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**Preliminary Report No. 12**

**ITALIAN ARMOURD CAR**

# AUTOBLINDA 40

School of Tank Technology  
Egham

May 1943

## FOREWORD

The car arrived in this country in good condition. This is accounted for by the comparatively small mileage covered, and by the considerable trouble taken to protect components from corrosion or damage during transit. After a few minor adjustments the car was made a runner, and mechanically it appeared to be fairly sound with the exception of the steering which needs some attention. Our observations on the performance are in no way intended to constitute a field trial as this is to be carried out by F.V.P.E. at a later date. However, as the result of a brief run, a few observations with regard to the handling and performance of the car are given later in this foreword.

Mechanically the car has many interesting and certain commendable features. The distributed drive to all four wheels and the four wheel steering, make it possible to use a single differential at the expense however of a very large number of bevel gears. The effect of variations in angular velocity of the wheel, due to the cross-pin type universal joint, is very considerably minimised by the hub reduction gear, and further by the four wheel steering which allows a reasonable turning circle to be obtained with a small angular wheel movement. If one can assume that this arrangement is satisfactory, the absence of four constant velocity universal joints constitutes a very considerable economy in manufacture. The five speed gearbox and overdrive gear, giving six forward speeds, gives a wider range than is usual in Armoured Car practice. A directional control lever reverses the whole transmission and allows the rear driver to use the first four speeds. Thus the car may be driven in either direction.

The wheels are not easily removable but detachable rims are fitted. Two spare rims are carried on either side of the hull and are mounted on hubs which are free to revolve. The tyres on the spare rims are therefore able to take the weight of the car to avoid bellying over very rough country.

Of the engine very little can be said, as in the interests of time, and in view of the forthcoming running trials it was not considered advisable to dismantle this unit. Externally it appears to be fairly orthodox and the estimated power given on page 11 should be taken as being very approximate, as neither the capacity nor speed range are known. Access to the engine is difficult, and the tubular chassis cross member which passes over it would appear to be decidedly inconvenient when

removing or replacing the unit.

While the general mechanical layout appears to have been well thought out and designed specifically for the job, the mechanical details in certain cases contrast strikingly in their inadequacy or shoddiness. The whole construction and layout of the rear driver's section savours of modification or after-thought. The main petrol tank under the floor is only protected by a light gauge tray and is extremely inaccessible. The forward tank feeds into the main tank by gravity and no stop cock is provided in the line. There are other similar examples of bad design.

The electrical equipment is generally of good quality. The inter-communication equipment appears to be an aircraft installation, the various units being marked "REGIA AERONAUTICA." The dynamo seems to be much smaller than would be required for the size of batteries carried, and may not be the original. No fuses could be found and it is assumed that the circuits are unprotected, which is rather surprising.

With regard to the armament and armour, it is noticeable that again the lack of attention paid to detail design considerably reduces the potency of the car as a fighting vehicle. The one man turret does not conform to the latest British requirement for a three man turret. The exposed traverse gears, the awkward position of the 2 cm. cocking handle and the limited observation in the turret are in our opinion decidedly undesirable features. There is no electrical equipment in the turret and consequently no rotary base junction. The commander is therefore faced with the problem of what to do with his headphone and microphone leads when traversing the turret.

It is impossible to sight the rear hull gun when it is fully depressed and extremely difficult to do so at any angle under zero. The gunners seat is not in line with the gun and he must lean awkwardly in order to sight when the gun is traversed left. His back is fouled by the turret gunners seat when the turret is straight ahead or traversed left. These points and the improvised appearance of the gun mounting suggest the possibility that the rear hull gun was added as an afterthought. The wooden ammunition racks are very roughly constructed. In general, splash protection is noticeable by its absence. A desirable feature on the other hand is the clean belly of the car and for this reason it is thought that its ability to cross wire obstacles may be good.

As the result of a brief cross country and road run the following points were noted with regard to the handling and performance. Owing to the defective steering which caused very severe "shimmying" at speeds over about 20 m.p.h. it was not possible to drive above this speed.

The engine pulled fairly well at slow speeds and from the front driving position was mechanically quiet especially in view off the fact that no bulkhead is fitted. Engine fumes were barely noticeable in the fighting compartment when driving forward, but were decidedly objectionable when in rear control. There did not

appear to be any tendency for the engine to overheat in rear control although very little running was done in this direction.

The first four gears are noisy and the change is extremely slow. The absence of a clutch stop makes upward changes on rising ground difficult. The direct and overdrive gears, fifth and sixth, being of constant mesh, are much quieter and the change is, of course, is much quicker. The change from front to rear control is simple to effect from the front driving position and if the normal gear lever is in neutral, the clutch need not be used. From the rear driving position, however, the directional control lever is so situated that it is almost impossible to operate it.

At low speeds the steering was reasonably light by virtue of the fact that it is extremely low geared. As there is absolutely no self-centring action when driving in either direction, it is assumed that there is no castor angle. At about 15 mph there was a tendency to "shimmying" which increased in violence unit at about 20 m.p.h. the car was almost uncontrollable. It is considered that, although this defect is obviously an abnormal state of affairs, the apparent lack of castor angle may aggravate this tendency.

The hydraulic brakes were quite light to operate, but not very positive.

The independent suspension was excellent over both road and cross country and although extremely soft it did not appear to cause any undue degree of rolling or pitching at the fairly slow speeds which were attained.

The front driving position is quite comfortable, but the rear driving position is impossibly cramped for a tall man. The lack of any side vision is a decided disadvantage.

The car was driven into a small muddy depression of clay and became completely bogged even though the differential was locked. There was no question of clutch slip or of insufficient engine power as all four wheels were turning. It is not considered that most other four wheel drive vehicles would have become bogged under similar conditions, and the fact that the car was shod with comparatively smooth "Libia" tyres may have been partly responsible for this rather surprising failure.

In conclusion it may be said that the general impression is that the basic design has been well thought out with a view to producing a manoeuvrable high speed fighting vehicle, but that certain detail design features particularly with regard to the fighting arrangements have received such scant attention that the potential possibilities have not been fully realised.

