

throttle opening. This is obtained by the taper needle attached to and working with the throttle, and to the special method of compensation employed.

Rich Mixture for Starting

An independent adjustment of the taper needle is provided on some models to give a specially rich mixture at times when required, such as when starting a cold engine, the methods employed to obtain the adjustment being as follows:—

- (1) By a vertical rod engaging with a special quick-thread in the centre of the throttle, and which raises or lowers the taper needle $\frac{1}{4}$ in. for one complete turn. The bar is screwed right-hand so that turning anti-clockwise raises the needle, thereby richening the mixture. Should the throttle control cable restrict the required amount of turn, holes in the side of the bar give alternative positions for the operating rod (see Fig. 34).

- (2) By a Bowden-operated control fitted to the handlebar. The nipple soldered to end of inner cable rests against the head of taper needle, which is kept in contact with the nipple by a spring, so that when the inner cable is moved up and down, the needle follows because of the spring pressure. The control is marked "rich" and "weak" to indicate the needle setting. On no account should the control lever be used as an ordinary "air-control lever" is used. It should remain stationary except when deliberately wishing to alter the size of the jet for starting from cold, or when an extra-rich mixture is required.

The carburetter described above is known as the "two-lever" pattern, and the construction, which is similar for Lightweight and Middleweight types, is shown in Fig. 35.

Action of the Carburetter

The action of the carburetter is very simple, and reference to the sectional drawings, Figs. 34 and 35, will make it clear.

THE VILLIERS CARBURETTER

BEFORE giving details of the various types and models in use, it may be of interest, particularly to novices, to briefly describe the action of the carburetter.

The function of the carburetter is to supply the engine with a mixture of petrol and air which, when compressed by the piston of the engine, is ignited by the spark from the magneto.

Petrol-Air Mixture Supply

Liquid petrol issues through the jet orifice into a stream of rapidly moving air, by which process it is converted into a highly atomised vapour. The vacuum created in the crankcase sucks this vapour through the choke, or bore, of the carburetter, the amount passing into the crankcase being controlled by the throttle slide, the strength of the vapour or mixture depending on the proportion of petrol emerging from the jet and the air passing through the carburetter.

In most carburetters the size of the jet is fixed so that a set quantity of petrol with air is constantly fed to the engine. This proportion is determined for average running, but obviously it is desirable to vary this according to the engine requirements, because at times a much richer mixture, *i.e.*, a greater proportion of petrol to air, may be needed.

In the Villiers carburetter, the amount of petrol that is allowed to issue from the jet is automatically proportioned to the amount of air that is allowed to enter the crankcase, from which it follows that a wider range of engine conditions is covered than is the case in which the carburetter has a fixed jet.

The carburetter is entirely automatic in its operation, and gives a correctly adjusted mixture over the whole range of

Depressing the float by means of the tickler situated at the side of the body causes the petrol to rise and thereby creates a well of petrol at (a), which is sucked into the cylinder via the crankcase at the first kick of the starter. The size or area of the jet orifice (b) is controlled by the taper needle (c) with the opening and closing of the throttle, but for starting from cold

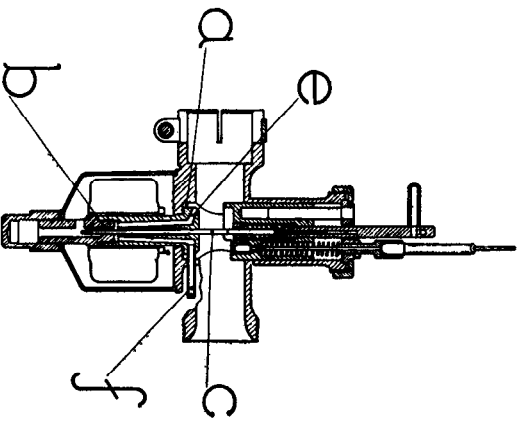


FIG. 34.—SECTIONAL ARRANGEMENT OF SINGLE-LEVER CARBURETTER.

the taper needle is raised in the jet independently of the throttle by means already explained. When the engine is warmed up the needle is lowered to weaken the mixture for normal running. The position of the needle relative to the throttle will then not be required to be altered until again starting from cold.

The automatic compensating action of the carburetter is now described. The mixture is supplied by the carburetter in two ways—first, by the suction of the piston on the orifice (e),

and secondly, by the force of the head of petrol through the jet (b) which is always submerged.

