

THE BURMAN GEAR BOX

BURMAN & SONS LTD.
RYLAND ROAD,
BIRMINGHAM, 15.

Phones: CAL. 2671 (Six lines)
Grams: Burmanth, B'ham.

The Burman Gear Box.

FOREWORD.

The modern Gear Box is a complex piece of mechanism, and while it is hoped that the information set out in this handbook will be of interest both to those who are unaccustomed to the handling and maintenance of intricate pieces of mechanism and also the experienced mechanic, we do not recommend the former to undertake any extensive dismantling of the latest types of Gear Box. In such cases the work should be undertaken by an experienced mechanic who will readily understand the section drawings and instructions given herein.

It is impossible to describe here in detail all the models and types made by us since we began the manufacture of Gear Boxes, but we have included all the most important features, which, in the main, apply to all our models. If any user wishes to inquire about any point which is not to be found in the following remarks, we shall be only too glad to help him in any way we can, if he will write to us direct.

Finally, we would like to ask any user of our Boxes who has any suggestion to make which might lead to an improvement, either in operation or control, to communicate with us. Only by keeping in close touch with the rider can the manufacturer hope to keep his goods efficient, up-to-date, and always in demand.

GENERAL DESIGN.

There are certain features on all our Gear Boxes, whether 3 or 4-speed, which are common to all models. The gears are

all constantly in mesh, thus obviating the risk of tooth wear and breakage, as in the old clash type Gear Box. The actual gear changes are effected by means of dog Clutches of ample dimensions, which minimises all risk of damaging the gears if a faulty change should be made. In certain models the dog Clutches are made in the form of gear teeth, which gives a much quicker gear change and also obviates any back lash through the gears. All Burman gears are made from oil toughened nickel chrome steel, which is entirely free from heat treatment distortions. This steel is of a very tough fibrous nature, and after cutting, is subjected to a treatment which burnishes the gear teeth and puts a very high polish on them. Following this they are heat treated and rendered so tough as to withstand wear indefinitely, while not being sufficiently brittle to fracture. This hardness is not to be confused with the glass hardness in case hardened gears, and it will, therefore, be found that Burman gears are capable of being marked or scraped by a sharp file, although they are very considerably stronger and more durable than a case hardened tooth of the same size.

The gear positions in all ratios are locked, when in place, by a patent rack and pawl mechanism inside the Gear Box. This allows a clean, silent change to be made without fear of missing or running through the gear desired. All the parts of this mechanism are fully immersed in lubricant and in the case of the 3-speed and L.W. 4-speed models, are actuated by a Bell Crank Lever, which is, in turn, operated by a Lever connected directly to the control. In the case of the Medium and Heavyweight 4-speed models, gear changing is effected by means of forks operating on a Camshaft, which, in turn, is locked in the various positions by a pawl and spring mechanism.

The gears all run on case hardened steel shafts, and in the case of the Mainshaft, this is supported at each end by heavy journal Bearings, while the Layshaft is supported on graphite impregnated self-lubricating Bushes.

It should be noted that in order to allow for expansion when the Gear Box is warmed up, slight endwise movement is allowed for in the various Shafts.

Another feature common to all Gear Boxes is the Kickstarter mechanism, which is entirely separate from the major portion of the Box, and is only in operation during the actual process of

starting. This is infinitely superior to the method of mounting the Kickstarter on the Layshaft axle, which causes the Layshaft Bearings to wear quickly (as owing to necessities of design, the Bearing cannot be made large enough to stand the strain) and results in considerable noise. In addition, the ratio of the gearing with the Layshaft type of Kickstarter is inadequate to turn the engine over quickly enough to start the present day fast revving light fly-wheel engine, especially when cold or sluggish.

The Burman Kickstarter is made throughout of oil hardened nickel steel, and being separate from the Box, is designed so as to give efficient service through a long life of violent usage.

The Clutches on all Burman Gears are of the multi-plate type and consist of a number of steel plates carrying the friction material, alternated with plain steel plates. The friction plates are located in and driven by the Clutch Housing which is attached to the Chain Wheel, and the plain steel plates are attached to the Clutch Centre, which is fixed on the Mainshaft. The Clutch is operated by a rod passing through the centre of the Mainshaft, the one end of the rod being held in a recessed cup in the Clutch Spring Plate, while the other bears against the Operating Lever itself.

There has been a good deal of controversy on the subject of cork versus asbestos fabric as friction material for Clutches. Our recommendation is as follows:—For ordinary touring, traffic work, road racing and sprint racing, cork is by far the best material; but for sand racing, motorcycle football and freak trials, we recommend fabric. Briefly, the advantages and disadvantages of each are these: Cork possesses greater gripping power, is unaffected by oil or water, and being slightly elastic, takes up the drive of the engine in a smooth, progressive and shockless manner. Cork, however, will not stand continued slipping, as it is liable to char and burn. Fabric, on the other hand, does not grip so well as cork, and therefore, needs a stronger spring pressure to carry the same load; it is liable to slip when exposed to oil or water, and it is very fierce on taking up the load, due to its hardness and incompressibility. It will, however, not burn out when slipped continuously, although under such conditions, it quickly becomes glazed and will not transmit the same load as before unless provided with a new surface.

It should be noted that when in use, cork is apt to expand slightly and then bed down. To allow for the subsequent bedding down, a certain amount of play is necessary in the Clutch Operating Mechanism, and there should be, therefore, at least $\frac{3}{8}$ " free movement in the Bowden Clutch Cable before the Clutch actually operates. This is equivalent to about $\frac{1}{2}$ " to $\frac{3}{4}$ " on the end of the Clutch Handlebar Lever.

It is very important, in order to obtain the full gripping power of the Clutch, that the cork inserts should be perfectly flat and to size. The cork is cut to size and inserted into the steel Clutch plate. The complete plate is then fed into a machine which automatically grinds down the cork till it is exactly the correct thickness. The plate is then ready for use.

It is for this reason that we do not recommend users fitting their own corks. In the first place, they cannot obtain cork of the correct grade, and, secondly, they cannot grind the corks so level or so true as is necessary to obtain the best results. The plain steel plates are set dead flat by hand in order that there may be no "high spots" and consequent loss of friction area. It is close attention to this point that results in the well-known smoothness and lightness of the Burman Clutch.

All models previous to January, 1927, have a Ball Race in the Clutch Chainwheel (Fig. 1). This consists of two hardened steel cones separated by thin pen steel washers. If wear occurs in this Ball Race (noticeable by play from side to side in the Chainwheel), the Race should be taken apart, one or more of the spacing washers withdrawn, and then re-assembled. The Chainwheel should run perfectly freely, but without sideways movement.

In models after January, 1927, a Roller Race is fitted (Fig. 2), this being stronger and more durable than the old type and needs no adjustment whatsoever. It should, however, be taken down and packed with grease every 5,000-7,000 miles. A feature of all Burman Clutches is that the Chainwheel Sprocket runs perfectly true and in line when the Clutch is disengaged. In many other makes, the Sprocket is without support when free, and consequently wanders out of line, causing Chain and Sprocket wear.

One important point is often missed by riders, and that is: The Clutch Control wire and cables should be kept well greased and entirely free from sharp bends throughout its length from handlebar

to Gear Box. Failure to ensure this leads to stiff Clutch operation and consequent fatigue in driving.