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PRELIMINARY REPORT  
ON  
**ITALIAN ARMOURD CAR**  
**AUTOBLINDA '40'**  
(Received from Middle East)

EXAMINED AT CHOBHAM (D.T.D. No. 3004) D.T.D. PROJECT NO.  
V.7021. May, 1943 EXAMINERS : MAJOR J.D. BARNES, R. T. R., and MR.  
D.M. PEARCE, B.A. (Cantab).

**1. TYPE**

ABM '40' 4 x 4 armoured car. Chassis No. 40788. Year: 1941.

**2. IDENTIFICATION MARKINGS**

The figure "8" appears in black paint on upper nearside hull plate and on the upper offside hull plate and the nearside front wing. A pennant, black over red, with a crescent moon and two palm trees superimposed is also painted on the upper offside hull plate. The words "Polish Carpathian Lancer" are painted in black on the upper nearside hull plate.

**3. GENERAL CONDITION**

The general condition of the vehicle appears to be good and the total distance recorded on the speedometer is only just over 4,000 miles.

Only a few minor adjustments were necessary to make it a runner. The tyres on all four wheels are slightly worn, but those on the two spare rims appear to have had little use.

**4. WEIGHT**

As received and partially stowed:

Total 6.9 tons.  
Front Wheels: 3.05 tons.  
Rear Wheels : 3.85 tons.

Estimated total weight in battle order : 7.5 tons.

### **5. SPEED**

Not tested. Speedometer shows maximum speed in 6th gear as 78.5 K.P.H. (49 m.p.h.). This figure indicates forward speed. The highest ratio which can be engaged by the rear driver is 4th and the maximum speed in this gear is indicated as 38.5 K.P.H. (24 m.p.h.) on the speedometer.

### **6 CREW**

Four: Commander/Gunner, two drivers (one fore and aft) and a rear hull gunner.

### **7. DIMENSIONS**

LENGTH 17' 1½ "  
WIDTH 6' 4¼"  
HEIGHT 7' 11 5/8"  
CLEARANCE 13 ½" (under hull)  
CLEARANCE 10 ½" (under spare rims)  
WHEELBASE 10' 7¾ "  
TRACK 5' 6 ½"

### **8. ARMAMENT**

#### **Turret Guns**

#### **2 cm. Breda.**

Markings: "Canone da 20 M/M Controaereo - Mod.1935  
No. 3809 Brescia 1940 - XVIII - "

Total Weight: 150 lb.

Total Length: 80 ins.

Weight of Barrel: 61 lb.

Length of Barrel: 57 1/2 ins.

The gun is gas operated and the regulator has ten positions. It is fed by plate chargers, each charge holding 8 rounds. The feed is from the left hand side and the empty cases are returned to the plate which is ejected to the right. A safety catch is provided on the firing handle and a buffer adjustment on the rear cross piece. A flash eliminator consisting of a plain cylinder 6 3/8" long and 1 3/4" bore is fitted.

### 8 mm. M. G. Breda.

Markings: "8 mm. Metragliatrice Breda  
Mod. 38 - No.157. 30.XVII"

Total Weight: 55 1/2 lb.

Total Length: 35 3/4 ins.

Weight of Barrel: 11 1/4 lb.

Length of Barrel: 23 3/8 ins.

The gun is gas operated and is fed by spring loaded 24 round magazines of the Bren type. A safety catch is situated on the rear cross piece. The barrel can easily be removed.

Traverse. 360 deg - Both guns traverse with the turret and particulars of the traversing gear will be found on Page 8, Para II.

Elevation. Maximum Elevation: 18deg Maximum Depression: 9deg  
The elevating gear is operated by a handcrank on the left of the gunner. The handcrank has a radius of 3 1/4" and rotates on a transverse axis. Fourteen and a half turns of the crank are required from full depression to full elevation. The movement of the handcrank is transmitted through a worm to a phosphor bronze sleeve which rotates in a vertical plane in the elevating gear-box. This sleeve has a square female thread to suit a male member, the forked end of which swivels in a mounting bolted to the turret roof.

### Gun Mountings.

The 2 cm. gun mounting is of channel section, semi-circular extensions of the sides at the forward ends forming a bearing to carry lugs on which the gun is mounted.

The lugs are slotted across their inner faces to suit keys on the gun. Pins located in coincident holes in the mountings, and the lugs, secure the latter, and the withdrawal of these pins permits the lugs to be pulled clear of the gun, thus providing a quick and simple method of mounting or dismounting the gun. To facilitate the withdrawal of the lugs, eye-bolts are screwed into their outer ends. At the rear of the mounting the gun is secured by a single pin.

The M.G. mounting consists of two separate brackets bolted to the main mounting on the left hand side. The rear member is of orthodox slide pattern and the gun is secured to the front member by a locating pin.

### Cocking Gear

The cocking gear for the 2 cm. gun is between the right side of the gun mounting and the telescope tube. The cocking piece is secured to a slide which travels in guides and in a slot machined in the side of the mounting. This slide is secured to a single roller chain which is fitted to sprockets mounted alongside the gun



mounting. The rearmost sprocket is turned by a handcrank of 4 3/4" radius - three turns of the crank being necessary to cock the gun. A clock spring housed in a drum through which the crankshaft passes is wound as the cocking piece is drawn back. When the gun is cocked, the crank handle, which is hinged, is swung back and by this action the crank is disengaged and the cocking piece returned by the spring. It is worthy of note that when the hand-crank is at the point nearest to gunner it can only be turned with difficulty by a normally proportioned man owing to lack of clearance between the man's body and the crank. The distance between the crankhandle and backrest at this point is 9" with gun in horizontal position. This difficulty exists throughout the full arc of elevation and depression. In the latter case, the handle is uncomfortably close to the gunner's face which constitutes a source of danger should the handle be released before being disengaged from the return spring.

### Sighting

Telescopic :	Field: 30 deg	Magnification: 1
	Length of Telescope:	32 5/8"
	Weight with brow pad:	14 lb. 7oz.
Markings :	CANNOCCHIALE DI PUNTAMENTO CAMPO 30 deg - ING 1 x SAN GEORGIO S.A.I. GENOVA - SESTRI No. 88215.	