The suction of the engine on the orifice (e) draws air through the compensating tubes (f) across the top of the jet (b), where it mixes with and breaks up the petrol, and so issues from (e) into the main air stream as a partially atomised vapour.

If the load on the engine is increased, so reducing the

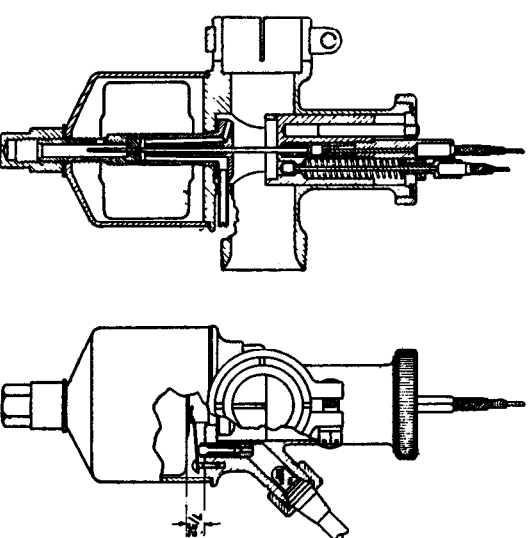


FIG. 35.—SECTIONAL ARRANGEMENTS OF TWO-LEVER CARBURETTER.

engine speed, as, for instance, when climbing, the suction on the orifice (e) is reduced. This would weaken the mixture but for the fact that the petrol issuing from the jet (b) is constant, thereby richening the partially atomised vapour coming through (e), the combined effect being that the mixture strength remains constant irrespective of engine speed or load. The main jet being in the centre of the float chamber, the mixture is not upset by the tilting of the machine. In the original Villiers carburetter, the needle controlling the entry of petrol into the carburetter rested directly on the float, but for some

years a lever giving increased pressure on the needle seating has been interposed between the bottom end of needle and top of float. Should this lever become damaged or bent it should be reset to give a distance of $\frac{7}{16}$ in. between top of float and underside of carburetter body.

Tuning the Carburetter

Providing the correct combination of jet and needle is used, the carburetter will provide the correct mixture at all throttle positions and speeds. Having set the independent needle control when the engine has warmed up, the engine should be controlled by the throttle lever only. The combination of jet and needle size is determined when the first of any model is type-tested, and then during the testing of the production model it is only a question of adjustment to the needle position in relation to the end of the throttle.

All needles for all types of carburetters are marked on the side, the figures indicating the degree of taper. For most of the carburetters fitted to engines of 147 c.c. and over needles are available in the following sizes: 1 $\frac{1}{2}$, 2, 2 $\frac{1}{2}$, 3, 3 $\frac{1}{2}$, 4, 4 $\frac{1}{2}$, 5, 6, 7. The jet fitted at the bottom of the centrepiece varies in orifice size according to the type of carburetter, but in all cases identification figures are stamped either on the head or side of the centrepiece, and when ordering spares, these markings should be quoted, together with the number of the engine to which the carburetter is fitted. In no case should the jet be removed from the centrepiece, as this component cannot be supplied separately as a spare part.

To tune the carburetter, first obtain, by altering the jet-control lever, the most satisfactory position of the needle for slow running on the road when the engine is warm, and then open the throttle lever quickly. If the engine dies out it shows that the mixture is too weak, and a needle with a greater degree of taper should be fitted. If it is found possible to open it quickly and the engine is inclined to hunt, the mixture is obviously too "rich", and a needle with less taper should be fitted.

Again the mixture is shown to be too "rich" if when running at speed and the throttle is closed the engine hesitates or momentarily ceases to fire. When the needle best suited for speed is obtained, it will be the best one for economy and power.

Best Position for Jet Lever

There is no definite rule as to the best running position of the jet lever, but it is wise to set it so that when turned as far as it will go to the weak position, the mixture is actually too weak to run. This means that for normal running it will have to be a little way towards "rich", and would always give a margin of safety, otherwise if it were as far as it would go in the weak position, one would never be quite certain that one was running on the best setting.

If necessary, in the case of a single-lever carburetter, the small bar should be unscrewed from the needle rod and replaced in another hole at right angles to the previous one, so that the needle rod may be turned round farther. In the case of the two-lever carburetter, there is a screw with a lock-nut on the body of the handlebar control. By screwing this in, the mixture is made weaker, and by screwing it out, it is made "richer". It is very necessary that at all times the compensating tubes are clear. Should one be lost, on no account must this be replaced by a screw or plug. Should this be done the carburetter will not function satisfactorily.