SHOCK ABSORBER.

In some Burman Gear Boxes no Shock Absorber is fitted, but the majority are so fitted in such a way that the drive is transmitted from the Chainwheel to the Clutch through rubber buffers. These, while being perfectly rigid laterally, allow a radial movement of approximately $\frac{3}{8}$ " which absorbs any ordinary harshness. They are made of special oil resisting rubber and the diagrams giving section arrangements of the Clutch show the method of attachment and also the dished recesses into which the compressed rubber can expand, thus preventing any crushing and destruction of the buffers. It should be mentioned that although, for the sake of uniformity, a number of holes are drilled round the Chain Wheel to allow for the fitment of these buffers, they are not necessarily all used; thus, it is quite in order to find three, four, six or eight shock absorber buffers in varying types of Clutch, the smaller Clutches having the smaller number of buffers, and the larger Clutches the larger number so as to absorb more effectively the larger power transmitted. It is, therefore, quite in order that in some cases all the holes should not be filled with buffers and empty spaces should not necessarily be taken as indicating that they have been omitted or lost.

THE CONTROLS.

These are of two types, the hand or tank control and the foot control, which is integral with the Gear Box. As far as the latter is concerned, this will be dealt with later on in the booklet in describing in detail the various types of Gear Boxes.

As far as tank controls are concerned, certain precautions should be observed to ensure perfect action. When testing, the machine should be in middle gear. If the controls are correctly adjusted, the gear lever should be exactly in the centre of the middle gear notch, with an equal space on either side. The arm on the gear lever to which the rod is attached, and the lever on the box, should be as nearly as possible at right angles to the rod itself. If these conditions are not satisfied, the length of the rod should be adjusted by means of the yokes and nuts provided, or the control moved round bodily on its support after loosening the

set screw on the control body (the part which is attached to the tank tube). In particular the adjustment should be checked every time the Gear Box is moved for chain adjustment, as failure to have the gears correctly adjusted leads to damage of the control operating mechanism inside the Box.

DISMANTLING THE GEAR BOX.

3-speed Models.

We do not recommend the dismantling of Gear Boxes to any but those who have had a mechanical training. Though not in itself a difficult task, the re-assembly calls for an accuracy in positioning and fitting that can easily lead a novice astray. To the latter we recommend the despatch of the Gear Box in its entirety to ourselves or a competent mechanic.

As a Gear Box is a difficult piece of mechanism to handle without special tackle, it will be found more convenient to start the process of dissembling when the Gear Box is still in the frame. It should be placed in gear and the rear wheel locked by means of the brake.

In cases where a band is fitted on the Clutch, this should be removed, the Clutch adjusting nuts unscrewed, and the Clutch springs, spring cups and spring plate can then be taken off. The clutch plates may then be removed and should be preserved in the same order as they are taken out, so that they may be replaced in the same relative positions. This will expose the nut holding the Clutch on the Mainshaft. This should be unscrewed and the Clutch may be removed bodily.

In the case of models, " Q," " M," " S.M." " ME," " E," " L," " SE," and " S.L," the Clutch Centre is secured to the Mainshaft by means of a taper and key (Figs. 1 and 2), and should be removed by giving a sharp tap on the end of the Mainshaft with a piece of soft metal while pressure is exerted between the Clutch and the Driving Sprocket by means of a screw driver or tyre lever. This should loosen the Clutch assembly on the taper, which can then be removed completely. In the case of models " R," " W " and " T " (Figs. 3 and 4), the Clutch is castellated on to the Mainshaft and can readily be taken apart, exposing the Roller Race and Clutch shock absorbers. The Gear Box should then be removed from the frame and the remainder of the process of dismantling proceeded with.

It is assumed that the Clutch Cable has been detached from the Gear Box and the Clutch Lever, and in the case of hand control models, the next step is to remove the domed bracket holding the Clutch Lever by undoing the two screws provided. The Cover Plate over the Kickstarter Quadrant should be removed and the Kickstarter with its Quadrant and Spring can then be removed from its axle. This will expose the Kickstarter Ratchet mechanism. On models, " E," " L," " SE," " SL," " R," " W " and " T " (Figs. 1 and 3), this is secured by a single nut which can be unscrewed. In the case of models " Q," " M," " SM " and " ME " (Fig. 2), after unscrewing the first nut, the Kickstarter Ratchet and Spring, together with the Ratchet Pinion Bush may be removed, after which the Kickstarter Ratchet itself must be unscrewed with a tubular spanner. Next, the nuts holding the endplate of the Gear Box should be removed, and the whole end play will then be free to slide from the Gear Box. In the case of models " Q," " M," " SM," " ME," " EL," " SE " and " SL," the Layshaft Spindle, which is a drive fit in the Kickstarter Case plate, will also come away. The end plate also carries the two control Levers and their distance piece, which, if necessary, can be dismantled separately. The Mainshaft can next be removed. In the case of models " R," " W " and " T " (Fig. 3), this should slide out from the Clutch end, as the castellated diameter on which the Clutch is mounted will not slide through the Driving Gear. In all other models the Mainshaft should slide towards the Kickstarter end of the Gear Box.

The screw at the bottom of the Box controlling the Pawl Spring can be removed, together with the spring. In the case of models " E," " L," " SE " and " SL " (Fig. 1), this spring is assembled through the side of the Box and can be removed after removing the Kickstarter Case. It will now be found that the complete gear assembly can be removed from the Gear Box, with the exception of the Driving Gear with its ball bearings and rear Sprocket attached. There is no necessity for these parts to be removed unless the rear Sprocket and Driving Gear show any sideways movement which points to the Ball Race being worn. If it is necessary to remove the Sprocket, the Sprocket nut must be removed, which in some cases is held by a locking ring which, in turn, is fastened by a grub screw. In other cases, locking is effected by merely punching the metal of the Driving Gear lock nut into the castellations of the Driving Gear. In these cases on the

infrequent occasions when it is necessary to move the Driving Sprocket and Driving Gear Nut, it is desirable to fit a new Nut when re-assembling.

The Gear Box is now completely dismantled and can be cleaned, examined and the necessary adjustments or repairs made.

When re-assembling the Gear Box, a reverse procedure to the above should be followed. On no account should force be used if difficulty in re-assembling is found, as all parts should slide into position without any force being necessary, otherwise damage will result.

It is important that the two Sliding Gears should be properly meshed one with the other by means of the flanges provided for the purpose, and also that the Operating Lever block on the Bell Crank Lever should be in position on the Mainshaft Sliding Gear. These details are shown in the various illustrations herewith.

It is also important to note that the ball on the end of the Inner Control Lever should fit into the spherical recess on the Bell Crank Lever, also shown on the drawing.

If the gears and the inside of the Box have been cleaned with paraffin after disassembling, the various bearings, and, in fact, all parts, should be oiled before re-assembly.

In cases where speedometer drive is fitted in the Gear Box, the sleeve holding the secondary pinion, together with the pinion, should be removed before taking the Gear Box apart, otherwise the spiral gears will jam and cause damage.

It should be noted that there are no left hand threads in the manufacture of the Gear Box, with the exception of the Kickstarter Lever in the models where this is screwed to the Kickstarter Quadrant. Except in cases where the Quadrant needs renewing, these two parts should not be disassembled.