The telescope is housed in a tubular member bolted to the right hand side of the gun mounting. The instrument is a straight tube type with an articulated eyepiece and brow pad. There would appear to be no "zeroing" device fitted. Firing. Both the 2 cm. and the co-axial M.G. are fired by foot control. Pedals are mounted on either side of a central tubular support which is taken from a triangular bracket bolted to the turret flange under the gun mounting. The "pull" is transmitted to the triggers on the guns through "Bowden" type cables. A "tee" type footrest is fitted to the central support, immediately over the firing pedals and a further footplate is provided behind and below them.

### Gunner's Seat.

The turret gunner's seat is mounted on two tubular supports bolted to the turret flange and rotating with it. The seat is hinged to the supports and when not in use it is automatically folded back by coil springs incorporated in the hinges. A body strap is provided to prevent the gunner being unseated when travelling over rough country. The seat is adjustable for height allowing a range of 4". The adjustment is not a quick one and necessitates the loosening of two nuts on the clamps securing the seat to the supports. A padded back rest, also bolted to the turret flange, is provided.

### Hull Gun.

The gun is a similar weapon to that mounted in the turret.



Markings: METRAGEL BREDA TIPO C.A. CAL 8.  
No. 2458 - 41 -XIX.

Traverse and Elevation:

Traverse 28 deg

Maximum Elevation 14 deg

Maximum Depression 7 deg

The traverse and elevation of the gun are by hand. The mounting may be clamped at any point in the arc of traverse by tightening a wing nut on a screw projecting from the outer cup about which travels a slotted quadrant which is screwed to the traversing ring.

A leather strap hanging from the roof provides a means of steadying the gun when it is not in use.

Gun Mounting.

The mounting which is of "Gimbal" type consists of four main members, a stationary ring bolted to the hull in which the assembly is mounted, an inner ring which swings in a vertical axis and an inner hemisphere moving about a horizontal axis which forms the mantlet. The inner hemisphere is 15 mm. thick. The fourth member of the assembly is the gun mounting which is of orthodox slide and locating pin type. The mounting is bolted to the inside face of the inner hemisphere. To allow clearance for the magazine when the gun is loaded it has been necessary to cut a suitable opening in the hull roof and a domed cover 10 mm. thick and 6" high is bolted over this opening.

Sighting.

Telescopic: Field 20 deg Magnification 1

Length of telescope 20 ins. Weight with browpad 5 lb. 5 oz.

Markings: CAMPO 20 deg - ING 1x  
SAN GEORGIO S.A.I.  
GENOVA - SESTRI  
No. 100293.

The telescope is a straight tube type and is mounted on the left of the gun. There would appear to be no "zeroing" device fitted.

Firing.

The gun is fired by its own hand trigger and only the single hand control is provided.

Gunner's Seat.

The gunner is provided with a hinged seat mounted on the hull floor. His position

is decidedly uncomfortable and he must lean awkwardly to the left to place his eye to the sighting telescope.

### **9. AMMUNITION CARRIED.** (See Fig.3)

2 cm. - 344 rounds.

Racks are fitted in the fighting compartment to accommodate 43 plate chargers each containing 8 rounds of 2 cm. ammunition. Fourteen of these are carried on the offside and 29 on the nearside. The racks are of wooden construction and there is a separate compartment to hold each magazine in horizontal position. A strip of spring steel with a step riveted to its outer end is fitted to each end of each compartment to retain the magazines in position. Canvas curtains are fitted to the front of each tier of compartments.

8 mm. - 2040 rounds.

Stowage for 85 magazines each constructed to hold 24 rounds of 8 mm. ammunition is provided by wooden racks fitted to the sides of the fighting compartment. There are 40 compartments on the offside and 45 on the nearside. The magazines are carried in vertical position and a brass strip screwed along the front of each row of racks and projecting slightly over the edge of the shelves serves to hold the magazines in place.

The wooden racks in all cases are of very flimsy construction and it is doubtful if they would stand up to their load over hard going. The fire risk occasioned by the use of wood cannot be overlooked.

### **10. ARMOUR**

Details of armour thicknesses and angles will be found on drawings appended. The general construction is of flat plates bolted together, although a small amount of plate forming has been used in visor flaps, ventilating cowls, hatch covers and wheel arches. The bolts are countersunk and have conical heads. They are generally of 10 mm. diameter and spring washers are used very largely but not throughout. Where riveting has been used, the rivets are flush with the outside surface of the plate.

The fitting of the plates is generally bad, and even in such exposed positions as the nose, considerable gaps occur between the plate edges. Very little attempt has been made to protect the crew against bullet splash. Turret ring protection is provided only at the rear by a length of 6 mm. angle section bolted to the top plate.

Approximate Brinell hardness figures were obtained with a "Poldi" portable tester for the main plates of the hull and turret.

In all cases tested the armour was found to be homogeneous of approximately 320 - 340 Brinell hardness number, with the exception of the turret front plate. This plate is cast and has a Brinell hardness number of approximately 197.

## **II. GENERAL CONSTRUCTION**

Chassis.

The channels of the side members face outwards The frame is braced by a channel section cross member at each end, and by two further cross members which also serve to carry steering boxes and the lower radius arms of the suspension units. A tubular bridge of 3" diameter braces the frame at each end at the point where the suspension units are mounted.

#### Hull.

The contours of the hull may be readily seen from the photographs and drawings appended. It is constructed almost entirely of flat plates butt jointed over strips of flat or angle section to which they are bolted or riveted. The hull is bolted to the chassis frame and a laminated packing material is used in the joint.

There is no belly tray fitted but the power plant and transmission units are protected by three trays. The rear petrol tank, petrol filter, radiator header tank and rear driver's instruments and steering column are mounted on a light channel section framework of welded construction. The base is bolted to the chassis frame, and the top to the rear engine cover plate and to the tubular cross member of the chassis. Mudguards are fitted over each wheel and are bolted to the hull.

#### Turret.

The turret is in the form of an octagonal truncated pyramid and is of bolted construction. Internal Dimensions :

Turret Ring Diameter....3' 2¼" Width at Base ....3' 9"

Front to rear at base...3' 9" Width of Mantlet..11 8½"

Height of Turret.....1' 9"

Headroom (from floor of fighting compartment to turret roof) 6' 6 5/8"

#### Turret Traverse.

Traverse of 360 deg is provided. The floor does not rotate but the gunner's seat and footrest are suspended from and move with the turret. The traversing gear is bolted to the turret flange on the right of the gunner. It is operated by a handwheel of 3 1/4" radius through bevel gears, a worm and wheel and a pinion to turret ring. Ninety five turns of the hand-wheel are necessary for complete traverse.