TYPES OF CARBURETTER IN USE

Lightweight and Middleweight Carburetters

The types of carburetter previously described are known as the single-lever carburetter and the two-lever carburetter, and these are made in two sizes, namely, the Lightweight and Middleweight types.

The Lightweight is made to fit on a stub 1 in. in diameter and the Middleweight pattern is for a 1 $\frac{1}{8}$ -in. stub; the other main differences are the diameters of the choke, throttle and

float chamber. The construction of both types is generally as shown in Figs. 34 and 35.

To Change the Taper Needle—Single-lever Carburetter

In early pattern carburetters, the needle-adjuster rod, which is screwed in the centre of throttle, was split and bulged on the end to prevent rotation due to vibration. To change the needle, remove carburetter from inlet manifold or cylinder, and unscrew the knurled top ring, when the throttle with needle can be withdrawn from the carburetter body. Unscrew the rod in centre of throttle; the taper needle with spring can then be pushed out from underneath.

Nowadays a special S-shaped damper is fitted, having a centre lip extended to engage in the slot cut in the end of the adjuster rod, so that the taper needle has to be removed from the bottom of the throttle. Before this can be done, however, the slotted, screwed bush surrounding the needle has to be undone; this is best done by using a special screwdriver made from a piece of tube long enough to clear the needle end, and having two tongues on the end to engage in the slots in the bush.

To Change the Taper Needle—Two-lever Carburetter

Remove the throttle with needle from the carburetter body as explained for the single-lever model. The needle, however, has to be removed from the top of the throttle, but before this can be done the hexagon throttle extension which carries the needle control cable has to be unscrewed; the needle with the spring under the head can then be pushed up through throttle.

It is advisable to fit a new spring when replacing the needle, because the old one may have taken a set, and it is very essential that the head of needle is kept in contact with end of control cable. Fit the new spring with the small end-coil next to head of needle. Replace throttle and top ring exactly as for the single-lever carburetter.

Dismantling Carburetter

Remove from engine and withdraw throttle as already explained. Turn carburetter upside down and unscrew nut securing float chamber. Remove the fibre washer, then float cup and fibre joint washer between cup and body. On older type carburetters not having the fuel needle lever fitted, the fuel needle will now be exposed, and will drop out if the body is turned over. When it is required to remove the fuel needle where the lever is fitted, it is first necessary to remove the centrepiece, and before this can be done, the compensating tubes have to be unscrewed from the head of the centrepiece. Under the head of centrepiece is fitted a fibre washer, which must be in position when reassembling. Having pushed the centrepiece up through the throttle bore, the fuel-needle lever can be swung on one side to allow the needle to come out.

Carburetters having a nut-and-nipple connection for the fuel pipe have filter gauzes inside the screwed connection in the body. At one time a cup-shaped filter was fitted at the bottom of the hole in addition to the detachable visible filter at the top, but the top filter only is now fitted, and with this in position the bottom filter should be removed. The body is now ready for cleaning, which is best done with petrol and a brush, and compressed air where available.

Reassembling Carburetter

First examine the body, making sure that the two small vent holes in the circular-shaped flange are clear. (In later models air enters the float chamber via the tickler.) Before refitting the fuel needle examine the taper portion, and if found to have any ridges or to be pitted, a new needle should be used. Should flooding occur after assembly the seating in the fuel bush can be remade by gently tapping the exposed end of the needle whilst in position, the needle lever, of course, being swung round out of the way. Next fit the centrepiece with fibre washer in position under head, and shank of centrepiece between the fork of fuel-needle lever; then screw the con-

pensating tubes, using just sufficient force to tighten without damaging the slotted end. Place float on centrepiece, and check distance between float and underside of body, which, with float resting on fuel-needle lever, should measure $\frac{3}{8}$ in. Correct, if necessary, by bending the lever.

Refit the fibre float-cup washer, then the cup after having examined the top face and removed any foreign matter, followed by the small fibre washer, and lastly the bottom nut, which should be tightened only sufficiently to secure a petrol-tight joint. If too much force is used there is the danger of stripping the thread on the centrepiece.