After the final assembly of the Gear Box is completed, it should be tested for free running in each gear before refitting in the frame, and all parts should be carefully tested to ensure that no excess play is noticeable in any part.

Sometimes trouble is occasioned when re-assembling the Kickstarter mechanism and spring. If a new spring is to be fitted, this should be assembled as received from us, i.e., with the spring tightly coiled and bound with wire. This presents no trouble

whatever, and, when assembled, the wire should be cut with a pair of pliers and removed. If, however, it is desired to re-fit an old spring, the following procedure should be adopted. Attach each end of the spring to its correct pin and slide the Kickstarter on to its centre pin. Keeping the Kickstarter at the top of the centre pin, wind the spring up 2 to $2\frac{1}{2}$ turns, keeping the coils from riding over each other by means of a screw driver, then gradually work the Kickstarter down to its correct position, using the screw driver with the other hand to keep the spring in position. The description may sound difficult, but actually in practice it will be found to slip into place quite easily.

Positive foot change mechanism cannot be fitted to models, "E," "L," "SE" and "SL," but is fitted to the other 3-speed models and is shown in Fig. 5. It is not necessary to dismantle the control when dismantling the remainder of the Gear Box, as it will be found that when the Kickstarter Case is removed, the whole control will come with it. When, however, it is desired to examine the control mechanism, dismantling should not be attempted until the Kickstarter Case is removed, for whilst, by the removal of the two hexagon nuts which secure the Lever, the entire control may be dismantled, on re-assembling, it may be found that the controlled Inner Lever has come out of the slots on the sleeve.

The operation of the control is as follows:

A double-edged pawl is pivoted on a pin secured in a steel plate, so that it can engage with the ratchet teeth cut on the surface of a Sector which is keyed to the Spindle carrying the Control Inner Lever. Behind the Pawl and Ratchet is the body casting which is also pivoted on the Spindle. On the back of this casting are two bosses which bear against stops on the Bush which is integral with the Kickstarter Case, and thus limit the movement of the Lever. When operating the foot control, the pawl swings over and one of its teeth engages in an appropriate tooth on the Ratchet. This moves the Spindle over, moving the Inner Control Lever and thus changing the gears exactly as a hand control would. The control then comes up against its stop and the springs fitted restore the control to its original position ready for the next gear change to be selected.

Model "R" Gear Box with enclosed Foot Change.

The latest type of model "R" 3-speed Gear Box has a foot control which is fully enclosed by an aluminium casting and is not

of the external type as described previously. The latest type is very similar to the enclosed foot change mechanism described and illustrated in connection with the model "H" Lightweight 4-speed Gear Box, and the same instructions regarding dismantling and assembling apply.

4-speed Lightweight Model "H."

The earlier types of model "H" Gear Box are almost identical in design with the models "R," "T" and "W," with the exception, of course, that they have four speeds instead of three. Exactly the same procedure as detailed previously should be followed, and, in the case where foot control is fitted, this is of the external type similar to the 3-speed models, and again the same procedure should be followed.

On the later type, the whole of the Kickstarter mechanism and the Foot Control mechanism are enclosed inside the aluminium casing, and a slightly different procedure should be followed. A perspective view of this type of Gear Box is given herewith (Fig. 6), and shows quite clearly the procedure to be followed.

Firstly, the Kickstarter Lever and the Foot Control Lever should be removed by undoing the clamping nuts and bolts when the Levers will slide freely from the castellated shaft to which they are fitted. The nut securing the outer aluminium case can then be unscrewed and the whole of the outer case slipped off the pins on which it is fitted. The Clutch Lever will come away with the outer casing, as this is fitted to an additional aluminium casting which is pressed in to the outer casing. The nut on the end of the Mainshaft should then be unscrewed, and the Kickstarter Spindle, together with Quadrant and Spring, should be removed, when this will expose other Nuts holding the secondary Kickstarter Case on to the Gear Box itself. This case can then be removed and the same procedure followed as with the 3-speed Gear Boxes in removing the gears and selector mechanism.

It should be noted that in this case the Bell Crank Lever is mounted on a shaft which projects right through the Gear Box, and this shaft can be removed by unscrewing the nut at the one end, when the shaft will slide out.

The foot control mechanism is of an entirely different type from that used on the 3-speed and earlier 4-speed Gear Box, and

while the lay-out is quite clear from the drawing shown, it should be emphasized that the two self-centering springs should be mounted in such a way that the two arms should rest parallel, one on each side of the pins shown. Under no circumstances should the arms be crossed, although a replacement spring, when delivered, will have the arms crossed, due to the natural tend of the spring.

When re-assembling, the reverse process to that mentioned above should be followed. When fitting the final Case, a number of parts have to slip into engagement, and, as will be seen from examining the drawing, the $\frac{1}{16}$ " diameter peg which is fitted in the aluminium case has to engage between the arms of the larger of the two springs. If, when assembling, it is found that this peg comes up against the spring and does not fall between the arms properly, it will be necessary to rock the Gear Lever Pedal slightly backwards and forwards, when the whole assembly will fall naturally into place.

On this type of Gear Box also it should be noted that a ball is fitted in the socket fitted in the spring plate, against which the end of the clutch rod bears. It is important that this ball should not be lost when dismantling.

On 1937 and later types of "H" Gear Box, the clutch operation on the Kickstarter end is similar to that shown in Fig. 7, which is also used on the Heavyweight 4-speed Boxes. In this case the Clutch Lever engages on a short rod with a slot in one end, the other end of this rod bearing against a ball, the other side of which is contacted by the Clutch rod. The operation is quite clear from the drawings shown. It is not necessary to move the Kickstarter in its assembly before dismantling in these later types, unless, of course, any of the Kickstarter mechanism requires examination.

Heavyweight 4-speed Models "C" and "BA."

In some models the Clutch Operating Lever is fitted on the outside of the Gear Box; in others it is enclosed. As far as the first type is concerned, the Clutch Operating Lever should first be removed and the small nuts holding the aluminium end cover unscrewed. The end cover will then come away without difficulty, and it should be noted that it is not necessary to remove the Kickstarter Lever. It will be found that part of the Foot Control Operating Mechanism, where this is fitted, will come away with the outer case. It is important to mark the Foot Control Ratchet

and Pawl before removing, so that they may be assembled in exactly the same way when re-fitting.

The remainder should then be removed; the nut on the end of the Mainshaft unscrewed, and the small nuts holding the secondary case in position removed. The case will then come away from the Gear Box studs, but care should be taken not to lose the rollers (set of 12) forming the Roller Race on the cam Spindle. Next unscrew the Pawl Spring Plug at the bottom of the Gear Box to allow the removal of the Pawl Spring, after which the entire gear assembly, together with Cam Spindle and Operating Forks can be removed from the Gear Box en bloc. It may be found that removal is rendered easier if the Mainshaft is first taken out.

The subsequent removal of the Driving Gear and rear Sprocket can be made on the same lines as with the 3-speed models.

If it is necessary to replace the Forks on the Operating Cam, this can be done by removing the split pin holding the Fork pin in position, when the pin can be removed by means of a pair of pliers and the Fork will then slide off the cam. It should be noted that the two Forks are not identical, and when re-ordering for replacement purposes, state whether the Fork is for the Layshaft or the Mainshaft Gears.

