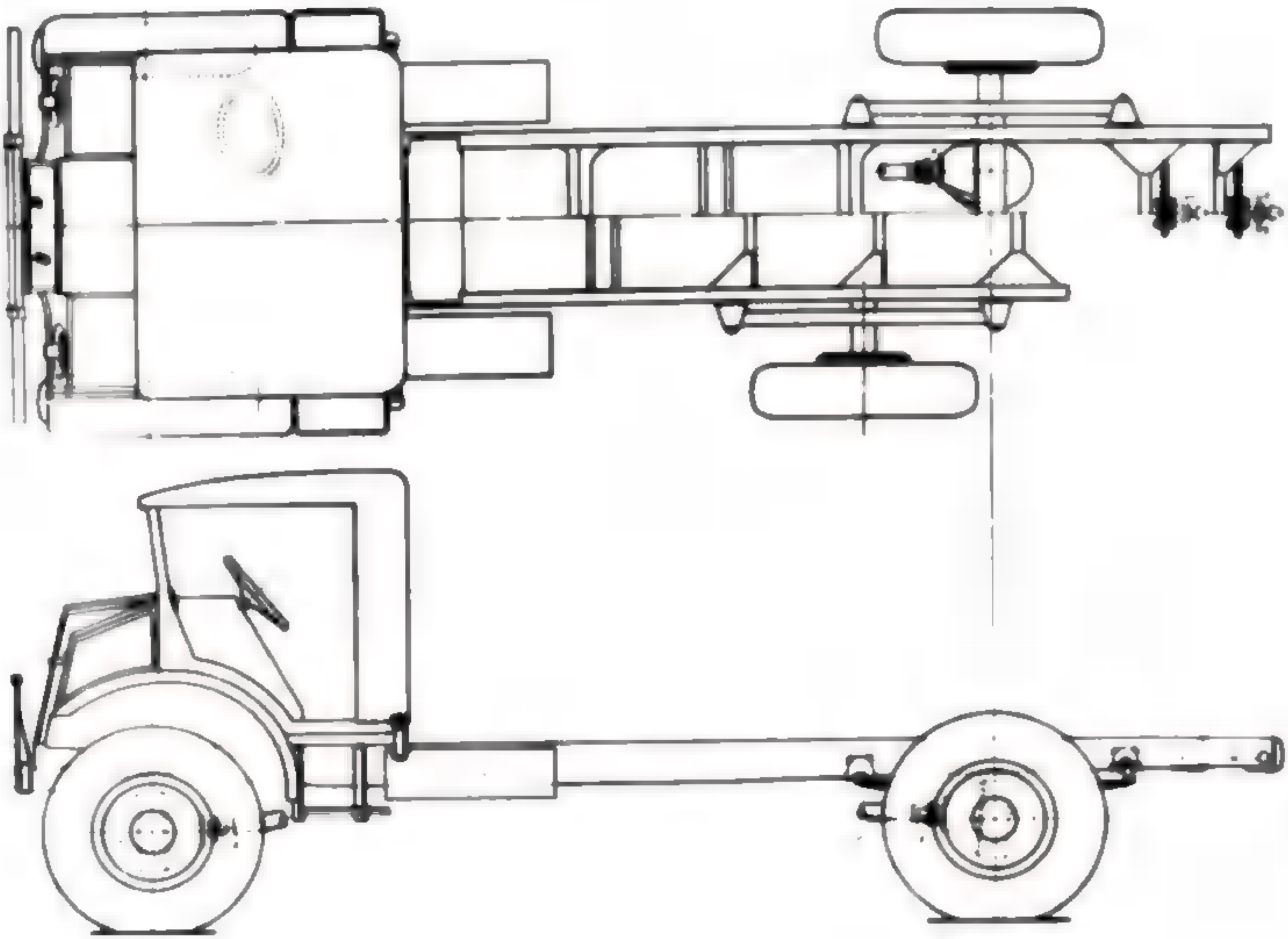
PARTS BOOK:- F60-01, (CAN.) F60S-C1 (BRI.)

DRIVERS HAND BOOK:- F30-HC1/F60S-HC1 (CAN.)
F30-HB1/F60S-HB1 (BRI.)

COST OF CHASSIS [redacted] CAB:- approx. 2000.00.

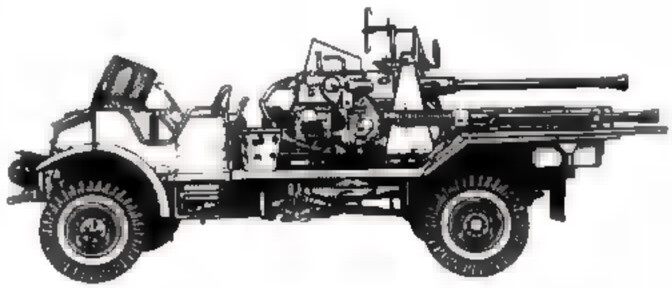
QUANTITY PRODUCED:- approx. 17,000.

APPLICATIONS:- General Service, Stores, Winch, Derrick, Dump, Bofors.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 BOFORS CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 6435 lbs.

Permissible Max. Gross Weight 15580#.

WHEELBASE:- 134.2 ins.

Back of Cab to end of Frame, 138.5 ins.
Rear Axle to end of Frame, 52.8 ins.

TIRES:- 10.50 [redacted] 16 W.D. - 5.

TREAD:- Front, 72 ins.
Rear, 70.5 ins.

OVERALL LENGTH: 244 ins. complete Vehicle.
WIDTH: 94 ins. complete Vehicle.
HEIGHT: 92 ins. complete Vehicle.

ANGLE OF APPROACH:- 46°.

ANGLE OF DEPARTURE:- 39°.

TURNING CIRCLE:- L.H. 58 feet.
R.H. 58 feet.

AXLES:- Front: Full Floating Spiral Bevel. Ratio 7.16:1. 6 inch Rzeppa Constant Velocity Joints.

Rear: Full Floating Spiral Bevel. Ratio 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic, with Vacuum Booster. Front 14 ins. by 2 ins. Rear 15 ins. by 3.5 ins. Lining Area 303 sq. ins.

Parking: External Contracting, mechanical on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 12.2 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear, High Transfer Case 2.9%. Low Transfer Case 5.3%.

MAXIMUM SPEED:- 50 M.P.H. @ 3400 Engine R.P.M.

CRUISING RANGE:- 350 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- In Production, for five feet.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. 2 Centrifugal Pumps driven by Double V Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 100 A.[redacted]. Capacity. 3 Cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford. [redacted] Cylinder V Type L Head. Displacement: [redacted] cu. ins. Max. B.H.P. 95 @ 3600 R.P.M. Max. Gross Torque 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure [redacted] lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type with special cross members and inner and outer reinforcements. Width 34 ins. Maximum Section Modulus 12.1 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 12, Length 38 ins. Width [redacted] ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 12, Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. [redacted] and Roller Type. Ratio 24.4:1. 18 inch Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1. Reverse 7.82:1. Transfer Case, 2 Speed. Ratios 1:1 and 1.87:1.

REFERENCE

CODE:- F60B.

MAINTENANCE MANUAL:- MB-F1(B)

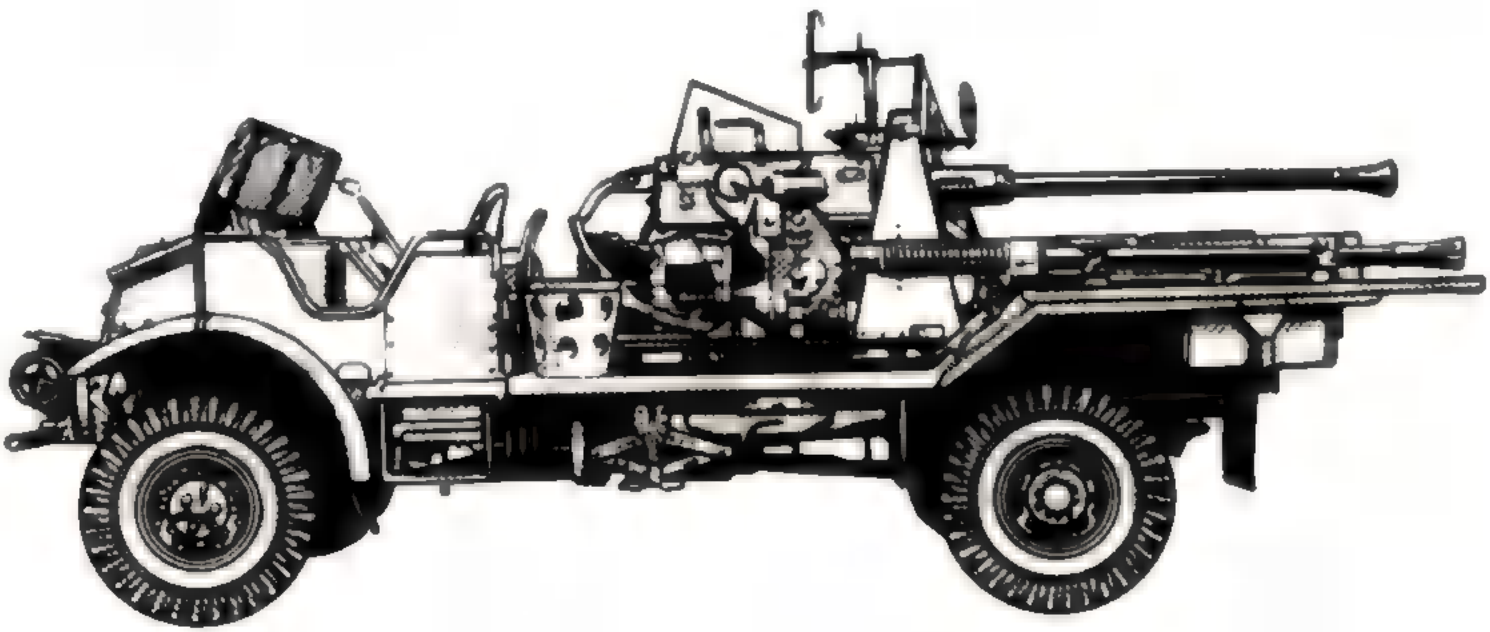
PARTS BOOK:- F60B-01.

DRIVERS HAND BOOK:- F60B-HC1 (CAN.)
F60B-HB1 (BRI.)

COST OF CHASSIS [redacted] CAB:- with Gun 11,530.00.

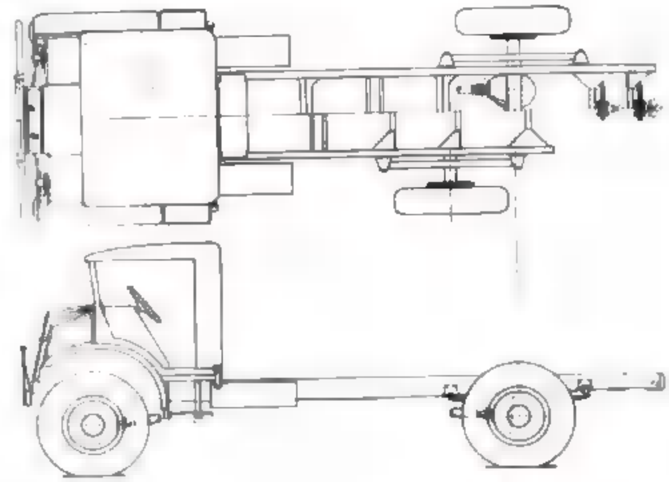
QUANTITY PRODUCED:- 501.

APPLICATIONS:- Self Propelled 40 mm. Bofors.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 16000#.

WHEELBASE:- 158 ins.

Back of Cab to end of Frame, 161.8 ins.
Rear Axle to end of Frame, 52.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 69 ins.
Rear, 69 ins.

OVERALL LENGTH: 240 ins.
WIDTH: 89 ins.
HEIGHT: 90 ins.

ANGLE OF APPROACH:- 65°.

ANGLE OF DEPARTURE:- 40°.

TURNING CIRCLE:- L.H. 65 feet, 11 ins.
R.H. 66 feet, 11 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio 7.16:1. 6 ins. Bendix Weiss Constant Velocity Joints.

Rear: Full Floating Spiral Bevel, Ratio 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 15 ins. x 3.5 ins. Rear, 15 ins. by 3.5 ins. Lining Area 396 sq. ins. Vacuum Booster equipped.

Parking: External contracting, mechanical on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 10.6 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 2.25%. Low Transfer Case 5.11%.

MAXIMUM SPEED:- 55 M.P.H. @ 3400 engine R.P.M.

CRUISING RANGE:- 250 Miles.

FORDING DEPTH:- [redacted] ins.

WADE PROOF:- Design Released, Not Produced.

AIRPORTABLE:- In Production.

CLUTCH:- Single Plate Dry Disc, 10.8 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss, Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- Chevrolet. 6 cylinder Valve in Head. Displacement: 216 cu. ins. Max. B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 @ 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. ins.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 11.92 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 11, Length 40 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 12, Length 50 ins. Width 2.5 ins. Auxiliary 6 Leaves, 2 Spacers.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio: 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 speeds forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1 4th, 1:1. Reverse 6.98:1. Transfer Case, 2 Speed Ratios: 1:1 and 1.87:1.

REFERENCE

CODE:- C60L.

MAINTENANCE MANUAL:- MBC-2.

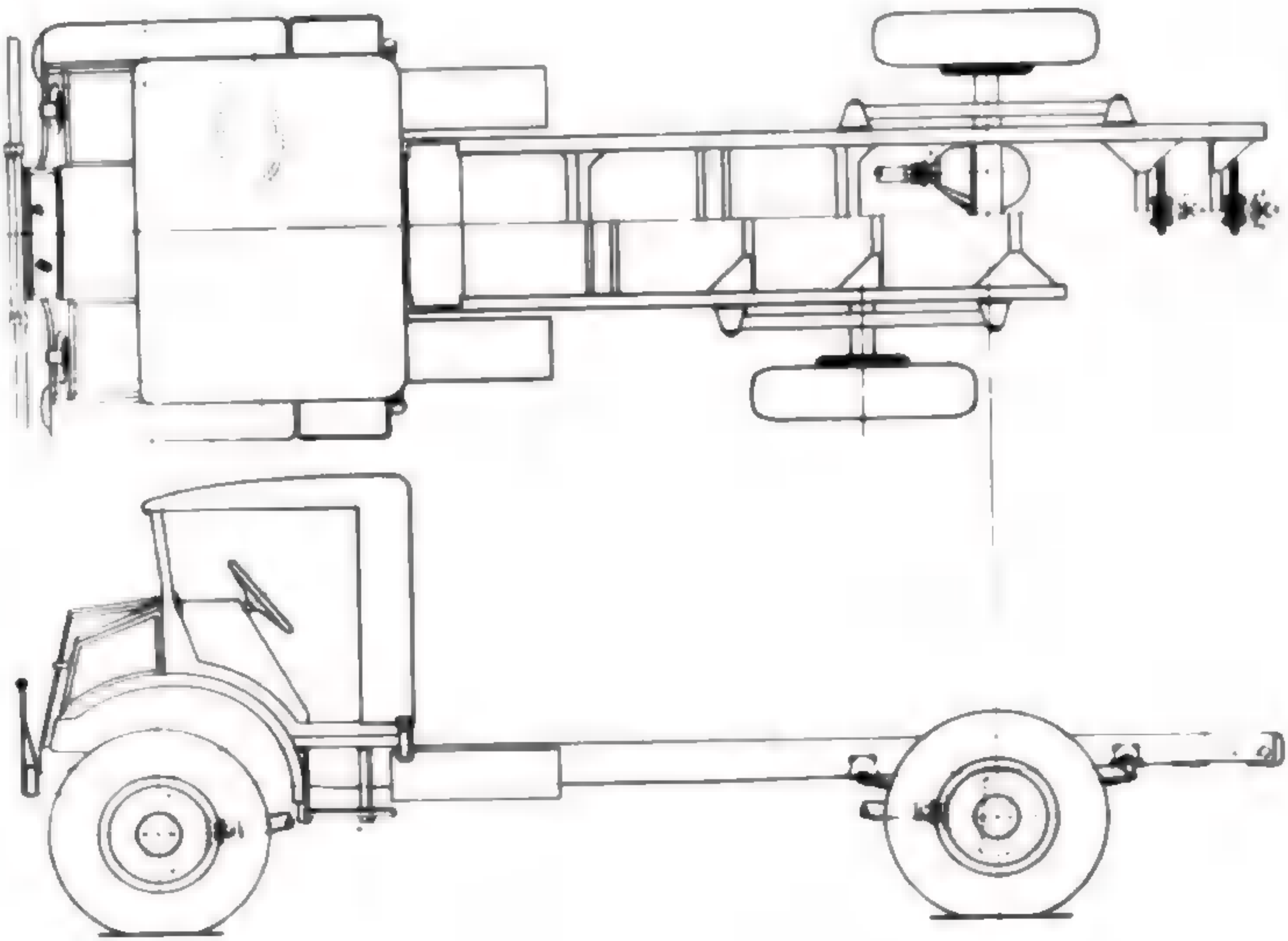
PARTS BOOK:- C60L-03.

DRIVERS HAND BOOK:- C60-HB1 (BRI.)
C60-HC1 (CAN.)

COST OF CHASSIS & CAB:- approx. 2000.00.

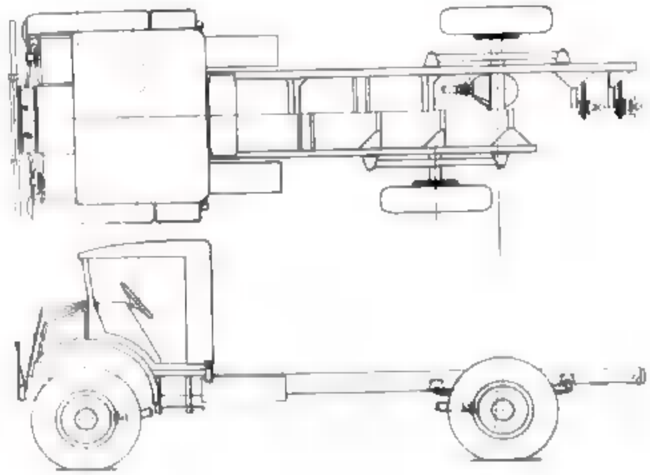
QUANTITY PRODUCED:- approx. 80,000.

APPLICATIONS:- General Service, Stores, Light Machinery, Dental, Gasoline Tank, Breakdown, Office; Machinery Lorrys D1-1, 130, J, B.C., and BS.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 16000#.

WHEELBASE:- 158.2 ins.

Back of Cab to end of Frame, 162.5 ins.
Rear Axle to end of Frame, 38.2 ins.

TIRES:- 10.50 x 20 W.D. - 5.

TREAD:- Front, 70.2 ins.
Rear, 69.2 ins.

OVERALL LENGTH:-240 ins.
WIDTH:- 83 ins.
HEIGHT:- 89 ins.

ANGLE OF APPROACH:- 68°

ANGLE OF DEPARTURE:- 40°

TURNING CIRCLE:- L.H. 69 feet, 5 ins.
R.H. 68 feet, 7 ins.

AXLES:- Front: Full Floating Spiral Bevel, 6 inch Rzeppa Constant Velocity Joints. Ratio: 7.16:1.

Rear: Full Floating Spiral Bevel. Ratio: 7.16:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic, with Vacuum Booster. Front 15 ins. by 3.5 ins. Rear 15 ins. by 3.5 ins. Brake Lining Area 396 sq. ins.

Parking: External contracting, Mechanical, on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 11.9 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear: High Transfer Case, 2.4%. Low Transfer Case, 5.4 %.

MAXIMUM SPEED:- 55 M.P.H. [redacted] 3400 Engine R.P.M.

CRUISING RANGE:- 200 miles.

FORDING DEPTH:- 24 ins.

[redacted] PROOF:- In Production, for 5 ft.

AIRPORTABLE:- Design Release[redacted] Not Produced.

CLUTCH:- Single Plate Dry Disc, 11 ins. Dia.

COOLING SYSTEM:- Circulating liquid, pressure type 2 centrifugal pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin type. Capacity of System: 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints:open type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 100 A.H. Capacity: 3 cell. Starter: Bendix actuated. Generator: [redacted] Amp. Capacity.

ENGINE MAKE:- Ford 8-Cylinder V-type L Head. Displacement, 239 cu.ins. Max. B.H.P. 95 @ 3600 R.P.M. Max. Gross Torque: 178 @ 1850 R.P. . Lubrication: Full Pressure from Gear Pump. Pressure, 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gal. Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm type, mechanically actuated.

FRAME:- Ladder type with reinforcements. Width 34 ins. Maximum section Modulus 11.3 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of leaves: 12. Length 38 ins. Width 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves: 10. Length 45 ins. Width 2.5 ins. Auxiliary: 7 Leaves.

STEERING:- Right Hand Drive, Worm and Roller. Ratio: 24.4:1. 18 inch Steering Wheel.

TRANSMISSION:- [redacted] Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1. Reverse 7.82:1. Transfer Case [redacted] speed. Ratios: 1:1 and 1.87:1.

REFERENCES

CODE:- F60L

MAINTENANCE MANUAL:- MBF1

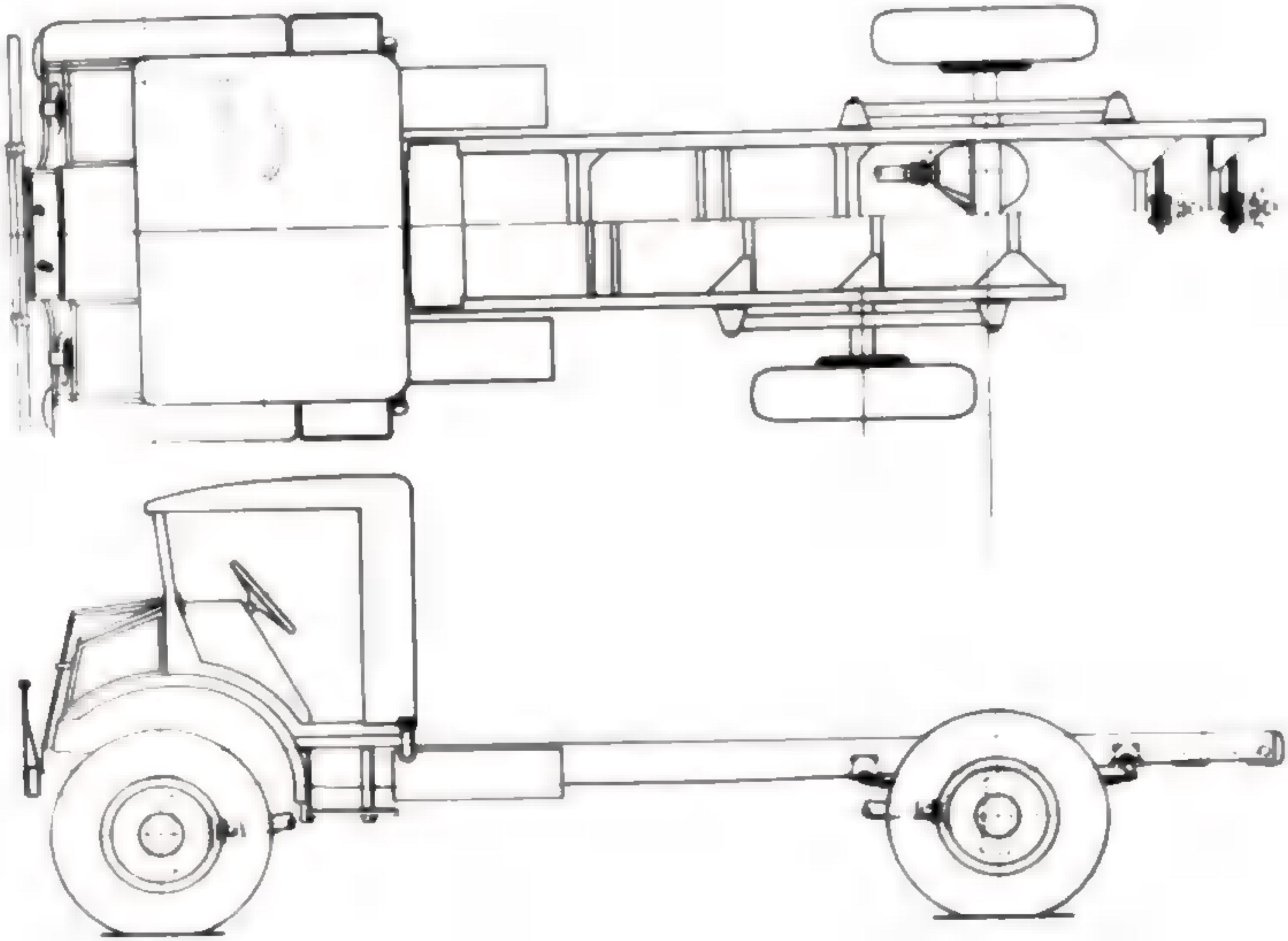
PARTS BOOK:- F60L-01

DRIVERS HAND BOOK:- F60L-HC1 (CAN.)
F60L-HB1 (BRI.)

COST OF CHASSIS [redacted] CAB:- approx. 2000.00.

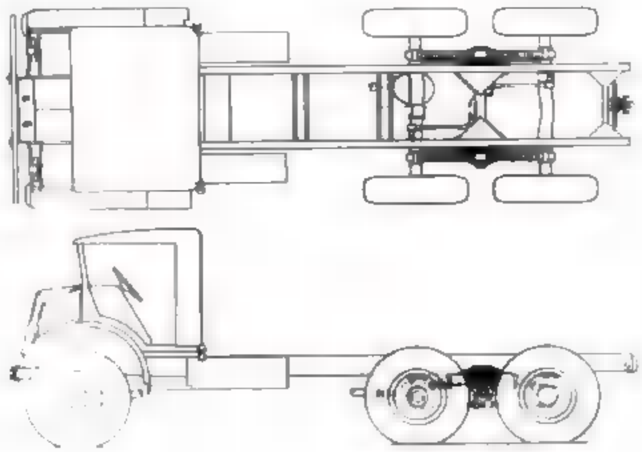
QUANTITY PRODUCED:- approx. 80,000.

APPLICATIONS:- General Service, Stores, Light D Machinery, Partes, Breakdown, Machinery Lorries A, B, CZ, F, M and Z.



VEHICLE CHASSIS SPECIFICATION

3 TON 6x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Cab Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 18000#.

WHEELBASE:- 160.2 ins. to C/L of Trunnion.

Back of Cab to end of Frame, 172 ins.
C/L of Trunnion to end of Frame, 59½ ins.

TIRES:- 10.50 x 20 W.D. - 7.

TREAD:- Front, 70.2 ins.
Rear, 69.2 ins.

OVERALL LENGTH:- 259.2 ins.
WIDTH:- 84.2 ins.
HEIGHT:- 88.5 ins.

ANGLE OF APPROACH:- 59°.

ANGLE OF DEPARTURE:- 37°.

TURNING CIRCLE:- L.H. 72 feet, 1 in.
R.H. 70 feet, 3 ins.

AXLES: Front:- Full Floating Sprial Bevel. Ratio, 7.16:1. 6 ins. Rzeppa Constant Velocity Joints.

Rear: Driving: Full Floating Spiral Bevel. Ratio, 7.16:1
Trailing: Tubular.

BRAKES:- Service: 6 wheel internal expanding. Hydraulic, with 2 Vacuum Boosters, 1 for front 2 wheels and 1 for rear [illegible] wheels. Sizes of all Brakes 15 ins. by 3.5 ins. Total Lining Area 594 sq. ins. Vacuum reservoir provided.

Parking: External contracting on Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area 88 sq. ins. When actuated, front wheel brakes are also applied. Size of front Brakes 15 ins. by 3.5 ins, Lining Area 196 sq. ins. Total Parking Brake Area [illegible] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 10.5 B.H.P. per short ton.

GRADEABILITY:- In 4th Gear, High Transfer Case 1.5%. Low Transfer Case 4.2%.

MAXIMUM SPEED:- 55 M.P.H. [illegible] 3400 Engine R.P.M.

CRUISING RANGE:- 250 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- [illegible] requirement.

CLUTCH:- Single Plate Dry Disc, 11" Diameter.

COOLING SYSTEM:- Circulating liquid, Pressure Type. 2 centrifugal Pumps driven by Double 'V' Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System, 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Through Parallelogram system of Torque Rods. Universal Joints: Open type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery: 100 A.H. Capacity. 3 Cell. Starter Bendix actuated. Generator: 33 Amp. Capacity

ENGINE MAKE:- Ford, 8 cylinder V Type, L Head, Displacement: 239 cu. ins. Max. B.H.P. [illegible] [illegible] 3600 R.P.M. Max. Gross Torque: 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 60 lbs. per sq. in.

FUEL SYSTEM:- Two 12.6 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with inner reinforcement and side rail extension reinforcement. Width 34 ins. Maximum section Modulus 15.45 ins. cubed.

SPRINGS:- Front: Semi-elliptic with Houdaille Shock Absorbers. No. of Leaves, 13, Length 38 ins. Width [illegible] ins.

Rear: Full Floating Semi-elliptic. No. of Leaves, 11. Length 56.2 ins. Width 4 ins. Shock Absorbers not provided.

STEERING:- Right Hand Drive. Worm and Roller. Ratio: 24.4:1. 18 ins. Steering Wheel.

TRANSMISSION:- [illegible] speeds forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse 7.82:1. Transfer Case, 2 speed. Ratios: 1:1 and 1.87:1.

REFERENCE

CODE:- F60H

MAINTENANCE MANUAL:- MBF-1

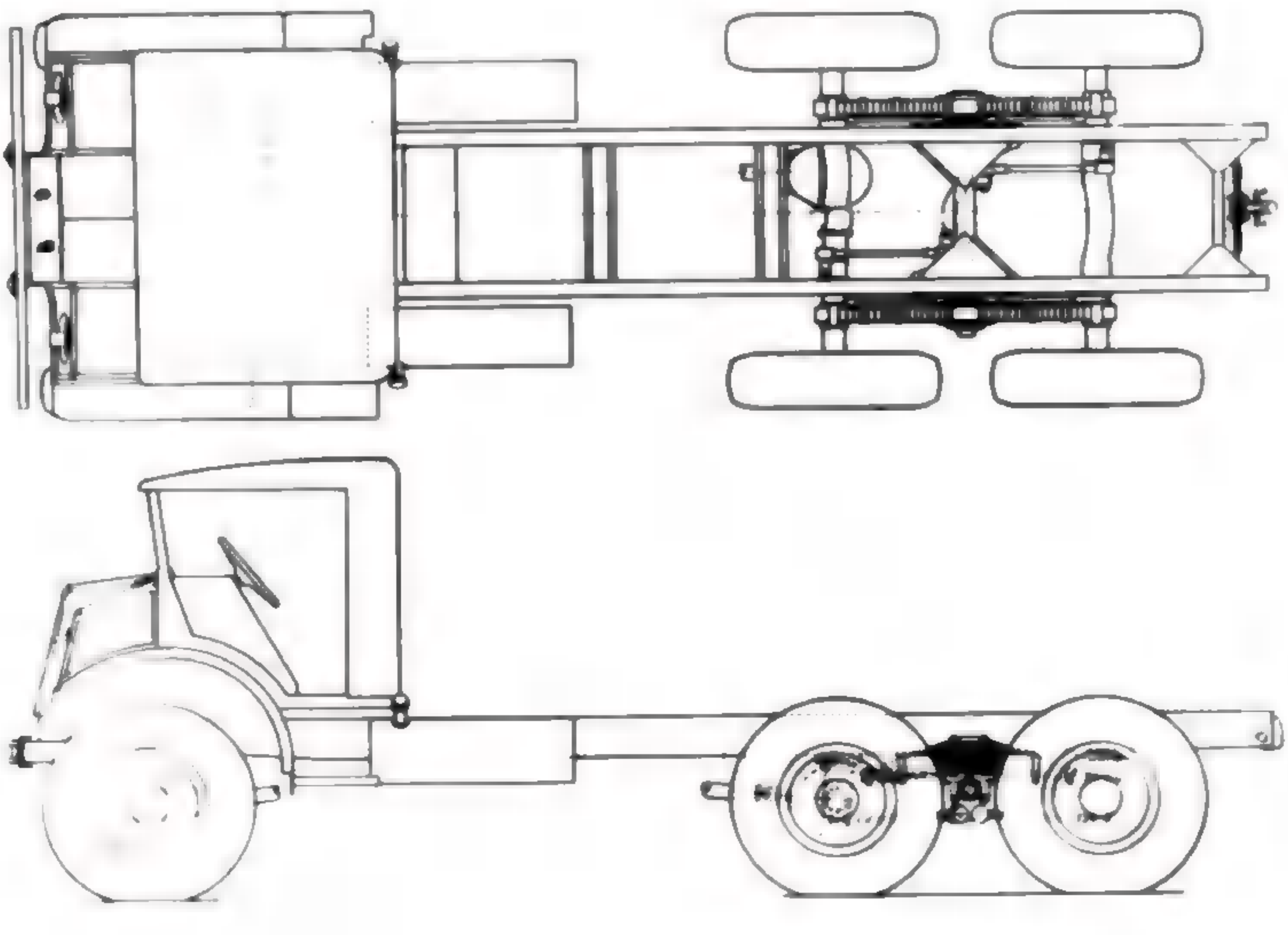
PARTS BOOK:- F60H-01.