When refitting the carburetter to engine, make quite certain that the body is pushed on to the manifold or cylinder stub as far as possible. There are two or four narrow slots in the body to allow the securing clip to function, and if the stub does not extend past the end of the slots, air will be sucked in, causing hard starting and erratic running. This point can be checked whilst the engine is running by putting a drop of thin oil on each slot; if there is a leakage the oil will be sucked in. If the carburetter will not push farther along the stub, a cure can be effected by binding with insulating tape.

Air Cleaners

Most present-day motor-cycle engines have an efficient air filter fitted to the carburetter when sent out, this usually being an oil-wetted pattern which requires cleaning about every 2000 miles or even less if the weather is dry and dusty.

The filter should be cleaned by dousing in petrol and then, when dry, immersing in thin engine oil. Allow to drain before refitting. This type of filter with a screwed adaptor for fitting to carburetter intake can be supplied to suit any of the older types of carburetter.

Midget Carburetter

This model was introduced at the same time as the Midget engine, and for some time was fitted exclusively to this model. Later it was used with the original 125-c.c. (Mark VIII-D) engine-gear unit, and also for certain Mark 9D engines.

The carburetter body is made to fit on a stub $\frac{1}{8}$ in. diameter, and can be identified by the word Midget inscribed on the knurled top ring. Throttle control is by a single lever only, the adjuster to take up cable slack being screwed into the centre of the top ring. A single compensating tube is fitted to the head of the centrepiece, the slotted end of the tube being visible in the centre of the choke after removal of end-cap or filter.

To change or adjust the taper needle, remove the throttle

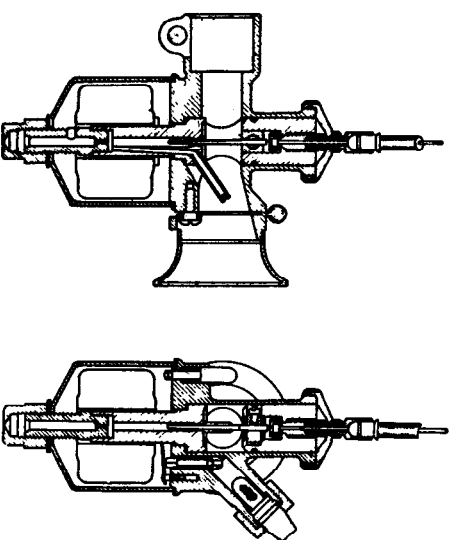


FIG. 36.—SECTIONAL ARRANGEMENTS OF MIDGET CARBURETTER.

with control cable after having unscrewed the top ring. In the side of the throttle will be seen the slotted head of a screw, but before this can be unscrewed, the retaining ring lying in the groove around the throttle must be removed. This retaining ring is fitted as a precaution against the screw entering the engine should it become detached from the centre sleeve. The taper needle is held by this screw in the sleeve, the adjustment being provided to obtain the initial setting to suit individual engines. The carburetter is dismantled as already described for the larger types, but to assist the user a sectional drawing, Fig. 36, showing the construction

is reproduced. The fuel-needle lever, which is interposed between top of float and end of needle and is common to all carburetters, is clearly shown.

Junior Carburetter

This carburetter was originally made when the Junior auto-cycle engine was introduced, and whilst the action is similar to the Midget carburetter, the construction details vary in several respects.

Taper-needle Adjustment.—Unscrew top ring and remove throttle with control cable attached. In the centre at top of throttle will be seen a slotted screw; turning this clockwise lowers the needle, giving a weaker setting. Turning in an anti-clockwise direction gives a richer setting. The head of the taper needle is kept in contact with the adjuster screw by the coil spring fitted under the head. The adjuster screw is split at the lower end, the ends being opened slightly before screwing into the throttle so as to give a damper effect to prevent rotation. Should this screw lose its pressure, remove and open ends sufficiently to make screw tight when refitted. When adjusting the position of the taper needle do not give more than half a turn at a time to the adjuster screw, and if the adjustment has been entirely lost, start off by placing the end of the screw two threads, or $\frac{1}{16}$ in., from top of throttle.

Dismantling Junior Carburetter

Dismantling is carried out in the same manner as with the Midget-type carburetter, with the exception that there is no compensating tube to be removed before the centrepiece can be taken out.