To re-assemble, the reverse procedure should be followed, first assembling the Operating Forks on to the Camshaft, then on to their respective gears and sliding down, thus making a sub-assembly of the two sets of gears and the cam assembly. The whole assembly should then be fed into place together, and the Mainshaft assembled subsequently. The rollers for the cam Spindle should be held in place in their grooves by smearing with thick grease, and the Kickstarter Case can then be assembled. Drawings are given showing the arrangement of the gears (Figs. 8 and 8A) and their cam Forks, and a separate drawing shows an exploded view of the foot change mechanism (Fig. 9).

When assembling the toothed Ratchet with the gear on the end of the Camshaft, it is important to ensure that the marked tooth of each member should be assembled together. The Pawl, Ratchet, Operating Plate and spring Box can then be assembled, and finally the outer case fitted and the Foot Control Lever put back into position.

To facilitate assembling the Kickstarter Spring, the Kickstarter Spring should be re-wound and bound with string or wire this being cut after the Case is located on its fixing studs, but before it is finally pushed into position, the Kickstarter being pulled down slightly in order that the Quadrant may clear the Kickstarter Stop Peg.

In later types of this Gear Box, the Clutch Operating Lever is inside the outer casing. This is quite clearly shown on the sectioned drawing (Figs. 7a and 7b and Fig. 10), the pressed steel Lever being held on a shaft which protrudes through the outer casing. A small cap held by two screws shows on the outside of the Gear Box, and on removing this cap, the whole Clutch Lever on its shaft may be adjusted inwards or outwards to take up play in the Clutch Rod. The Operating Lever itself bears on a forked shaft which fits into the end of the Mainshaft, a ball being fitted between this shaft and the Clutch Operating Rod itself. The adjusting nut should be screwed anti-clockwise to take up wear in the Rod and clockwise to give additional clearance. The aluminium cap locks the adjusting nut in position when it is re-fitted.

OTHER MODELS AND SPECIAL FITMENTS.

Lightweight 3-speed Gear Box Model "G."

This follows the same principles as the models "R," "T" and "W," excepting that it is fitted with a single-plate cork Clutch, the cork inserts being fitted in the Chain Wheel and on either side are plain plates.

To dismantle the Clutch, first remove the domed end cap, which it will be noticed has two small holes to take a peg Spanner, such as can be obtained from any Motor-cycle dealer, then unscrew the hexagon nut which secures the Spring, when it will be possible to remove the entire Clutch assembly.

The dismantling of the Gear Box itself is exactly the same as with the 3-speed models mentioned previously.

When re-assembling, it is important to screw up the domed end cap tight, as the Clutch Operating Rod bears against this, and its loss would prevent the Clutch being satisfactorily disengaged.

Heavyweight Needle Roller Clutch.

Certain of our Heavyweight Clutches, in place of the square rollers illustrated in the drawings of the Clutches, have the Clutch

Chain Wheel rivetted to a member which acts as an outer race for the needle bearing. The needle rollers rotate between the Mainshaft and this outer member and are held in position by a bronze cage with elongated slots in it (Fig. 11). Apart from this feature, the dismantling of the Clutch is exactly the same as explained previously and no special precautions are necessary.

GENERAL NOTES

Lubrication.

Every Box sent out from these Works is charged with grease and is safe to run without attention for at least 1,000 miles. It sometimes happens that a Box is slightly overcharged with grease at the Works to ensure a supply reaching every part of the bearings, and this surplus may work its way out of the Box. It will, however, cease after a few miles, and the grease having found its normal level, no further escape will occur.

All Boxes are sent out filled with grease and should be replenished every 1,500 miles with approximately 2-3 ounces of either Wakefield's Castrolase Medium, Gargoyle Mobilgrease No. 2, Shell Motor Grease Soft, Price's Belmoline "D" or Esso Grease. The Box should not be completely filled as this will result in the throwing out of the grease when the gears are revolving at high speeds (exerting a considerable pumping action). To obtain best results, the Box should be about one-third full.

On no account should heavy oil or grease be used to lubricate the Gear Box, as this tends, besides causing difficulty in operation, to be thrown to the sides of the Gear Box, leaving the Gears to run without adequate lubricant. If in cases of emergency no suitable grease is obtainable, a thicker grease can be used provided a sufficient quantity of ordinary engine oil is mixed with it to reduce its consistency. The Gear Box should always be refilled with the correct lubricant as soon as possible. For long distance races and fast touring we recommend our standard grease with the addition of about 25% of engine oil. For sprint races, the Gear Box should be washed out and a minimum quantity of thin oil can be used.

Apart from the gears, the clutch cable wire should be removed occasionally and greased, also the Clutch Operating Rod. The

Clutch Roller Race should be packed with grease every 5,000-7,000 miles, and the Clutch Operating Lever and other joints should be oiled fairly frequently.

In cases where speedometer drive is integral with the Gear Box, the speedometer spirals should be occasionally oiled with a light oil. The speedometer cable should be removed, and the sleeve to which the cable end is attached unscrewed from the Gear Box. The speedometer spiral gear can then be removed and lubricated.

SERVICE.

This is the most important link between manufacturer and user, and, realising it, we have done and are still doing, everything in our power to develop this service to its utmost. We have a chain of Service Depots and we are continually extending these to all parts of the world. At each of these Depots may be had expert attention and advice, and spares of every kind may be had from stock. At these Works special facilities are afforded, and clients can be assured of express service at all times. Every order for parts is executed the same day it is received, unless some exceptional circumstance arises which prevents this. When a Gear Box is returned for repair it is overhauled immediately and a report and estimate despatched the same day. It then awaits its owner's instructions. Immediately these are received, the Box is repaired and despatched.

As regards spare parts, we keep a full stock of spares for seven years after the particular model has become obsolete and out of production. After that period, stocks are allowed to become depleted and are only made to order. This naturally necessitates a slight delay, but we do not think that this is unreasonable. Whenever a part on an existing model is altered, it is made in such a way as to be still adaptable, and all stocks of the previous type are allowed to run out, the improved type taking its place. We thus give all users, old as well as new, the benefit of the improvement.

WHEN ORDERING SPARES.

It is extremely important when ordering Spare Parts to quote all the symbols and numbers stamped on the top of the Kickstarter

side of the Gear Box. It also helps us if the name and type of machine is mentioned, the correct part number or a detailed description, and, best of all, the old part itself sent as a pattern. These precautions may seem excessive, but, in view of the large number of different types and specifications, are necessary, and will ensure immediate and certain attention, no delay being occasioned through sending wrong parts or in unnecessary correspondence. It is also advisable for individuals who have no ledger account with us to send a remittance sufficient to cover the cost of the part required. This saves delay in sending pro-forma invoices. We can, however, send parts cash on delivery on request.

It is most extraordinary how many parcels we receive containing parts with no indication of the sender, and also letters without the address of sender. Please, therefore, always put your name and address (preferably in block capitals), and if you send parts by parcel post, put your name and address in the parcel and send a covering letter giving instructions. The same procedure should be followed with Gear Boxes sent for repair.

Our Service Department is always ready to advise on any point the rider may care to raise. We are always ready both to receive criticisms and consider suggestions, as we wish to manufacture an article that is as nearly perfect as is possible, and we can only do this by keeping in close touch with the actual users.