DRIVERS HAND BOOK:- F60H-HC1(CAN.)
F60H-HB1(BRI.)

COST OF CHASSIS & CAB:- approx. 2600.00.

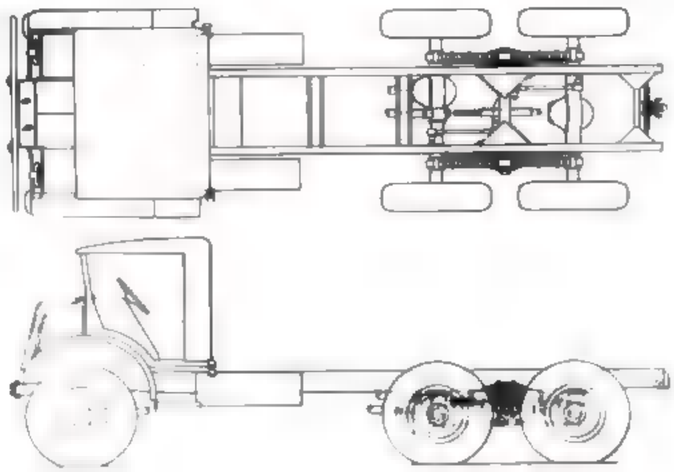
QUANTITY PRODUCED:- approx. 4000.

APPLICATIONS:- Stores, Workshop, Machinery, Breakdown, Motor Boat, Wireless, Lubrication, Derrick, Pontoon.



VEHICLE CHASSIS SPECIFICATION

[redacted] TON 6x6 CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 18000#.

WHEELBASE:- 160.5 ins. to C/L of Bogie.

Back of Cab to end of Frame, 171.2 ins.
Rear Axle to end of Frame, 33.9 ins.

TIRES:- 10.50 x [redacted] - W.D. - 7.

THREAD:- Front, 69 ins.
Rear, 69 ins.

OVERALL LENGTH: 240 ins.
WIDTH: 89 ins.
HEIGHT: 90 ins.

ANGLE OF APPROACH:- 60°.

ANGLE OF DEPARTURE:- 45°.

TURNING CIRCLE:- L.H. 70 feet, 1 in.
R.H. 69 feet, 2 ins.

AXLES:- Front: Full Floating Spiral Bevel, Ratio 7.16:1. 6 ins. Bendix Weiss Constant Velocity Joints.

Rear: Bogie: 2 Axles, Full Floating Spiral Bevel. Ratios each: 7.16:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 15 ins. by 3.5 ins. Rear 15 ins. by 3.5 ins. on all four wheels. Lining Area 594 sq. ins. Vacuum Booster (Hydrovac) equipped.

Parking: External contracting, mechanical [redacted] Propeller Shaft. Size 9.5 ins. by 3 ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 11.56 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 2.1%. Low Transfer Case 5.7%.

MAXIMUM SPEED:- 47 M.P.H. @ 3000 Engine R.P.M.

CRUISING RANGE:- 280 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- [redacted] Requirement.

AIRPORTABLE:-No Requirement.

CLUTCH:- Single Plate Dry Disc 11.5 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by Double [redacted] Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System 14.8 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Front: Hotchkiss. Rear: Through Parallelogram Torque Rods. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: 34 Amp. Capacity.

ENGINE MAKE:- General Motors. [redacted] Cylinder Valve In Head. Displacement: 270 cu. ins. Max. B.H.P. 104 @ 3000 R.P.M. Max. Gross Torque 220 [redacted] 800 to 1800 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in.

FUEL SYSTEM:- Two 20 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 13.73 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 16. Length, 40 ins. Width [redacted] ins.

Rear: Full Floating Semi elliptic. No. of Leaves 17. Length 59.5 ins. Width 3 ins.

STEERING:- Right Hand Drive, Recirculating Ball Type. Ratio: 25.6:1. Shock Absorber installed to reduce Kick. [redacted] ins. Steering Wheel.

TRANSMISSION:- 4 Speeds forward, 1 Reverse. Ratios: 1st, 6.35:1, 2nd, 3.31:1, 3rd, 1.73:1, 4th, 1:1. Reverse 7.54:1. Transfer Case 2 Speed, Ratios: 1:1 and 2.05:1

REFERENCE

CODE:- C60X.

MAINTENANCE MANUAL:- M660-C1.

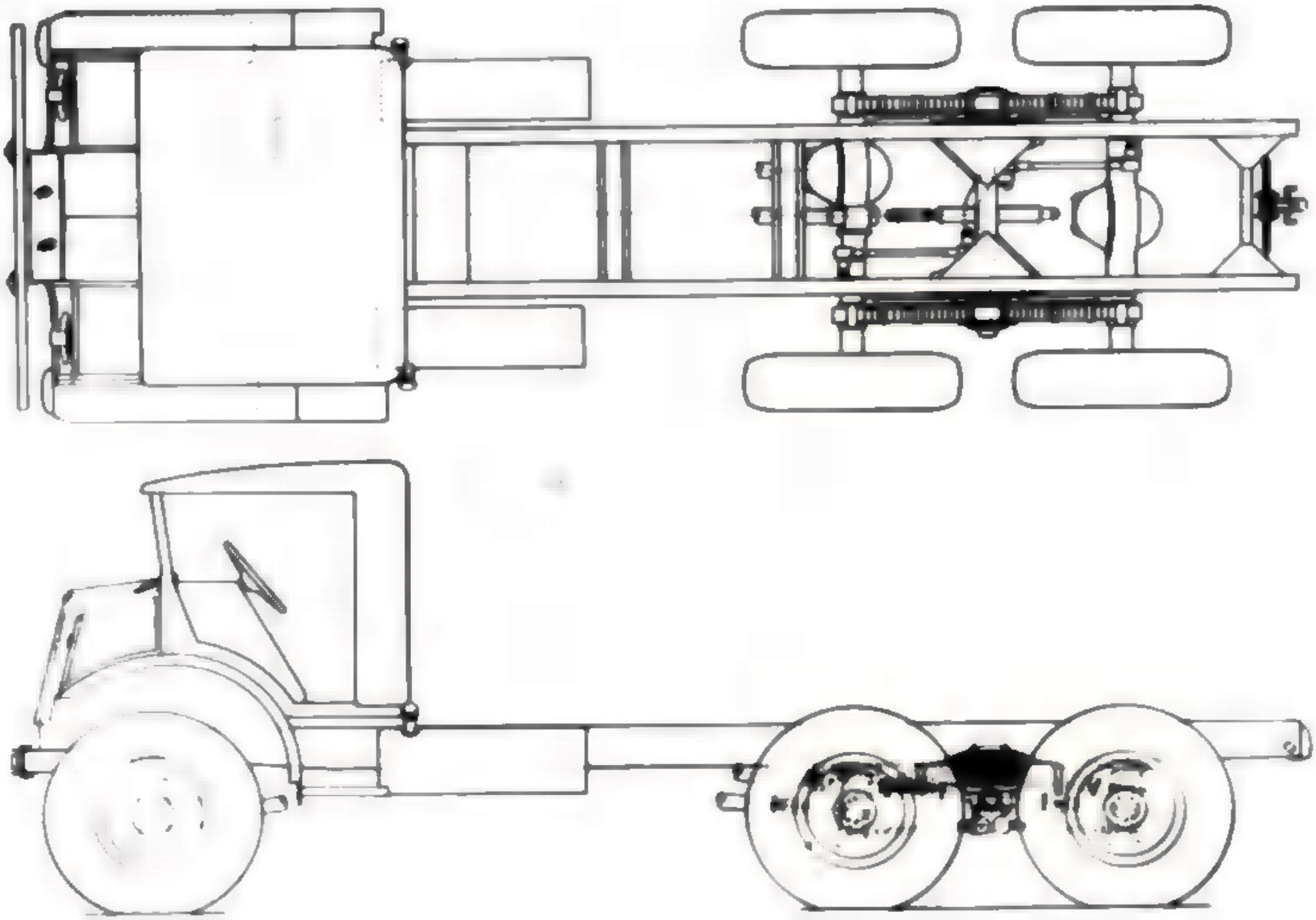
PARTS BOOK:- C60X-03.

DRIVERS [redacted] BOOK:- C60X-HB1 (BRI.)
C60X-HC1 (CAN.)

COST [redacted] CHASSIS & CAB:- approx. 3000.00.

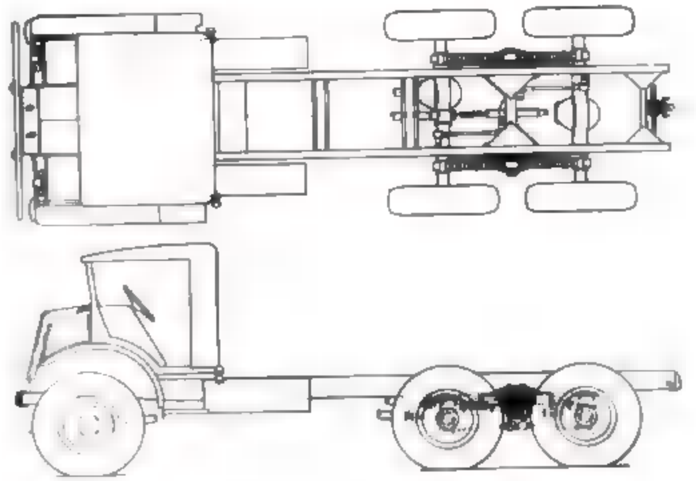
QUANTITY PRODUCED:- approx. 2700.

APPLICATIONS:- Artillery. Armament Repair, R.C.A.F., Maintenance. Machinery Lorries, A, B, C, D, F, CZ, RE and Z.



VEHICLE CHASSIS SPECIFICATION

3 TON 6x6 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Chrysler Corporation of Canada Ltd. and General Motors of Canada Ltd.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 21000#.

WHEELBASE:- 150.5 ins.

Back of Cab to end of Frame, 151.2 ins.
Rear Rear Axle to end of Frame, 37 ins.

TIRES:- 10.50 x 20 W.D. - 7.

TREAD:- Front, 69 ins.
Rear, 69 ins.

OVERALL LENGTH: 220 ins.
WIDTH: [redacted] ins.
HEIGHT: 90 ins.

ANGLE OF APPROACH:- 60°.

ANGLE OF DEPARTURE:- 45°.

TURNING CIRCLE: L.H. 65 feet.
R.H. 65 feet.

AXLES:- Front: Full Floating Spiral Bevel. Ratio 7.16:1. [redacted] ins. Bendix Weiss Constant Velocity Joints.

Rear Bogie: 2 Axles, Full Floating Spiral Bevel. Ratios each: 7.16:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 15 ins. by 3.5 ins. Rear 15 ins. by 3.5 ins. on all four wheels. Lining Area 594 sq. ins. Vacuum Booster (Hydrovac) equipped.

Parking: External Contracting mechanical on Propeller Shaft. Size 9.5 ins. by [redacted] ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 15.5 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Transfer Case 2.9%. Low Transfer Case 8.4%.

MAXIMUM SPEED:- 50 M.P.H. [redacted] 3200 Engine R.P.M.

CRUISING RANGE:- 240 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter.

COOLING SYSTEM:- Circulating Liquid. Pressure Type. Centrifugal Pump driven by double V Belts from Crankshaft. Radiator: Cellular Type. Capacity of System 20 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Front: Hotchkiss. Rear: Through Parallelogram Torque Rods. Universal Joints : Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 120 A.H. Capacity. 3 Cell. Starter: Bendix actuated. Generator 35 Amp. Capacity.

ENGINE MAKE:- Chrysler. 6 Cylinder, in line, L Head. Displacement 323.5 cu. in. Max. B.H.P. 140 @ 3600 R.P.M. Max. Gross Torque 260 @ 1600 to 2000 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in. Engine governed at 3200 R.P.M.

FUEL SYSTEM:- Two 20 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type with inner reinforcement. Width 34 ins. Maximum Section Modulus 13.73 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 16, Length 40 ins. Width 2 ins.

Rear: Full Floating Semi Elliptic. No. of Leaves 17, Length 59.5 ins. Width [redacted] ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio 25.6:1. Shock Absorber installed to reduce kick. 18 ins. steering wheel.

TRANSMISSION:- [redacted] Speeds forward, 1 Reverse. Ratios: 1st, 5.0:1, 2nd, 3.07:1, 3rd, 1.71:1, 4th, 1:1. Reverse 5.83:1. Transfer Case [redacted] Speed. Ratios 1.15:1 and 2.60:1. As F.A.T. Low Range Transmission 6.35:1.

REFERENCE

CODE:- Nil (Pilot Model).

MAINTENANCE MANUAL:- Nil.

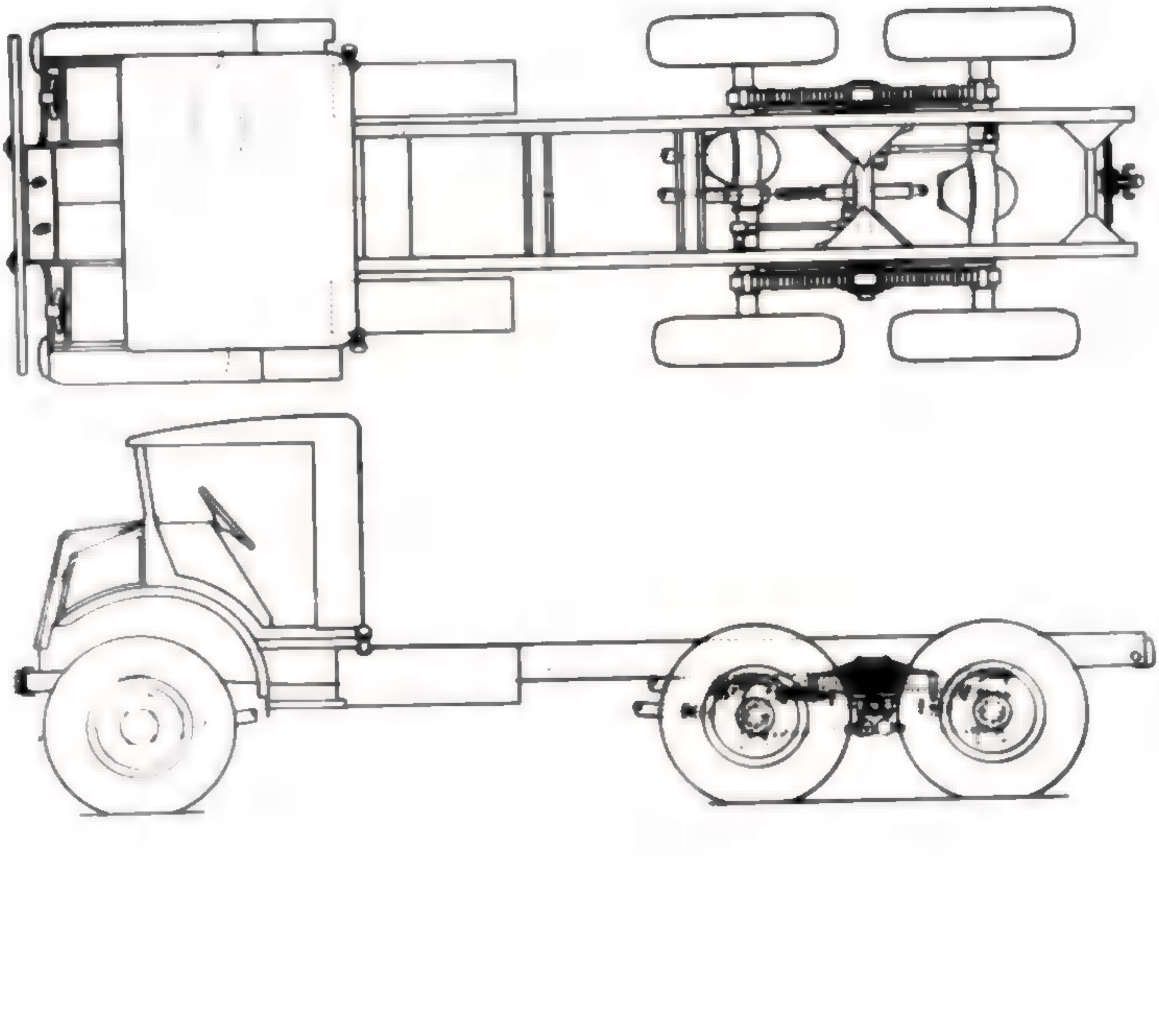
PARTS BOOK:- Nil.

DRIVERS HAND BOOK:- Nil.

COST OF CHASSIS [redacted] CAB:-

QUANTITY PRODUCED:- 5.

APPLICATIONS:- General Service, F.A.T.



M.T. CHASSIS PRODUCED IN U.S.

Certain units were basically produced in the U.S. to U.S. specifications and accepted as such, while others were modified in Canada to the requirements of the specific User. A very brief outline of these units is herewith recorded. The reader is referred to certain U.S. Specifications for more complete Data.

Other units were produced in the U.S. to Army Engineering Design Branch Specifications. These are described in more detail on individual sheets.

(a) 4-Ton 6x6 - 201 in. W.B., Diamond T, on dual 9.00 [redacted] 20 tires, conventional type cab; spark ignition engine and air pressure operated brakes. This unit [redacted] basically to U.S. Specification LP-91-801F in a long wheelbase. It was used for G.S., Machinery M; Bridging Lorries; and Derrick. The bodies and equipment were installed in Canada.

(b) 4-Ton 6x6 - 151 in. W.B. Diamond T on dual 9.00 x 20 tires, as in (a) above was basically to U.S. Specification LP-91-801F. Additional apparatus [redacted] added in Canada.

(c) 6-Ton 6x6 - 196 in. W.B. Brockway on dual 12.00 x 20 tires; conventional type cab; spark ignition engine and air pressure Brakes. This unit [redacted] basically to U.S. Specification No. T-1137A.

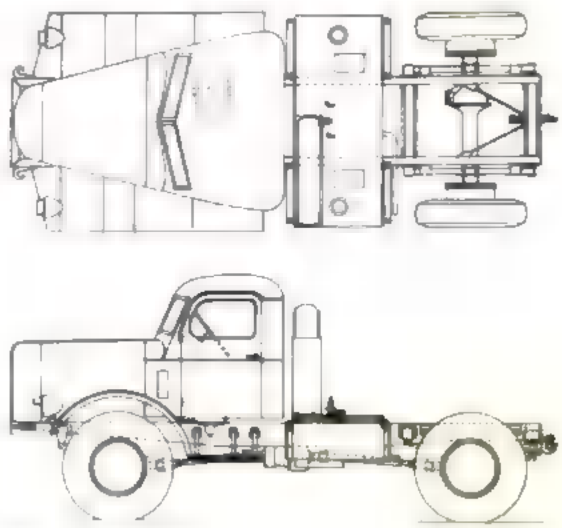
(d) 6-Ton 6x6 - 177 in. W.B., Mack on dual 10.00 x 22 tires; conventional type soft cab; spark ignition engine and air pressure brakes. This unit [redacted] basically to U.S. Specification No. LP-91-821L. Its use [redacted] as a G.S.

(e) 10-Ton 6x4 - 201 and 166 in. W.B. Mack on dual 11.00 x 24 and single 13.50 x 20 tires respectively; conventional type cab; available either in Spark ignition or Compression ignition engine. Used [redacted] G.S. and the basic 166 in. W.B. chassis for Heavy Breakdown. The former is covered by U.S. Specification No. TAC-ES-681, the latter by A.E.D.B. Specification O.A. 154.

(f) Transporter 40 ton 6x4 - 179 in. W.B. Diamond T on 12.00 x 20 dual tires and air Brakes. Basically to U.S. Specification No. ES-568 and used with Rogers' Trailer. [redacted] modified unit was used to pilot a 50 ton transporter Semitrailer.

VEHICLE CHASSIS SPECIFICATION

3.5 TON 4x4 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Four Wheel Drive Auto Company.

TYPE:- Conventional.

LOAD CARRYING CAPACITY:- 3.5 Tons.

Permissible Max. Gross Weight 17000#.

WHEELBASE:- 136.0 ins.

TIRES:- 10.50 x 20 - Pneumatic - 5.

TREAD:- Front, 72.6 ins.
Rear, 72.6 ins.

OVERALL [redacted]: 212.0 ins.
WIDTH: 85.0 ins.
HEIGHT: 96.0 ins.

ANGLE OF APPROACH:- 45°.

ANGLE OF DEPARTURE:- 42°.

TURNING CIRCLE:- L.H. 62 feet.
R.H. 62 feet.

AXLES:- Front: Full Floating Spiral Bevel. Ratio 5.28:1. Ring Type Universals.

Rear: Full Floating Spiral Bevel. Ratio 5.28:1.

BRAKES:- Service: Internal Hydraulic expanding. Front 16x2.2 in. Rear 17.25x4 in. Lining Area 317 sq. in.

Parking: External contracting mechanical on Propeller Shaft - 10 in. Dia. [redacted] in. wide. Brake Area [redacted] sq. in.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter.

COOLING SYSTEM:- Circulating Liquid. Radiator, Tubular Type. Capacity of Radiator 22.5 Qts.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 153 A.H. Capacity. 3 Cell.

ENGINE MAKE:- Waukesha 6 cylinder, L Head, 320 cu. in. displacement. Max. B.H.P. [redacted] 2800 R.P.M. Max. Torque 224 @ 1200 R.P.M. Lubrication: full pressure from Gear Pump.

FUEL SYSTEM:- Two 35 gallon capacity fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type.

FRAME:- Ladder Type. 34" Wide. Five Cross Members. Maximum Section, 9 ins. x 3 ins. x 0.25 ins. channel.

SPRINGS:- Front: Laminated Semi Elliptic. No. of Leaves 10, Length 44 ins. Width 2.5 ins.

Rear: Laminated Semi Elliptic. No. of Leaves 21, Length 48 ins. Width 2.5 ins.

STEERING:- Right Hand Drive. Ross Twin Lever Cam and Lever Type. 22 in. Dia. Steering Wheel.

TRANSMISSION:- Five Speeds forward, 1 Reverse. Ratios: 1st, 7.53:1, 2nd, 4.3:1, 3rd, 2.52:1, 4th, 1.42:1, 5th, 1:1. Reverse 7.37:1.

[redacted]

POWER/WEIGHT:- 7 B.H.P. per Short Ton.

GRADEABILITY:- In Low Low 29% for Train.

MAXIMUM SPEED:- 37 M.P.H. @ 2800 Engine R.P.M.

CRUISING RANGE:- 400 Miles.

FORDING DEPTH:- 24 ins.

[redacted] **PROOF:-** No requirement.

AIRPORTABLE:- No requirement.

REFERENCE

CODE:- 70446-C-TRAC-1.

MAINTENANCE MANUAL:- HAR-FWD-3.

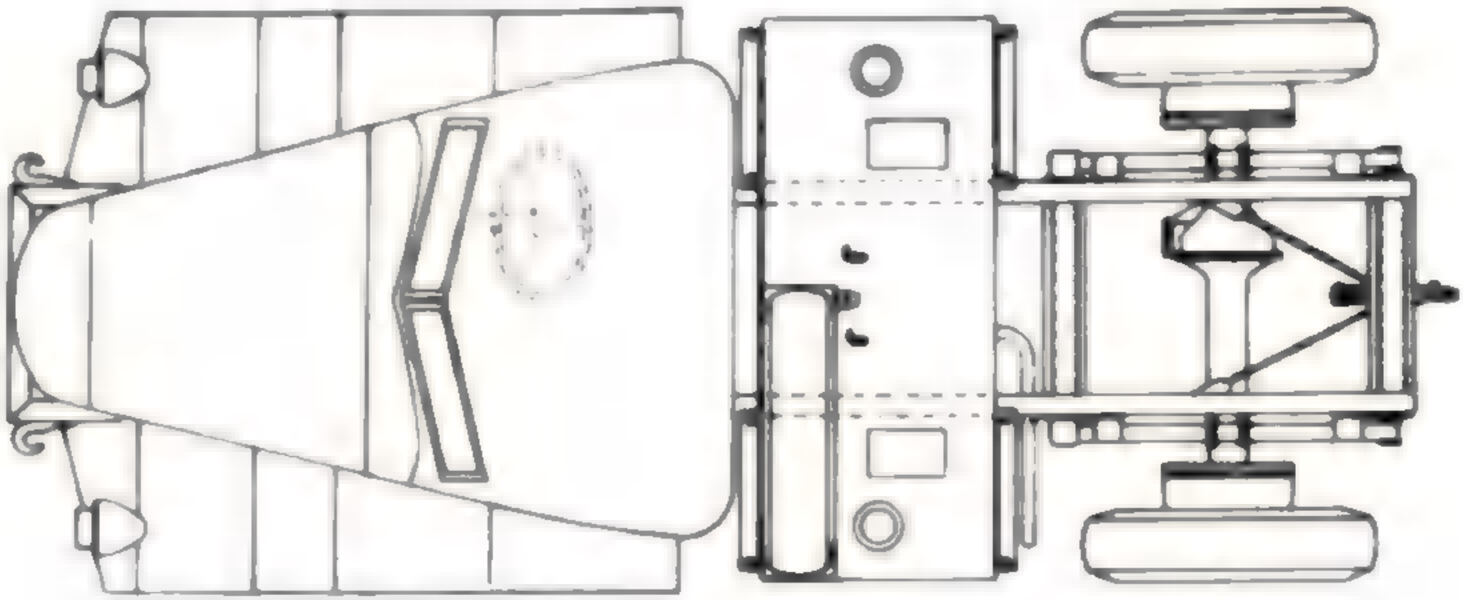
PARTS BOOK:- FWD-HAR-03.

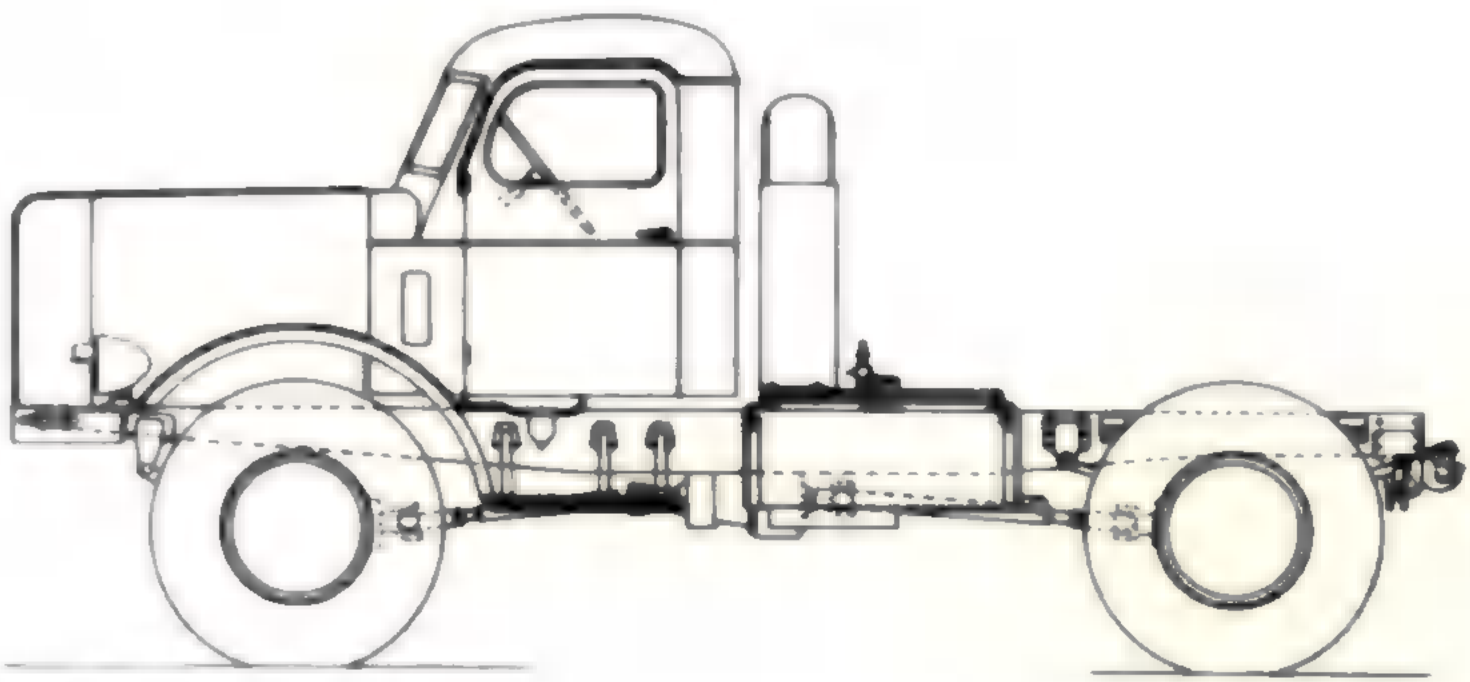
DRIVERS HAND BOOK:-

COST OF CHASSIS [redacted] **CAB:-** approx. 5600.00.

QUANTITY PRODUCED:- 1200

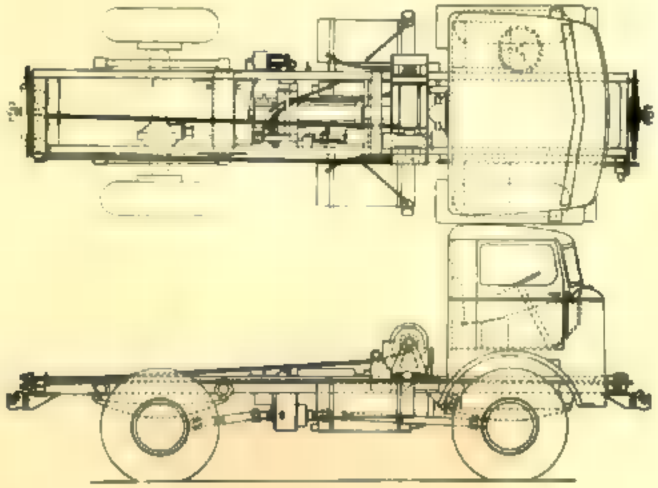
APPLICATIONS:- As Tractor for 6 Ton Semi Trailer 12M-FS-1.





VEHICLE CHASSIS SPECIFICATION

[redacted] TON - 4x4 CHASSIS [redacted] CAB



CHASSIS MANUFACTURER:-

Four Wheel Drive Auto Company.

TYPE:- Cab-Over-Engine.

LOAD CARRYING CAPACITY:- 8960 lbs.

Permissible Max. Gross Weight 28,000#.

WHEELBASE:- 144.0 ins.

Back of Cab to end of Frame, 170 ins.
Rear Axle to end of Frame, 52 ins.

TIRES:- Singles - 13.50 - 20 W.D.; Duals 9.00 x 20 and 1100 [redacted] 20.

TREAD:- Front, 70.75 ins. on single tires.
Rear, 71.0 ins. [redacted] single tires.

OVERALL LENGTH: 265.0 ins. [redacted] single tires.
WIDTH: 90.0 ins. on single tires.
HEIGHT: 106.0 ins. on single tires.

ANGLE OF APPROACH:- 32°.

ANGLE OF DEPARTURE:- 30°.

TURNING CIRCLE:- L.H. 60 feet.
R.H. 60 feet.

AXLES:- Front: Full Floating Bevel Drive, Ratio 4.31:1. Ring type Universals.

Rear: Full Floating Bevel Drive, Ratio 4.31:1.

BRAKES:- Service: [redacted] Wheel internal expanding Hydraulic, air pressure actuated. Front and Rear 17.25 by 4 ins. Total Lining Area 496 sq. ins.

Parking: External contracting type on Propeller Shaft - 11.5 by 7 ins. Lining Area 220 sq. ins.

CLUTCH:- Single Plate Dry Disc 14 ins. Dia.

COOLING SYSTEM:- Circulated liquid type, centrifugal pump driven by gears from cam shaft. Tube and Fin type radiator core, capacity of system 30.7 Imp. quarts, Thermostatic controlled.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 12 Volt Single Wire System. Battery Capacity 153 A.H.; 6 cell, Starter, automatic engagement; Generator 17 amp. Capacity.