The bevel gears, pinion and roller are entirely exposed and constitute a source of danger through clothing or other matter becoming entangled with them. A lock is provided in the form of a spring loaded plunger engaging splines on the handwheel shaft. No free turn of the turret is provided. "G" clips may be adjusted by means of wing nuts. The tightening of these clips whilst not forming a positive lock against the operation of traverse gearing, prevents movement through backlash in the gearing during travelling. When the clips are loose there is a tendency for the turret to jump when the vehicle is travelling. When the turret guns are depressed the 2 cm. gun mounting fouls the dome in the roof of the hull which is provided to clear the magazine on the hull M.G. Consequently the turret cannot traverse completely with the guns in this position.

Gun Mantlet. The turret gun mantlet is of semi-cylindrical construction, the thickness of the plates used being 9 mm. The circular cheeks are bolted to the curved front plate through angle section riveted to the latter. The cheeks form the bearings for the trunions on which the mantlet pivots. The front plate of turret is a single casting and forms a mounting for the mantlet. No protection against splash is provided either inside or outside

## **12. OBSERVATION**

### Forward Driver's Visor.

A vision port for the forward driver is mounted in the front vertical plate and is offset 5" from centre line. The opening measures 19½" x 6 7/8". A non-slitted hinged B.P. flap is fitted and is operated by a tubular lever on the right of the driver. Three positions of opening and one locked position are permitted and the flap is secured in these positions by the engagement of a pawl in a quadrant. The pawl is disengaged by pressure of a spring loaded plunger which passes through the lever. A swivel bolt is fitted at each end of the visor presumably to secure a glass which is deficient. Above the visor, the front vertical plate and top plate are cut away to form an opening for an episcopes. This opening is cut 2" down in the front plate and 2" back in the top plate and is 8" wide. The episcopes mounting incorporates a roller shutter which may be used to close the port when the instrument is not in its mounting. The episcopes is deficient.

### Rear Driver's Visor.

The driver at the rear of the vehicle is provided with an identical visor to the forward driver. It is situated on the nearside of the rear vertical plate. No provision is made for an episcopes for this driver.

### Commander's Vision.

Periscopic: Field 300 Magnification 1  
Height of periscope: 16"  
Weight with browpad and mounting 16 lb. 4 oz.  
Weight of periscope only 7 lb. 8 oz.

Markings : CANNOCCHIALE PANORAMICO DI OSSERVAZIONE  
CAMPO 30deg ING. 1 x  
SAN GEORGIO S.A.I.  
GENOVA - SESTRI  
No. 94951

The periscope is mounted under a domed cover on the nearside of the turret roof. The instrument operates on the dial sight principle and has a stationary eyepiece. The object prism is easily removable and the whole instrument may be readily dismantled and stowed. In order to guide the user as to the direction of vision the following inscription is engraved on the eyepiece screen:

AVANTI (Front)	DESTRA (Right)
DIETRO (Back)	SINISTRA (Left)

#### Revolver Ports.

A revolver port is fitted in the top plate of each side door and in each turret side plate. The construction of the ports is shown in fig. 6.

### **13. ACCESS DOORS AND ESCAPE HATCHES**

#### Hull.

Access to the hull is obtained by a halved door on each side, situated slightly forward of the centre. The lower half of each door is hinged to the lower hull side plate and the upper half to the upper side plate. The top half of the openings covered by these doors is rectangular and measures 1' 6" x 1' 6¼" whilst the lower half is in the form of a trapezium measuring 1' 6" at the top, 10½" at the bottom and 1' 6¼" in height.

The doors are of 10 mm. plate and a lip is formed on the lower edge of each upper half door to overlap the upper edge of the lower half which is chamfered to suit. Each half door is secured by a casement type catch, the spindle of which passes through the door in a spring loaded boss. The catch locates in a quadrant fitted to the side plate and in order to release the catch it is necessary to push inwards and turn a lever from the outside or to pull and turn a handle on the inside.

A barrel bolt is fitted to the inside of the upper half of each door to allow the crew to prevent the doors from being opened from the outside. Staples are fitted to the outside of each pair of doors and to the hull side plates to accommodate padlocks.

The hinges incorporate limiting stops to avoid damage to the catches by contact with the hull side when the doors are opened.

#### Turret.

There is an escape hatch in the top of the turret measuring 1' 8½" wide and 1' 3¼" from front to rear. This hatch is offset 4¾" to the offside of the turret. It is provided with a cover hinged to the front and is secured by two latches similar to those in the side access doors. A lip formed at the edges of the cover locates over a splash ring riveted to the turret top.

A circular aperture of 4" diameter is provided in this door. A sliding B.P. cover is provided and is secured by a handnut.

A loading hatch for mounting the 2 cm. gun is provided in the rear of the turret and measures 14¾" x 14". A B.P. door hinged to the top is fitted to this hatch. This door is locked by two bolts which are actuated by a pinion engaging in racks at ends of bolts. The operation is by lever on the inside of the door, which cannot be opened from the outside.

#### Engine Cover Plate Hatches.

Two hatches of trapezoidal plan each measuring 36" x 14" x 10" provide access

to the engine. They are hinged to the centre. These covers are louvered for air inlet and each is secured by 3 brass swivel bolts hinged to engine cover plate.

Head Lamp Flaps. (See Fig 5)

The front head lamps are recessed in the front vertical plate and may be completely covered by B.P. flaps. These flaps are hinged at the top and may be opened or closed by the forward driver, each flap having a separate lever and spring loaded pawl engaging a quadrant.

**14. ENGINE**

Maker. S.P.A.

Type. 6 cylinder in line

Fuel. Petrol

Markings. S.P.A. 518931 21-11-40 Abm.1. 100041

Rating.

(See Foreword) capacity not measured. Estimated maximum B.H.P. approximately 100 - 120.

Valves.