We have had considerable experience in racing and will advise on gear ratios, type of Box and everything in conjunction with this branch of the Sport. We have enjoyed many successes in every part of the racing world, and we will prepare, on request, special racing Gear Boxes where desired.

GEAR RATIOS.

The rider can determine the gear ratios of the machine he is using in the following manner:—

$$\begin{aligned} & \text{Top Gear} = \frac{\text{Number of teeth in Back Hub Sprocket} \times}{\text{Number of teeth in Clutch Sprocket}} \\ & \frac{\text{Number of teeth in Engine Sprocket} \times}{\text{Number of teeth in Driving Sprocket}} \end{aligned}$$

This gives the Top Gear ratio, and the other ratios can be obtained by multiplying this figure by the ratios given in our

leaflets relating to the various types of Gear Boxes. For example, if the Top Gear is determined as being 5 to 1 and the ratios in the Gear Box are given in our leaflet as 1—1.62—2.64, the complete ratios will be 5—8.10—13.20.

Finally, we would point out that we take pride in our work and do our utmost to ensure that every Gear Box we turn out is perfect. We therefore beg the user to do his part, namely, to keep it in good order, and use it with care. Our reputation is in your hands.

GEAR BOX TROUBLES—THEIR CAUSE AND CURE.

In the following lines we have tried to summarise the faults which occasionally arise with the best of Gear Boxes. These are mostly due to inattention by the rider to the customary minor adjustments which are inseparable from the Motor-cycle. While we do claim that the Burman Gear Box is the best designed and best constructed Box obtainable, it would be foolish to claim that it is immune from any kind of trouble, whatever its treatment. We therefore append a short list of common failings, the remedies for which can easily be applied by the novice, to whose lot such troubles usually fall.

CLUTCH SLIP.

This may be due to several causes:—

- (a) Clutch not engaging properly due to mal-adjustment. See Bowden cable is free in its casing (it may have stuck and thus holds the Clutch out), and that the Clutch Lever works freely. Also make sure that the requisite $\frac{1}{8}$ " clearance is allowed between Clutch Rod and ball in Clutch Lever (see paragraph on Clutches).
- (b) In the case of fabric Clutches, slip may be caused by oil or water on the clutch plates. Remove plates, clean thoroughly and replace.
- (c) Insufficient spring tension. The clutch springs are adjustable for tension and can be tightened up with a screw driver. They should not be screwed up solid or Clutch will not withdraw; the correct adjustment is when

the spring nuts are just flush with the end plate. The springs may also have lost their original tension due to tempering through heat if the Clutch is continually slipped for a long time.

CLUTCH NOT FREEING.

This may be due to wear on the Clutch Rod, which can be allowed for by adjustment of the screw and lock nut in spring plate, or by the other adjustments given previously in this booklet, or to over-tightening of the clutch springs (see above). It may be also due to too much slack in the Bowden cable, due to stretching of the wire. This slack can be taken up by unscrewing the cable adjuster or by means of the adjustment provided in the Gear Box, as described previously. It may also be caused by the projections on the clutch plates wearing grooves in the clutch case. This is caused by wear on the Chainwheel race, which allows the clutch case to oscillate relative to the clutch plates, causing excessive wear. The Clutch Race should be adjusted, or renewed if necessary, and if the clutch plates and clutch case are so badly worn as to require renewing also, this should be done.

In the case of Clutches completely enclosed in an oil bath, this may also be due to Clutch drag caused by using the wrong quality of oil. Under no circumstances should oil having a castor oil base be used, as this tends to gum up the Clutch and causes difficulty in freeing. It is sometimes very effective to add a small quantity of paraffin to the Chain Case to cure trouble of this nature, otherwise it is necessary to dismantle, clean out and reassemble. It is also very often caused due to insufficient backlash being allowed between the Clutch Operation mechanism, as mentioned earlier in this booklet on the subject of Clutches.

Clutch drag can also be caused through too tight an adjustment of the Clutch Race, and this point should be watched when the Clutch has been dismantled for any reason. This only applies to the taper Clutch Races, and does not apply to the Roller Races, where no adjustment is allowed for.

GEARS JUMPING OUT.

On the hand control Boxes, this is nearly always due to the non-coincidence of gear positions in the Box with that of the gear

lever in the gate. This results from movement of the Gear Box for purposes of chain adjustment, and subsequent failure to check over the gear positions. This is quickly put right by adjustment of the length of control rod, as described earlier in this pamphlet.

It is sometimes due to weakening of the Pawl Spring, which controls the gear selector mechanism inside the Box, and it can also be caused after prolonged wear of the gear dogs.

In the case of the Heavyweight 4-speed Boxes, wear on the Operating Fork is shown by the gears jumping out. Top Gear jumping out on 4-speed Boxes may, in some cases, be due to worn Driving Gear Bearing. This allows the Driving Gear to tilt and gradually works the gears out of engagement. On foot operated Boxes, a badly worn Foot Control Ratchet or Pawl may result in the desired gear not going properly into mesh, with the result that it quickly jumps out again. Under these conditions if the Foot Change Lever is then depressed a second time, the next gear in succession may be obtained, and not the gear originally desired. The remedy is, of course, the replacement of the worn part.

GEARS HARD TO OPERATE.

This may be due to stiffness in the control joints, too strong a Pawl Spring (see above) or too thick a grease in the Gear Box. This latter is a frequent source of trouble, and we take this opportunity of once again pointing out the necessity of using the correct grade of grease as specified by us for our Gear Boxes.

GEARS " CRASHING " WHEN CHANGING UP OR DOWN.

Frequently this is due to mal-adjustment of Gears, as pointed out above. It is not necessary with Burman Gears to double-clutch either up or down. If instructions as given previously in this pamphlet are followed, silent changes are inevitable. If a very quick or " racing " change is desired, very little pressure should be put on the Clutch. It should not be fully withdrawn, but merely eased, when a perfect change will result. This may also be due to Clutch drag, particularly when the machine is stationary, and a cure for this is dealt with previously.

GREASE ESCAPING.

See paragraph on Lubrication.

KICKSTARTING.

When the engine is cold and the oil has solidified, gumming up the piston, it is sometimes a problem to start the engine. As to the best method of freeing the engine, hints will generally be found in the handbook issued by the makers of the engine, but it helps the rider considerably if the following procedure is adopted. First push Kickstarter down until compression is felt (about two-thirds of the way down is the best position), then release Kickstarter and loose it back to its original position. Next, with exhaust lever lifted, kick the Lever down with some force, releasing the exhaust when about half-way down.

CLUTCH SPROCKET LOOSE.

If the Clutch Chainwheel can be moved relative to the Clutch Case, it is a sign that the shock absorber rubbers are wearing and should be replaced.

If, however, there is no movement between the Chainwheel and the Clutch Case, but the two together can be rocked from side to side, then the ball or Roller Race inside the Chainwheel needs adjustment. In the case of the Ball Race, this play can be taken up by removing the Clutch, taking apart the races and removing one or more of the small spacing washers (see paragraphs on Clutch). With the Roller Race, about 1/64" end play is permissible; if tilting is found on the Chain Wheel, then possibly wear has taken place, and new rollers may be required.