ENGINE MAKE:- Waukesha SRKR; 6 cylinder L Head; 517 cu. in. Displacement. Max. B.H.P. - 126 [redacted] 2400 R.P.M. Max. Gross Torque 368 pound [redacted] feet [redacted] 600 R.P.M; governed @ 2250 R.P.M.; Lubrication pressure; by oil pump [redacted] 15 - 40 pounds.

FUEL SYSTEM:- Two - 33.2 Gallon Fuel Tanks; carburetor up draft; Fuel pump Diaphragm type mechanically actuated.

FRAME:- Ladder type; Width 34 ins., Maximum Section Modulus 8.6 ins. cubed.

SPRINGS:- Front: Semi Elliptic, No. of Leaves 14; Length 48 ins; Width 2.5 ins.

Rear: Semi Elliptic, No. of Leaves 16, Length 50.5 ins; Width 3.0 ins. Auxiliary 7 Leaves. - Length 38 ins.

STEERING:- Right hand drive. Cam and Twin Lever type gear; Ratio 27:23:27 to 1; 20 ins. Steering Wheel.

TRANSMISSION:- 5 Speeds forward and 1 Reverse. Ratios of 9.95; 5.83; 3.15; 1.85 and 1:1; Reverse 8.95:1. Transfer Case Ratios [redacted].05:1.

PERFORMANCE

POWER/WEIGHT:- 9 B.H.P. per Short Ton.

GRADEABILITY:- In fifth gear 3%.

MAXIMUM SPEED:- 37 M.P.H. @ 2250 Engine R.P.M.

CRUISING RANGE:- 250 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- No requirement.

REFERENCE

CODE:- 80444C; 100444C.

MAINTENANCE MANUAL:- C444 - F.W.D.3.

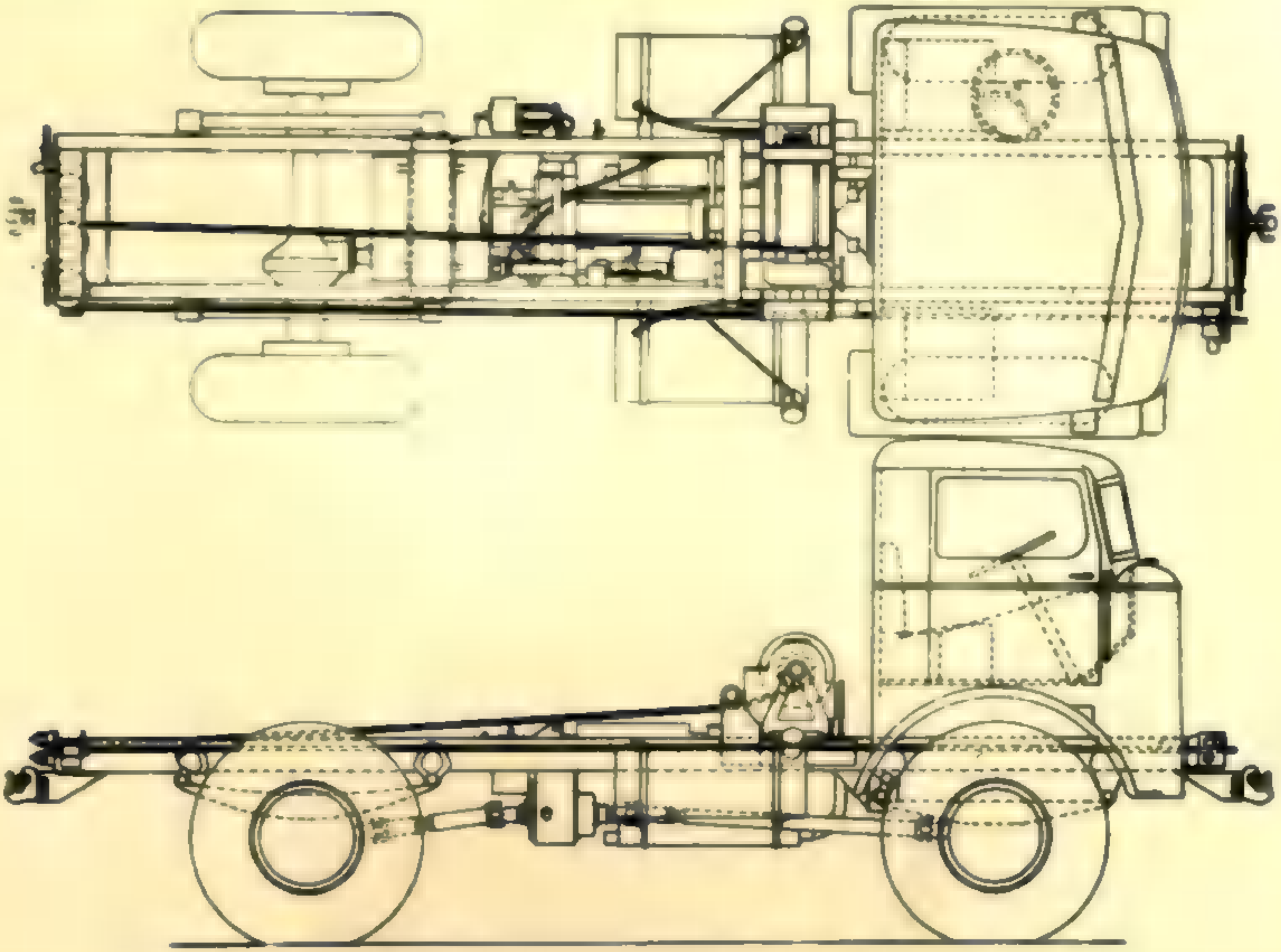
PARTS BOOK:-

DRIVERS HAND BOOK:- N11.

COST OF CHASSIS & CAB:- approx. 9600.00

QUANTITY PRODUCED:- approx. 900

APPLICATIONS:- As M.A.T.; Prime Mover for 10 Ton Semi Trailer; Laundry Trailer, Low Loader; or; Tires and ratios are changed in Prime Mover Role.



MODIFIED CONVENTIONAL CHASSIS

Canadian manufacturing capacity for ALL WHEEL DRIVE VEHICLES [redacted] limited to [redacted] degree, on such components [redacted] Front Axle Steering Ends, Transfer Cases, Cab Sheet Metal, with the result that the User's requirements for vehicles in very large quantity [redacted] met by using the Commercial manufacturing facilities which were available. This resulted in a considerable number of vehicles being produced which closely approached Civilian Vehicle Design, but included alterations which could be readily made to facilitate their Military Role. These [redacted] classed as MODIFIED CONVENTIONAL.

The majority of these vehicles were of 2-wheel drive, and except for [redacted] few passenger Sedans and Station Wagons, were considered in light of their drive [redacted] "Back Area Operational Units". However, under certain conditions of the military operations experienced in Europe, it [redacted] from reports that at times such vehicles were farther forward than visualized from [redacted] design standpoint.

A third Contractor, in addition to the two building C.M.P. All Wheel Drive Vehicles, was thrown into the picture. This resulted in [redacted] Power Plants becoming available, the details of which are covered in the Specification Sheets on his vehicles; other components peculiar to his civilian production affected to a degree the type of vehicle produced.

The basic changes made to modify the Commercial Load Carriers may be briefly outlined [redacted] follows -

(a) Military Single W.D. Tires and Wheels were specified of [redacted] size within the limiting clearances.

(b) With (a) above, Hub and Steering Ends were changed to suit.

(c) Power Plant was fitted for controlled ventilation; sealed carburetion; adjusted to use Standard Service Fuel; equipped with military oil filter and air cleaner.

(d) Cooling System was fitted with overflow tank.

(e) Vehicle Lighting was arranged to current Blackout Specifications both [redacted] to number and location of lamps, and standardized to C.M.P. designs.

(f) Tow Hook of C.M.P. design [redacted] provided on the rear of 15-Cwt. and 3-Ton chassis.

(g) Military Tools and Equipment were provided to meet the Task System of Maintenance.

(h) Additional fuel capacity [redacted] provided.

(i) Painting [redacted] altered to agree with C.M.P. painting requirements.

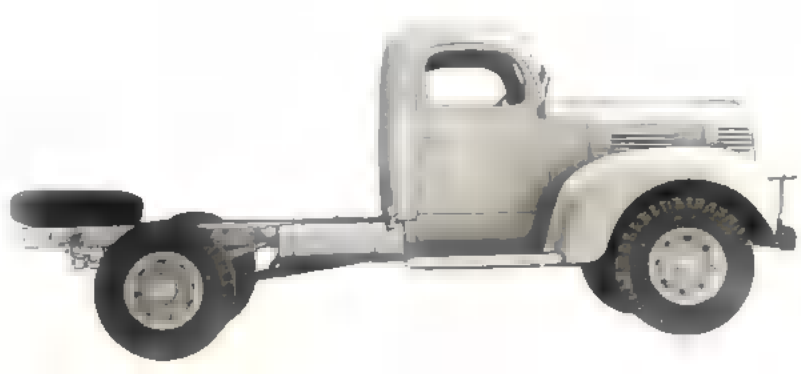
(j) The Control of the vehicles was Right Hand.

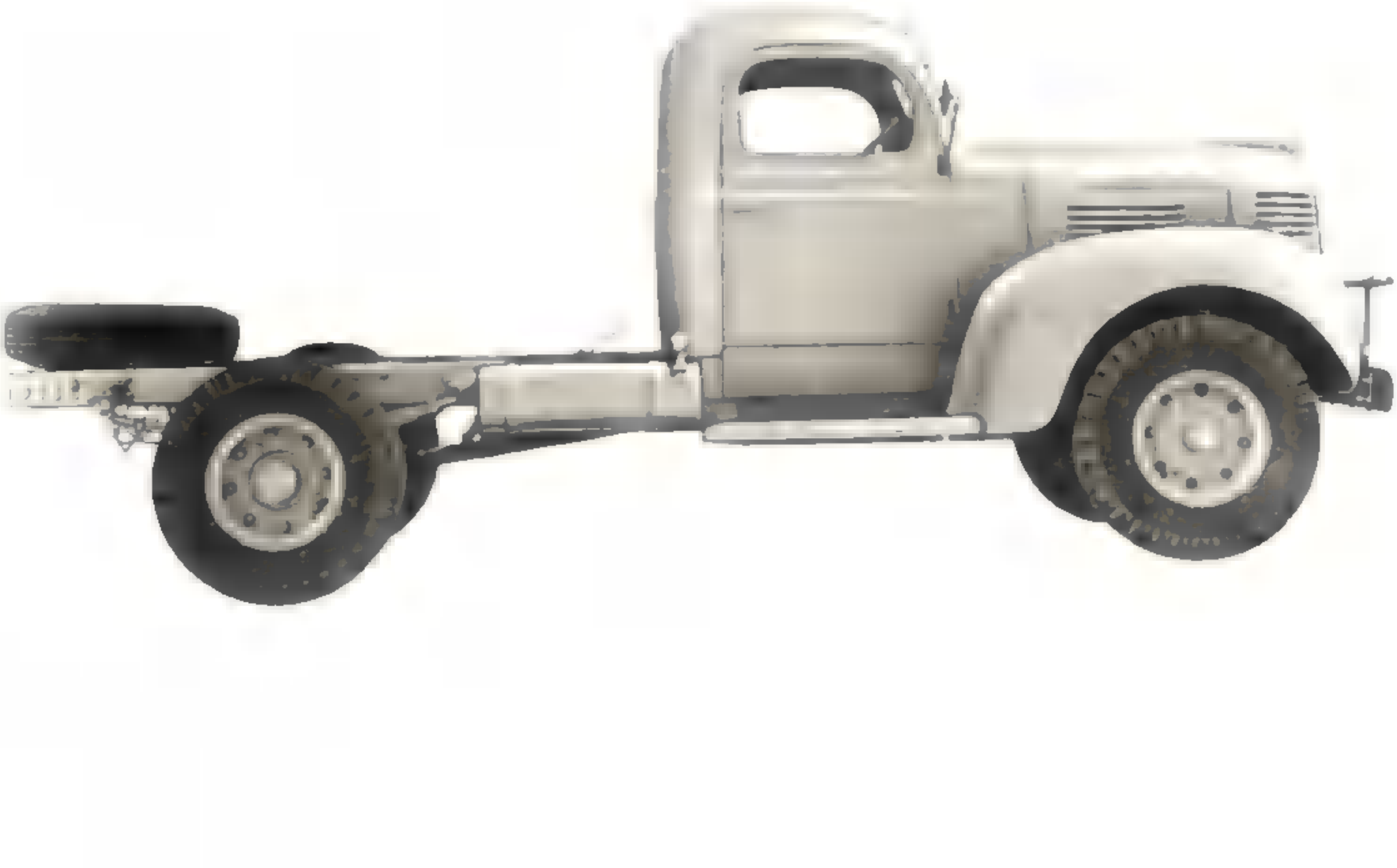
(k) The Vehicle Battery was standardized with C.M.P. Vehicle Battery.

(l) Suitable Shock Absorbers were provided [redacted] the Rear Axle, in addition to the front usually fitted [redacted] commercial designs.

(m) Wheel Brake Sizes were modified to accept military wheels.

(n) Power Driven Tire Pump was specified [redacted] 3-Ton Units.





As in the case of All Wheel Drive Vehicles the Military use of Modified Conventional Units brought to light certain weaknesses which were unforeseen. These were examined and typical changes made are listed hereafter along with other revisions found necessary due to war time limitations of manufacturing or supply.

(a) Heavy Duty Clutches were installed.

(b) Rear Axles of the 2-Speed type were specified [redacted] 3-Ton models to provide the best all round performance for highway and off the road operations. Alternative Axles of the Hypoid type in Single Speed [redacted] accepted in lieu of the above, when demand became greater than the availability of 2 Speed Axles.

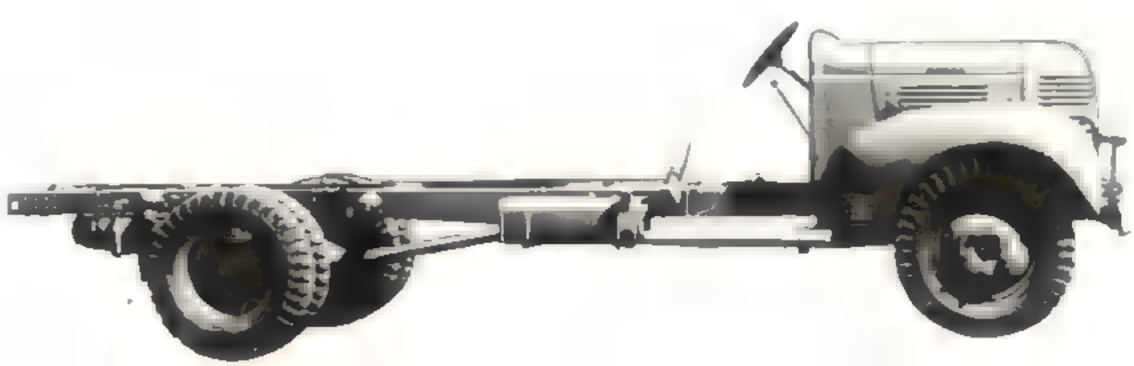
(c) The inherent Tire Loading of conventional vehicles did not lend itself to good results when single tires were provided. The front single tires [redacted] under-laden, while the rear ones were, in 3-Ton chassis, overloaded. This Rear Tire Overloading aggrevated the short life expectancy of Synthetic Tires. It [redacted] subsequently decided that Military Tires and Wheels should be replaced with Conventional Dual Tires, as practically all vehicles at that date, [redacted] consigned to India, where Commercial Size Tire manufacturing capacity [redacted] available.

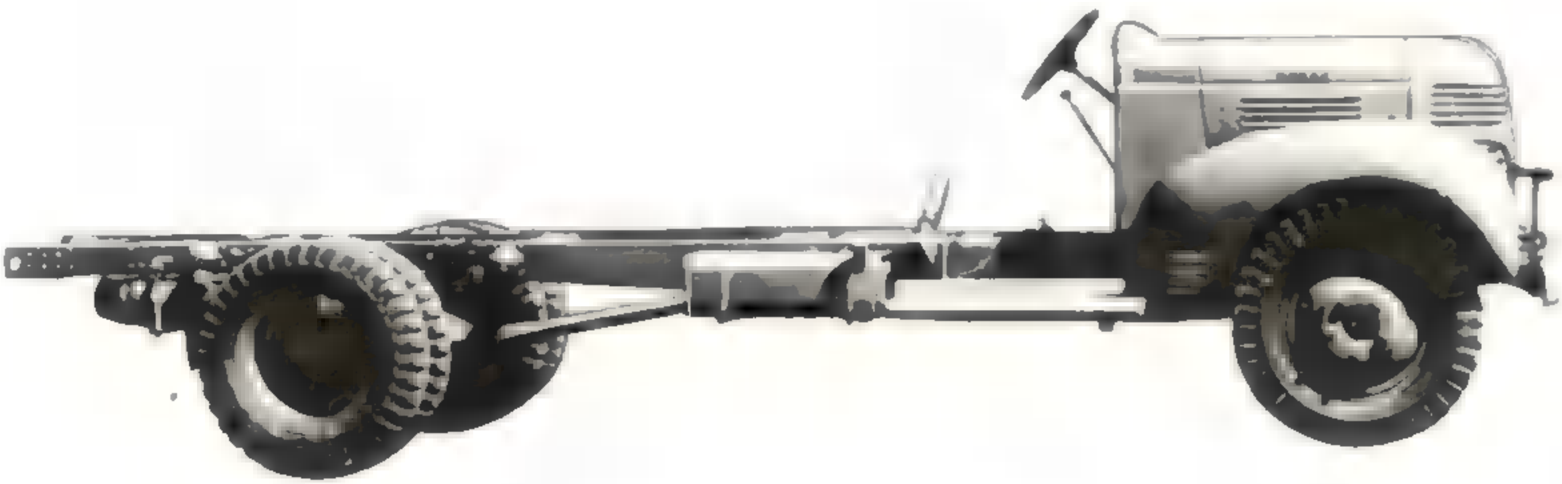
(d) The Front Axles and Steering Ends were found to require heavying up to withstand the military operations.

(e) Steering Gears of greater capacity [redacted] provided than on similar civilian units.

(f) Shrouds and larger Radiators of the 'Tropic' size were provided to give adequate cooling capacity.

(g) Some Field Reports indicated that the Modified Vehicles in 3-Ton class, were unstable [redacted] related to similar size 4x4 vehicles. These complaints being of a general nature, [redacted] difficult to pin point. It [redacted] however felt that they originated to [redacted] degree with inexperienced driver personnel in the [redacted] from which complaints originated. No basic changes [redacted] made in the troublesome vehicles up to termination of production.





In a very limited quantity, Commercial Sedans were produced to Specifications which required minor modifications for their Military Role. For further data in this regard, the reader is referred to [redacted].D.B. Specifications O.A. 101, 72, 61, 52, 22.

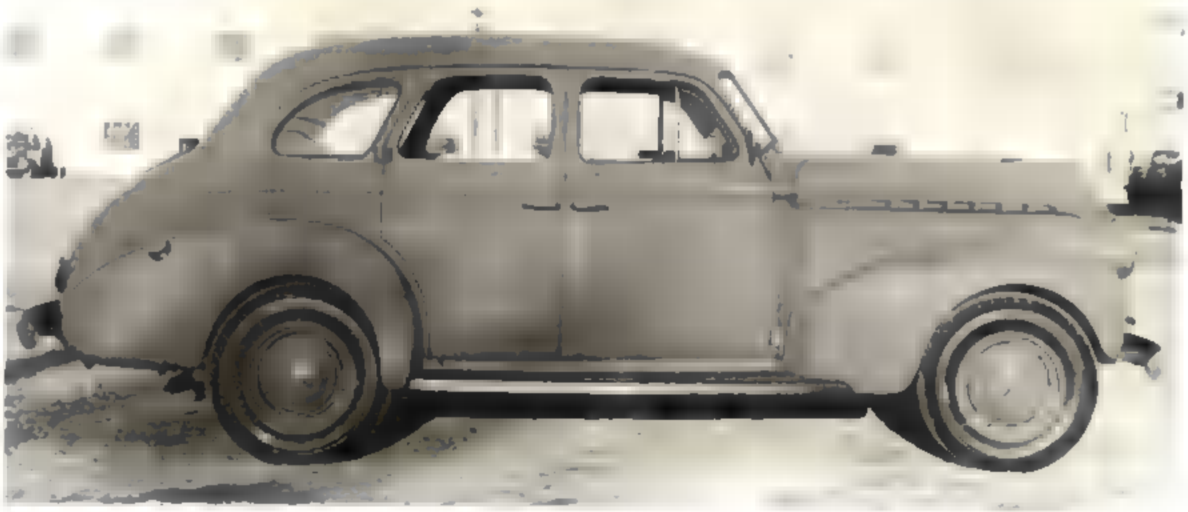
Likewise, Station Wagons were also produced, in which [redacted] Special Military Size Tires were used [redacted] well [redacted] Commercial Type, depending [redacted] the User's demands. The subsequent production of C.M.P. Personnel Carrier reduced the demand for Station Wagons in Active Theatre Operations to [redacted] negligible quantity. Reference to A.E.D.B. Specifications O.A. 71, 23, 24, will clarify the current vehicle produced.

REFERENCES

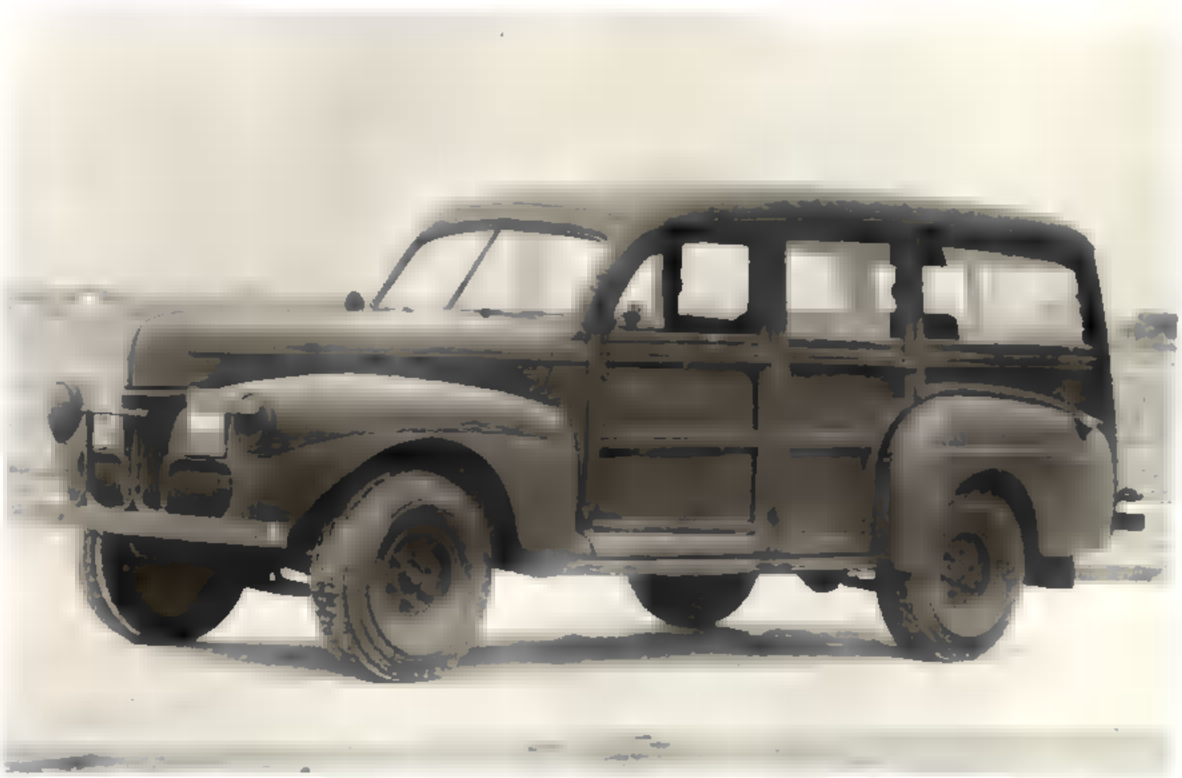
A.E.D.B. Specification No. O.A. [redacted]

A.E.D.B. Specification No. O.A. 66

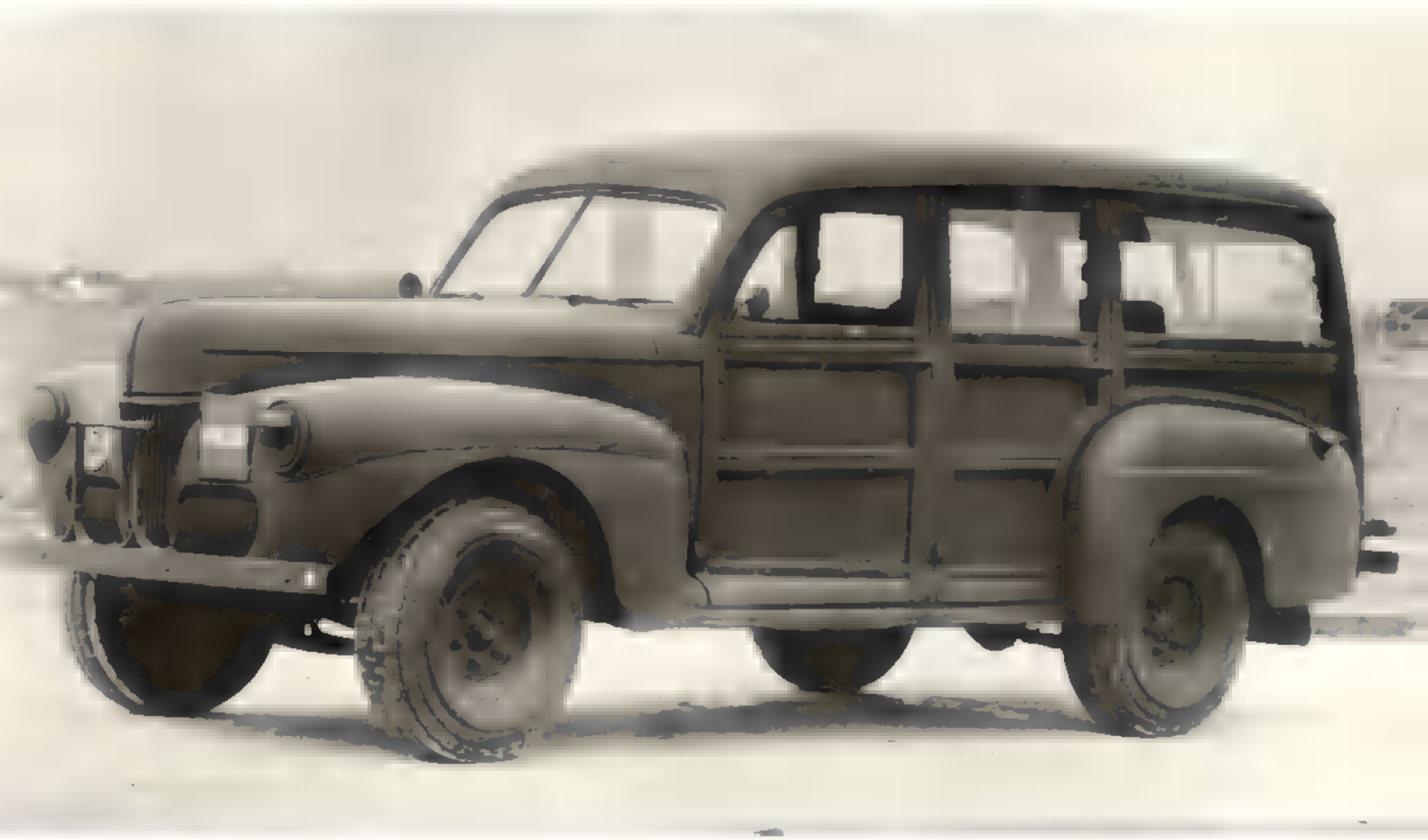
A.E.D.B. E.E. Report No.



STAFF CAR LIGHT

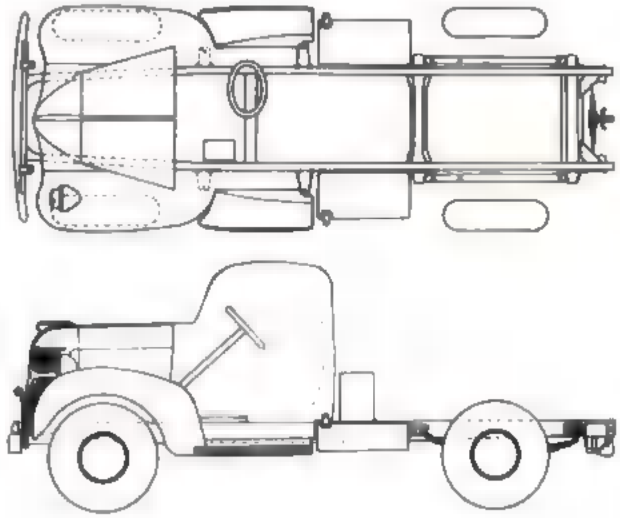


STATION WAGON W.D. TIRES



VEHICLE CHASSIS SPECIFICATION

15 CWT. [redacted] CHASSIS & CAB



CHASSIS MANUFACTURER:-

Chrysler Corporation of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 15 Cwt.

Permissible Max. Gross Weight 8750#.

WHEELBASE:- 128.5 ins.

Back of Cab to end of Frame, [redacted] ins.
Rear Axle to end of Frame, 39.8 ins.

TIRES:- 9.00 x 16 W.D. - 5.

TREAD:- Front, 61.5 ins.
Rear, 64 ins.

OVERALL LENGTH: 199.2 ins.
WIDTH: 77 ins.
HEIGHT: 81.8 ins.

ANGLE OF APPROACH:- 42°.

ANGLE OF DEPARTURE:- 36°.

TURNING CIRCLE:- L.H. 47 feet.
R.H. 50 feet.

AXLES:- Front: Elliot I Beam.

Rear: Full Floating, Hypoid. Ratio 6.285:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 14 ins. by 1.8 ins. Rear 15 ins. by 3.5 ins. Lining Area 302 sq. ins.

Parking: External contracting mechanical on Propeller Shaft. Size 7.8 ins. by 2 ins. Lining Area [redacted] sq. ins.

PERFORMANCE

POWER/WEIGHT:- 26.3 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear, 6.4%.

MAXIMUM SPEED:- 50 M.P.H. @ 3200 engine R.P.M.

CRUISING RANGE:- 420 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- [redacted] requirement.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Cellular Type. Capacity of System 16 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 110 A.H. Capacity. 3 Cell. Starter: Mechanical Shift. Generator 35 Amp. Capacity.

ENGINE MAKE:- Chrysler. [redacted] Cylinder L Head. Displacement: 236 cu. ins. Max. B.H.P. 115 [redacted] 3800 R.P.M. Max. Gross Torque 190 [redacted] 1500 to 2200 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in.

FUEL SYSTEM:- Two 15 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type. Width 34 ins. Maximum Section Modulus 5.229 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 11, Length 39 ins. Width 2 ins.

Rear: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 10, Length 52 ins. Width 2.2 ins.

STEERING:- Right Hand Drive. Worm and Sector Type. Ratio 23.2:1. 17 ins. Steering Wheel.

TRANSMISSION:- [redacted] Speeds Forward, 1 Reverse. Ratios: 1st, 6.40:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse 7.82:1.

REFERENCE

CODE:- D15.