There are two overhead valves per cylinder mounted in three separate heads. The valves are push-rod operated through rocker arms and clearance is adjusted by square head set screws at end of rocker arms. The rocker shaft in each head is mounted in two bearings. Double valve springs are employed and caps are fitted to ends of valve stems. The springs are retained by split cones. Three aluminium rocker-box covers are fitted, one for each head, each incorporating a gauze breather under which is a baffle plate.

Fuel Capacity.

Three petrol tanks with a total capacity of 46 gallons are fitted as follows :

One under floor of fighting compartment with a capacity of 26.5 gallons, the filler cap for which is situated forward on upper nearside hull plate. A second fuel tank is mounted in steel straps in scuttle formed by front glacis plate, immediately over driver's knees. This tank has a capacity of 12 gallons. The filler cap is mounted on the top of the tank and is accessible through the glacis plate on removal of a cast B.P. domed cover. A third tank is mounted in steel straps on the offside of the rear scuttle formed by the engine cover plate. The capacity of this tank is 7.5 gallons and its filler cap is at the top of the tank and is accessible from the inside of the vehicle.

Petrol Pumps and Fuel System.

Two electric diaphragm type petrol pumps are mounted alongside the main fuel tank underneath the floor of the fighting compartment. The circuit is controlled by the ignition switch. Their output is coupled and the fuel is conveyed via a single copper pipe, a two-way cock and a bowl type filter mounted under the rear

petrol tank to the carburettor. The filter is marked: "ZENITH - TORINO". The fuel in the forward tank is fed by gravity to the main tank. The small tank at the rear contains the reserve supply of fuel which is fed to the carburettor by gravity via the two-way cock in a position between reserve and normal.

There is no inscription to indicate that this constitutes "OFF" position. The two positions marked being

"Reserve" and "Normale."

A priming cock is provided for each cylinder. These are mounted on near side of the engine below the sparking plugs.

#### Carburettor.

Of up-draught type and mounted on off-side of engine under exhaust and inlet manifold.

#### Exhaust.

The exhaust manifold is on the offside of the engine. A cylindrical silencer is mounted on the hull side.

#### Air Cleaners.

There is a dry type air cleaner mounted low down on the offside of the engine at the flywheel end. Its element is accessible through the fighting compartment, a wing nut being provided for its removal.

#### Ignition.

A Marelli magneto is mounted low down on the nearside of the engine and is driven off the timing gears through an enclosed shaft and a metal vernier type coupling. The magneto is fully screened to prevent radio interference. An impulse starter is incorporated in the magneto. The plug leads are also fully screened by a braided metal sheath and are carried through a tubular metal support to six 14 mm. Marelli three point sparking plugs. The centre electrodes of the plugs are enclosed and the leads are secured by means of shouldered nuts which contact the leads with the electrodes.

#### Dynamo.

A Magnetti Marelli dynamo is mounted forward on the offside of the engine and is driven from the timing case through a shaft and roller chain type flexible coupling.

#### Voltage Control.

The dynamo voltage is controlled by a vibrating contact type controller mounted to the right of the rear driver's panel, and a cut-out is fitted in the same case. A small box carrying a 12V 5W lamp and switch is mounted underneath the control unit, the lamp being connected to terminals marked +D and +Q (dynamo positive and battery positive) which would indicate that this lamp is a warning lamp for the rear driver.



### Starters.

A manual starting handle is provided which engages a dog at the end of the crankshaft. An orifice is provided for the starting handle in the tail plate, a screwed cap being fitted for protection. An electric starter, solenoid operated, is mounted on the offside of the engine. It is of the orthodox type with Bendix pinion type of engagement.

### Accumulators.

The accumulator consists of four 6 V batteries of Marelli manufacture. They are housed in pairs on each side of the vehicle in steel boxes under the floor of the hull and on the outside of the chassis members immediately beneath the hull doors. To obtain access to the batteries is a lengthy and somewhat difficult task. It necessitates removal of two stowage boxes on either side of the hull, in addition to removal of a large portion of the floor plates. Numerous bolts and setscrews are involved, many of which are themselves inaccessible. It is probably for this reason that the acid level in all accumulators was found to be low and that considerable corrosion had occurred at the terminals. Further points of interest are that there are no drain holes in the carrier boxes. Consequently spilled acid tends to cause corrosion here. The faces of the rubber mats laid across the top of the accumulators to insulate them from the floor plates become wet through condensation and their efficiency as a di-electric is considerably reduced. There is no ammeter in the circuit.

### Governors.

A centrifugal governor driven in line with the dynamo is fitted, but is not connected to the carburettor, the connecting lever having been secured to the case of the unit by a sealed wire.

A suction type governor is incorporated in the carburettor but is not in operation owing to damage to adjusting screw from the butterfly, which is presumably held in the full open position.

### Cooling.

Water; radiators (sealed system), centrifugal pump and two fans.

### Radiators.

Two radiators are mounted vertically side by side at the rear of the engine compartment. An independent header tank with a capacity of 2.5 gallons is mounted on the near side of the rear scuttle in steel straps. The filler cap is at the top of the tank on the inside of the vehicle. The matrix of each radiator is constructed in six sections, each section consisting of a bank of tubes coupled to its neighbour by a double banjo type union at the top and bottom.

### Water Pump.

A centrifugal water pump is driven in line with the dynamo and governor.

### Fans.

Two aluminium radial flow fans are mounted in a bulkhead at the rear of engine

in front of radiators. They are driven from the crank shaft at engine speed by single Vee belts.

Air is taken through louvers, in the rear engine cover plate and, having passed over the engine, is exhausted by fans through the radiators and louvers in the upper tail plate and an opening in the lower tail plate which is protected by a B. P. cowl.

#### Vibration Damper.

A large Lanchester type vibration damper is mounted behind the fan drive pulley.

#### Lubrication.

Lubrication is by forced feed, the sump being dry. An oil canister is mounted on the nearside of the engine. The filler cap which incorporates a dipstick is situated on top of the canister and is accessible through the nearside engine cover plate hatch. A further cap marked SCARRICO OLIO (Used Oil), on top of the canister gives access to a remote controlled drain plug. The plug is opened by turning a square section rod which is carried through the canister to the aforementioned cap.