CLUTCH SPRINGS BECOMING UNSCREWED.

When a Clutch is operated, the Springs each tend to rotate slightly. Normally this is quite insufficient to unscrew the holding-down nut, but if, as sometimes happens, the springs are fastened by rust, mud, or similar conditions to the nut, the nuts may become unscrewed. The remedy is to clean the springs and nuts, polish the ends of the springs by rubbing on emery cloth, and re-assemble with a touch of grease or oil on the nuts and springs.

KICKSTARTER JAMMING.

This may be due to the Quadrant teeth and Ratchet Pinion teeth not engaging properly, due to the sharp edge on the Ratchet Pinion teeth having become worn. The cure for this is filing the

teeth to a sharp point, and if the first tooth on the Quadrant is damaged, this should also be filed to give a suitable lead.

KICKSTARTER SLIPPING.

This is due either to a stripped Quadrant or worn Ratchet teeth.

FOOT CHANGE LEVER AND KICKSTARTER LEVER NOT RETURNING TO POSITION.

This is, in most cases, due to a broken spring.



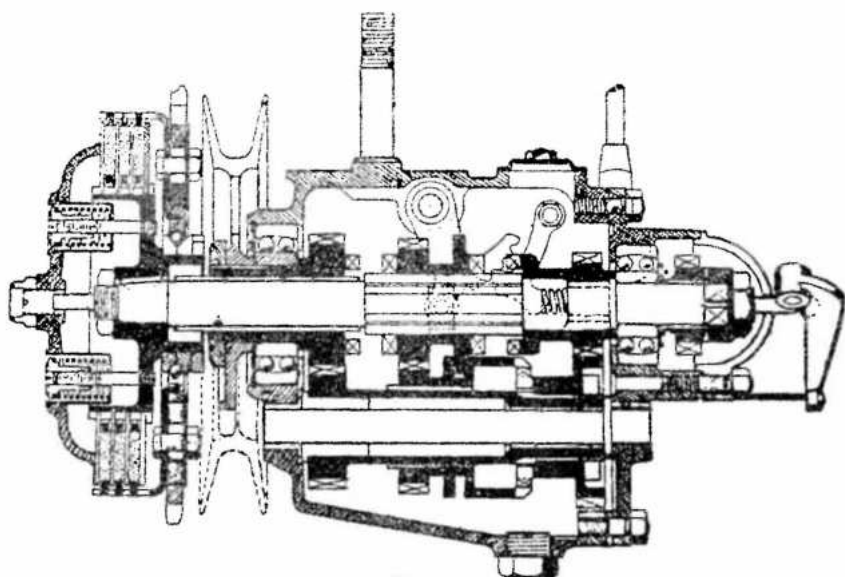


Fig. 1.

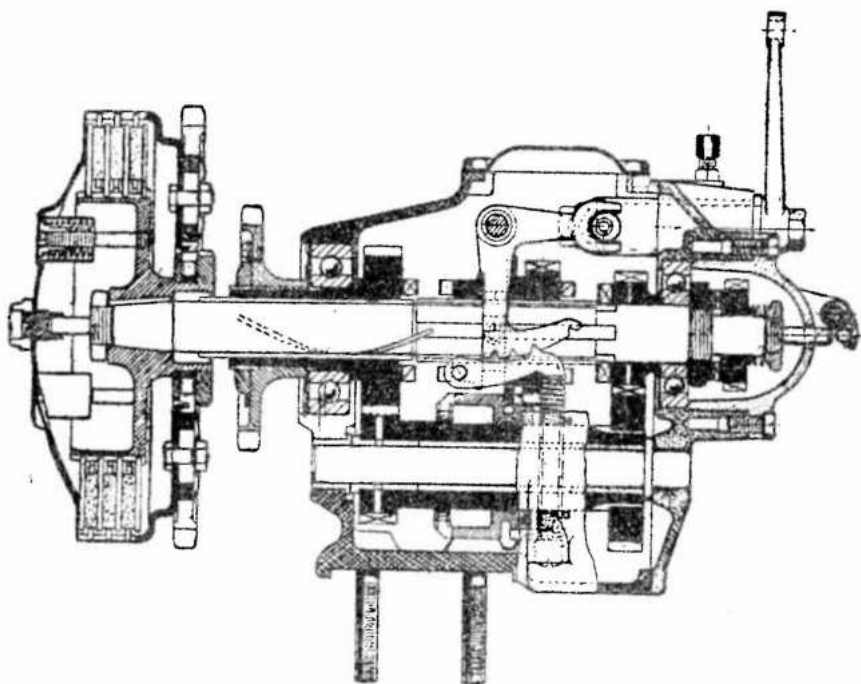


Fig. 2.

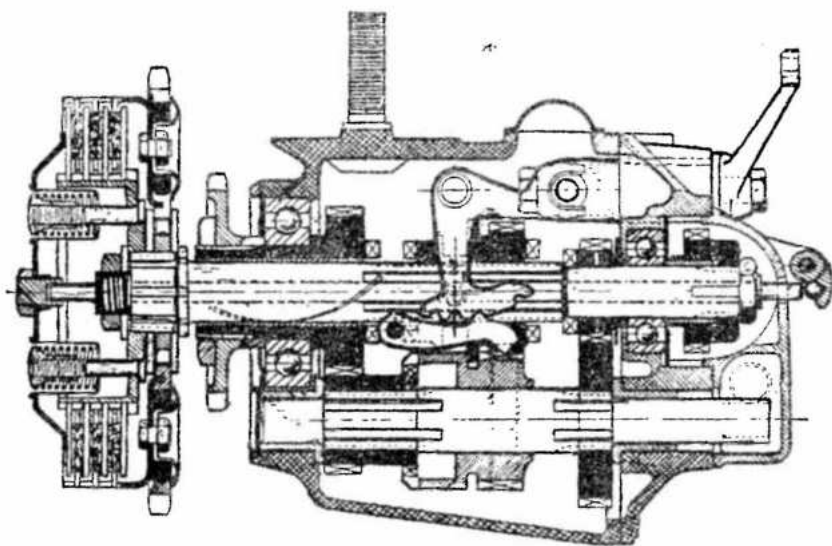


Fig. 3.

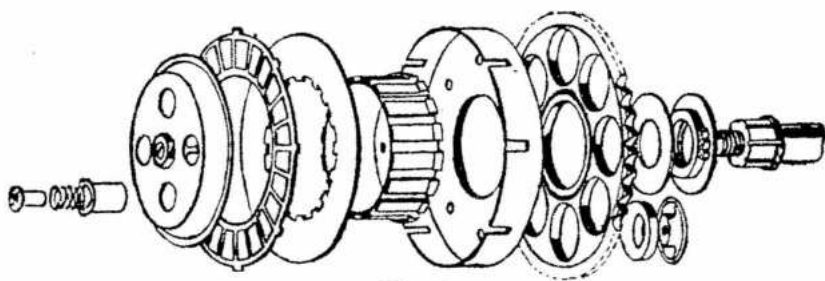


Fig. 4.