MAINTENANCE MANUAL:- CB-D1

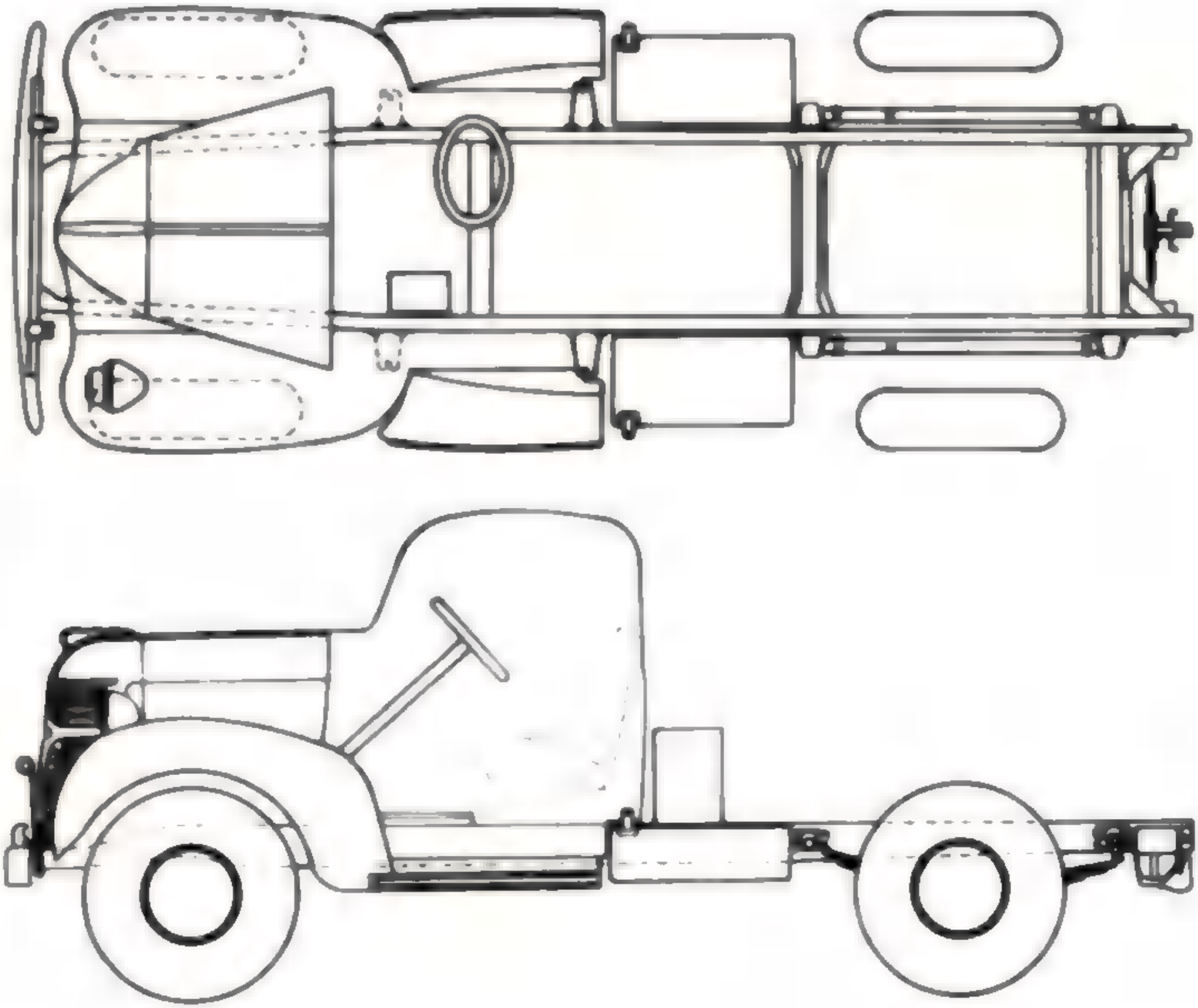
PARTS BOOK:- [redacted] 4096, 4084.

DRIVERS HAND BOOK:- [redacted] 4077, 3925, 3948.

COST OF CHASSIS & CAB:- approx. 1100.00.

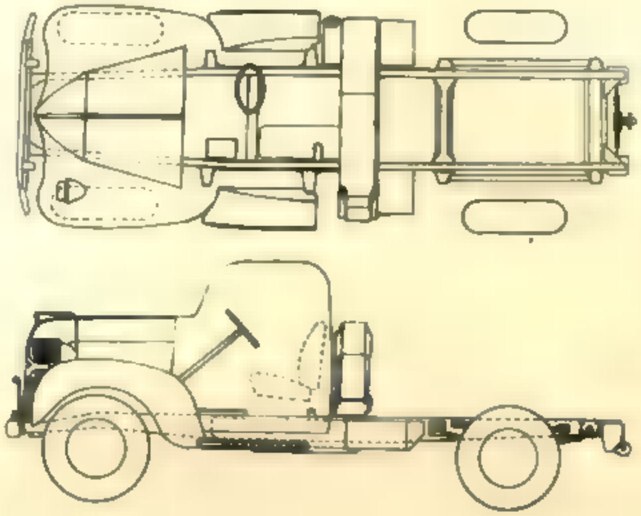
QUANTITY PRODUCED:- approx. 27,000.

APPLICATIONS:- General Service, Van, Water Tank.



VEHICLE CHASSIS SPECIFICATION

[redacted] CHASSIS & CAB



CHASSIS MANUFACTURER:-

Chrysler Corporation of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 14500#.

WHEELBASE:- 136 ins.

[redacted] of Cab to end of Frame, 96.8 ins.
Rear Axle to end of Frame, 36 ins.

TIRES:- 10.50 x 16 W.D. - 8.

TREAD:- Front, 61.6 ins.
Rear, [redacted] ins.

OVERALL LENGTH:- 203 ins.
WIDTH:- 74.8 ins.
HEIGHT:- 83.8 ins.

ANGLE OF APPROACH:- 42°.

ANGLE OF DEPARTURE:- 38°.

TURNING CIRCLE:- L.H. 56 feet.
R.H. 62 feet.

AXLES:- Front: Elliot I Beam.

Rear: Full Floating Eaton, 2 Speed. Ratios: 6.33:1 and 8.81:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 14 ins. by 1.8 ins. Rear 15 ins. by 3.5 ins. Lining Area 302 sq. ins. Vacuum Booster equipped.

Parking: External contracting mechanical on Propeller Shaft. Size 7.8 ins. by 2 ins. Lining Area 48 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 15.85 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear, High Axle Range 3.42%. Low Axle Range 4.96%.

MAXIMUM SPEED:- 50 M.P.H. [redacted] 3200 engine R.P.M.

CRUISING RANGE:- 360 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Cellular Type. Capacity of System 16 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 110 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator 35 Amp. Capacity.

ENGINE MAKE:- Chrysler. [redacted] Cylinder. 2 Head. Displacement: 236 cu. ins. Max. B.H.P. 115 @ 3800 R.P.M. Max. Gross Torque 190 @ 1500 to 2200 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in.

FUEL SYSTEM:- Two 15 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type. Width 34 ins. Maximum Section Modulus 6.7 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 11, Length 39 ins. Width 2 ins.

Rear: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 12, Length 52 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Sector Type. Ratio 23.2 :1. 17 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 6.40:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse 7.82:1.

REFERENCE

CODE:- D603.

MAINTENANCE MANUAL:- CB-D1.

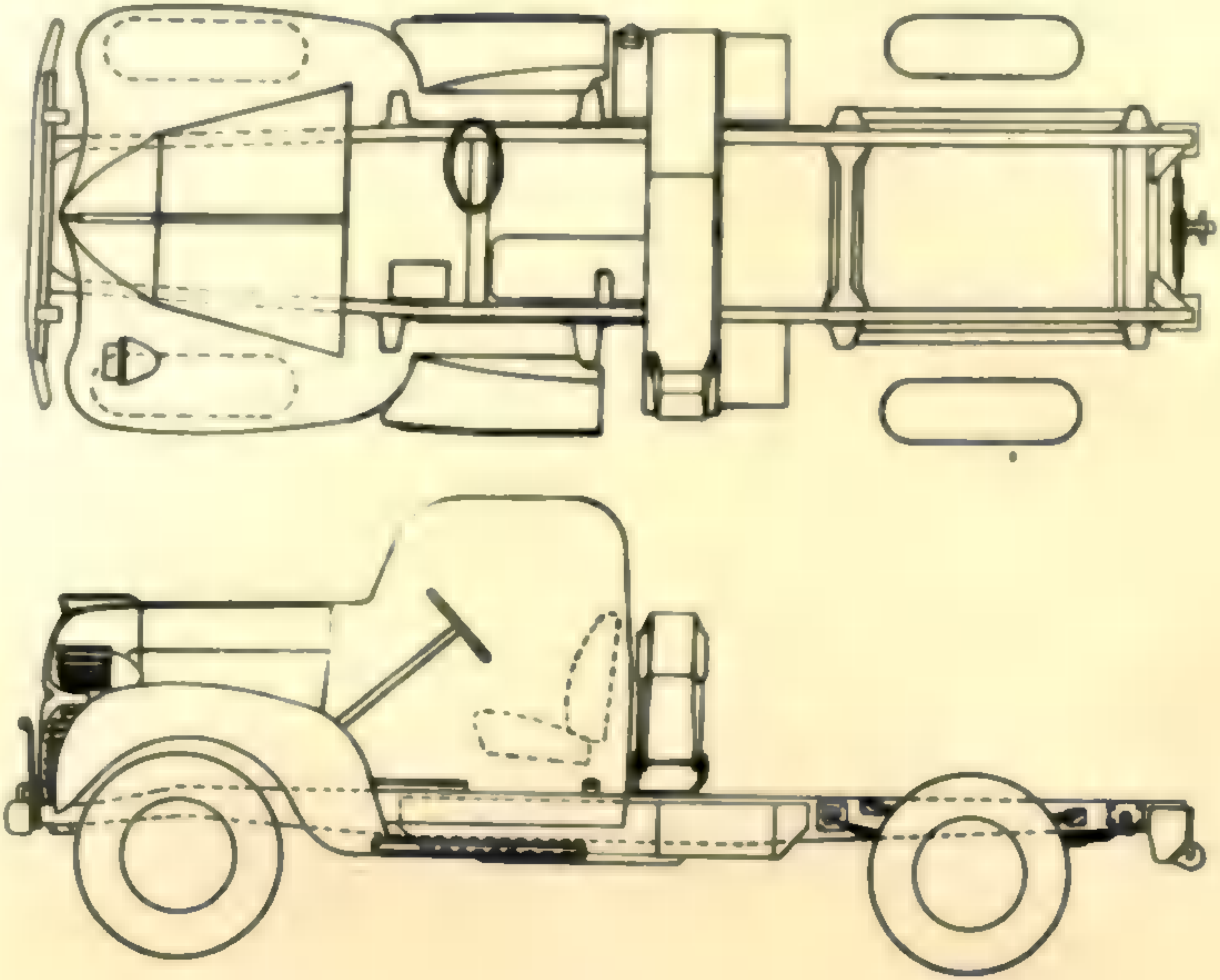
PARTS BOOK:- W4116, [redacted] 4123.

DRIVERS HAND BOOK:- [redacted] 3946, [redacted] 4079.

COST OF CHASSIS & CAB:- approx. 2000.00.

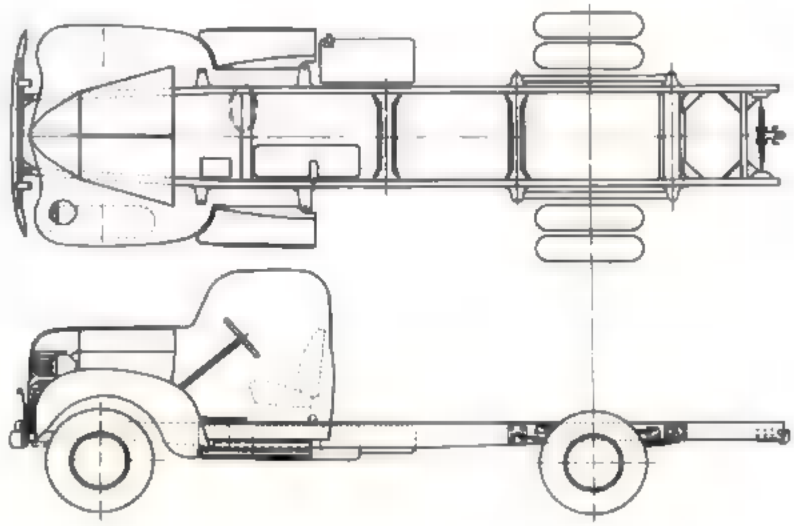
QUANTITY PRODUCED:- approx. 20,000.

APPLICATIONS:- Dump.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS [redacted] CAB



CHASSIS MANUFACTURER:-

Chrysler Corporation of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 14500#.

WHEELBASE:- 160 ins.

Back of Cab to end of Frame, 145.2 ins.
Rear Axle to end of Frame, 60.5 ins.

TIRES:- 7.50 [redacted] 20 C.C. - 7. Duals on Rear.

TREAD:- Front, 57.8 ins.
Rear, [redacted]5.9 ins.

OVERALL LENGTH: 251.2 ins.
WIDTH: 75.5 ins.
HEIGHT: 83.2 ins.

ANGLE OF APPROACH:- 40°.

ANGLE OF DEPARTURE:- 27°.

TURNING CIRCLE:- L.H. 59 feet.
R.H. 62 feet.

AXLES:- Front: Elliot I Beam.

Rear: Full Floating, Hypoid. Ratio: 7.16:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 16 ins. by 2.5 ins. Rear 16 ins. by 2.5 ins. Lining Area 344 sq. ins.

Parking: External contracting mec hanical on Propeller Shaft. Size 7.8 ins. by 2 ins. Lining Area 48 sq. ins.

PERFORMA[redacted]

POWER/WEIGHT:- 15.85 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear 4.18%.

MAXIMUM SPEED:- 45 M.P.H. @ 3200 Engine R.P.M.

CRUISING RANGE:- [redacted] Miles.

FORDING DEPTH:- [redacted] ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- No requirement

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Cellular Type. Capacity of System 16 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 110 A.H. Capacity. 3 Cell. Starter: Mechanical Shift. Generator 35 Amp. Capacity.

ENGINE MAKE:- Chrysler. [redacted] Cylinder. L Head. Displacement: 236 cu. ins. Max. B.H.P. 115 [redacted] 3800 R.P.M. Max. Gross Torque 190 [redacted] 1500 to 2200 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 40 lbs. per sq. in.

FUEL SYSTEM:- Two 15 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type. Width 34 ins. Maximum Section Modulus 8.69 ins. cubed.

SPRINGS:- Front: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 11, Length [redacted] ins. Width 2 ins.

Rear: Semi Elliptic with Hydraulic Shock Absorbers. No. of Leaves 12, Length 52 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Sector Type. Ratio 23.2:1. 17 ins. Steering Wheel.

TRANSMISSION:- [redacted] Speeds Forward, 1 Reverse. Ratios: 1st, 6.40:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse 7.82:1.

REFERENCE

CODE:- D60L-D.

MAINTENANCE MANUAL:- CB-D1.

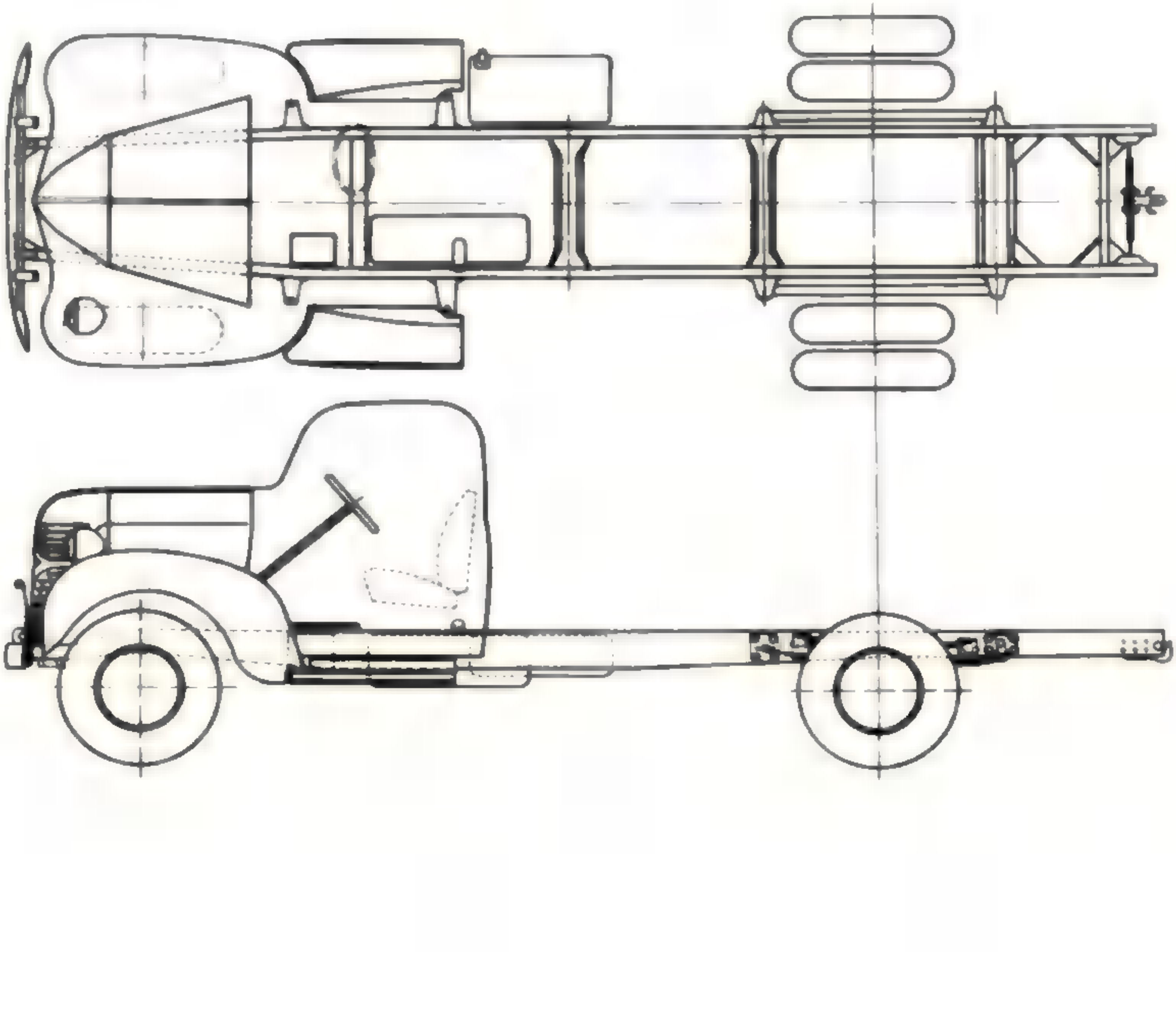
PARTS BOOK:- [redacted] 4120, [redacted] 4128.

DRIVERS HAND BOOK:- D60L-D-HB1. - [redacted] 4089.

COST OF CHASSIS [redacted] CAB:- approx. 2000.00.

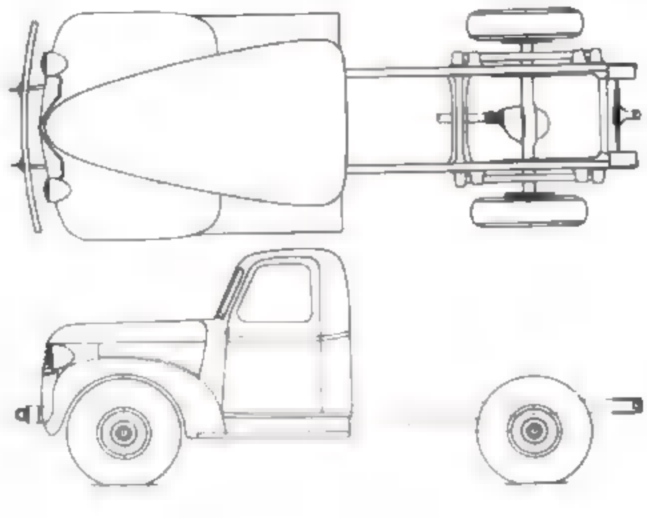
QUANTITY PRODUCED:- approx. 40,000.

APPLICATIONS:- General Service, Load Carrier.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 9800 lbs.

Permissible Gross Weight of Train 22850#.

WHEELBASE:- 134 ins.

Back of Cab to end of Frame, 98.5 ins.
Rear Axle to end of Frame, 30 ins.

TIRES:- 7.50 x 20 C.C. (7). Duals on Rear.

TREAD:- Front, 72 ins.
Rear, 65.5 ins.

OVERALL LENGTH: 173 ins.
WIDTH: 80 ins.
HEIGHT: 87 ins.

ANGLE OF APPROACH:- 40°.

ANGLE OF DEPARTURE:- 48°.

TURNING CIRCLE:- L.H. 56 feet.
R.H. 56 feet.

AXLES:- Front: Non Driving I Beam.

Rear: Full Floating Eaton 2 Speed. Ratios: 6.33:1 and 8.81:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 14 ins. by 2 ins. Rear, 15 ins. by 3.5 ins. Lining Area 303 sq. ins. Vacuum Booster equipped.

Parking: External contracting mechanical on Propeller Shaft. Size 8 ins. by 2.5 ins. Lining Area 61.5 sq. ins.

PERFORMANCE

POWER/WEIGHT FOR TRAIN:- 8.31 B.H.P. per Short Ton.

GRADEABILITY FOR TRAIN:- In 4th Gear High Axle Range 1.4%. Low Axle Range 2.3%.

[redacted] SPEED:- 50 M.P.H. [redacted] 3200 Engine R.P.M.

CRUISING RANGE:- 336 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- [redacted] requirement.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter

COOLING SYSTEM:- Circulating Liquid, Pressure Type. 2 Centrifugal Pumps driven by Double V Belts from Crankshaft. Radiator: Tube [redacted] Pin Type. Capacity of System 19 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 100 A.H. Capacity. 3 Cell. Starter: Bendix actuated. Generator: 33 Amp. Capacity.

ENGINE MAKE:- Ford. 8 Cylinder V type L Head. Displacement: 239 cu. ins. Max. B.H.P. [redacted] @ 3600 R.P.M. Max. Gross Torque 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 60 lbs. per sq. in.

FUEL SYSTEM:- Three Fuel Tanks. Two of 12.5 Gallons each and one of 17 Gallon Capacity. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type, with inner and outer reinforcements. Maximum Section Modulus 15.3 ins. cubed. Width 34 ins.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 11, Length [redacted] ins. Width 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 12, Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Roller Type. Ratio 18.4:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1, 4th, 1:1. Reverse 7.82:1.

REFERENCE

CODE:- FC60ST.

MAINTENANCE MANUAL:- SE-29C.

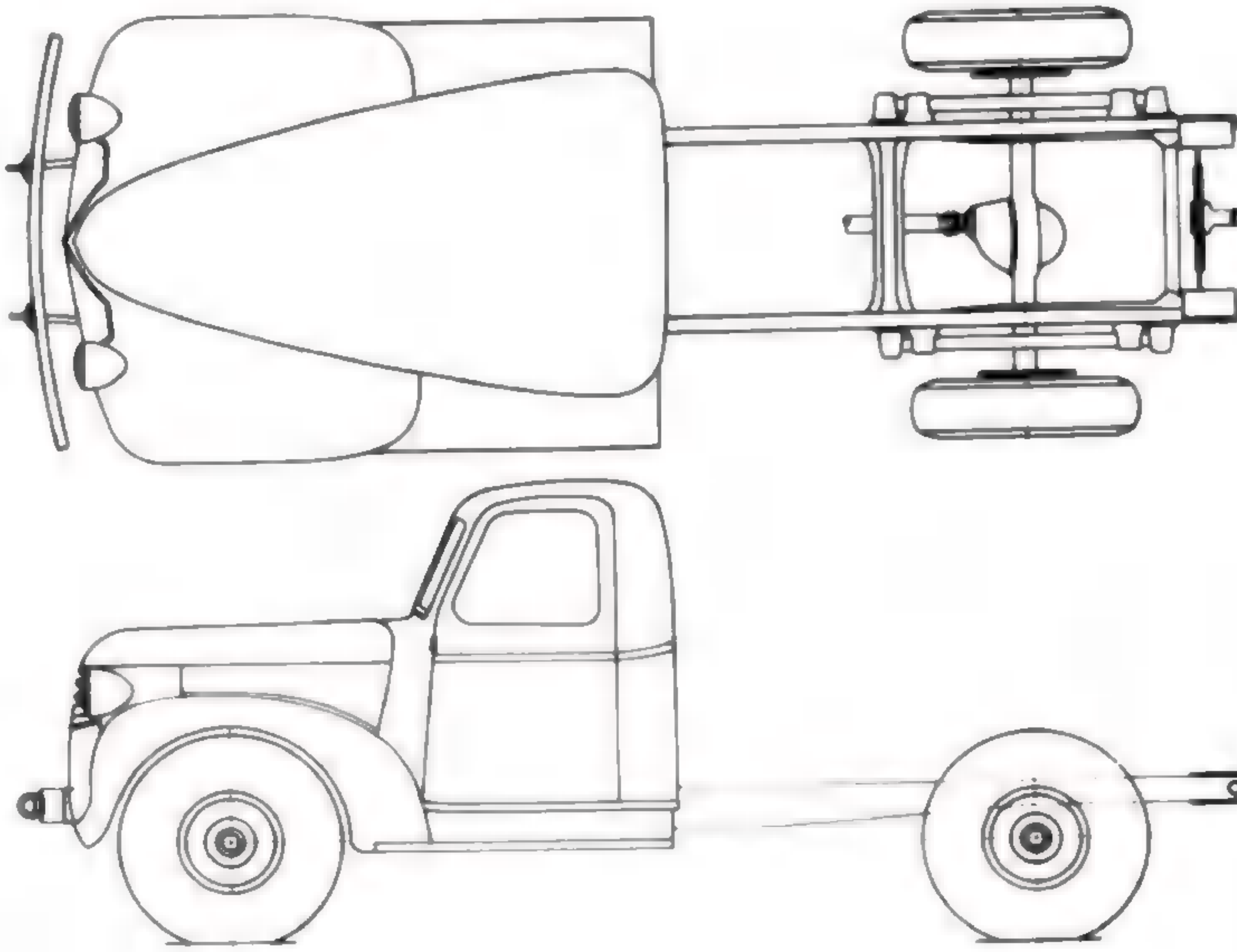
PARTS BOOK:- SE-207, SE-210.

DRIVERS HAND BOOK:- FC60ST-HB1 (BRI.)
FC60ST-HC1 (CAN.)

COST OF CHASSIS [redacted] CAB:- approx. 2300.00.

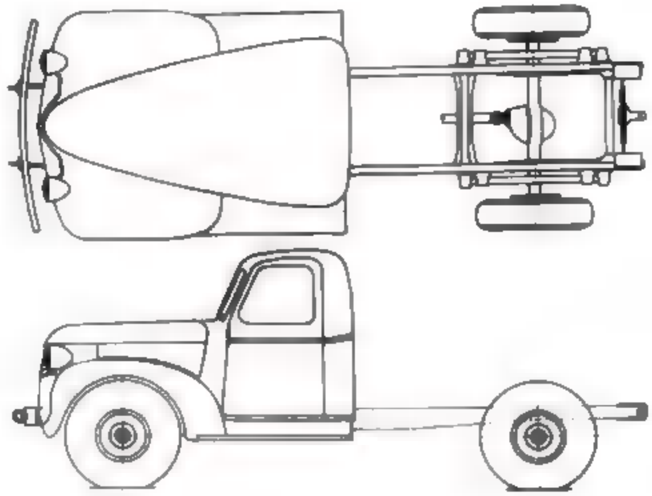
QUANTITY PRODUCED:- approx. 600.

APPLICATIONS:- Tractor for 1600 Gallon Semi Trailer.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS & CAB



CHASSIS MANUFACTURER:-

General Motors of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 14700#.

WHEELBASE:- [redacted] ins.

Back of Cab to end of Frame, 144.8 ins.
Rear Axle to end of Frame, 61.5 ins.

TIRES:- 10.50 x 16 W.D. - 5.

TREAD:- Front, 62 ins.
Rear, 65 ins.

OVERALL LENGTH: 253.8 ins.
WIDTH: 78.5 ins.
HEIGHT: 80 ins.

ANGLE OF APPROACH:-

ANGLE OF DEPARTURE:-

TURNING CIRCLE:- L.H. 57 feet, 6 ins.
R.H. 58 feet, 2 ins.

AXLES:- Front: Reverse Elliot I Beam.

Rear: Full Floating Eaton 2 speed. Ratios 6.33:1 and 8.81:1.

BRAKES:- Service: [redacted] Wheel internal expanding, Hydraulic. Front 14 ins. by [redacted] ins. Rear 16 ins. by 3 ins. Lining Area 330 sq. ins. Vacuum Booster equipped.

Parking: Mechanically operated on Rear Service Brake Shoes. Lining Area 215 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 11.56 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Axle Range 2.7%. Low Axle Range 4%.

MAXIMUM SPEED:- 46 M.P.H.

CRUISING RANGE:- 300 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- [redacted] requirement.

AIRPORTABLE:- No requirement.

CLUTCH:- Single Plate Dry Disc, 10.8 ins. Dia.

COOLING SYSTEM:- Circulating Liquid, Pressure Type. Centrifugal Pump driven by V Belt from Crankshaft. Radiator: Ribbed Cellular Type. Capacity of System 13 Qts. Thermostat and Overflow [redacted] equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 90 A.H. Capacity. 3 cell. Starter: Mechanical Shift. Generator: [redacted] Amp. Capacity.

ENGINE MAKE:- Chevrolet. 6 cylinder Valve in Head. Displacement: 216 cu. ins. [redacted] B.H.P. 85 @ 3400 R.P.M. Max. Gross Torque 170 [redacted] 1200 R.P.M. Lubrication: Pressure, Pressure Stream and Splash, using Gear Pump. Pressure 14 lbs. per sq. in.

FUEL SYSTEM:- Two 12.5 Gallon Fuel Tanks. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, Mechanically actuated.

FRAME:- Ladder Type with outer Reinforcing Plate. Width 36 ins. Maximum Section Modulus 8.47 ins. cubed.

SPRINGS: Front: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 10, Length 40 ins. Width 2 ins.

Rear: Semi Elliptic with Delco Shock Absorbers. No. of Leaves 11, Length 45.8 ins.

STEERING:- Right Hand Drive. Recirculating Ball Type. Ratio 23.6:1. 18 ins. Steering Wheel.

TRANSMISSION:- [redacted] Speed forward, 1 Reverse. Ratios: 1st, 7.06:1, 2nd, 3.48:1, 3rd, 1.71:1, 4th, 1:1. Reverse 6.98:1.

REFERENCE

CODE:- C60L/X2.

MAINTENANCE MANUAL:- CB-C1.

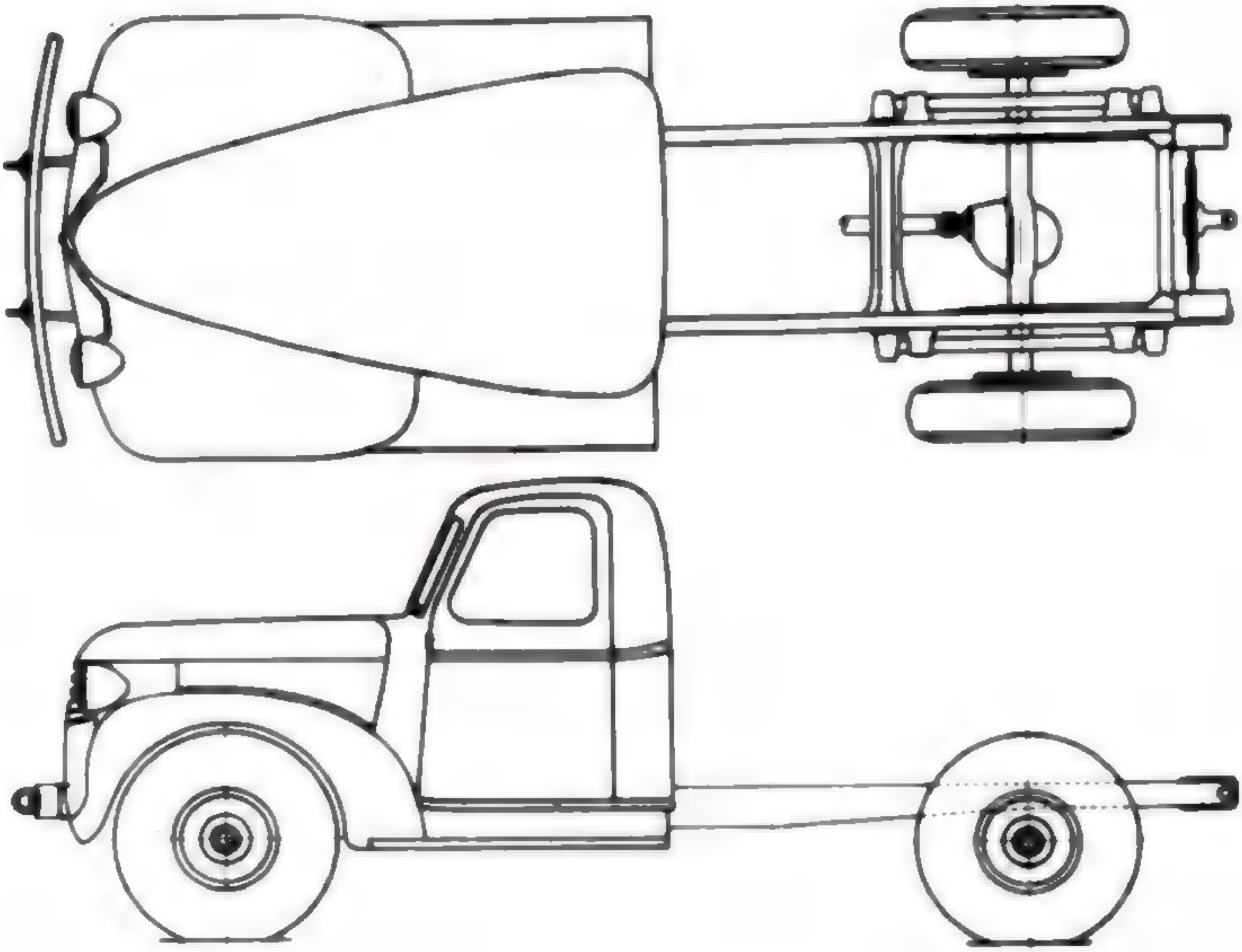
PARTS BOOK:- 204

DRIVERS HAND BOOK:- Not supplied.