#### Oil Cleaner.

A cylindrical type gauze filter is mounted between the oil canister and the engine. The gauze elements are accessible from the rear driving section by the removal of the top cap of the filter bowl. An Auto Klean type filter operated by the clutch pedal is incorporated in the same mounting.

#### Mounting.

The engine is mounted at four points on trunions in "Silenbloc" type bushes. From the flywheel end the engine is inclined at 2deg from the horizontal.

### **15. GEARBOX AND TRANSMISSION**

#### Clutch and Gearbox.

From the engine the drive is transmitted via a dry plate clutch to a crash type gearbox. This is integral with the clutch housing at the engine end and mounted on a support fitted to each side of the chassis frame at the other end. The mounting follows the same incline as the engine, i.e. 2deg. The box contains two compartments. The larger contains a five speed unit, fifth gear being direct. The main shaft is mounted above the layshaft and the selector shafts are on the left hand side. straight tooth spur gears are employed. In the smaller compartment which is to the rear of the main box, next to the clutch, is an overdrive gear. The gears are of helical tooth constant mesh type. Fifth and sixth gears are only available to the forward driver and it is necessary for him to depress a plunger type stop incorporated in his change speed lever in order to pass the lever into the gate for their selection.

It would appear that some difficulty has been experienced in engaging third gear as the teeth on the pinions are badly burred. The change speed levers are coupled by a shaft incorporating two cross pin type universal joints and movement of the

levers is somewhat heavy in consequence.

A separate reverse gearbox is bolted to the output or forward end of the main gear box and therefore reverses all the gears. Coupled controls are provided to enable either driver to operate the reverse gearing, the directional control levers being inscribed "INVERSORE." "AVANTI - INDIETRO".

#### Distribution Box. (See Figs. 9 & 10)

The drive from the gearbox is transmitted via a short cardan shaft and a large fabric disc joint to the distribution box. This box is mounted approximately amidships in the chassis, and four separate output shafts take the drive from the box to each wheel. In plan, therefore, these shafts are in the form of an "X".

The drive into the distribution box is transmitted by a helical toothed crown wheel and pinion to a differential unit. Each half shaft from the differential drives through the helical bevels, one front and one rear wheel. Thus the front wheel on one side is positively geared to the rear wheel on the same side, and differential action can only take place between the pair of wheels on one side and the pair of wheels on the other. As four wheel steering is employed, the front and rear wheels of each side move on a common turning circle and differential action between them is therefore unnecessary. The differential may be locked by means of a sliding dog clutch which connects one half shaft with the differential casing. The four output shafts pass obliquely through the chassis frame and each incorporates a cross pin universal joint at each end. Each shaft is open after passing through the chassis frame but is enclosed between the distribution box and the frame, in two short tubular housings coupled by a fabric gaiter which allow for the movement of the shaft. The shafts to the forward wheels are 6" longer than those to the rear wheels.

#### Hub Reduction Gear. (See Fig.10)

The drive to each wheel is by separate helical toothed crown wheel and pinion in the wheel hub, housed in a cast bevel box which forms the brake back plate and supports the wheel bearings. The driving shaft passes through the king pin axis - at a point where it incorporates the outer universal joint - before entering the bevel box. The final reduction gears are therefore unsprung

### **16. STEERING**

Turning Circle - 41 ft. (To outside tyres in both forward and reverse on either lock).

The steering of the vehicle is operated on all the road wheels simultaneously from either the front or rear driving seats. This is achieved by the coupling of the front and rear steering units by a shaft incorporating two metal disc type universal joints. Actuation is through bevel gears at the base of each column. The forward steering column is mounted 6" to the near-side of the centre line and is inclined towards the rear of the vehicle at an angle of 10deg. The wheel is mounted at right angles to the column. Its movement is transmitted through bevel gears at the top and bottom of the column, to the coupling shaft and to a central worm and worm wheel. An arm moving in a horizontal plane and integral with

the worm wheel operates rods which connect to a steering arm on each stub axle.

The rear steering column is mounted on the near side of the vehicle and is inclined at 8deg to the offside to allow room for the driver's right leg. The steering wheel is mounted vertically. The gearing is similar to that used in the forward steering unit but longer shafts are necessary to convey the movement from the column to the worm.

Owing to the large number of bevel gears used in the layout, there is a considerable amount of backlash. A free movement of the steering wheel of approximately 90deg to 100deg is possible.

Lubrication of the steering units is effected by remote Tecalemit type grease nipples in the forward and rear driving sections. The word "GUIDA" (Steering) alongside the nipples indicates their purpose.

## **17. WHEELS AND TYRES**

The vehicle has four road wheels of detachable rim type and two spare rims mounted on rotating carriers at each side of the hull.

### Road Wheels.

The road wheels are of cast disc type of 1' 10" diameter (less rim and tyre). Six spoke-like ribs are incorporated in the design to give the necessary stiffness at the points where the securing clamps for the detachable rims are fitted.

The wheels are bolted to the brake drums by six hexagon headed bolts and the assembly is fitted to the hub with a key and secured by a large hexagon nut. The hubs are mounted on ball races which are lubricated from the final drive units. Pressed hub caps are secured by six hexagon head set screws.

### Spare Rim Carriers and/or Auxiliary Load Carriers.

The spare rim carriers consist of plain pressed discs. They are mounted on cast hubs with a parallel bore forming the bearing on which the wheel can rotate. The stub axles are bolted to the recessed hull plate. The stub axle is mounted at a height which permits the tyres to project 3" below the hull, this enabling the tyres to take the weight when crossing rough country, thereby minimising the danger of bellying. There is no drive to the spare wheels and there is no reinforcement of the hull where the axles are attached.

### Tyres.

Make : Pirelli Size : 9.74 - 24.

The tyres on the vehicle are of two types, four have a shallow sand tread and are marked "LIBIA" whilst two have an orthodox deeply moulded tread of the "Heavy Duty?" type.

## **18. BRAKING**

### Type: Lockheed Hydraulic

The main brakes on the vehicle are hydraulically operated on the four road wheels. They are applied by foot pedal in each driving section. The reservoir is mounted on the nearside of the forward driving section.