Reference to Fig. 37 will show that the air enters the centrepiece along a hole drilled in the body itself, but to ensure that this hole matches up with the hole in the centrepiece, the latter component has to be located correctly. This is done by a small screw situated below and at the left side of the petrol union. This screw has to be removed before the centrepiece can be raised, and of course replaced when the centrepiece is refitted.

The fuel-pipe connection to carburetter consists of a banjo swaged to the pipe and secured to the carburetter body by a bolt on which are fitted two fibre joint washers and a gauge filter. This filter should be cleaned occasionally in petrol, and when refitting, the fibre washer with the larger hole should be fitted next to the head of the bolt. Do not use excessive pressure when tightening the bolt, otherwise there is a danger of stripping the thread inside the body. Remove the air-

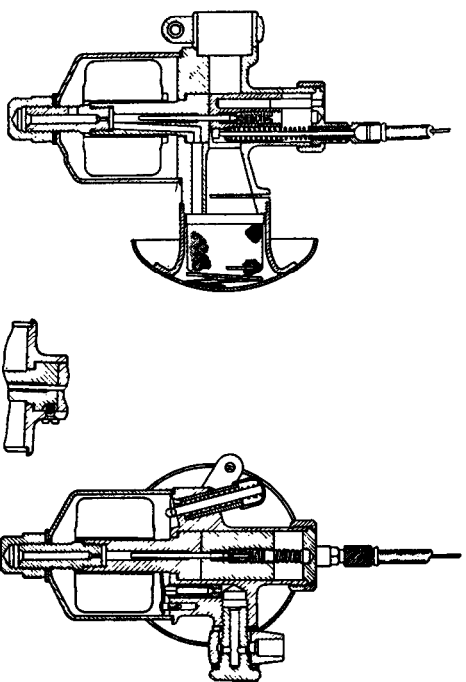


FIG. 37.—SECTIONAL ARRANGEMENTS OF JUNIOR CARBURETTER.

filter dome by unscrewing and clean the detachable filter by dipping in petrol.

The carburetter fitted to the Junior-de-Luxe engine has the petrol union on the opposite side to that of the original Junior-pattern carburetter, but apart from this feature the two carburetters are identical. The Junior-de-Luxe pattern can be used with the original Junior engine, but not vice versa.

Heavyweight Carburetter

This carburetter was made for and fitted only to the Mark XVIII-A engine, prefix letters UU, and as production of this

engine as a motor-cycle power unit was discontinued early in the late war, the numbers in use are small compared with the other models already described.

One model only was made, having two-lever control, one to the taper needle (N) and the other to the throttle, but features such as pilot jet, inverted fuel needle (C) and a stub diameter of 1¼ in. were peculiar to this type only.

The sectional drawing, Fig. 38, shows the construction clearly.

The pilot jet which functions up to about one quarter

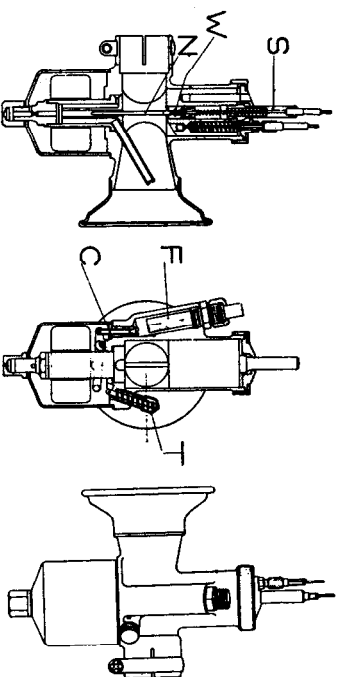


FIG. 38.—THE HEAVYWEIGHT CARBURETTER.

throttle opening is adjusted by a knurled screw situated at the base of the throttle chamber. To enrich the mixture, screw in clockwise, thereby reducing the air supply across the jet. A No. 2 needle is fitted as standard, and the position in relation to the end of throttle is adjustable irrespective of the lever control for raising the needle for cold starting. To adjust the needle unscrew the top sleeve (S) from the throttle, when the needle and holder will follow attached to the inner cable. The needle is held by a U-shaped wire (W) engaging with one of the several grooves in the needle. Extract the wire and reinsert in a higher or lower groove to give a richer or weaker mixture.

The fuel filter (F) is removable by unscrewing the hexagon union, and should be cleaned occasionally in petrol. Pressing the tickler (T) raises the fuel needle from the detachable seating, allowing fuel to enter the float chamber. The central compensating tube must be unscrewed before the centrepiece can be removed.