COST OF CHASSIS & CAB:- approx. 2000.00.

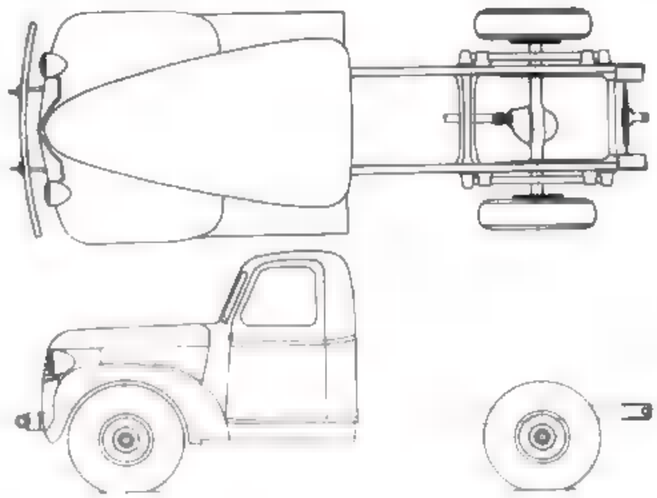
QUANTITY PRODUCED:- approx. 60,000.

APPLICATIONS:- General Service, Stores, Workshop, Wrecker.



VEHICLE CHASSIS SPECIFICATION

3 TON 4x2 CHASSIS & CAB



CHASSIS MANUFACTURER:-

Ford Motor Company of Canada, Limited.

TYPE:- Modified Conventional.

LOAD CARRYING CAPACITY:- 6720 lbs.

Permissible Max. Gross Weight 14275#.

WHEELBASE:- 158 ins.

Back of Cab to end of Frame, 144.5 ins.
Rear Axle to end of Frame, 60.5 ins.

TIRES:- 10.50 x 16 W.D. - 5.

TREAD:- Front, 72 ins.
Rear, 71.8 ins.

OVERALL LENGTH: 251 ins.
WIDTH: 80 ins.
HEIGHT: 87 ins.

ANGLE OF APPROACH:- 40°.

ANGLE OF DEPARTURE:- 27°.

TURNING CIRCLE:- L.H. 68 feet 3 ins.
R.H. 66 feet 5 ins.

AXLES:- Front: Non-Driving I Beam.

Rear: Full Floating Eaton 2 Speed. Ratios: 6.33:1 and 8.31:1.

BRAKES:- Service: 4 Wheel internal expanding, Hydraulic. Front 14 ins. by 2 ins. Rear, 15 ins. by 3.5 ins. Lining Area 303 sq. ins. Vacuum Booster equipped.

Parking: External contracting mechanical [redacted] Propeller Shaft. Size 6 ins. by 2.5 ins. Lining Area 61.5 sq. ins.

PERFORMANCE

POWER/WEIGHT:- 13.3 B.H.P. per Short Ton.

GRADEABILITY:- In 4th Gear High Axle Range 3%. Low Axle Range 4.4%.

MAXIMUM SPEED:- 50 M.P.H. @ 3200 Engine R.P.M.

CRUISING RANGE:- 348 Miles.

FORDING DEPTH:- 24 ins.

WADE PROOF:- No requirement.

AIRPORTABLE:- [redacted] requirement.

CLUTCH:- Single Plate Dry Disc, 11 ins. Diameter

COOLING SYSTEM:- Circulating Liquid, Pressure Type. 2 Centrifugal Pumps driven by Double V Belts from Crankshaft. Radiator: Tube and Fin Type. Capacity of System 19 Qts. Thermostat and Overflow Tank equipped.

DRIVE:- Hotchkiss. Universal Joints: Open Type.

ELECTRICAL SYSTEM:- 6 Volt Single Wire System. Battery 100 A.H. Capacity. 3 Cell. Starter: Bendix actuated. Generator 33 Amp. Capacity.

ENGINE MAKE:- Ford. 8 Cylinder V type L Head. Displacement: 239 cu. ins. Max. B.H.P. 95 [redacted] 3600 R.P.M. Max. Gross Torque 178 @ 1850 R.P.M. Lubrication: Full Pressure from Gear Pump. Pressure 60 lbs. per sq. in.

FUEL SYSTEM:- Two Fuel Tanks. One of 12.5 Gallons and one of 17 Gallons Capacity. Carburetor: Down Draft. Fuel Pump: Diaphragm Type, mechanically actuated.

FRAME:- Ladder Type, with Inner and Outer reinforcements. Maximum Section Modulus 15.3 ins. cubed. Width 34 ins.

SPRINGS:- Front: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 11, Length 36 ins. Width 2 ins.

Rear: Semi Elliptic with Houdaille Shock Absorbers. No. of Leaves 12, Length 45 ins. Width 2.5 ins. Auxiliary 7 Leaves.

STEERING:- Right Hand Drive. Worm and Roller Type. Ratio 18.4:1. 18 ins. Steering Wheel.

TRANSMISSION:- 4 Speeds Forward, 1 Reverse. Ratios: 1st, 6.4:1, 2nd, 3.09:1, 3rd, 1.69:1 4th, 1:1. Reverse 7.82:1.

REFERENCE

CODE:- FC60L.

MAINTENANCE MANUAL:- SE29C.

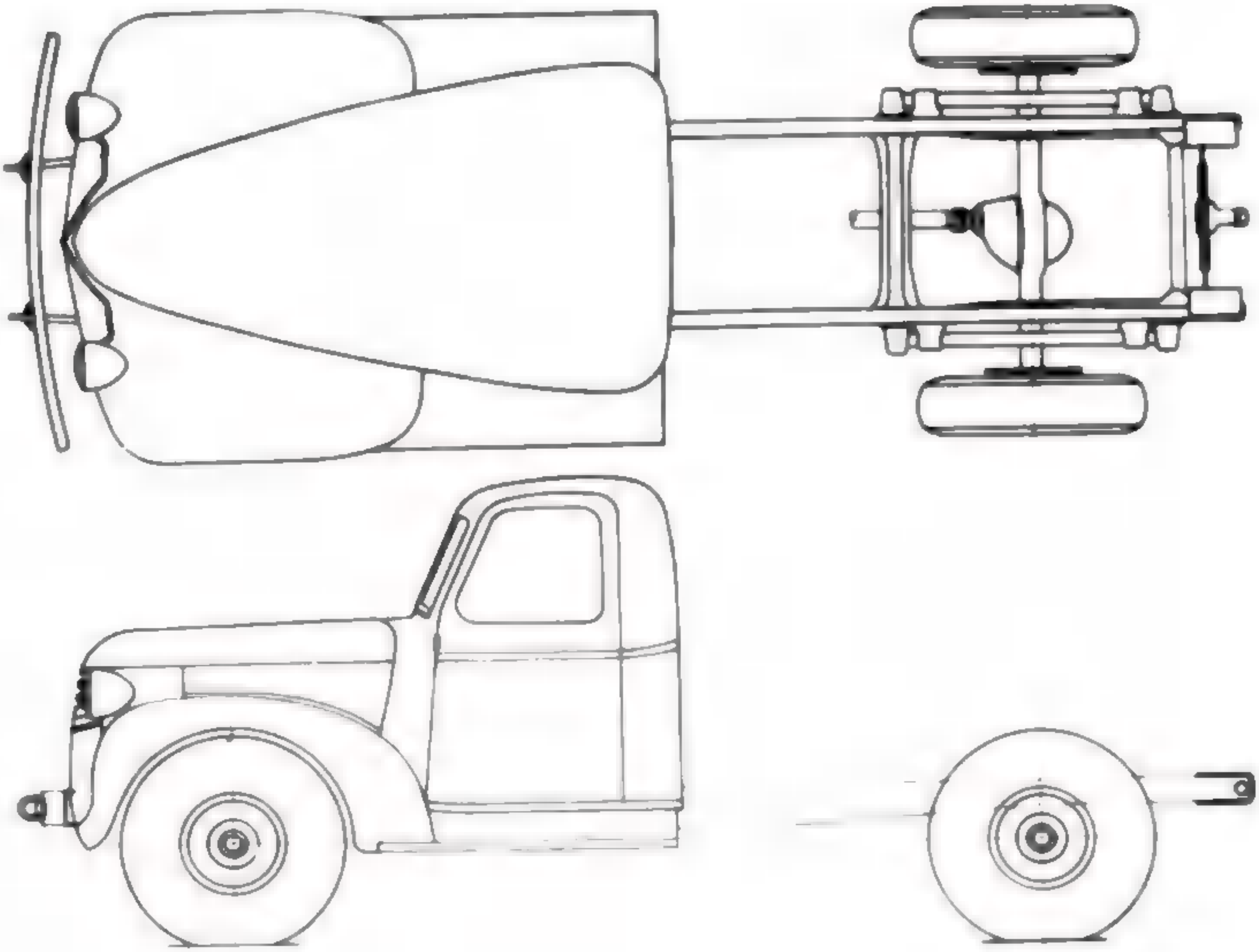
PARTS BOOK:- SE129C, SE131C.

INSTRUCTION BOOK:- SE29A.

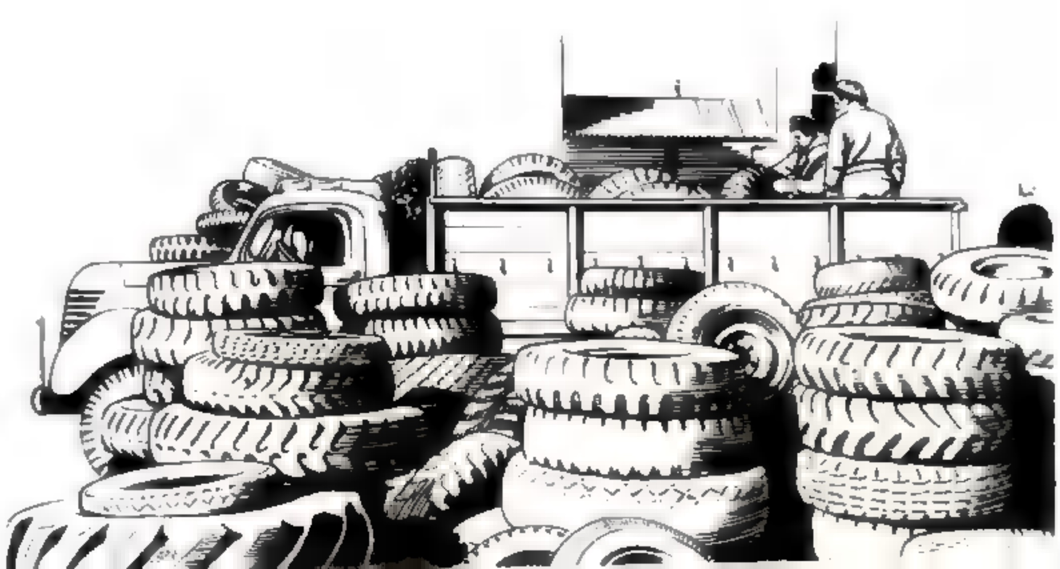
COST OF CHASSIS & CAB:- approx. 2200.00.

QUANTITY PRODUCED:- approx. 60,000.

APPLICATIONS:- General Service, Stores, Workshop.



TIRE & WHEEL DATA



FOREWORD

The development of adequate Canadian pneumatic tires for military vehicles falls roughly into two phases during the [redacted] period:

(a) Adaptation and development of the British [redacted] Department tires including the Run Flat tire,

(b) Introduction of synthetic substitutes for crude rubber in all military tires.

Prior to the war, Canada had patterned her vehicles and tires to a large extent after American design. The Canadian Industry [redacted] not, therefore, very well acquainted with special sizes of tires which had been developed in U.K. for strictly military use. In view of the decision to pattern Canadian Military vehicles after basic designs developed [redacted] U.K., it [redacted] the immediate problem of the Tire Industry to secure necessary equipment, specifications, etc. to produce these special War Dept. tires. Such sizes [redacted] 9.00-13, 9.25-16, 9.00-16, 10.50-16 and 10.50-20 [redacted] introduced in Canada and production started.

Compared to the commercial sizes in general [redacted] in Canada prior to the war, these special War Dept. tires were larger cross section, and in most [redacted] smaller diameter tires. These tires [redacted] built mainly in the chevron tread which had been in rather limited production in this country prior to the war. All of these factors complicated the technical problems which confronted the Canadian Tire Industry in the production of adequate War Dept. tires.

In the urgency of getting production started [redacted] War Dept. tires, each company made [redacted] of such mold equipment [redacted] could be secured, patterned after designs of their U.K. affiliates. Unfortunately, this led to the production in Canada of a variety of tread patterns and in some cases variations in the overall dimensions of the [redacted] tire size. Steps were taken to standardize markings and valve dimensions to permit interchangeability but tire size variations [redacted] allowed to remain.

Overloading has always been a serious problem in its effect on tire performance, but [redacted] in commercial practice had the Tire Industry been faced with the aggravated and [redacted] tinuous overload problem to which the 10.50-16 War Dept. tire [redacted] subjected. [redacted] has been pointed out, [redacted] compromises had to be accepted in the design of military vehicles and the continued [redacted] of the 10.50-16 tire on many types of military vehicles was definitely a compromise with efficient tire usage.

Recognizing this fact, the Canadia Army in Canada accepted only the 10.50-20 W.I tire as equipment for the 3-Ton vehicles, but the 10.50-16 tire continued to be used exten ively for overseas account. In fact, in 1944 the 10.50-16 tire represented 47% of the Cana dian production of the special [redacted] Dept. tires

Run flat (R.F.) tires were designe in U.K. to provide vehicle mobility in emergencies even when the tires [redacted] completely deflated of air. At [redacted] time, it [redacted] felt that all military vehicles should be equippe with this special type tire and original specifications for vehicles, to a large extent, called for the application of R.F. tires. Three Canadian companies, Dunlop, Firestone and Goodyear, all of whom had British [redacted] tions, [redacted] selected for the development and production of the R.F. tires in Canada. However, when it became a vital necessity [redacted] conserve the supply of crude rubber, this original practice of applying R.F. tires to all military vehicles had to be altered and pneumatic tires involving a smaller poundage of crude rubber applied in their place. R.F. tires continued to [redacted] used [redacted] forward-area combat vehicles but were largely replaced on the load-carrying type of vehicle.

With the seizure of the rubber producing areas by Japan at the close of 1941, a radical change in the handling of the rubber problems became necessary. Mr. B.M. Baruch, early in 1942, after completing the work of the U.S. Rubber Survey Committee, had these comments to say regarding the rubber situation:

> "Of all critical and strategic materials, rubber is the [redacted] which presents the greatest threat to the safety of our Nation and the success of the Allied cause. Production of steel, copper, aluminum, alloys, or aviation gasoline may be inadequate to prosecute the [redacted] rapidly and effectively [redacted] could wish, but at the worst, [redacted] still are assured of sufficient supplies of these items to operate our armed forces on a very powerful scale. [redacted] if we fail to secure quickly a large new rubber supply our [redacted] effort and [redacted] domestic economy

[redacted] (Continued)

[redacted] will collapse. Thus, [redacted] rubber situation gives rise [redacted] critical problem."

Pending the development of suitable synthetic substitutes for crude rubber, it be-[redacted] a matter of [redacted] utmost urgency that every conservation [redacted] which would reduce the drain [redacted] the stock of crude rubber available in the world, should be taken. The preparation of these conservation plans and the liai-[redacted] between the Canadian Industry [redacted] Using Forces was the function of the Army Engineering Design Branch. When it be-[redacted] apparent that the conservation [redacted] would be inadequate [redacted] that conversion to synthetic was [redacted] must, it [redacted] the responsibility of A.E.D.B. to develop and direct the large scale tire test program which [redacted] necessary to successfully carry out the conversion.

[redacted] PNEUMATIC [redacted] - [redacted] COUNTRY DESIGN.

TOP [redacted] (LEFT TO RIGHT) - GOODRICH, GUTTA [redacted] (10.50-16), SEIBERLING (10.50-20).

[redacted] (LEFT TO RIGHT) - DOMINION, DUNLOP, FIRESTONE, GOODYEAR (10.50-16).

[redacted] - SPECIAL [redacted] TIRES

TIRE [redacted] AND SOURCE	PLY	RIM	[redacted] LOAD (LBS.)	SECT. [redacted]	OUTSIDE DIAMETER	LOADED RADIUS DEFLECTION 13½%	18%	MAX. [redacted] SKID @ CENTERLINE	SHIPPING WEIGHTS TIRE, TUBE & FLAP	[redacted] (LBS.)
REGULAR PNEUMATIC - CROSS COUNTRY THREAD DESIGN.										
8.25-10										
Firestone	8	5.00S	2070	8.32	27.8	12.9	12.6	.470	52	
9.00-13										
Dominion	6	6.50F	1680	9.71	30.7	14.5	14.1	.535	53	35
Firestone	6	6.50F	1680	9.87	31.5	14.5	14.1	.535	52	35
Goodrich	6	6.50F	1680	9.53	31.1	14.5	14.1	.535	52	35
9.00-16										
Goodyear (MAS. ND)	[redacted]	6.50CS	2200	9.62	35.4	16.6	16.2	.620	81	49
9.00-16										
Dominion	10	6.00T	3080	9.61	35.68	16.30	16.00	.620	89	67
Dunlop	10	6.00T	3080	9.53	35.3	16.56	16.19	.620	87	67
Firestone	10	6.00T	3080	9.47	35.5	16.30	16.00	.620	92	67
Goodyear	10	6.00T	3080	9.40	34.8	16.34	15.98	.620	89	67
9.25-16										
Dunlop	8	6.00R	2240	8.9	33.3	15.64	15.28	.585	75	46
Firestone	8	6.00R	2240	9.2	33.4	15.30	15.00	.585	75	46
Goodyear	[redacted]	6.00R	2240	9.2	33.4	15.68	15.34	.585	73	46
10.50-16										
Dominion	12 (2)	6.00T	5150	10.6	37.8	17.3	17.0	.645	124	67
Dunlop	12 (2)	6.00T	5150	10.6	37.5	17.4	17.0	.645	122	67
Firestone	12 (2)	6.00T	5150	10.5	38.2	17.4	17.1	.645	119	67
Goodrich	12 (2)	6.00T	5150	10.7	37.4	17.2	16.8	.645	123	67
Goodyear	12 (2)	6.00T	5150	10.5	37.6	17.5	17.1	.645	119	67
Gutta Percha	12 (2)	6.00T	5150	10.5	38.2	17.4	17.1	.645	125	67
10.50-20										
Dominion	12	6.00T	5375	10.5	41.7	19.3	19.0	.645	145	99
Dunlop	[redacted]	6.00T	5375	10.5	41.3	19.4	19.0	.645	139	[redacted]
Firestone	12	6.00T	5375	10.2	42.3	19.5	19.1	.645	140	99
Goodrich	12	6.00T	5375	10.7	41.4	19.3	18.8	.645	142	99
Goodyear	12	6.00T	5375	10.3	41.6	19.5	19.1	.645	136	[redacted]
Gutta Percha	12	6.00T	5375	10.5	41.6	19.3	18.8	.645	142	99
Seiberling	12	6.00T	5375	10.5	41.4	19.5	19.1	.645	135	99
14.00-20										
Dominion	20	10.00	8288	14.6	47.7	22.2	21.8	.800	263	144
Goodyear	20	10.00	8288	14.7	47.5	22.1	21.6	.800	287	144

NOTE:- For information relating to commercial type tires used in military service, reference should be made to data books issued by individual manufacturers.

Tire, tube and flap weights vary with synthetic construction - weights given in this chart are based on information compiled September 15th, 1944.

TIRE DIMENSIONS - SPECIAL WAR DEPARTMENT TIRES

TIRE SIZE AND SOURCE	PLY	RIM	[redacted] LOAD (LBS.)	SECT. WIDTH	OUTSIDE DIAMETER	LOADED RADIUS DEFLECTION 13½%	18%	MAX. [redacted] NON SKID @ CENTERLINE	SHIPPING WEIGHTS TIRE, TUBE [redacted] FLAP (LBS.)	WHEEL
REGULAR PNEUMATIC - HIGHWAY TREAD DESIGN.										
9.00-16										
Dominion	10	6.00T	3080	9.5	35.3	16.3		.335	88	67
Firestone	10	6.00T	3080	9.4	35.2	16.3		.350	88	67
Goodyear	10	6.00T	3080	9.4	34.9	16.3		.350	87	67
Seiberling	[redacted]	6.00T	3080	9.4	34.8	16.3		.350	83	67
9.25-16										
Firestone	8	6.00R	2240	9.2	33.2	15.2		.350	68	46
10.50-16										
Dominion	12 (2)	6.00T	5150	10.6	37.6	17.3		.467	115	67
Firestone	12 (2)	6.00T	5150	10.2	37.2	17.1		.490	116	67
Goodrich	12 (2)	6.00T	5150	10.7	37.0	17.1		.500	114	67
RUN FLAT - CROSS COUNTRY TREAD DESIGN.										
7.00-18										
Dunlop	8	5.00	1792	7.2	32.4	15.3	15.1	.510	[redacted]	
8.25-10										
Firestone	8	5.00S	1120	8.2	27.7	13.0	12.6	.470	73	
9.00-16										
Goodyear	10	6.00T	2800	9.2	35.0	16.4	16.0	.620	136	67
9.25-16										
Goodyear	6	6.00R	1904	9.0	33.3	15.6	15.3	.550	111	[redacted]
10.50-16										
Goodyear	10	6.00T	3136	10.4	37.6	17.5	17.1	.645	169	67
10.50-20										
Goodyear	10	6.00T	3808	10.3	41.6	19.5	19.1	.645	199	99
14.00-20										
Goodyear	14	10.00	7280	14.7	47.5	22.1	21.6	.800	407	144

GENERAL REFERENCES.

D.M.&S. Files 73-T-35, 73-T-85, 73-T-54.

Technical Data Book on War Dept. Tires.

Report on Canadian Synthetic Tire Development Program - A.E.D.B. Report No. E-552.

Film of Normoyle Procedures and Test Course.

Canadian Reports - Normoyle - D.M.&S. File 73-T-85-41.

U.S. Ordnance Reports - Normoyle - D.M.&S. File 73-T-85-43.

Ministry of Supply (T.T.2.) - Tire Test Reports. D.M.&S. File 73-T-85-44.

Rubber Conservation Orders.

E.M.E. Instructions issued by Directorate of Mechanical Engineering, N.D.H.Q.

Meeting Minutes - Rubber Conservation and Technical Committee. (Including Sub-Committees) D.M.&S. File 73-T-85-46.

Tire & Rim Association - Akron, Meeting Minutes. D.M.&S. File 73-T-85-47.

Tire & Rim Association - 1942 Year Book Military Supplement, November 1943.

Ordnance Advisory Committee - Meeting Minutes. D.M.&S. File 73-T-85-48.

War Production Board (U.S.) - R-1 Orders. D.M.&S. File 73-T-85-49.

Polymer Corporation - Technical Data. D.M.&S. File 73-T-85-49.

Motor Vehicle Technical Tire Committee - Meeting Minutes (Formerly I.C.T.D.C.) U.K. D.M.&S. File 73-T-85.

SPECIAL FACTORS AFFECTING MILITARY TIRE PERFORMANCE.

(a) Dual vs. Single Tires.

While economy of operation, long life, maxi[redacted] tire mileage and [redacted] cost in dollars and in rubber [redacted] desired at all times, in military service the ability to traverse the route is imperative to the accomplishment of the military mission. In operational activities, vehicles must retain mobility on all types of roads or terrain. It [redacted] this fact which led to the use, in military service, of large cross section, bold tread design tires built to operate at [redacted] higher than normal deflection. The lowered ground pressure per square inch gave increased flotation. Almost without exception, these tires were used singly rather than [redacted] duals.

Commercially, in Canada and United States prior to the war, dual tire equipment [redacted] standard [redacted] the majority of transport vehicles. Such equipment [redacted] entirely satisfactory on the network of improved hard surfaced roads in these countries. It might be noted that U.S. continued with basic commercial vehicle design, involving the use of dual tires, for their principal load carrying vehicles in military service. In Canada, at the outbreak of war, the decision [redacted] made to pattern Canadian Military vehicles after basic designs already available in U.K. This involved the adaptation of the special War Dept. tire sizes which [redacted] intended for [redacted] [redacted] singles. As [redacted] consequence, Canadian tire technicians were faced with many problems not encountered ordinarily in Canadian commercial practice. When it became necessary to convert to synthetic substitutes for natural rubber, the problems of tread cracking [redacted] crack growth, peculiar to synthetic tires, were accentuated in the [redacted] heavily loaded, larger cross section tires. Due in part to this fact, Canada did not complete conversion of its military tires as quickly [redacted] the U.S. where production [redacted] concentrated on the smaller section tires.

It is not the place of this report to take sides between the two schools of thoughts, [redacted] favouring the use of single tires and the other favouring dual tires. However, field reports indicated that by the end of the war, it was reasonably well established that "singles" of proper size for load, speed and terrain type [redacted] superior to duals for military use in most theatres of operation.

Unquestionably, problems in connection with the production of larger section tires were greater, tires used as singles [redacted] easily damaged by being "run flat" and extensive overloading [redacted] frequent, nevertheless the tactical advantages in the [redacted] of single tires more than outweighed these disadvantages.

(b) Overloading.

In the design of military vehicles, extre[redacted] in operating conditions were usually considered and the strength of component parts based on such requirements. As [redacted] result, there was a healthy margin of safety when vehicles were operating under controlled conditions of speeds and loads.

This "safety margin" [redacted] not always maintained in the case of the tires. [redacted] study of military rated tire loads [redacted] compared with Tire & Rim Association standards [redacted] the percentage of overload in the three principal [redacted] Dept. tires.

Size	Rated Capacity War Dept.	T.&R.	Overload Approx %
9.00-16	3080 #	2870 #	7%
10.50-16	5150 #	3740 #	38%
10.50-20	5375 #	4290 #	25%

Every tire, regardless of type, is originally designed to carry [redacted] specific load at [redacted] specific inflation pressure. This load may be regarded as a maximum for the particular tire. If the tire is obliged to carry [redacted] load greater than that recommended, then tire performance must suffer.

Many military vehicles [redacted] adequately "tired" in relation to their rated capacity, but the 3-Ton vehicles [redacted] [redacted] class were overloaded, with resultant limited tire performance. Originally, the 3-Ton vehicles equipped with 10.50-20 tires were intended to have [redacted] gross weight, when carrying [redacted] 3-ton payload of approximately 15,700 lbs. This resulted in [redacted] rear axle load of 10,700 lbs. or about 5,350 lbs. per tire.

However, strengthening of component parts and addition of extra equipment increased this gross vehicle weight to nearly 17,000 lbs. of which about 11,500 lbs. were carried on the [redacted] axle. [redacted] [redacted] consequence, the "safety margin" [redacted] washed out and the tire [redacted] operating above its rated capacity.

[redacted] special case, Dodge 3-Ton 4x2, should be mentioned because of the [redacted] field complaints which [redacted] regarding the performance of the 10.50-16 tire on this vehicle. Due to distribution of vehicle weight and payload [redacted] this vehicle, when carrying 3 long tons, rear axle weights in excess of 11,000 lbs. resulted. In actual operational theatres, vehicle loads could not be controlled rigidly and were limited mainly by the capacity of the body. It was, therefore, inevitable that the tire equipment, loaded above its rated capacity normally, would be overloaded still further under these conditions.

Recommendations were made to replace the 10.50-16 by the 10.50-20 tire. The 10.50-20 tire had a slightly higher rated carrying capacity and [redacted] not overloaded to the [redacted] extent as the 10.50-16 in relation to Tire [redacted] Rim standards. These advantages more than balanced the increased unsprung weight in the use of the 10.50-20 tire and wheel assembly (about 50 lbs. per assembly) and the 10.50-20 tire was used on those vehicles where basic vehicle design factors would permit such a change. Practically all 3-Ton vehicles purchased for Canadian army account were equipped with 10.50-20 tires.

Another recommendation called for replacement of the 10.50-16 tire by dual 7.50-20 tires. This recommendation was not acceptable for any vehicles going to operational theatres, but [redacted] adopted to a limited extent for vehicles used internally by the Indian Government.

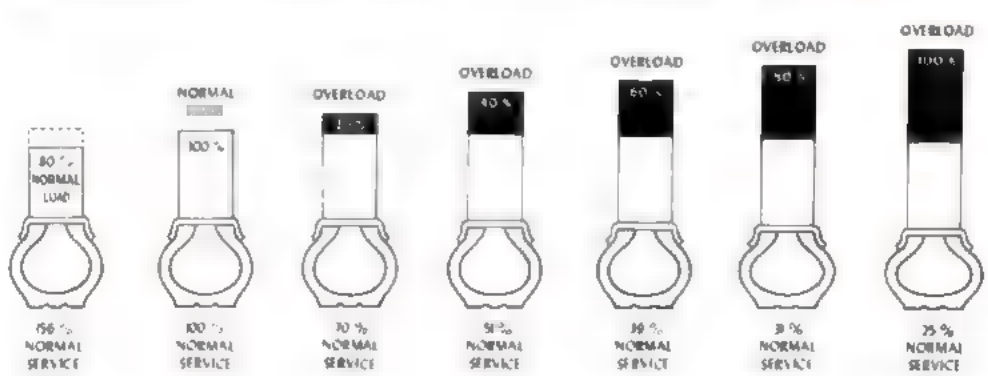
For those vehicles which remained [redacted] 10.50-16 tires, an attempt was made to have the payload reduced to 2-1/2 tons or, in effect, derate the vehicle from [redacted] 3-Ton to at least [redacted] 2-1/2 Ton vehicle. This [redacted] [redacted] accepted by the Ministry of Supply and the vehicles continued to be rated as 3-Ton vehicles. Actually, the reduction of payload was made in certain theatres to secure improved tire mileage [redacted] noted from the minutes of [redacted] meeting of the M.V.T.T.C. (January, 1945).

"Brigadier Hedges stated it had been reported from [redacted]rseas that very poor results [redacted] being obtained from the 10.50-16 size tire. This had become so marked in [redacted] theatre that the vehicle loading had been reduced from 3-Tons to 2-Tons, with [redacted] view to obtaining better tire performance."

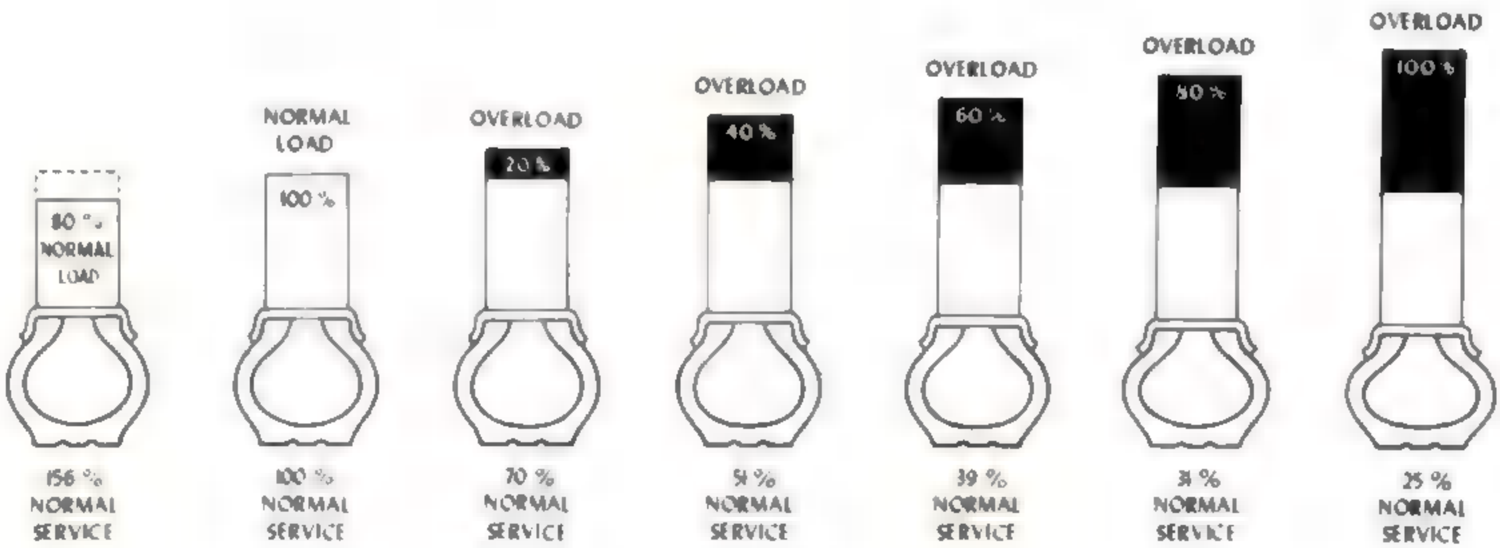
Improvements in the 10.50-16 tire were made by the introduction of rayon fabric, cap ply construction, and changes in compounds and construction, but the continued [redacted] of the tire under difficult, overloaded conditions, could only result in this tire giving, in general, limited service.