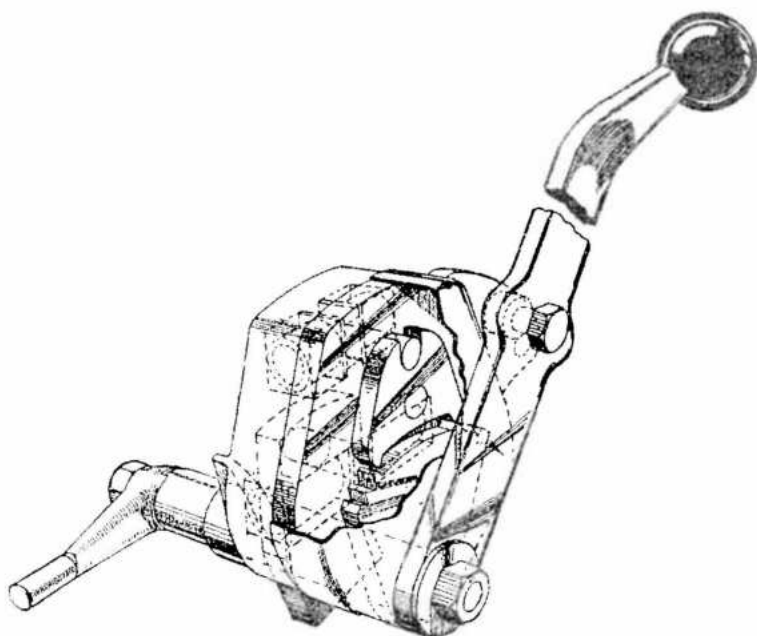


Fig. 5.

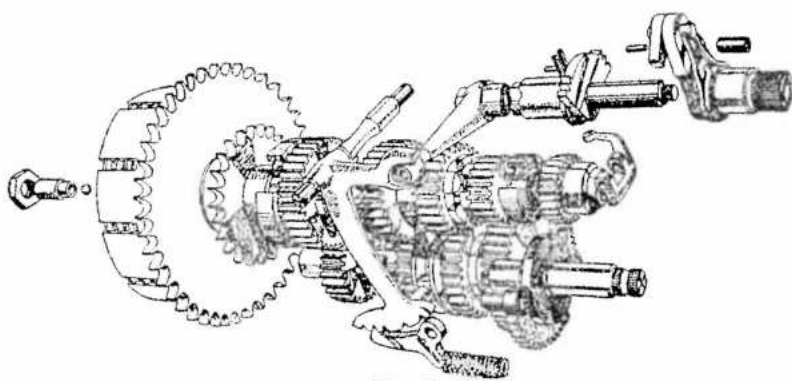


Fig. 6.

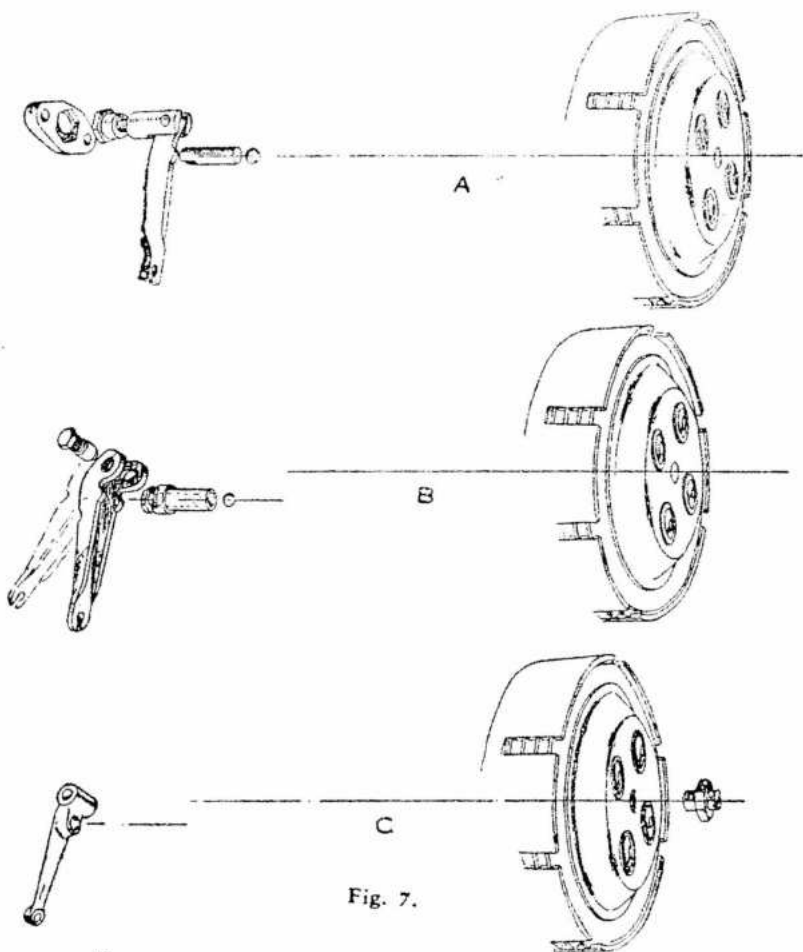


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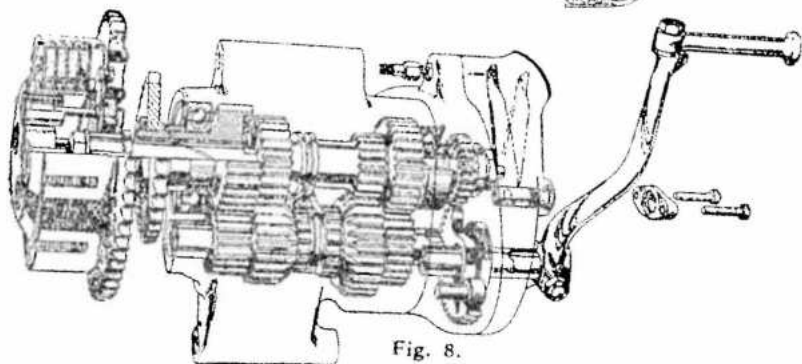


Fig. 8.

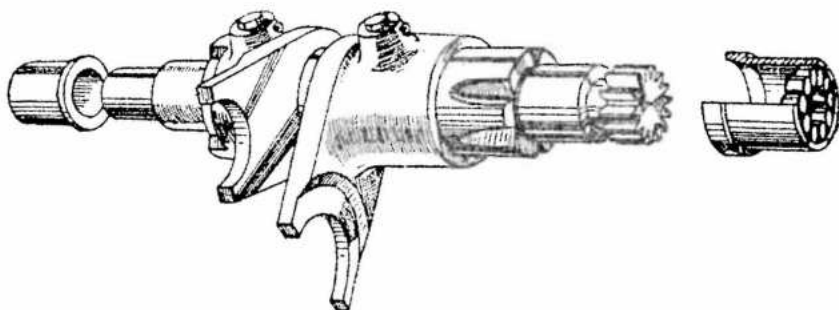


Fig. 8a.