The handbrake levers for each driver operate a transmission brake of orthodox pattern, interposed on the cardan shaft between the gearbox and the distribution box. The forward lever operates the brake via a cable and the rear operation is by rod. FIG. 12

## **19. SUSPENSION**

Type: Independent

Spring: Coil.

The wheel assembly is pivoted to the chassis on two wishbone type radius arms. The lower radius arm is longer than the upper arm and is attached to the lower end of the coil spring; the upper end of the coil spring being attached by a bracket to the chassis.

Two hydraulic shock absorbers are attached to the upper radius arm at the point where it is pivoted to the chassis.

The wheel ends of the upper and lower radius arms carry on trunnions the king pins, one being above and the other below the universal joint of the final drive shaft.

Some protection is afforded to the springs by 6 mm. plates turned outwards at each end and bolted to the hull side plates where they are cut away to accommodate the suspension units.

## **20. INSTRUMENTS AND CONTROLS**

Front Driver's Controls. (See Fig.15)

The forward driver's foot controls consist of a clutch pedal on the driver's left, footbrake in the centre and accelerator on the right. A hand brake lever, change speed lever, and directional control lever are situated on the right of the driver's seat approximately in line. Hand controls for throttle, choke, and for advancing or retarding ignition are mounted in a quadrant frame to the right of the gear lever.

Front Driver's Instruments. (See Fig.15)

There is a switchbox incorporating the following switches and instruments mounted under the glaxis plate to the right of the driver:-

- Speedometer -Calibrated in kph from 10 - 100 (the figures in brackets denote approximate speeds in mph)

1st. - 10 (6.2)

- 2nd. - 11.5 (7.2)
- 3rd. - 21.5 (13.4)
- 4th. - 38.5 (24)
- 5th. - 58 (36)
- 6th. - 78.5 (49)

- Petrol Gauge -Electric type operated by float and rheostat mounted on top of main petrol tank. The gauge registers fuel in forward and main tanks only.
- Ignition Switch - Cylinder lock pattern incorporating pilot light.
- Main Lighting Switch - Rotary type with three contacts.
- Starter Switch - Push button type.
- Panel Lamp - there is a bayonet type panel lamp holder with switch incorporated.
- Horn Button - mounted on steering column and operating orthodox electric motor horn fitted on glaxis plate

#### Rear Driver's Controls.

The rear driver's foot controls consist of a clutch pedal on the driver's left, footbrake in the centre and accelerator on the right. The hand levers are mounted on the left of the driver and comprise of a handbrake lever and change speed lever on the left of the gearbox, and directional control lever of crank type mounted on top of reverse box and operating on a vertical axis.

#### Rear Driver's Instruments. (See Fig.16)

The electrical switch box is mounted to the left of the driver and accommodates the following gauges and switches:

- Oil Pressure Gauge - Graduated 0 - 50 in divisions of S Km/cm<sup>2</sup>. The graduations 15 - 35 are marked in RED.
- Water Temperature Gauge - Graduated 30o - 110o (with the graduations 95 - 110 marked in RED)
- Ignition Switch- Of cylinder lock pattern. The key is deficient and the key to the forward switch is not interchangeable.
- Panel Lamp Bayonet type fitting with switch incorporated.
- Main Lighting Switch - Of rotary type with three contacts, operating lamps on rear wings.
- Horn Button. - Mounted on steering column and operating large rotary siren on engine cover plate.

### **21. DRIVER'S SEATS**

The forward driver's seat is of adjustable sliding type. The backrest is hinged to the nearside and secured by a barrel bolt on the offside. It is necessary for the driver to swing the backrest open to enable him to take position in his seat. The seat for the rear driver also has a sliding adjustment for leg length. The backrest is hinged but is easily removable. In order to take his position in the driving seat it is necessary for the rear driver to remove his steering wheel and a quick release

in the form of a captive wing nut is provided for this purpose.

## **22. COMMUNICATION**

The mounting for the wireless aerial is situated forward on the offside upper hull plate. The mast which is of 1" diameter aluminium tube and 7 feet long may be raised or lowered manually by a handwheel operating through bevel gears in a box mounted inside the roof of the hull to the right of and slightly behind the front driver's seat. The aerial is balanced in a vertical position by a counterweight and is dipped automatically by contact with the 2 cm. gun barrel when it is necessary for the gun to pass. The aerial may be held in the lowered position by the handwheel which incorporates a spring loaded plunger engaging in a hole in the bevel casing. The drive from the handwheel to the aerial is not positive and the aerial may be raised or lowered without damage should the handwheel be in a locked position. This drive is in the form of an annular cam attached to the aerial pivot shaft and driven by spring loaded followers attached to the bevel shaft.

The wireless sets are deficient but three flexibly mounted bases to the front right of the fighting compartment would indicate that the wireless equipment consists of a receiver, a transmitter and a power unit. The wireless batteries are carried in a large container to the left and right of the fighting compartment and are not charged by the engine dynamo. They are deficient. The inter-communication system is independent of the wireless. Supply for the inter-communication is taken from the wireless batteries to a small rotary power unit mounted to the right rear of the fighting compartment. This unit supplies the high tension for a two valve amplifier mounted next to it. Four control junction boxes are fitted in the vehicle, one for each driver, one to the rear right and one to the front left of the fighting compartment. These boxes have a red and green light, a three-way switch ("Off", inter-communication, R.T), a socket for the throat microphone (and presumably a head set5 jack and volume control. A call button is also fitted to each box. Since a green light is fitted in the lid of the amplifier the lights in the control junction boxes are possibly to indicate whether the switch is to R.T. or inter-communication.

## **23. LIGHTING SYSTEM**

The vehicle is fitted with two head lights at the front, and two head lights and a combined stop, tail and number plate light at the rear. The lights are controlled from switches on the driver's panels as detailed in para. 20.

The head lamps incorporate the side lamps having a side lamp bulb in a lampholder behind the reflector which has a small talc covered window cut in it near the centre.

The headlamps are fitted with double filament bulbs giving bright and dipped illumination. To prevent the bulbs being inserted wrongly the lamp holder bayonet catch slots are of different sizes as are the bulb cap lugs.

The light switches have four positions, "off", "side," "dipped" and "bright."