Many of the War Department tires were affected by vehicle overloading to [redacted] extent. For example, the original Scout cars [redacted] equipped with 9.25-16 tires, which [redacted] overloaded. It [redacted], however, possible in this case to effect [redacted] changeover to 9.00-16 10 Ply tires which provided adequate tire carrying capacity.

In the design of Military vehicles, careful attention should be given to provisi...



ILLUSTRATING THE EFFECT OF OVERLOAD ON TIRE PERFORMANCE



80 % NORMAL LOAD
156 % NORMAL SERVICE
NORMAL LOAD
100 %
100 % NORMAL SERVICE
OVERLOAD
20 %
70 % NORMAL SERVICE
OVERLOAD
40 %
51 % NORMAL SERVICE
OVERLOAD
60 %
39 % NORMAL SERVICE
OVERLOAD
80 %
31 % NORMAL SERVICE
OVERLOAD
100 %
25 % NORMAL SERVICE

of tire equipment, adequate for vehicle gross loads. Experience in this war would indicate that [redacted] ample "safety margin" should [redacted] allowed in the original selection of tire equipment to provide for "extras" which [redacted] invariably added.

(c) <u>Tread Patterns</u>.

(a) (b) (c)

[redacted] Department tires [redacted] available in three general tread types [redacted] illustrated in the above picture.

(a) Highway or Conventional tread,

(b) Cross Country or General Purpose Tread,

(c) [redacted] tread.

The Highway [redacted] type tires [redacted] limited in their [redacted] and the chevron type cross country tires [redacted] considered essential to [redacted] vehicle mobility in general military operations. As [redacted] measure of rubber conservation, some highway tires were used in operations in Canada, but [redacted] field reports continued to stress the need for the bold tread design [redacted] when the load carrying vehicles [redacted] operating principally [redacted] improved roads.

Changes were made in the tread design of the cross country tire during the war years. In the first place, the skid depths were reduced [redacted] rubber conservation measure. Secondly, the sharp angles [redacted] rounded to retard tread cracking in synthetic tires. Both of these steps undoubtedly reduced the tractive ability of the cross country tire to [redacted] extent, but [redacted] considered justifiable under the circumstances. Moreover, the resulting tires were probably closer to [redacted] effective compromise, between the conflicting demands of highway tread wear, bruise resistance and off-road mobility.

As will [redacted] in the picture of the various cross country tires produced in Canada, each manufacturer had [redacted] distinct tread design. With [redacted] possible exception of the Dunlop tire, these designs [redacted] of the "Directional" type. The Dunlop tread design [redacted] the closest approach to the "Non-Directional" tread design developed and used by U.S. Ordnance. Many differences of opinion existed regarding tread patterns [redacted] it would have been a difficult matter to decide, on the basis of field reports, on the most desirable tread design.

(d) <u>Standardization</u>.

This lack of uniformity in tread design and the variations in sectional and overall diameter measurements in War Dept. tires did give rise to a number of annoying problems.

The following study of dimensions of 10.50-20 War Dept. cross country tire illustrates the lack of uniformity in dimensions of W.D. tires.

10.50-20 12 Ply C.C.

Manufacturer	Sectional Width	Overall Diameter	Circumference (Centre)
Dominion	10.52"	41.72"	131.072"
Dunlop	10.52"	41.35"	129.909"
Firestone	10.16"	42.30"	132.894"
Goodrich	10.67"	41.44"	130.192"
Goodyear	10.30"	41.60"	130.699"
Gutta Percha	10.50"	41.60"	130.699"
Seiberling	10.46"	41.38"	130.004"

Chain fitment and spare tire carrier dimensions [redacted] problems complicated by this lack of standardized tire measurements. Even [redacted] serious were the difficulties in making sectional repairs. Variations in tread patterns and tire dimensions prevented the use of standardized molds.

Difficulties [redacted] also experienced in the handling of synthetic tubes where growth [redacted] greater than in crude tubes. Here the variations in the inside periphery measurements of the various tires and the differences in tube dimensions made it necessary to exercise special [redacted] to secure the proper tire and tube combination. This could be controlled on initial application, but

(a) (b) (c)

according to all field reports, was virtually impossible to watch in the repair depots.

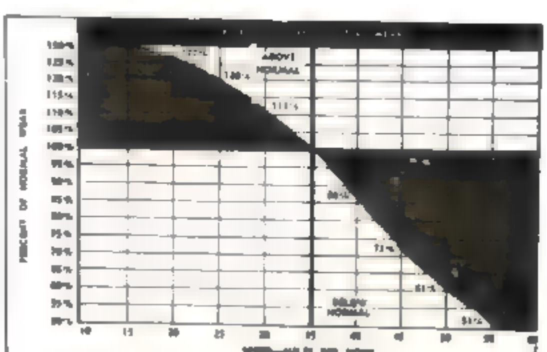
Example - Tire [redacted] Tube Fitment.
10.50-16 12 Ply W.D. Size.

	TIRE		TUBE	
	Inside Periphery	Bead Width	Cavity Sect.Cir.	Mold I.D.
Dominion	29.25	1.50	25.2	17.50
Dunlop	28.64	1.68	25.2	17.38
Firestone	29.82	1.70	23.5	16.50
Goodrich	28.75	1.70	24.4	17.50
Goodyear	30.08	1.66	25.5	17.25
Gutta Percha	29.29	1.67	25.2	17.25

In conducting the extensive road test program on synthetic tires, the analysis of results was frequently complicated by [redacted] effect that variations in tire measurements [redacted] tread design had on tire performance. It would seem not only advisable, but an absolute "must" for any future production of the special military tires to select or develop [redacted] cross country tread design and standardize all basic tire measurements [redacted] that all companies would [redacted] producing tires to identical dimensional limits.

(e) Tire Inflation Pressure, Load, Deflection.

War Dept. tires were designed to operate at [redacted] deflection of approximately 18%. Since deflection is a factor of the load carried and tire inflation pressure used, it is impossible to stipulate one standard air pressure for each individual tire without taking into consideration the vehicle on which it is used and the load carried. This [redacted] a radical change from commercial practice prior to the war, when it was customary to show maximum load and inflation pres[redacted] on the sidewall of the tire, which, of



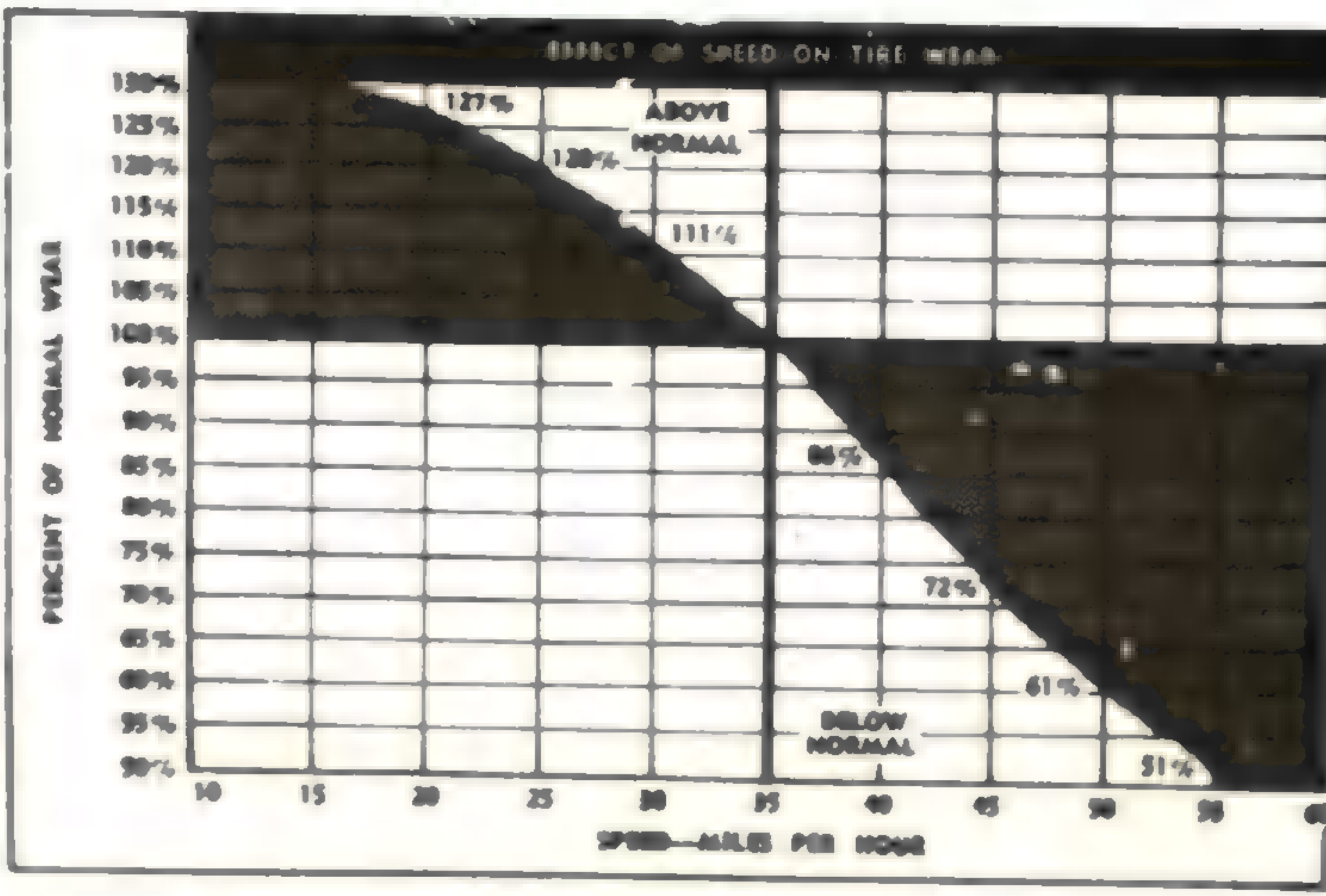
course, did not take into account the type of service in which the tire would be used. It [redacted] realized that military tire mileage could be increased by the [redacted] of [redacted] higher air pressure or conversely lower deflection, more [redacted] line with commercial practice. A special load inflation table, designed to produce 13½% deflection, was introduced for operations in Canada or other non-combat areas. The use of two different deflections and the necessity of supplying two separate load inflation tables created [redacted] difficulties for the field operating staffs. It [redacted] never intended that air pressures should [redacted] varied during actual operational tours, but unfortunately, difficulty in the handling of the matter did arise. Basically, it [redacted] intended that vehicles functioning in actual theatres of operations, regardless of the type of terrain traversed, should operate at 18% deflection. Vehicles in non-combat areas, principally on improved roads, should be operated at 13-1/2% deflection. Air pres[redacted] for the tires on individual vehicles should be determined in relation to the maximum load to be carried and stencilled on the vehicle for easy reference by the operator. Only, in that way, can [redacted] degree of control be maintained over vehicle tire pressure. Too [redacted] stress cannot be laid on the desirability of having a specially trained and independent group of tire inspectors to ensure that proper attention is paid to tire maintenance, in which tire pressure is but one of [redacted] important factors.

(f) Speeds.

Rapid tread wear and reduced tire life result from excessive vehicular speed. The effect of speed on tire wear is shown [redacted] the accompanying chart.

Realizing the effect of [redacted]ssive speed on tire performance, reasonable speeds for various classes of vehicles were established in routine orders and an attempt was made to exercise proper control.

In some of the initial tires at Normoyle, speeds were not carefully controlled and when coupled with high ambient temperatures, it was clearly shown that excessive speeds resulted in early tire failure.


EFFECT OF SPEED ON TIRE WEAR
PERCENT OF NORMAL WEAR
SPEED—MILES PER HOUR
ABOVE NORMAL
BELOW NORMAL
127%
120%
111%
86%
72%
61%
51%
130%
125%
120%
115%
110%
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
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35
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45
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60

REPORTS ON TIRE PERFORMANCE.

Considerable difficulty was experienced in obtaining accurate reports regarding tire performance from the field. Many reports gave no indication of the type of failure,probable cause,and such essential data [redacted] loads,speeds, type of terrain,etc., which were necessary for proper analysis. Lack of information [redacted] construed to [redacted] that little trouble was being experienced. This [redacted] not actually the case [redacted] was discovered when competent observers did get into the field.

Special mention is [redacted] of the following reports, copies of which [redacted] filed on D.M.46. File 73-T-85.

- Middle East Report, 1943,
- Hayes - Stanley Report, December, 1943 - March, 1944,
- Robson Report - Natousa, September 1944,
- Robson Report - Etousa, October 1944,
- Lt.Col. Binns' Report - 21st Army Group, January, February, 1945,
- Overseas Reports - R.C.E.M.E. Officers, October 1944 - March 1945.

Random quotations from field reports.

Middle East Report.

"The main [redacted] of premature failures in pneumatic tires are carcass breaks,tread separation and damage due to underinflated operation."

"The 10.50-16 tires are not strong enough."

"Single tires,operating at 30 to 40 lbs. inflation pressure [redacted] desirable than dual tires."

"There [redacted] to be a need for closer co-operation between the armies and rubber industries of the United States, England and Canada."

"Inflation pressure tables are too numer-[redacted] inconsistent."

Hayes - Stanley Report.

"Chief tire troubles in all theatres were tread cracking and separation."

"In Italy, enemy action,road demolitions, urgency of movement, [redacted]ssity for maintaining essential supplies, snow covered mountainous roads for which chains [redacted] essential and [redacted] weather conditions contribute to the detriment of tire performance."

"A lack of good tire technicians, who could keep Industry posted with information regarding tire performance."

"Unnecessary suffering was caused through R.F. tires causing hard riding on ambulances."

"Improved identification markings on side-wall required."

"A tread design sufficiently flexible to operate satisfactorily mainly on hard roads and yet rugged enough to operate [redacted] difficult terrain is required."

"Ultimate aim should be a standard pattern tread with standardized dimensions and construction."

Robson Report - Natousa.

"Synthetic tires in the larger sizes [redacted] adequate on tactical vehicles, but [redacted] giving tread cracking trouble on the more heavily loaded transport vehicles."

"1125 tires examined showed following causes of failures:

- 282 - Cut through by sharp object,
- 235 - Sidewall bruise or snag,
- 233 - Bruise breaks,
- 154 - Run Flat,
- 48 - Tread or ply separation,
- 38 - Tread cuts,
- 35 - Tread cracks,
- 35 - Worn out.

"Tires do not [redacted] out, they bruise or snag, [redacted] cut through or removed from other hazards."

"It is the writer's belief that ultimately all tires should have at least two extra plies to add [redacted]ass strength and resist cuts and snags."

Robson Report - Etousa.

"Truck transport service has been very severe; heavy loads and long high speed [redacted] have imposed a real test on tires."

"Mobile Tire Repair units have returned thousands of tires to service, and are filling a main requirement in tire conservation."

"Continue development of compounds to resist tread cracking in synthetic tires."

"Develop improved run-flat resistance in 6.00-16 and 9.00-16. 31% of removals in these sizes unfit for further service."

"Combat tires have proved their great value on armoured vehicles in E.T.O."

Lt.Col. Binns' Report.

"Briefly, it [redacted] be stated that there [redacted] no major tire manufacturing defects in the theatre."

"Carcass failures through defective construction were practically non-existent."

"It [redacted] generally considered by users of armoured vehicles that the R.F. tire [redacted] [redacted] very desirable piece of equipment on the vehicle."

"A definite preference exists for tires with [redacted] directional tread."

"Regular visits of tire technical staff to operational theatres should [redacted] permitted.

R.C.E.M.E. Officers' Report.

"The 10.50-16 tire still gives relatively poor performance and a large number of premature failures occur in this size. This is largely due to the fact that the tires are used on 3-Ton lorries and are overloaded."

"A combination of overloading, excessive speeds and sev[redacted] road conditions contribute definitely to the fast tread [redacted] on the 10.50-16 and 10.50-20 tires."

Comments by T.T.2. (Tech.) on performance of Canadian Tires which ran on test on U.K. proving grounds in July, August, September, 1944.

Quoted from Report T.2171/No. 2.

"The overall performance of the 10.50-20 C.C. S-6 R covers (70% G.R.S. and 30% Natural Rubber, distributed throughout [redacted] tire as [redacted] whole) made in Canada, is considered to be satisfactory.

These tires gave [redacted] much better performance than tires of similar size and construction of British Manufacture previously tested."

Comments by Mr. W.R. Walton, Chairman, Rubber Conservation and Technical Committee.

Quoted from letter October 9th, 1945.

"Undoubtedly the results that were finally achieved in Military Cross Country tires containing [redacted] high percentage of synthetic rubber could not have been obtained without the vast amount of testing that was carried out at Normoyle. If at any time in the future [redacted] state of emergency arises, the successful outcome of which is dependent on the satisfactory performance of pneumatic tires, it would appear desirable to instigate an industry-wide test programme at the start of such emergency period, whether or not the source of supply of major raw materials involved [redacted] in potential danger.

"The second observation that we would like to make has to do with the design of the product in relation to performance requirements. It is generally agreed that the performance of certain sizes of pneumatic tires used in this [redacted] would have been better if the sizes had been chosen for load carrying capacity [redacted] nearly in accordance with standards that had been used and proven by the tire industry over [redacted] period of [redacted] good many years, making due allowance for any potential in[redacted] in loading that might result from the exigencies of [redacted] time use. This might indicate the necessity for very close liaison between Army Design authorities and the tire industry at the initial design stage.

"The working relationship that exists today between Army Engineering Design Branch and the Tire Industry in Canada is of the highest character and could not be improved. It is to be hoped that such [redacted] relationship can continue in the future for the mutual benefit of the military services and the tire industry."

DEVELOPMENT DURING WAR YEARS.

(A) War Department Tires.

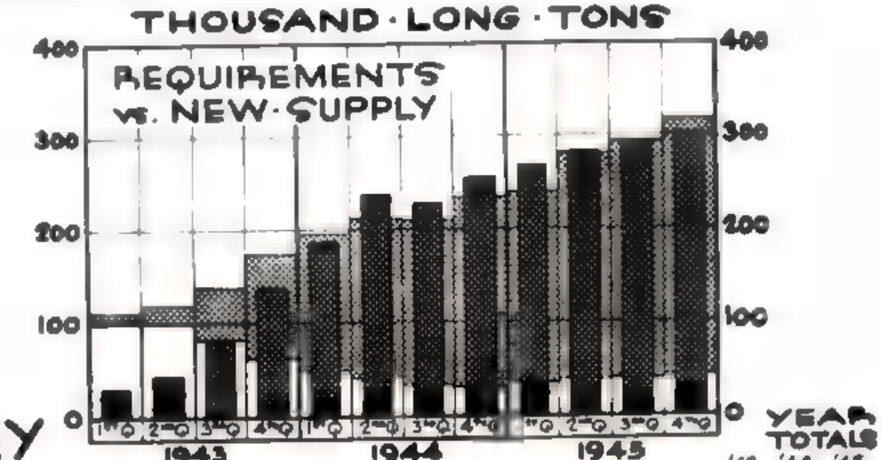
More than 90% of the natural rubber producing areas were cut off from the Allied Nations when Japan swept into the Malay States early in 1942. Foresight in the accumulation of a stock pile of natural rubber gave the United Nations approximately one year's supply. However, the limited productive facilities for the synthetic rubber (annual production 10,000 tons in 1940) meant that a tremendous expansion must take place before the output of synthetics could begin to [redacted] the increasing demand.

At a meeting in Ottawa on May 26th, 1942, attended by representatives of Industry, D.M.&S., and the Armed Services, Mr. Martin, Deputy Rubber Controller, announced that plans were being laid for the building of a plant at Sarnia for the production of synthetic rubber.

This plant, however, could not [redacted] in production until nearly the middle of 1943. In the meantime, every measure of conservation of the crude rubber supply had to be energetically adopted. The problem had devolved, in effect, into a [redacted] between the dwindling stock pile of crude rubber on the one hand and the productive capacity of the synthetic rubber plants to supply a substitute, on the other.

SUPPLY · OF · RUBBER · VS · REQUIREMENTS
UNITED · STATES · AND · CANADA · 1943–1945
BY QUARTERS *

THOUSAND · LONG · TONS

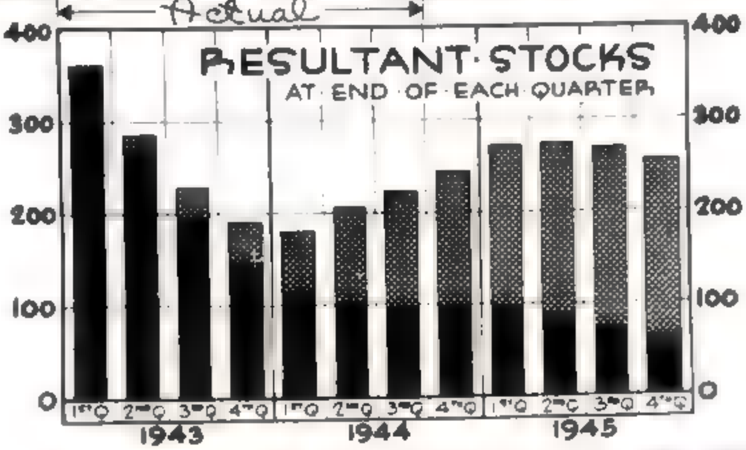


KEY

	1943 1st Q	2nd Q	3rd Q	4th Q	1944 1st Q	2nd Q	3rd Q	4th Q	1945 1st Q	2nd Q	3rd Q	4th Q	Year Totals '43	'44	'45
REQ'TS · TOTAL	111	119	138	174	197	212	211	[illegible]	240	282	294	317	542	854	1,133
SYNTHETICS	8	19	56	112	147	170	178	202	204	244	254	274	195	697	976
CRUDE	103	100	82	62	50	42	33	32	36	38	40	43	347	157	157
SUPPLY · TOTAL	30	43	80	137	186	238	228	255	268	283	289	303	290	907	1,142
SYNTHETICS	10	29	71	124	167	209	200	222	232	254	264	270	234	798	1020
CRUDE	20	14	9	13	19	29	28	33	36	29	25	33	56	109	123
STOCKS · TOTAL	362	286	228	191	180	206	223	244	272	273	268	254			
SYNTHETICS	7	17	32	44	64	103	125	145	173	183	193	189			
CRUDE	355	269	196	147	116	103	[redacted]	99	99	90	75	65			

* ALL DATA AS OF END OF QUARTERS

←— Actual —→



RUBBER BUREAU · WAR · PRODUCTION BOARD · 15 JANUARY 1945

When it is realized that 87% of the natural rubber used for defence purposes (Government requirements) in March, 1942, [redacted] used in the manufacture of military tires, the importance of the conservation steps insofar [redacted] tires [redacted] concerned cannot be over-emphasized.

The fact that by mid-summer of 1944, the productive capacity of the synthetic rubber producing plants in U.S. and Canada had reached [redacted] point sufficient to supply the Allied requirements and that the Tire Industry had successfully adapted the synthetic product for military tire usage, may be claimed to have had an important bearing on the effective prosecution of the war.

In this section dealing with development of military tires during war years, the principal steps taken to conserve natural rubber are outlined, followed by [redacted] discussion of the steps of conversion to synthetic rubber.

CONSERVATION MEASURES.

1. Replacement of Run Flat tires and Cross Country or General Purpose Pneumatic tires in Canada by conventional Highway tread tires.

Based on test results indicating that greatly improved mileages could be expected from the use of conventional tires on military vehicles, which [redacted] operating on improved roads, steps [redacted] taken early in 1942, to provide sufficient such tires to replace all R.F. and C.C. or G.P. tires in use in Canada. In this way, R.F. tires, with much higher crude rubber content, could [redacted] saved for [redacted] on combat vehicles. At the [redacted] time, C.C. or G.P. tires [redacted] freed for use in actual theatres of operations where the bold tread pattern provided essential traction.

It is, of course, impossible to estimate the actual savings in crude rubber usage by any one conservation [redacted] However, [redacted] idea of the magnitude of the changeover program made on Canadian Army vehicles in Canada can be gained from the fact that more than 22,000 tires [redacted] replaced.

REFERENCES.

D.M.&S. File 73-T-35, D.D.P. 42-181.

2. Replacement of Run Flat Tires as Original Equipment.

Faced with the drastic curtailment in the supply of crude rubber at the end of 1941, the decision to equip the majority of military vehicles with tires of Run Flat construction had to [redacted] reconsidered. The R.F. tire used from 50% to 60% more rubber in its construction than the regular pneumatic tire in the [redacted] size. Here was an opportunity to save [redacted] very considerable volume of crude rubber. In Vatel 625, dated March 23rd, 1942, British Ministry of Supply agreed to limit the [redacted] of R.F. tires to the following types of vehicles.

a. Wheeled armoured fighting vehicles including armoured command vehicles.

b. Car Light Reconnaissance.

c. 6-Pdr. Portee Vehicles.

Immediate action was taken to implement this ruling. In the case of many vehicles, it involved the development of [redacted] tire carrier, since vehicles equipped with R.F. tires were not always provided with [redacted] spare tire.

[redacted].

D.D.P. 42-180, D.C.I. 42-573, 42-601, D. of Mech. Letter 10 Apr.'42, on D.M.&S. File 73-T-35.

3. Conventional Tread tires [redacted] front wheel positions.

At the same time as regular pneumatic tires were approved for the majority of vehicles to replace Run Flat tires, it [redacted] agreed to apply conventional tread tires to front wheel positions. This [redacted] temporary measure due largely to shortage of mold equipment for the production of cross country or general purpose tires. Tires applied to [redacted] wheel positions and the spare tire were of cross country tread pattern.

REFERENCES.

D.D.P. 42-180, Vatel - 625.

4. Direction of Rotation of Chevron Type Tires.

Although remaining a somewhat contentious question and [redacted] completely agreed upon in U.K. and Canada, decision [redacted] made to apply cross country tires with chevron type treads [redacted] that the open end of the chevron contacted the ground first. Instruction letter No.7, dated March 3rd, 1941, indicated longest life and best performance could be expected from cross country tires applied in this manner when the vehicle [redacted] operating mainly on hard surfaces. It [redacted] admitted that some tractive effect [redacted] sacrificed when the vehicle operated in off-the-road service since [redacted] tread would not clean itself as originally intended by the manufacturer.

It is questionable whether this ruling [redacted] very effective in conserving rubber, and field maintenance [redacted] were encouraged to move tires from wheel to wheel without regard to the direction of rotation of the tire itself. This "switching" of tires between various positions has always been considered good commercial practice to equalize tread wear.

. Reduction in Crude Rubber Content.

Considerable saving in crude rubber [redacted] made by introduction of reclaim rubber into the tread and friction compounds. Amount of reclaim used [redacted] controlled by volume percentage in relation to crude rubber according to the following schedule.

		% By Volume	
	GRADE	New Rubber	Whole Tire Reclaim
For	A	73	0
Tread &	B	59.5	17.5
Capping	C	47.9	31.4
Stock	D	40.4	41.3
	E	26.0	57.0
	F	0	89.3
For Truck	A	88.5	0
Frictions	B	77	9.3

An estimated scale of expected mileages of the various grades was set up, based on the 'A' grade [redacted] 100%. It [redacted] agreed that [redacted] minor reduction in tread wear [redacted] acceptable in consideration of the consequent increase in unit quantities.

On February 19th,1942, tread and friction compounds were approved for War Department tires (regardless of tread type) as outlined in the following chart. Commercial sizes were degraded along similar lines with the amount of reclaim introduced into the tire dependent on the severity of the service in which the tires were to be used. In the principal military sizes the 'A' grade friction compound [redacted] maintained

Size	Friction	Tread
7.00-18	A	B
8.25-10	B	B
9.00-13	B	B
9.00-16	A	B
9.25-16	A	B
10.50-16	A	[redacted]
10.50-20	A	B
13.50-20	A	B

to ensure a high grade carcass suitable for recapping. Overseas Reports indicated that [redacted] considerable percentage of military tires were damaged through various causes before the tread had worn smooth. From this fact, it would appear that the reduction of crude rubber in the tread [redacted] fully justified as [redacted] measure of rubber conservation. To effect [redacted] similar reduction in carcass friction quality in military tires would have been too dangerous to contemplate without [redacted] extensive test program, for which facilities could not be made available at the time.

REFERENCES.

D.C.I. 42-153, D.C.I. 42-472.

6. Reduction of Skid Depths.

[redacted] volume savings in crude rubber consumption per unit was accomplished by a reduction of the skid or pattern depth in War Dept. cross country tires. Standardized skid depths were adopted for all War Dept. tires produced in Canada based on the measurements agreed upon between U.S.and U.K. for lend lease tires.

Maximum permissible skid depths taken at the mold cavity centreline, were set up [redacted] outlined in the following schedule:

Tire Size	Max. Skid Depth at Centreline
7.00-18	.535"
8.25-10	.470"
9.00-13	.535"
9.25-16	.585"
9.00-16	.620"
9.00-20	.620"
10.50-16	.645"
10.50-20	.645"
12.00-20	.7[illegible]0"
13.50-20	.800"

Two methods were used by the manufacturers to accomplish the reduction of skid depth required. In the main, molds were recut to secure the correct depth, but at least one company replaced moldinserts with new inserts made to the [redacted] measurement.

[redacted] an example of thesavings in crude rubber accomplished by the reduction of skid depth, the av[redacted] crude rubber consumption for the 10.50-20 C.C. tire [redacted] cut approximately 3 lbs. per unit or 6%.

[redacted]

Minutes of Meetings held in Ottawa to discuss progress in reduction in crude rubber requirements in Government specifications. 17 Feb. '42 and 27 May '42.

Minutes March 23/43 Meeting of Defence Standards Committee (Akron).

D.M.& S. File 73-T-35 - Jansen to Major Cumner, [redacted] May '42.

7. Introduction of Metal Beadlocks to replace Rubber Beadspacers.

Although the wide usage of R.F. tires [redacted] military vehicles was being curtailed as outlined in (2) above, [redacted] important savings in crude rubber was made by the introduction of [redacted] metal beadlock to replace the rubber beadspacer previously supplied with R.F. tires.

In May, 1942, the low-flange hinge type metal beadlock [redacted] approved for service [redacted] in [redacted] three principal sizes of R.F. tires: 9.00-16, 9.25-16 and 10.50-20, and as a consequence, it [redacted] necessary for the Canadian Industry to adopt standardised bead profiles for R.F. tires to permit the satisfactory use of metal beadlocks. Closer tolerances in regard to bead widths were adopted based on standards establish[redacted] by the Defence Standards Committee of the Tire and Rim Associationon March 23rd, 1942, as tabled below:

Tire Size	Bead Width	Tolerance One [redacted]	Two [redacted]	Rad.	Radius Center	Control Height.
7.00-18	1.20	±.06	±.08	1.75	18.25	1"
8.25-10	1.50	±.06	±.08	1.56	10.25	1"
9.00-16	1.50	±.06	±.08	1.75	16.25	1"
9.25-16	1.25	±.06	±.08	1.56	16.25	1"
10.50-16	1.70	±.06	±.08	2.00	16.50	1"
10.50-20	1.70	±.06	±.08	2.00	20.50	1"

The above bead width measurements were adopted for R.F. tire production only, and [redacted] never applied to regular pneumatic tires.