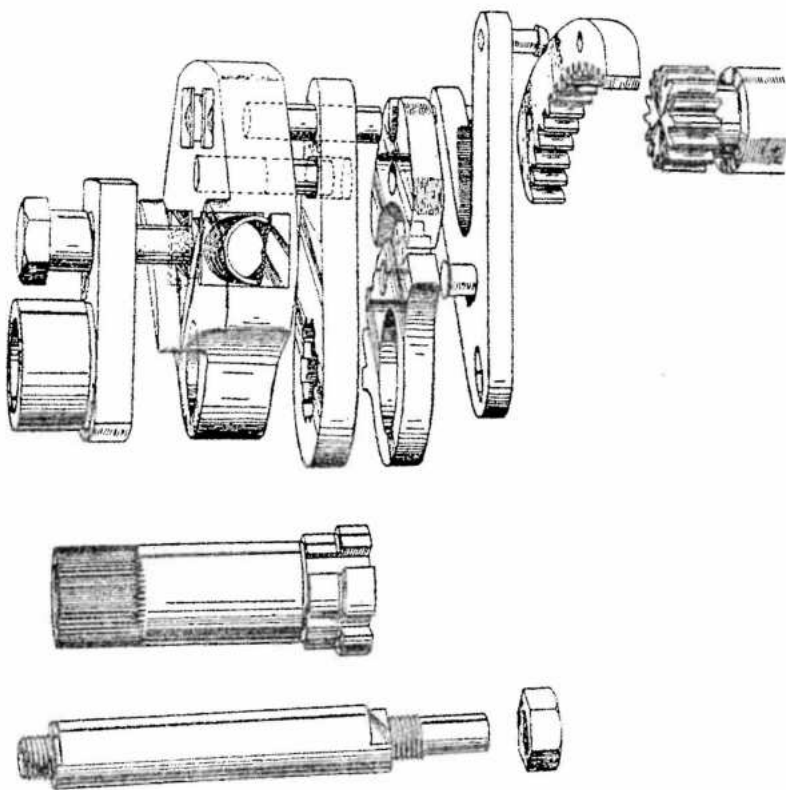


Fig. 9.

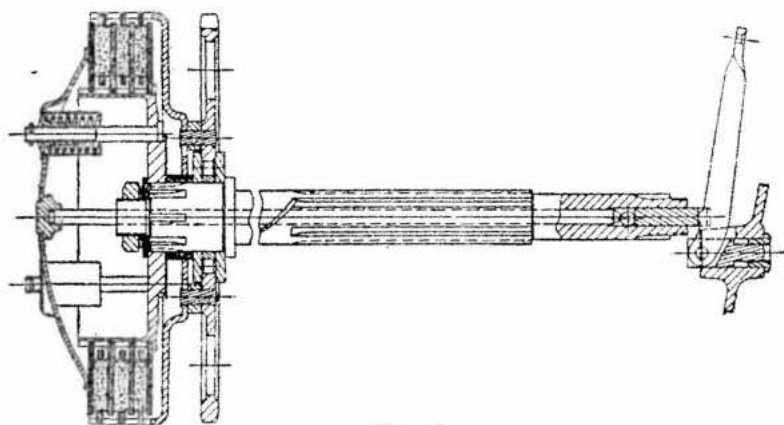
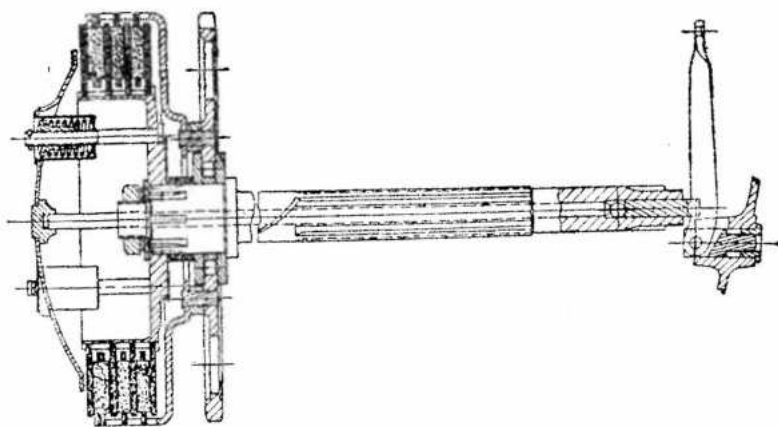


Fig. 10.

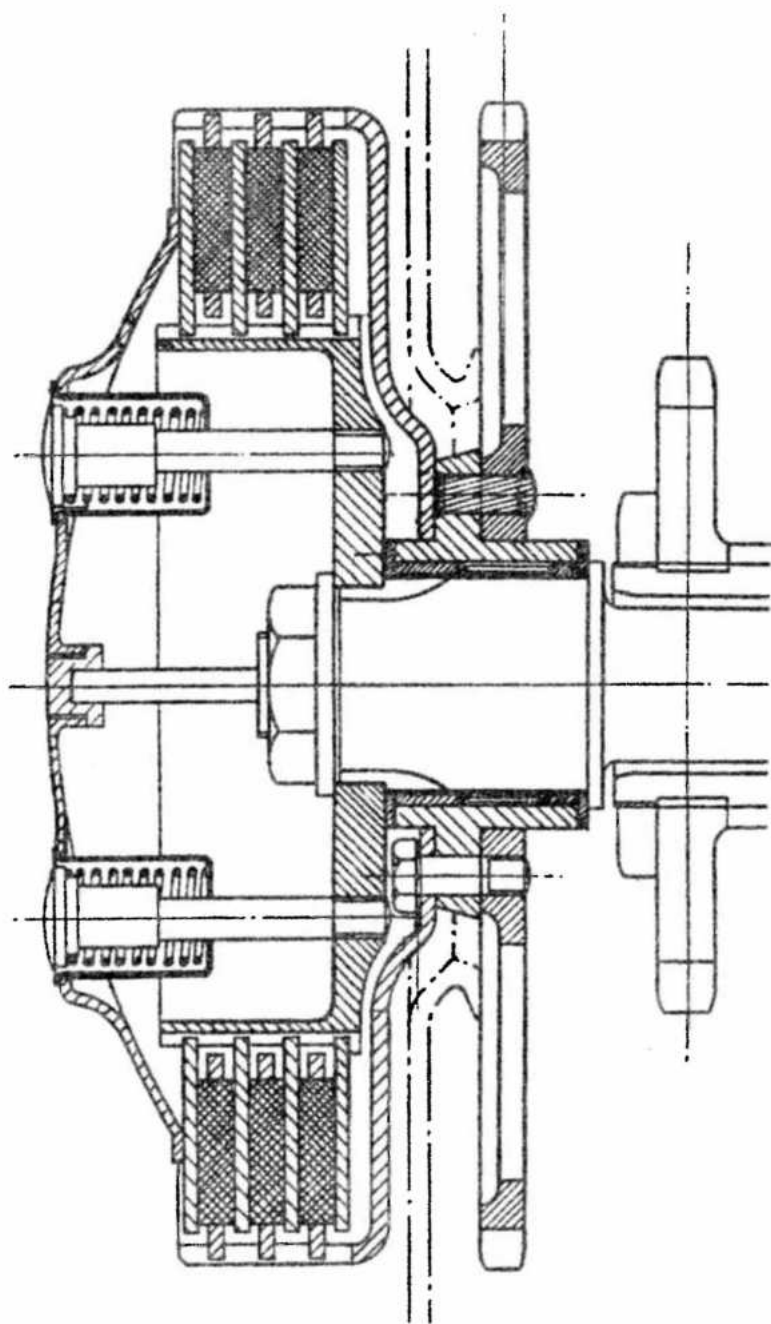


Fig. 11.