Internal illumination is limited to three hooded lamps, one on each driver's panel and one under the turret ring at the 12 o'clock position. There are no circuits in the turret and no base junction is fitted.

## **24. VENTILATION**



In each forward side of the turret is an opening for ventilation measuring 1.5" x 11.5". A B.P. cowl of 8 mm. thickness is bolted to the turret side to protect each opening.

There is a further opening for ventilation in the offside hull plate behind the spare rim carrier. This opening is provided with B.P. protection in addition to that provided by the spare rim carrier.

The air taken by this inlet is directed through a metal duct to the space between the fighting compartment floor and the belly trays at a point slightly forward of the distribution box.

### **25. OUTSIDE STOWAGE**

Mountings are provided on each side of the rear engine cover plate to accommodate spades. One of the spades is deficient.

On the lower hull plate forward of the spare rim recess are two brackets which form a mounting for a machete.

### **26. TOWING HOOKS**

Robust towing hooks are provided and are riveted to the hull side plates at the rear of the vehicle and to the upper nose plate at the front.

A towing link is bolted centrally on the tail plate the link being secured to the mounting by a clevis pin with a forked end in which is a hinged retaining key.

A spherical attachment for a towing bar is mounted centrally on the upper nose plates between the towing hooks.

A central towing eye is riveted to the lower nose plate. Lifting hooks are not fitted to either the hull or the turret.

### **27. INSIDE STOWAGE**

A wooden box to accommodate driver's episcopes is mounted on the floor of the hull on the left of the driver's seat.

A wooden shelf fitted to the turret flange on the left of the gun forms stowage for the gun clearing tools.

A further wooden shelf on the offside of the turret flange is probably intended to hold charger plates containing empty cases. Stowage for spare M.G. barrels is provided by metal clips and leather straps on the front of the wireless battery boxes.

On either side of the hull door openings are metal stowage bins which are constructed to fit the radius of the spare rim and rear wheel arches. The capacity of each of the rear bins is approximately 2 cu. ft. and of each of the forward bins approximately 0.4 cu. ft.

Small wooden boxes mounted over each of the latter have a capacity of approximately 0.3 cu. ft. and may be used to stow field rations. For stowage of ammunition see "Ammunition Carried" Para 9.

### **28. FIRE FIGHTING APPLIANCES**

There are mountings for two fire extinguishers on each side of the fighting compartment. The mountings are a few inches forward of the door openings and

the extinguishers may be reached from outside the vehicle when the top half of the doors are open.

Two of the extinguishers are deficient.

### **29. VULNERABLE POINTS**

There are numerous chinks at the joints between plate edges, particularly at the junction of the nose and hull side plates, and the tail plates and side plates. In the case of the former the driver is exposed to splash as is also the forward petrol tank. The gaps at the rear, and the air intakes and outlets in the engine compartment, render the radiators and engine liable to damage from the same source. In fact absence of splash protection is general throughout the construction, the gun mantlets, hull doors and vision and revolver ports all being vulnerable.

Owing to the spring loaded bosses used in the hull door latches it is possible for them to be forced open approximately 5/16". The crew, particularly the hull gunner, and the rear driver, are thus liable to suffer from S.A.A. attack directed at these points from the rear.

The commander's periscope is vulnerable since the object prism is unprotected. This should constitute an important target there being no other vision devices in the turret apart from the sighting telescope and revolver ports.

### **30. RECOGNITION POINTS**

The most striking feature in the vehicle's broadside silhouette is its back to front appearance. This is accentuated by the deflector on the hull top plates and the rear hull M.G.

From the front the large inset headlamps in the front vertical plate with their B.P. flaps and the stove pile appearance of the 2 cm. gun barrel are noticeable points. From the rear the long sloping engine cover plate and ball mounted M.G. on the offside should afford recognition points.

### **31. MANUFACTURERS MARKINGS**

Chassis. No. 40788 MATRICOLA No. 40788

Armament.

2 cm. BREDA-CANONE DA 20 M/M CONTROAEREO - MOD. 1935  
No. 3809 BRESCIA.  
1910 - XVIII.

8 mm  
(Turret) BREDA 8 M/M METRAGLIATRICE MOD. 38 No. 157. 30 XVII

8 mm  
(Hull) BREDA METRAGEL TIPO C.A. CAL 8. No.2458 - 41 - XIX

Optical Instruments.

Turret Telescope. CANNOCCHIALE DI PUNTAMENTO SAN GEORGIO S.I.A. No. 88215. GENOVA SESTRI

Hull Telescope. No. 100293. GENOVA SESTRI

Periscope\* CANNOCCHIALE PANORAMICO DI OSSERVAZIONE No. 94951 GENOVA SESTRI

Engine.

(Engine Number) S.P.A. 518931 21-11-40 Abm.1 100041.

Petrol Pump. COSTR. ARRONAUTICHE FONDERIE SOMIA LOMBARDO ITALIA.  
SECONDA ROTA AUTO FLUX.  
BREVETTATO.

Magneto. MARELLI

Dynamo. MAGNETTI MARELLI D.90 RK. 1/12 ? 1100, 136495.

Accumulators. VARALLI.

Gearbox.

S.P.A 100039

Wheels.

GIANETTI IRRONNO.

Tyres.

PIRELLI SUPERFLEX 9.74 x 24.

- Four marked- LIBIA. 1- T RAIFIX Nos: 133 A 361;101 C 930 E; MADE IN ITALY. F.142 E 782; 642 H 351.
- Two marked- HEAVY DUTY. RINFORZATO Nos. 640 C 914 E.L.; INPORTE D'ITALIE 635 D 112 E.

Brake Reservoir

FIAT. FREUD-IDRAULICO SISTEMA. AUTOMOTIVE PRODUCTS CO.  
LOCKHEED  
LICENZO. LONDON

Inter-Communication.

REGIA AERONAUTICA. INTERFONICO TIP. RA 42 INDUSTRIA

**RADIOTEONICA**

Power unit No. 0156 ITALIANA Amplifier No. 0157 VIA ALBENGA No. 12  
Roma

Fire Extinguishers.

ESTENTORE A TETRA 1/2 LITRE TELLUM. BREVETTI FERRA 2 CORSO  
MD. AZEGUO 72 TORINO.