8. Field Maintenance.

Mention should be made, in any study of rubber conservations measures, of the steps which were taken by the Canadian Army to "conserve" vehicle tires already in operation

Tire maintenance had been the responsibility of the Ordnance M.T. officers up to this time, but early in 1942,the critical rubber supply situation demanded closer supervision of tire [redacted]sage andarrangements were made to have a special tire maintenance officer for each military districtin Canada. Experienced tire men, the inspecting officers were detailed to educatethe maintenance staffs in each unit in proper tire maintenance methods, supervise the tire work shops and generally control the use of tires in military operations.

Through the issuance of Canadian ArmyLocal E.M.E. Instructions and the monthly publication "CAM", details of proper tire maintenance were given wide circulation. Through these mediums, it was possible to stress conservation measures, outline improved service methods and draw attention to any changes in construction involving special application in the field.

Recapping and repair depots were established at several points in Canadato provide adequate service facilities. Closer attention was paid to routine tire inspection to [redacted] that repairing and/or recapping [redacted] carried out at the proper time. By this closer supervision of general tire usage, the [redacted]age military tire life was increased considerably.

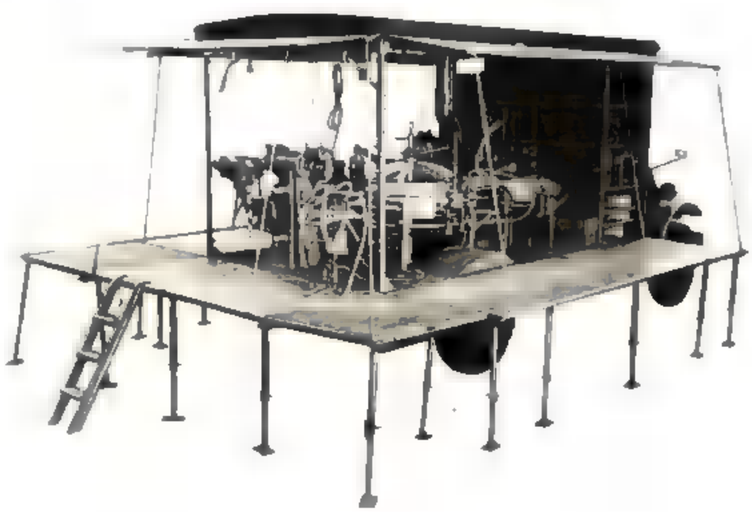
Tire inspection and maintenance in over[redacted] operations [redacted] under the control of the British Army Staff,although the Canadian Army did establish one tire repair depot in England.

Mobile repair units - tire repair equipment mounted on a single vehicle or series of vehicles - were introduced to fill [redacted] real requirement in tire maintenance in the field.

The British Army used [redacted] series of five vehicles to carry the complete recapping and repair equipment with other necessary supplies. The U.S. had developed a two vehicle combination, which when set up, made use of a tarpaulin "marquee" between the two vehicles to provide working quarters. Technical Officers at Directorate of Mechanical Engineering designed and produced a pilot model of a repair unit as a single vehicle. This compact little unit had many advantages but, unfortunately, did not arrive overseas in time for a complete trial under battle area conditions. Theoretically, the small compact unit, built on a chassis of sufficient carrying capacity, could be used to advantage in forward areas. In fast moving operations, base tire repair depots were left far in the rear and could not be easily moved from place to place, whereas the mobile units were quickly set up and dismantled.

<u>REFERENCE</u>.

D.N.D. File - H.Q. 38-72-384-37.



ABOVE - Tire Repair Shop at Central Mechanization Depot, London.

BELOW - Mobile Tire Repair Unit with sides of body opened.

DEVELOPMENT DURING WAR YEARS. (CONT'D)

[redacted] DEPT. TIRES TO SYNTHETIC RUBBER.

Synthetic rubber differs from natural rubber in many essential characteristics, and critical problems [redacted] processing [redacted] handling of synthetic compounds confronted the manufacturers [redacted] they started in to substitute synthetic rubber in whole or in part for the crude rubber previously used. In handling this difficult situation, it [redacted] natural [redacted] imperative that Industry should pool its technical knowledge and work together.

In Canada, the Rubber Conservation and Technical Committee [redacted] established to analyse jointly the problems affecting [redacted] Rubber Industry and to assist the Rubber Controller.

Problems relating specifically to tires [redacted] tubes [redacted] handled by a special Sub-Committee. This Committee met at frequent intervals with representatives of A.E.D.B. to discuss technical problems [redacted] initiate necessary action.

Regular minutes of these meetings [redacted] prepared and copies [redacted] D.M.&S. File 73-T-85.

Development of Test Program.

With the first trials of synthetic tires, both in U.S. [redacted] in Canada, it became apparent that [redacted] extensive test program would be necessary to assist Industry in carrying out the conversion program. The urgency of the situation and the fact that military type vehicles were not available to Industry for individual company road testing, [redacted] it necessary for A.E.D.B. to arrange facilities for large scale road test operations for the entire Canadian Tire Industry. Suitable year-round test facilities were not available in Canada and arrangements [redacted] to [redacted] U.S.Ordnance Proving Ground at Camp Normoyle.

U.S. Ordnance selected Camp Normoyle, [redacted] Antonio, Texas, as the base for their road test operations for the following reasons:

(a) Weather suitable for year-round test operations,

(b) Relatively high [redacted] temperatures,

(c) Suitable terrain to provide all varieties of road conditions desired.

Details of arrangements with U.S.Ordnance and basic data regarding the test program are covered in complete detail in "Report on Canadian Synthetic Rubber Development Program" (E-552, November, 1945).

The magnitude of the development program necessary to prove the adequacy of synthetic tires for military use can [redacted] indicated by these statistics.

- [redacted] C.M.P. vehicles in Canadian test operations with [redacted] of the vehicles running [redacted] than 100,000 miles,
- [redacted] than 5,000,000 vehicle test miles,
- [redacted] than 20,000,000 tire test miles,
- [redacted] than 4,500 experimental tires road tested.

Gravel road, paved highway and rough [redacted] country area were selected in varying percentages as test courses to simulate [redacted] closely as possible actual conditions under which tires might [redacted] required to operate in war theatres. The Normoyle course [redacted] considered a [redacted] test of tires by all who had [redacted] opportunity to [redacted] over the course. More than 2400 springs broken [redacted] Canadian vehicles during the test operations is testimony of test course severity.

Technical Development.

The introduction of synthetic substitutes into the manufacture of tires involved [redacted] great deal [redacted] than the replacement, pound for pound, of the crude rubber previously used. The Industry, therefore, approached the problem by [redacted] series of steps, each step involving an increasingly greater percentage of synthetic. In smaller sized tires, it [redacted] possible to produce an adequate tire using 100% synthetic. In larger military truck tires from 70% to 90% synthetic [redacted] used satisfactorily.

For ease of identification, each stage [redacted] given [redacted] code number [redacted] outlined in the following schedule:

S-2 - Approximately 65% of Rubber Hydrocarbon used in [redacted] tread [redacted] GR-S synthetic, but 100% natural rubber carcass was retained. This involved the use of approximately 35-40% synthetic content overall depending on thetire size.

S-7 - The [redacted] crude rubber ceiling was used as for S-5, but the synthetic rubber used [redacted] not restricted entirely to the tread but distributed throughout the casing at the manufacturer's discretion.

S-6 - Approximately 70% GR-S synthetic and 30% crude rubber [redacted] used, distributed throughout the casing at the manufacturer's discretion.

S-9 - Approximately 80% GR-Ssynthetic and 20% crude rubber [redacted] used,distributed throughout the casing at the manufacturer's discretion.

S-4 - Approximately 90% GR-S synthetic, and 20% crude rubber was used, distributed throughout the casing at the manufacturer's discretion.

S-8 - Approximately 92-1/2% GR-Ssynthetic and 7-1/2% crude rubber,distributed throughout the casing at the manufacturer's discretion.

S-3 - 100% GR-S synthetic. [redacted] small percentage of crude rubber (average 1.25%)was permitted in this construction for use in production of cements required.

It was possible, of course, to by-pass many of the conversion steps in the development of suitable compounds for use in the [redacted] lightly loaded smaller sized tires. For purposes of example, [redacted] detailed study of the development of four sizes, representing [redacted] important part of the military tire requirements, is outlined. Two of these sizes (6.00-16, 7.50-20) were converted to GR-S synthetic based [redacted] tests carried out by U.S. Ordnance and covered by R-1 orders, issued by W.P.B., in Washington, D.C. No attempt was made to duplicate U.S.tests and Canadian conversions were made on issuance of Rubber Conservation Orders by the Rubber Controller following the R-1 orders. The other two sizes (9.00-16, 10.50-16) were converted [redacted] result of Canadian test program. It might [redacted] noted that all conversions in [redacted] cial sizes [redacted] blanket conversions, mandatory for all Manufacturers at the [redacted] time. For the special War Dept. sizes, conversions were almost invariably based on road test results and approvals granted to individual companies [redacted] test performances so justified.

(1) <u>6.00-16 4 Plyand 6 Ply(All Tread Patterns)</u>

The first tests of tires of this size [redacted] run [redacted] tires manufactured in S-5 construction, i.e. 100% GR-S synthetic tread on [redacted] 100% crude rubber carcass. These tests [redacted] carried out in the [redacted] of 1942,at Camp Seeley in California, and later at Camp Normoyle in Texas. The first tests on S-5 showed such promising results that a jump [redacted] made immediately to S-3, i.e. 100% GR-S synthetic in tread and carcass. On vehicles operating at 50 m.p.h., and atmospheric temperatures up to 115°F. these 100% synthetic tires proved to be quite satisfactory with mileages averaging between 13,000 and 15,000. Numerous recheck

<u>NORMOYLE TEST COURSE</u>

[redacted] THE LEFT IS A SCENE ON THE GRAVEL ROAD. THE OTHER PICTURE GIVES AN INDICATION OF THE ROCK LEDGES [redacted] LOOSE BOULDERS ENCOUNTERED IN THE CROSS COUNTRY PORTION OF THE COURSE.

tests [redacted] made confirming the initial results obtained [redacted] this size.

Therefore, adopting U.S. specification, Canadian manufacturers were able to start production of S-3 tires in the 6.00-16 [redacted] other passenger [redacted] sizes [redacted] well [redacted] truck tires up to 7.00 size, almost [redacted] the synthetic rubber [redacted] available [redacted] production quantities.

By Rubber Conservation Order No. 65, effective July 1st, 1943, conversion [redacted] S-3 synthetic was made mandatory in all sizes up to 7.00.

2) <u>7.50-20/34 x 7 10 Ply (Mud & Snow & Highway Tread).</u>

First tests by U.S. Ordnance in this size were run in May, 1942, using [redacted] with the 6.00-16, [redacted] S-5 construction, (100% synthetic tread [redacted] a natural rubber carcass). Speeds were maintained at 35 m.p.h., and the course included 10% gravel but no [redacted] country terrain. Severe cutting and cracking developed in these initial tests. The test [redacted] repeated involving some cross country terrain, but again the tires fail[redacted] at early mileages due to the [redacted] cutting, cracking and chipping which took place.

These tests demonstrated one of the principal weaknesses of synthetic rubber - reduced resistance to cutting, chipping and cracking, both on the highway and cross country. Synthetic rubber has poor tear resistance, which [redacted] that once a slight cut or crack has started it is subject to rapid growth.

Industry chemists worked intensively on this problem of tread cracking, and gradually developed [redacted] 100% synthetic tread compound which rendered quite adequate service.

For the first tests involving synthetic rubber in the carcass of the tire, test tires were prepared in S-4 construction (90% synthetic, 10% crude). Failures in this construction occurred at early milea[redacted] due to bruise breaks, heat blowouts [redacted] separation of the tread from the carcass. It [redacted] found that synthetic tires developed a higher operating temperature, which [redacted] basically responsible for excessive heat build-up and blowouts.

Several important steps [redacted] taken to combat these causes of premature tire failure, [redacted] follows:

(a) The allowable natural rubber [redacted] used mainly in the region of the last two plies and breakers, where it [redacted] of the most help in resisting heat and hence, combating separation. The industry chemists also worked out new compounds to operate at lower temperatures, thereby resisting heat failures.

(b) Extra reinforcing plies extending across the crown of the tire, known [redacted] "cap plies", were introduced.

(c) Rayon cord [redacted] introduced into the body plies.

These constructional features and better compounds improved the synthetic truck tire to the point that it [redacted] delivering mileages closely comparable with natural rubber tires in normal military service.

In Canada, production of the 7.50-20/34x 7 tire was converted to an S-6 construction in September, 1943. At this time, rayon cord was not available for this tire since the limited rayon supply [redacted] required for more essential usage, but by the middle of 1944, rayon was available in sufficient quantity for use in the 7.50-20/34 x 7 tire.

In October, 1944, as a further step in crude rubber conservation, this size [redacted] converted to S-4 rayon construction where it stayed until the end of the war.

(3) <u>9.00-16 10 Ply Cross Country [redacted] Dept. Tire.</u>

This tire [redacted] a special War Dept. size and [redacted] no counterpart in the U.S. line-up. It [redacted] used on a wide variety of C.M.P. vehicles and [redacted] selected by A.E.D.B. as one of the three War Dept. tires to be intensively road tested. It [redacted] agreed that other smaller section War Dept. tires of lesser load carrying ability could be converted to synthetic on the basis of test results on the 9.00-16 10 Ply tire. C.M.P. 4x4 General Service vehicles [redacted] used at Normoyle for tests of the 9.00-16 tire.

Initial Tests. (9.00-16 W.D. Tire).

The first test on this size was applied on May 3rd, 1943. Tires were made in [redacted] S-5 cotton carcass construction (100% synthetic tread on 100% crude carcass). Course included 70% Highway, 15% Gravel and 15% Cross Country area. Results were not considered sufficiently satisfactory to warrant production approval. Cutting and cracking of the tread [redacted] but the principal cause of failure [redacted] bruise breaks.

In view of results of first test, tires of lower synthetic content (S-2 - 65% of tread [redacted] synthetic) [redacted] applied on test. Results of this test [redacted] uniformly satisfactory in relation to the crude control tires and in view of the urgent need to [redacted] crude rubber, production approval release on S-2 construction [redacted] issued on July 2nd, 1943, to the four participating companies, Dominion, Dunlop, Firestone [redacted] Goodyear.

From examination of the tires returned from the first test, the manufacturers [redacted] able to incorporate [redacted] improvements in [redacted] tires for a repeat test on S-5 construction. Satisfactory results were obtained and production approval releases [redacted] given on August 17th, 1943, for production of 9.00-16 in S-5 construction.

On the basis of the results on [redacted] 9.00-16 10 Ply W.D. tire, production releases [redacted] also given to all producing companies in 8.25-10, 9.00-13 and 9.25-16 War Dept. C.C. tires, without the necessity of actual separate tests.

Conversion to S-6 Cotton.

Moving into the next stage of conversion, S-6 cotton tires were applied [redacted] test. High ambient temperatures (90°F to 100°F) and uncontrolled speeds resulted in very erratic [redacted] unsatisfactory performance. Bruise breaks, tread separation and tread cutting and cracking [redacted] the principal causes of failure.

Introduction of Rayon Fabric.

Rayon fabric [redacted] introduced for the first time replacing cotton in the body plies and breakers in a test on S-6 (70%) synthetic tires. Greatly improved results indicated the marked superiority of the rayon fabric. Two of the participating companies, Dominion and Firestone, showed mileages in [redacted] of the crude cotton control tires and production approval releases were issued to these two companies on November 22nd, 1943, for conversion to this construction.

[redacted] the advice of the Rubber Controller that rayon could not yet be allocated to the 9.00-16 10 Ply W.D. tire, [redacted] repeat test in S-6 cotton cord construction [redacted] applied. Cap ply construction [redacted] used in these test tires for the first time [redacted] this size. Results were much more satisfactory than in previous S-6 cotton test, [redacted] one company, Dominion, was given production approval release for 10 Ply (2 Caps) S-6 cotton carcass construction based on this test.

So that facilities could be devoted entirely to the testing of 10.50-16 and 10.50-20 tires, further development work on the 9.00-16 tire [redacted] suspended during the first quarter of 1944. During this period, supply of rayon increased sufficiently to permit its allocation for the 9.00-16 tire and development work on S-6 rayon tires was resumed. In the next tests applied, carcass breaks were considerably reduced in number with the [redacted] of rayon fabric in the body plies. However, many tires were being injured by being cut through. Stones tended to lodge in the tread cuts or cracks and eventually work through the tire cords. Cutting and cracking was, however, not nearly as [redacted] as in the original tests, indicating improved tread compounds. Dunlop and Goodyear [redacted] granted production approval release on May 24th, 1944, in S-6 Rayon construction.

Conversion to S-4 Rayon.

With all companies approved on S-6 rayon construction, the next step was to S-4 (90% synthetic). Tires were produced in both 10 Ply (No Cap) and 10 Ply (2 Cap) construction. Actually, the results showed no superiority in the 10 Ply (2 Cap) construction, and production [redacted] therefore, confirmed in the 10 Ply (No Cap) construction for the 9.00-16 W.D. tire. [redacted] this first test [redacted] S-4 construction, results [redacted] very satisfactory for Dominion and Firestone tires. However, by joint Industry - A.E.D.B. agreement production approval release [redacted] withheld pending the results of [redacted] confirmation test.

By this stage of testing, [redacted] groups of synthetic tires were giving [redacted] mileage in practically every test higher than the crude cotton tires being used as control tires. No change in course percentages [redacted] made, with the 9.00-16 tests always operating [redacted] the 70% Highway, 15% Gravel and 15% Cross Country course.

Excellent results [redacted] attained in [redacted] repeat test on S-4 rayon construction and based on this test, all 9.00-16 W.D. producers, Goodyear, Dominion, Firestone, Dunlop, Seiberling, were given production approval release, March 12th, 1945.

Conclusion.

The test program carried out to complete the conversion of the 9.00-16 W.D. has been outlined in [redacted] detail. The Industry development staffs [redacted] to take every possible [redacted] to produce adequate tires using the smallest possible percentage of crude rubber. Improvements in compounding and in factory processing methods [redacted] coupled with changes in fabric, and sometimes mold design to achieve the desired end.

(4) 10.50-16 C.C. War Dept. Tire.

Problems encountered in the development of [redacted] adequate 10.50-16 Cross Country synthetic tire for military [redacted] much [redacted] difficult than those encountered in developing the 9.00-16 synthetic tire. This [redacted] due largely to the load factor involved. Whereas the 9.00-16 tire carrying its rated load of 3080 lbs., [redacted] only 7% overloaded according to Tire and Rim Association standards; the 10.50-16 tire carrying 5150 lbs. [redacted] 38% overloaded. Both tires were used on the [redacted] wheel, 6.00-16 x 1½". Actually, commercial practice would recommend at least [redacted] rim width of 7.33" for the 10.50 cross section tire. It is felt that this narrow rim width accentuated the problem for this heavily loaded tire.

More than 50 test projects [redacted] established and run in the program of developing a satisfactory synthetic military tire in

NORMOYLE TEST COURSE

THE 3 TON VEHICLE HAS JUST COME UP [redacted] 19° GRADE - TYPICAL OF MANY STEEP GRADES IN THE CROSS COUNTRY PORTION OF THE TEST COURSE.

the 10.50-16 size. Construction for the 10.50-16 [redacted] finalized on S-6 rayon (70% GR-S synthetic overall). Tests were actually run in S-4 construction (90% synthetic) and S-9 construction (approximately 80%) but results [redacted] not permit conversion beyond the S-6. Fortunately, the supply of crude rubber [redacted] sufficient to enable the continued production of both the 10.50-16 [redacted] [redacted] 10.50-20 tiresin the S-6 construction.

Preliminary Tests.

Tires [redacted] produced in S-5, S-2, and S-6 constructions for the first test projects. Tires built to S-5 construction [redacted] applied on test on May 3rd,1943. Regular U.S. Ordnance course, involving 70% Highway, 15% Gravel and 15% Cross Country area, [redacted] used for this initial test.
Speeds were restricted to 30 m.p.h. Results from this first test were very disappointing with the majority of the tires failing at early mileage due to carcass breaks. Tread cutting [redacted] cracking was not too severe, but this [redacted] due largely to the fact that the tires had failed at such early mileage.
The tires in S-2 constructionwere applied at [redacted] and while the results were not [redacted] satisfactory as desired, production approval releases were given to four (4) companies, Dominion, Firestone, Goodrich and Goodyear [redacted] August 4th, 1943, based on the urgent [redacted] of effecting immediate reduction of crude rubber [redacted]ge.

Reduced Loads.

Unsatisfactory performance resulted in the second test [redacted] S-5 construction. Consideration [redacted] given to the recommendation of the Tire Technical Committee to reduce the load under which the 10.50-16 tire [redacted] being tested. The Industry contended that it [redacted] impossible to evaluate the service of the synthetic tread when the tires [redacted] operating only very limited mileage due to carcass failures. Accordingly, tires in S-6 construction were tested at [redacted] reduced load of 4500 lbs. and [redacted] repeat test on the S-5 construction [redacted] [redacted] at 4,000 lbs. In this latter test, [redacted] company, Goodrich, showed satisfactory results and production release on S-5 construction was given to this company [redacted] August 17th, 1943.
It might be noted that cap ply construction was used by the Goodrich Company in the preparation of the tires for thistest project. The results indicated the marked advantage of this construction in the 10.50-16 tire and these results were confirmed in later tests.
Several tests were run with the tires operating at the reduced load of 4,000 lbs. with all companies'tires showing improved performances. However, on September 23rd, 1943, British Ministry of Supply representative refused to accept tires which had been approved for production [redacted] [redacted] result of test projects run at the reduced loads. Accordingly, all production [redacted]leases on S-2 and S-5 constructions were rescinded and production of military tires in this size was resumed using A.S. crude. From this point on, all testing [redacted] done at the full rated load of 5150 lbs.

Approval for Cap Ply Construction.

Based on the results achieved by those companies which had introduced cap ply construction into the 10.50-16 tires, this construction was approved for all production. Tests were run at later stages in an attempt toascertain relativeadvantages of the 12 Ply 2 Cap construction versus straight 14 Ply construction. Due to indefiniteness of the results attained, production of the 10.50-16tire was continued on the 12 Ply 2 Cap construction.

Introduction of Rayon.

Rayon fabric became available in limited quantities early in the fall of 1943 and was immediately incorporated into the 10.50-16 test tires. Practically all tests from this point on [redacted] of S-6 rayon tires. Steady improvement in test results could be noted. On January 12th, 1944, Dominion were given production approval release on S-6 rayon tire. At the [redacted] time, Dominion and Goodrich weregiven productionapproval release for the 8-6 cotton tire. Rayon [redacted] still in very short supply and quantities [redacted] not sufficient [redacted] yet for all 10.50-16 production by all companies. On February 25th, 1944, Firestone, Goodrich [redacted] Goodyear qualified for production approval release for the 8-6 12 Ply 2 Cap ray[redacted] tire.

C.C. Tread Design Recuts.

During the initial stages [redacted] testing, it [redacted] very evident that the inherent tendency of the 100% synthetic treads to crack [redacted] considerably aggravated by the presence of acute tread bar angles and sharp radii fillets. As [redacted] consequence, certain [redacted] facturers reworked their existing tire molds rounding out tread bar angles and increasing fillet radii. This [redacted] of considerable help in reducing the tendency to tread cracking. Tires built in the recut molds were applied on test and as soon [redacted] satisfactory performance [redacted] indicated, the changes [redacted] made in all production molds. This change in mold design should not be confused with the reduction in skid depths of [redacted] country treads which was carried out as [redacted] rubber conservation measure. This recutting of the molds was [redacted] step to improve synthetic tire performance [redacted] [redacted] carried out only in those molds where improved performance of the synthetic tire could [redacted] expected.

[redacted] SHOWING EFFECT ON MOLD RECUT [redacted] 10.50-16 GOODRICH TIRES.

Change in Test Course.

A special series of tests, under Project No. CN-17, were run in the fall of 1943, employing only AB crude rubber tires. This was done to evaluate the effect of varying course percentages on tire performance. The basic course setup by U.S. Ordnance involved the use of 70% Highway, 15% Gravel and 15% Cross Country. Overseas Reports from theatres of operations had indicated that load carrying vehicles [redacted] operating to [redacted] considerable extent [redacted] improved roads and that percentagewise, cross country mileages did not reach more than 5% of total mileage travelled. Tests [redacted] run using a course made up of 70% Highway, 25% Gravel and 5% Cross Country. In other tests, the elimination entirely of the cross country course indicated that the sustained operation on highway [redacted] gravel induced a higher percentage of tread separation failures.

As a result of these special course development tests, the percentages used for the 10.50-16 and 10.50-20 tests [redacted] changed to the following: Highway 70%, Gravel 25%, Cross Country 5%. All tests in these sizes after December, 1943, [redacted] run at these course percentages.

Every effort [redacted] made to control carefully all variable factors affecting the test results. Loads, speeds and course percentages were checked closely. It [redacted] impossible to keep in uniform condition the gravel and [redacted] country portions of the course, and, of course, seasonal temperature changes affected test results to [redacted] marked degree.

Comparison with Crude Tire Performance.

To evaluate the effect on tire performance of the changes in weather and course, it [redacted] the policy of A.E.D.B. to [redacted] in every test project [redacted] set of AB crude cotton tires [redacted] "controls". The varying compounds and constructions used in the synthetic tires made it difficult to compare results of successive tests without the natural rubber control tires. To eliminate the variations between crude rubber tires from different manufacturers, control tires for the 10.50-16 tests [redacted] all supplied by one company.

Similarly in the 9.00-16 and 10.50-20 tests, crude control tires were also supplies from one manufacturer.

The performance of all crude cotton tires had been considered adequate for military service prior to the introduction of synthetic and was used, therefore, as a measuring stick ofthe performance of the synthetic tires.

A study of all 10.50-16 S-6 rayon tires which were road tested during period December, 1943 to December,1944, as compared with the crude control tires which ran at the same time,shows a favourable comparison for the synthetic tires:

10.50-16 C.C. 12 Ply 2 Cap S-6 Rayon tires - 4376 miles (335 tires), average mileage.

10.50-16 12 Ply 2 CapAB Crude Cotton tires - 4282 miles (60 tires), average mileage.

Conclusion.

All manufacturers were producing 10.50-16 S-6 rayon tires by June 1944, under D.C.I. or D.D.P. approval. Introduction of rayon fabric, cap ply construction, improved compounding and processing methods allplayed a part in the long step from the first discouraging tests onsynthetic tires in this size.

FINAL CONVERSION POSITION.

SYNTHETIC CODE, FABRIC TYPE AND SOURCE SHOWN FOR EACH SPECIAL WAR DEPT. TIRE.

Regular Pneumatic Type (Cross Country Design.

8.25-10 8 Ply C.C. S-4 Cotton.
Source - Firestone.
9.00-13 6 Ply C.C. S-6 Cotton.
Sources - Dominion, Firestone, Goodrich, Seiberling.
9.00-16 8 Ply (2 Caps) M&S N.D.S-8 Cotton.
Source - Goodyear.
9.00-16 10 Ply C.C. S-4 Rayon.
Sources - Dominion, Dunlop, Firestone, Goodyear, Seiberling.
9.25-16 8 Ply C.C. S-4 Rayon.
Sources - Dunlop, Firestone, Goodyear.
10.50-16 12 Ply (2 Caps) C.C. S-6 Rayon.
Sources - Dominion, Dunlop, Firestone, Goodrich, Goodyear, Gutta Percha.
10.50-20 12 Ply C.C. S-6 Rayon.
Sources - Dominion, Dunlop, Firestone, Goodrich, Goodyear, Gutta Percha, Seiberling.
13.50-20 20 Ply C.C. S-7 Rayon.
Sources - Dominion, Goodyear.

Regular Pneumatic Type (Highway Design).

9.00-13 6 Ply Hwy. S-7 Cotton.
Sources - Dominion, Seiberling.
9.00-16 10 Ply Hwy. S-6 Rayon.
Sources - Dominion, Firestone, Goodyear, Seiberling. (Seiberling not yet approved by test in S-6 construction).
9.25-16 8 Ply Hwy. S-7 Cotton.
Source - Firestone.
10.50-16 12 Ply 2 Caps Hwy. S-6 Rayon.
Sources - Dominion, Firestone, Goodrich. Only Goodrich approved in this S-6 construction by test.

Run Flat Type (Cross Country Design).

7.00-18 R.F. B + B Cotton.
Source - Dunlop.
8.25-10 R.F. C + B Cotton.
Source - Firestone.
9.00-16 R.F. B + B Cotton.
Source - Goodyear.
9.25-16 R.F. B + B Cotton.
Source - Goodyear.
10.50-20 R.F. B + B Cotton.
Source - Goodyear.
13.50-20 R.F. B + B Cotton.
Source - Goodyear.

It will be noted from the above schedule that R.F. tires remained as natural rubber. Several tests were made on the Indoor Bureau of Standards machine and also at Normoyle in an attempt to effect a conversion to synthetic. The 8.25-10 R.F. tire in S-4 construction gave satisfactory performance on indoor tests, but no facilities were available for road tests. Tests were run at Normoyle on both the 9.00-16 and 10.50-20 R.F. tires. Results on the 9.00-16 tire in S-6 construction were promising and conversion to this construction was a definite possibility if requirements had warranted it.

(B) Pneumatic Tubes and Flaps.

The adaptation of the special War Dept. tubes and flaps presented little problem to the Canadian Industry. Minor difficulties concerned with valve measurements and angles had to be cleared up to [redacted] interchangeability in the field. Because each Canadian manufacturer duplicated the specifications of its U.K. affiliate and produced tubes to fit its [redacted] tires, [redacted] lack of standardized tube dimensions resulted. As [redacted] the case with tires, this failure to standardize basic tube measurements presented [redacted] problems, particularly following conversion to synthetic rubber.

Conversion to Synthetic.

In the critical interim period, before synthetic rubber was available for the production of tubes, it was possible to effect some savings in crude rubber usage by reducing the volume of rubber required for each tube and using reclaim rubber on a limited basis.

In converting to synthetic rubber, Canada and U.S. jumped directly to 100% synthetic construction, whereas in U.K., experimental tubes [redacted] using both crude and synthetic rubber in about [redacted] 50 - 50 combination.

In July, 1943, conversion to GR-S synthetic [redacted] made mandatory for the majority of tubes other than the strictly War Dept. tubes. Some War Dept. sizes (9.00-16, 10.50-16 and 10.50 - 20) [redacted] run [redacted] test at Normoyle during the later part of the year, with quite promising results. Difficulties [redacted] experienced with splice and valve pad adhesion but these processing problems [redacted] ironed out as the companies gained [redacted] experience in handling the GR-S synthetic stocks. Based again on the urgent necessity to [redacted] natural rubber, early in 1944, approval [redacted] given to all companies to convert production of W.D. tubes to GR-S synthetic.

Service problems in the field were made more difficult with the introduction of GR-S tubes. Special repair materials and methods had to be introduced for the repair of these tubes. Vulcanized repairs were essential and consequently, tubes had to be returned to base workshops. Special attention had to be given to the lubrication of the tube and method of insertion in the tire. The GR-S tube perfor[redacted] satisfactorily in original application, but excessive stretch occurred in service and buckling developed in re-application of the tube in another tire. The tendency of the GR-S tube stock to tear easily caused many tubes to be rendered unfit for further service after [redacted] simple puncture.

Conversion to GR-I (Butyl) Synthetic.

It [redacted] well known that another synthetic, GR-I (Butyl), had essential properties which made it more suitable for inner tubes. However, the supply of this material [redacted] very limited and it [redacted] not until the [redacted] of 1944 that quantities produced at Sarnia became sufficient to use in the production of tubes.

Conversion [redacted] made in July, 1944, to GR-I (Butyl) synthetic for passenger and small truck tubes. Tests were applied immediately at Normoyle [redacted] War Dept. tubes made with Butyl rubber.

Buckling and creasing of the tube [redacted] very serious factor in the first tests [redacted] Butyl tubes. Butyl tubes did not, however, show the [redacted] tendency to tear as had been noted in the case of tubes manufactured of GR-S synthetic. [redacted] special tube test [redacted] applied using GR-S, GR-I and crude tubes operating under the [redacted] test conditions. Results of this test gave clear indication of the superiority of the GR-I tubes. Measurements of tube growth indicated that GR-I tubes, while stretching [redacted] than the crude rubber tubes, did not stretch to the same extent [redacted] the GR-S tubes. The Industry chemists and the Polymer technical staffs worked intensively [redacted] this problem of stretch and much improvement could be noted in later tests of GR-I tubes. By the end of 1944, decision to convert all tube production to GR-I (Butyl) synthetic had been reached.