This carburetter was fitted to the first Mark 3E engines, prefix letters V.V., but later the Middleweight two-lever pattern of carburetter was used for these engines.

TRACING CARBURETTER TROUBLES

Constant Flooding

Flooding may be caused by :—

- (1) Foreign matter on the fuel-needle seating.
- (2) Dirt between centrepiece and float, causing jamming which prevents the float pressing against the fuel-needle lever.
- (3) Punctured float made too heavy by entry of petrol.
- (4) Tickler jamming when depressed, due to dirt or perhaps a broken return spring.

Spitting Back

A weak mixture is usually the cause and may be due to the following :—

- (1) Incorrect setting of the taper needle control, which should be moved towards the "Rich" position.
- (2) Restricted fuel supply to carburetter caused by :—
 - (a) Dirty filter on petrol tap or in carburetter union.
 - (b) Blocked petrol pipe.
 - (c) Vent hole in filler cap of tank being partially obstructed.
 - (d) Vent hole in carburetter body. In the Lightweight, Middleweight and Midget carburetters there are two vent holes in the base of the body, but in the Junior, Heavyweight and some of the later Lightweight models, the vent hole is in the tickler cap.

STANDARD CARBURETTER SETTINGS

Engine.	Capacity, c.c.	Carbu- retter.	No. of jet.	Taper needle.
Mk. VI-C	147	L/W	3	2½
Mk. VII-C	147	L/W	3	2½
Mk. VIII-C	147	L/W	3	2½
Mk. VI-A	247	M/W	3	2½
Mk. VII-A	247	M/W	3	2½
Mk. VIII-A	247	M/W	3	2½
Mk. IX-A	247	M/W	3	3
Mk. IX-B	247	M/W	3	3
Mk. IX-A	342	M/W	3	4
Sports	172	M/W	3	3
T.T.S.S.	172	M/W	3	3½
Mk. IE	196	M/W	3	3½
Mk. 2E	196	M/W	2	4
Mk. 3E	196	M/W	2	4
Super Sports	196	M/W	2	5
Mk. IX-BA	342	M/W	2	4
Mk. X-A	247	M/W	2	5
Mk. XVI-A	247	M/W	2	5
Mk. IX-BA	247	M/W	2	5
Mk. XIV-A	249	M/W	2	5
Mk. XVII-A	249	M/W	5I	2 Special
Watercooled	249	M/W	2	0
Mk. XII-C	148	M/W	2	4
Mk. XV-C	148	M/W	2	4
Mk. XIV-B	346	M/W	2	4
Midget	98	M/W	8	5½ Midget
Junior	98	Junior	8I	2
Junior-de-Luxe	98	Junior	7J	2
Mk. VIII-D	125	Midget	8	6
Mk. 9D	125	Midget	8	6
Mk. 9D	125	L/W	3	3
Mk. 9D	125	L/W	3	3 Special
Mk. 1F	98	Type 3/I	8 (Type	20 (Type
Mk. 2F	98	Type 6/o	6/o)	6/o
Mk. 10D	122	Junior	8J	2½
Mk. 6E	196	Type 3/4	0.083	3I
		Type 4/5	0.081	4½

The L/W, Type 3/I carburetter has the internal adjustment to taper needle as shown in Fig. 60, p. 129.

(e) Water in petrol. This may only be in the carburetter, in which case remove the bottom nut of float cup and drain off, having first of all shut off the supply from tank.

(f) Fuel needle stuck in its seating, thus preventing fuel entering the float chamber.

(3) Air leaks where carburetter fits on to manifold or cylinder; the body must be a good fit, and pushed right on. A worn throttle slide will allow extra air to enter and thereby upset the mixture, and also allow the slide to flutter in the body, causing a rattle sometimes difficult to locate.

Engine Will Not Stop

When the throttle lever is in the closed position, the end of the throttle must rest on the top of the centrepiece, otherwise mixture will continue to be drawn into the crankcase. To check, remove the end-cap, or filter, and if the throttle is not right down, lower it by screwing in the cable adjuster at top of carburetter. If the full adjustment will not allow the throttle to fully close, the outer cable is probably trapped or has too many bends in it, which, in effect, shortens the inner cable, thus preventing the full movement. Another cause may be binding of the throttle due to dirt. The remedy is to remove throttle, clean and smear with a little thin oil before replacing.