It [redacted] possible to [redacted] of the special restrictions which had been necessary with GR-S tubes. Shipment in boxes involved no special difficulty for GR-I tubes. In the field, GR-I tubes could be repaired by the same methods and with the [redacted] materials [redacted] had been used for natural rubber tubes. Tendency to tear was not as serious in GR-I tubes and consequently, tubes were not rendered unserviceable with every puncture.

DEVELOPMENT DURING WAR YEARS. (CONT'D)

(C) Rubber Beadspacers and Metal Beadlocks.

Rubber beadspacers were conceived in U.K. with the development of the Run Flat tire [redacted] a [redacted] of preventing tire slippage at low or zero inflation pressure. In principle, sufficient lateral compression of the tire beads [redacted] developed between the beadspacer and the rim flanges after the W.D. divided type wheel was closed, to prevent the tire beads slipping on the rim.

When it became necessary to reduce consumption of crude rubber, rubber beadspacers [redacted] replaced in most sizes with "Metal Beadlocks" which performed the same function. Metal beadlocks were manufactured in three types in U.K., U.S. and Canada.

U.K. produced what was known [redacted] the "segmental type" beadlock. This beadlock [redacted] composed of a circular spring steel band on which [redacted] mounted [redacted] series of spring steel shoes or saddles spaced 4" centre to centre [redacted] the circular band. It [redacted] necessary to use a flap with the segmental type beadlock. This beadlock [redacted] not produced in Canada nor was it used in Canadian production assemblies.

Canada produced and standardized on the "low-hinge type" beadlock which is [redacted] full circle steel band, cross cut and hinged to permit collapse to a smaller diameter for insertion in and removal from the tire.

LOW-HINGE TYPE BEADLOCK

The United States produced the "low-hinge type" beadlock and in addition, also used an "endless channel type" beadlock, which is [redacted] endless band of steel used only with small size "combat" (the U.S. equivalent of R.F.) tires [redacted] divided wheels.

REFERENCES.

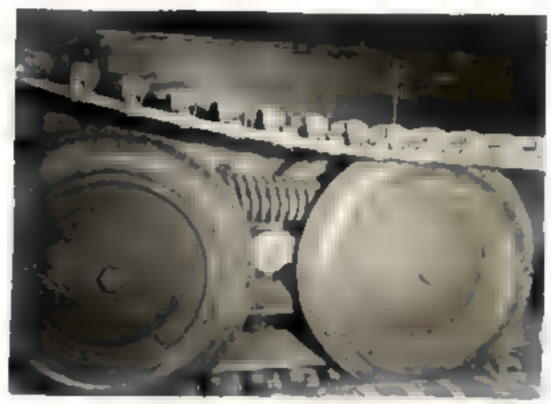
Toledo Woodhead Springs, Limited. Drawing Nos. 1040, 1041, 1042, 1068.

Addendum to Technical Memorandum No. 178, May 14th, 1943.

Design Change Instructions - 42-743, A2-115, B3-599.

B.F. Goodrich - U.S. Army Training School Manual - Combat tires - Section I.

(D) Special Snowmobile Tire.



When the decision was made to build [redacted] Armoured Snowmobile, it became necessary to develop a Run Flat tire in the 4.50-16 size.

Aside from its ability to operate for [redacted] time at zero inflation, the natural ruggedness of an R.F. tire [redacted] very desirable for this vehicle, where frequent damage to the tire sidewalls had occurred in the regular pneumatic tires.

Although synthetic rubber [redacted] available, this [redacted] R.F. tire and tube were developed first in crude rubber. However, synthetic rubber (GR-S) was used satisfactorily in the beadspacer. After the crude tire had performed adequately, a series of experimental tests were conducted to effect a conversion to synthetic.

Final production specification called for [redacted] S-4 synthetic (GR-S) tire, butyl (GR-I) tube, [redacted] GR-S beadspacer. Some difficulty was experienced with the beadspacer and for extra stability, a wire core [redacted] inserted.

REFERENCES.

D.M. & S. File 73 - V - 16,

D.C.I.'s B5-3, B4-2306, B4-2500.

Miscellaneous Rubber Parts.

In the manufacture of military vehicles, rubber was being used in many component parts other than the tires and tubes. Such items included ignition cable, hose, fan belts, spring bumpers, grommets and many others. When the supply of natural rubber became critical, immediate steps were taken to reduce or eliminate the crude rubber from these mechanical parts. In some cases, it was possible to revert back to parts used previously which did not contain rubber.

Reclaim rubber provided a satisfactory substitute in [redacted] other parts. As syntheticrubbers became available, they were also used in many parts.

Some synthetics, such [redacted] Neoprene, had essential properties, which made it superior to natural rubber for certain uses. Neoprene was more resistant to chemicalaction by petroleum products than natural rubber. Industry did an excellent job developing, testing and incorporating into production the various substitutes for the natural rubber components.

It was not possible, however, to develop adequate substitutes for all natural rubber parts and some items had to remain [redacted] natural rubber. For example, master cylinder and wheel cylinder cups could not be produced satisfactorily in synthetic rubber for these critical brake parts. Although considerable development work [redacted] done on synthetic rubber fan belts, an adequate belt was not developed for use [redacted] Ford military vehicles and crude rubber belts continued to be used.

REFERENCES.

D.M. & S. File 73 - T - 54 - 1.

COMPARATIVE CONVERSION SCHEDULE, BY END-PRODUCTS, SHOWING RATIO OF NATURAL AND SYNTHETIC RUBBER CONSUMPTION, (EXCLUDING RECLAIM)

UNITED STATES - UNITED KINGDOM - CANADA

APRIL 1945.

	United States		United Kingdom		Canada	
	Natural %	Synthetic %	Natural %	Synthetic %	Natural %	Synthetic %
TRANSPORTATION						
Passenger Tires	2.4	97.6	5.7	94.3	1.8	98.2
Passenger Tubes	1.0	99.0	13.3	86.7	0.0	100.0
Motorcycle Tires	-	-	5.4	94.6	-	-
Motorcycle Tubes	-	-	56.1	43.9	-	-
Truck [redacted] Bus Tires, (including Flaps)	24.2	75.8	36.9	63.1	26.0	74.0
Truck and Bus Tubes	0.4	99.6	46.9	53.1	0.0	100.0
Airplane Tires	25.8	74.2	42.1	57.9	40.0	60.0
Airplane Tubes	62.5	37.5	98.4	1.6	100.0	0.0
Farm Tractor & Implement Tires	2.8	97.2	6.3	93.7	(1.4	98.6
Farm Tractor & Implement Tubes	0.5	99.5	2.3	97.7	(	
Pneumatic Industrial Tires	3.5	96.5	-	-	(Negligible	100.0
Pneumatic Industrial Tubes	Negligible	100.0	-	-	(	
Bicycle Tires	0.0	100.0	19.3	80.7	(14.3	85.7
Bicycle Tubes	0.0	100.0	47.2	52.8	(	
Truck Type Solids	6.7	93.3	(41.9	58.1	-	-
Industrial Solids	5.5	94.5	(			
Bogie Rollers, Tank Blocks, Tread [redacted] Tracks.	31.0	69.9	78.5	21.5	37.9	62.1
Camelback - Truck Type	(		(		2.9	97.1
Airplane Type	(5.5	94.5	(		-	-
Passenger Type	(		(24.9	75.1	4.9	95.1
Tire & Tube Repair Materials	70.1	29.9	(		58.6	41.4
Valves and Airbags	40.6	59.4	-	-	-	-
Total Transportation	17.1	82.9	34.9	65.1	19.8	80.2
GENERAL RUBBER GOODS	7.0	93.0	25.2	74.8	11.8	88.2
GRAND TOTAL	14.1	85.9	32.2	67.8	18.3	81.7

SOURCE: Materials Division,
Rubber Bureau, W.P.B.

WAR DEPARTMENT WHEELS.

The divided type wheel for [redacted] with [redacted] Department tires was developed in U.K.against the following basic design requirements,

(a) Rugged construction,

(b) Being capable of accommodating Run Flat tires with beadlocks,

(c) Ease of dismantling in the field.

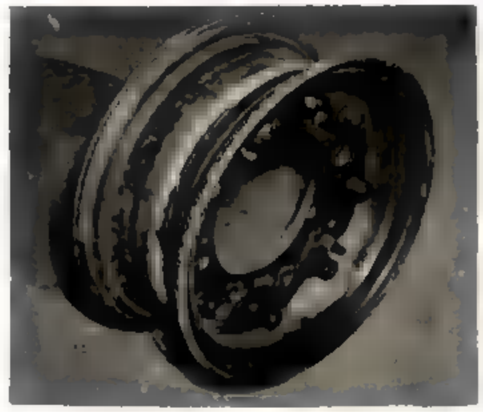
The accommodation of the R.F. tireand beadlock [redacted] the most restricting requirement. In [redacted] up to 15 tons pressure was requir-[redacted] at the rim flanges to obtain [redacted] necessary lateral bead compression.

As the war progressed, by far the greatest percentage of these wheels were used with pneumatic tires rather than R.F. tires and as [redacted] consequence, the "safety margin" in wheel strength [redacted] wheels [redacted] of the vehicle component parts that [redacted] virtually trouble-free.

Practically, the only trouble which did occur [redacted] with the clamping bolts, which fractured at the lowest thread or cracked through the head of the bolt. Extensive investigation of this problem was carried out and some changes made.

When used with pneumatic tires, the W.D. wheel was, perhaps, unnecessarily strong and as a consequence, [redacted] penalty [redacted] paid in excessive unsprung weight imposed on the vehicles. Some development work was carried out with [redacted] view to reduction of wheel weight, but this [redacted] limited to investigation of the use of reduced steel gauges and "light" metal.

It [redacted] shown that 25% reduction of wheel weight could be satisfactorily accomplished by [redacted] of lighter gauge of steel. However, it is felt that weights could be still further reduced by [redacted] redesigning of the wheel to eliminate the duplication of the wheel naves in both halves of the wheel. This would involve the [redacted] of [redacted] locking ring arrangement similar, in effect, to that used with American Combat wheels. Such [redacted] wheel could adequately fill the requirements for War Dept. use, including the application of the R.F. tire, and at the same time, effect a 25-40% reduction of wheel weight. In redesigning the W.D. wheel, it would also appear to [redacted] desirable to standardize the diameters of the hub hole and the mounting bolt circle to permit interchangeability with commercial type wheels.



[redacted] - 10.50-20 Tire mounted [redacted] 6.00-20 x 1-1/2" Wheel.
BELOW - 6.00-16 x 1-1/2" Wheel.

Design Changes explored during War Period.

(A) Change from Valve Depressions to Valve Slots. As [redacted] result of [redacted] investigation of the British Industry into the desirability of replacing valve tunnels or depressions with open slots, the change [redacted] introduced in U.K. production in 1944. A.E.D.B. and Canadian Industry agreed on the desirability of the change and steps were taken to effect the change in production. However, after [redacted] study was made of cost involved and limited wheel production, the change was not carried out in Canada.

REFERENCES:

- I.C.W.D.C. Minutes, March 17th, 1943,
- I.C.W.D.C. Minutes, April 19th, 1944,
- D.C.I. B4-1626.

(B) Reduced Gauge of Steel.

[redacted] study of the possibility of reducing the gauge of steel used in War Department wheels was carried out. The following advantages could [redacted] gained provided adequate wheels could [redacted] produced in a reduced [redacted] steel,

(a) Reduction of unsprung vehicle weight,
(b) Reduction of steel consumption,
(c) Reduction of material cost.

Experimental 6.00-20 x 1-1/2 wheels [redacted] produced in two (2) gauges of steel. Comparison with the weight of the regular production wheel gives some indication of possible weight savings.

Production Wheel (.312/.327") - 99 lbs.
Experimental Wheel (.237") - 74 lbs.
Experimental Wheel (.218") - 71 lbs.

The .237" gauge wheels were run in the Ottawa area. Some clamping failures secured during the test, but all wheels completed the test in serviceable condition at [redacted] maximum rear wheel mileage of 35042.

REFERENCE.

A.E.D.B. Report No. E-306.

The .218" gauge wheels were run at Ottawa, Normoyle, Windsor and Oshawa. Actual wheel failures occurred on these tests and wheels of the.218 [redacted] of steel must be consideredinadequate without [redacted] additional modifications of design.

REFERENCE.

A.E.D.B. Report No. E-471.

(C) Light Weight Aluminum Alloy.

Against [redacted] requirement of reduced vehicle weight for airportable vehicles, experimental wheels wereproduced using aluminum alloy. The test wheels were 6.00-20 x 1½" size, using .320" [redacted] material, formed dead soft and heat treated after forming. Severe cracking at the clamping bolt holes at very early mileages and the inherent "softness" of the material made these wheels unsuitable for service use.

REFERENCE.

A.E.D.B. Report No. E-510, July 25th,1945.

(D) Investigation of Clamping Bolt Problems.

1. 6.00-16 x 1-1/2"

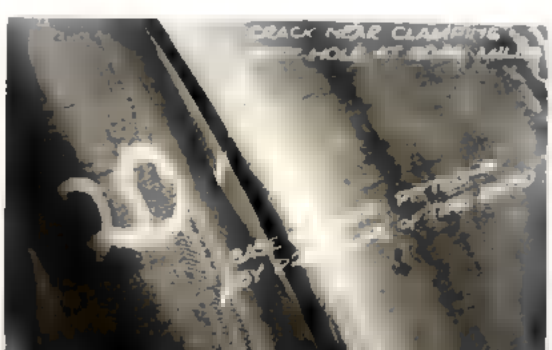
Field defectreports indicated that some clamping bolt failures were being experienced and whilethis problem never reached serious proportions,an investigation was carried on at Normoyle,Texas, in conjunction with the synthetic tire tests.

Five (5) groups of wheels (new current production 6.00-16 x 1-1/2") were tested at various clamping bolt torques, ranging from 300 Ft. Lbs. to 125 Ft.Lbs.

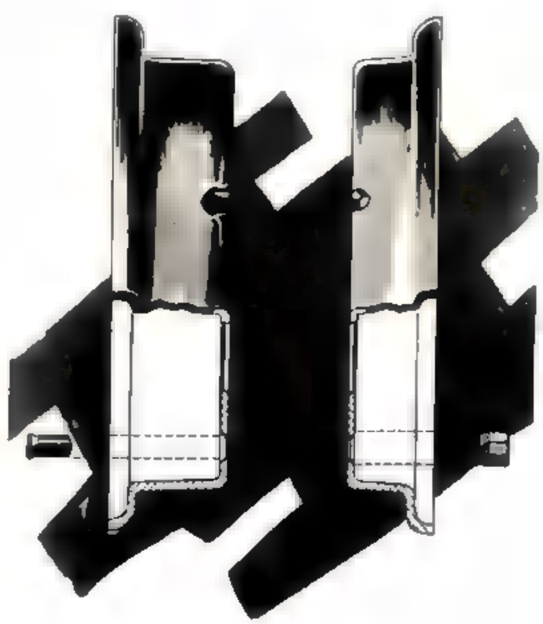
REFERENCE. A.E.D.B. Report No. E-298.

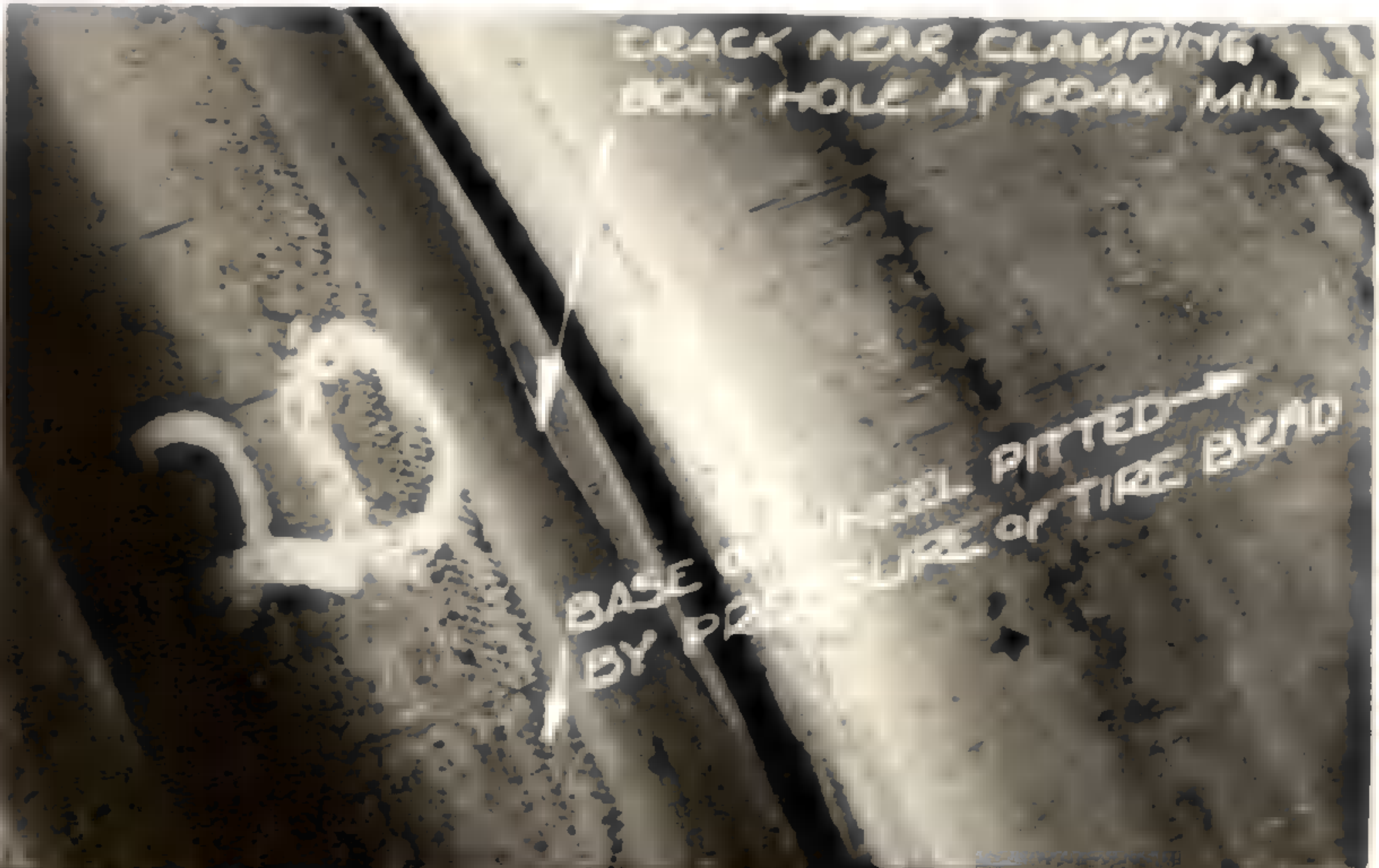
Test results [redacted] not entirely conclusive. At any torque above 200 Ft. Lbs., bolts were drawn through the hole in the wheel nave.

Based on the test results, D.A.D. made the recommendation that clamping bolts on the 6.00-16 x 1½" W.D. divided type wheels be drawn up to 150/180 Ft.Lbs.

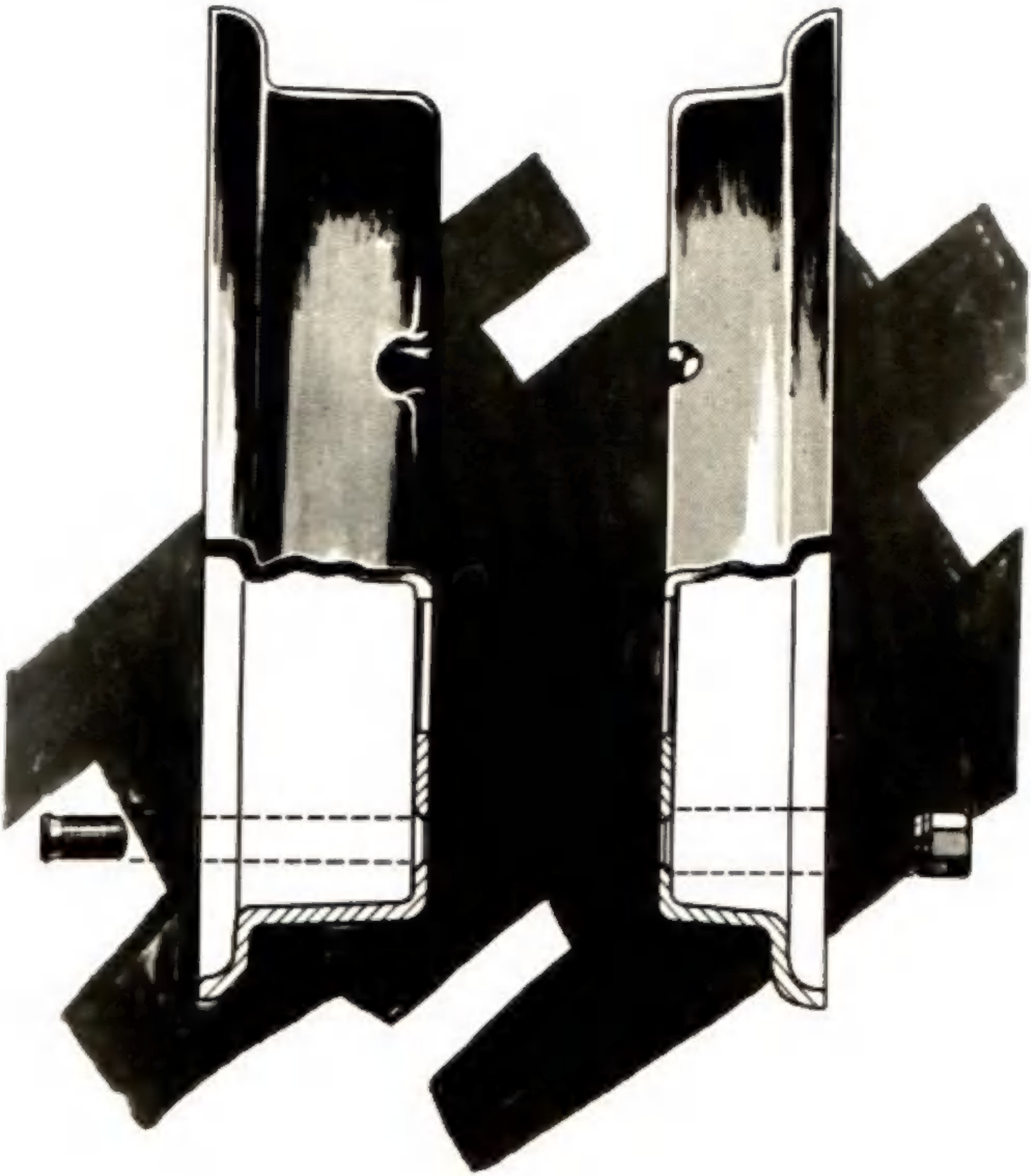


E.P.6.00-20x1½ Experimental [redacted] 25/5 [redacted] type wheel constructed of aluminum 1945.


6.00-16 x 1½
W D [redacted] WHEEL
[redacted] F-190



E.P.6.00-20x1½ Experimental W.D. divided 25/5
394 type wheel constructed of aluminum 1945.



2. 6.00-20 x 1-1/2".

Reports indicated that elimination of the welding atthe mushroom head of the clamping bolt on this wheel might result in increased life of the bolts. With this end in view, Kelsey Wheel Company, Windsor, made up an experimental wheel using bolts with a knurled shank which were pressed into the hole in the wheel nave.

This experimental wheel and one standard production wheel were taken to the Physical Metallurgy Laboratory for comparative torsion and compression tests, results of which were as follows,

STUD	TORSION FOOT POUNDS	COMPRESSION LOAD IN POUNDS
Welded	297	6,590
Pressed	238	16,120

While this information could not be considered conclusive, the torsion value of the "pressed" bolt was sufficiently low to discourage pursuing the development further.

REFERENCE.

D.M. & S. File 73 - W - 4,

P.M. Lab. Report No. 6473.

(E) Use of Wider Base Rims.

Considerable discussion took place in Canada and U.K. regarding the use of the heavily loaded 10.50-16 and 10.50-20 War Dept. tire on the 6.00 wheel. It was contended that some improvement in performance could be achieved by using a wider rim than the 6". Actual road tests of the 10.50-16 tire on 7.33" and 8.37" wheels were projected in U.K. but had not been applied by war-end.

Commercially, in the past few years, there has been a trend towards the use of wider base rims particularly in the U.S. Tire and Rim Association have carefully controlled the changes made to ensure uniformity. In highway operation, the wider rim produces stability in high speed operations, and yields maximum tire tread life. Of course, in this type of operation, high inflation pressures are employed, and the tire is permitted very little flexure.

On the other hand, the argument against the use of wider base rims in military service is based on the fact that in off-road operations at reduced inflation pressure, the narrow rim permits flexure to be distributed more evenly through the sidewalls and produces a wide bending flexure with less pronounced angular kinking.

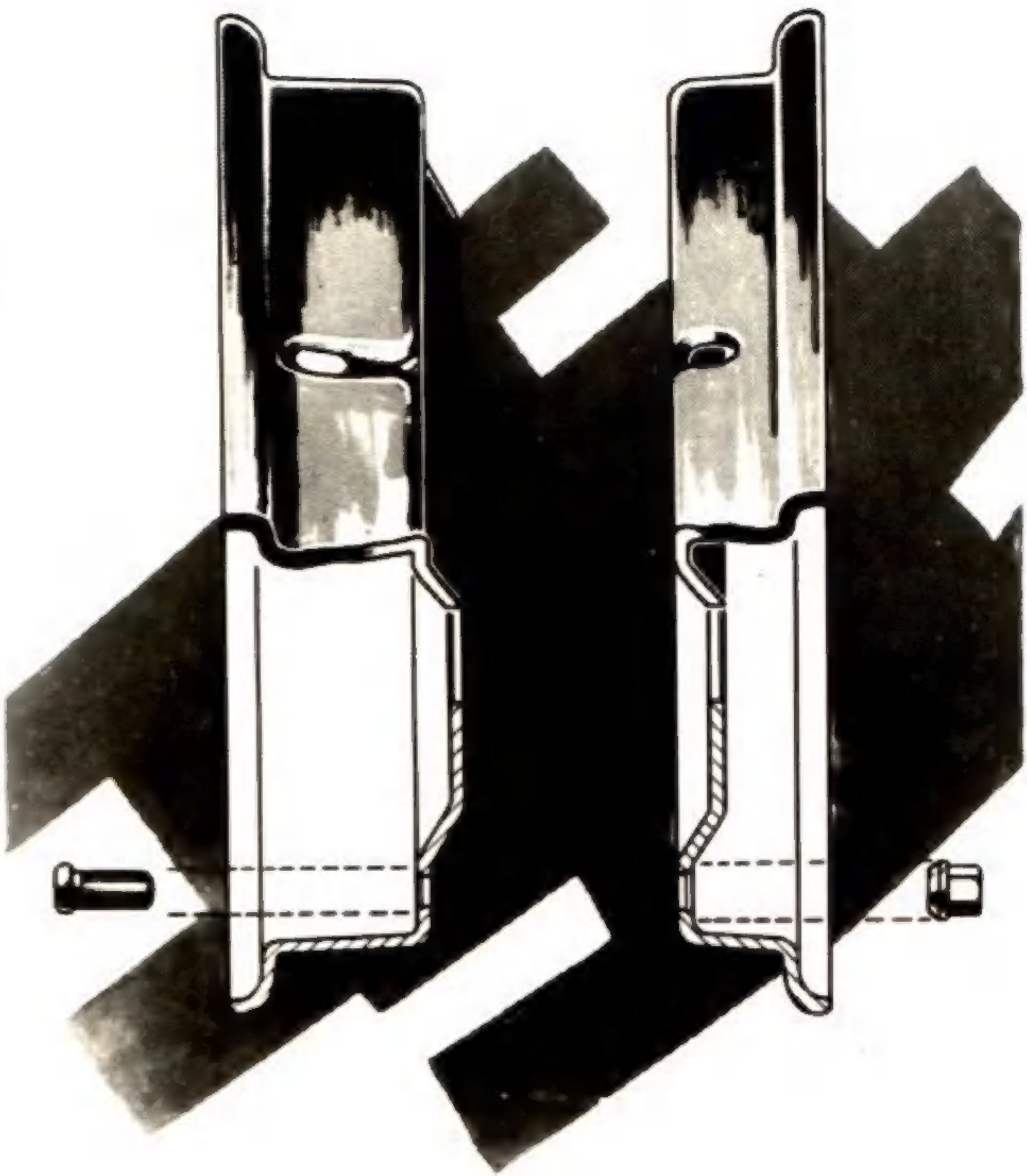
6.00-20 X 1½
W.D. DIVIDED TYPE WHEEL
[illegible]

Design Changes made during the War Period.

(1) Clamping Bolts.

Clamping bolt problems were confined almost entirely to 6.00-16 x 1-1/2" and 6.00-20 x 1-1/2" wheel sizes. Up until October, 1940, both of these wheels used the same identical bolt (D.N.D. Drawing No. 1676 and 1677). This was a flush head countersunk type of bolt with the circumference of the head chamfered on opposite sides to provide two cavities to be filled with weld.

In October, 1940, a mushroom type head bolt was adopted for the 6.00-20 x 1-1/2" wheel (D.N.D. Drawing No. 10691 & 10692). No further changes were made in this bolt. In March, 1942, a new bolt was introduced for the 6.00-16 x 1-1/2" wheel which eliminated the chamfered sides on the circumference of the head and added a 3/16" radius undercut to the root of the first thread immediately under the head. (D.M.&S Drawing B-14800 and 14806). Insufficient clearance between wheel and hub flange or



brake drum on many vehicles using the 6.00-16 x 1-1/2" wheel prevented the use of a mushroom type head bolt for this wheel.

It might be noted that U.K. experienced some difficulties with clamping bolt failures on their production wheels and investigated many points which would have affected wheel interchangeability if introduced into production. Radical changes such as the use of an increased number of smaller diameter bolts on a wider bolt circle were being considered. However, the value of these suggested changes had not been proven and consequently, no recommendations made affecting Canadian production.

<u>REFERENCES</u>.

D.M. & S. File No. 73 - W - 4,

Letter Millman to D.D.E.M. July 21st, 1944,

Letters from C.H. Stevens, (M.O.S.).

(2) <u>Knurled Flanges</u>

Original W.D. divided type wheel specifications called for an "upset" knurling on the inside of all wheel flanges. This was to assist in preventing tire slippage on both R.F. and pneumatic types when operated at low or zero inflation pressures. This practice was discontinued on Canadian W.D. wheel production due to the inability to obtain a satisfactory knurl with available factory machine equipment.

<u>REFERENCES</u>.

D.C.I. B3-199, February 19th, 1943,

D.M.&S. File No. 73 - W - 4.

<u>WAR DEPARTMENT DIVIDED TYPE WHEEL DATA</u>

WHEEL SIZE	5.00-10 15/16"	5.00-18 7/8"	6.00-16 1-1/8"	6.00-16 1-1/2"	6.00-20 1-1/2"	6.50-13 7/8"	6.50-13 7/8"	10.00-20 1-3/4"
Tire Size	8.25-10	7.00-18	9.25-16	9.00-16 10.50-16	10.50-20	9.00-13	9.00-13	14.00-20
Flange Height	1-5/16"	7/8"	1-1/8"	1-1/2"	1-1/2"	7/8"	7/8"	1-3/4"
Rim Base Width	5.00	5.00	6.00	6.00	6.00	6.50	6.50	10.00
Rim Base - O.D.	10.00	18.00	16.00	16.00	20.00	13.00	13.00	20.00
Rim Base - Taper	1-1/2 °	3°	5°	1-1/2 °	1-1/2 °	5°	5°	1-1/2 °
Centerline Offset	.218"	.950"	.5625"	.250"	1.0"	.50"	1.27"	1.313"
Mounting Bolt Circle Diameter	8.00"	6.75"	10.827"	10.827"	10.827"	5.50"	6.875"	13.189"
Assembly Drawing Number	24976	HA868	F10536	189	191	25781	23642	E11231
Drawing Origin	Kelsey Detroit	Dunlop England	D.N.D.	D.N.D.	D.M.&S.	Kelsey Windsor	Kelsey Windsor	D.M.&S.
Wheel Assembly Weight (Lbs.).	23.50		45.62	66.75	99.00	36.00	36.50	144.00
Gauge of Material	.218/ .232"	.176"	.218/ .233"	.312/ .327"	.312/ .327"	.182/ .192"	.213/ .233"	.357/ .419"
Type of Material C. - .08/.12% S. - .04% P. - .04% Mn. - .3/.6% Si. - .04%	Hot Rolled, Low Carbon, Deep Drawing Steel							