MODERN AUTO-CYCLES

B. G. CHADWICK

Tudor Jones

January 1956

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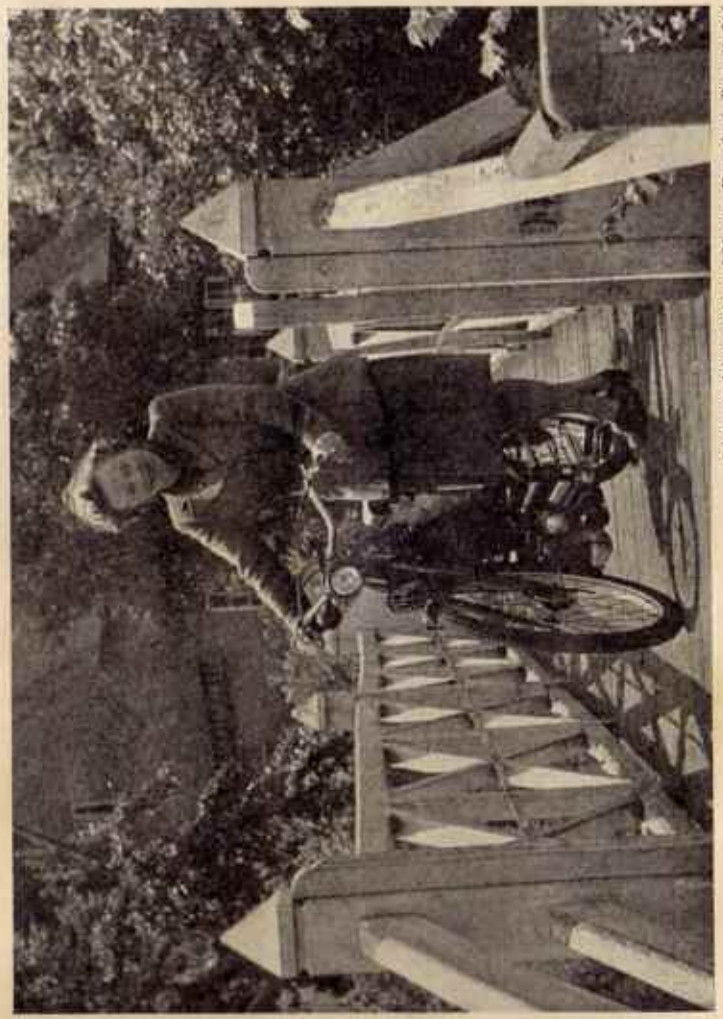

Photograph by courtesy of Messrs. Francis & Barnett, Ltd.

OFF THE BEATEN TRACK.

THE QUIET BY-WAYS ARE OPEN TO ALL WHO OWN AN AUTO-CYCLE.

MODERN AUTO-CYCLES

THEIR CARE AND MAINTENANCE

BY

B. G. CHADWICK

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FOREWORD

THE object of this book is to provide a simple, yet comprehensive explanation of all that goes to make up "the works" of the modern Auto-Cycle, how to get the best from the machine, and how to carry out satisfactorily the few running repairs and maintenance overhauls which the owner must expect to undertake from time to time. In this age of mechanization, it is fairly safe to assume that most owners will have some idea of the elementary principles underlying internal combustion engines. For those readers who do not, a short section explaining these principles is included.

Auto-Cycles have now been on the market for a considerable number of years, and in the early days, like a lot of other road vehicles, were not always reliable. The modern version, however, is a sturdy and well-tried machine, capable of carrying its rider almost anywhere. It has, in fact, undergone some remarkable trials and emerged with flying colours.

Providing the cheapest possible form of motor transport, the Auto-Cycle has found a large and well-deserved following in this country. It makes possible an ideal touring holiday and provides a reliable means of transport to and from business. Whether it be a shopping excursion to the nearest town, or a run to the coast on a summer's day, the Auto-Cycle rider is assured of a cheap, healthy, and almost certainly a trouble-free journey. For the young beginner it affords a safe and simple introduction to its elder brother, the motor cycle, whilst for those not so young, all the hard work and the inevitable trials and tribulations of cycling are smoothed out. Gone are the days when one must of necessity cope with recalcitrant engines and transmission systems. With its high performance and carefully designed engine, the Auto-Cycle rider is assured of an easy and satisfactory start even on the coldest day. No one need have a moment's apprehension before buying an Auto-Cycle on the score that it may be difficult to manage. It is hoped to show in the course of the next few chapters

FOREWORD

that anyone who can ride a cycle, can, with very little extra practice, manage an Auto-Cycle with safety under all conditions likely to be met with on the road.

No attempt has been made to differentiate between the merits of the various makes—all are reliable little machines and are certain to give satisfaction. A short section at the end of this book gives hints on the purchase of second-hand models and will, I hope, serve as a guide for those who for one reason or another wish to invest in a part-used machine and naturally wish to avoid " buying a pup."

My sincere thanks are due to the many manufacturers who have wholeheartedly co-operated by supplying a fund of information, without which I should have been unable to put this book into print.

B. G. CHADWICK.

Stow-on-the-Wold, Glos.

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CHAPTER I

LEARNING TO RIDE—THE CONTROLS—LICENSING AND INSURANCE REGULATIONS

RIDING an Auto-Cycle is only slightly more complex than normal cycling. Assuming the rider to be at home on an ordinary pedal cycle, there is no reason at all why, after an hour or two's practice, he or she should not be equally so on the mechanized version. Basic road discipline will be familiar and success will be only a matter of accustoming oneself to the unfamiliar feel of being pulled along without physical effort, becoming conversant with the few extra controls and, most important of all, understanding why one operates the controls and what happens to the "works" when they are operated.

Getting to Know the Machine.—A few moments spent in looking over the new machine will be well worth while before the novice makes his first solo.

Brakes.—At a glance one can find on right and left handlebars the normal type front and rear brake levers common to most pedal cycles. Note that on one or two makes the rear brake is not operated by a handlebar control but in connection with the clutch or pedal mechanism. The brakes, instead of retarding the wheels by means of rubber blocks as is the case with many pedal cycles, operate by way of the wheel hubs on the internal expanding principle, thereby giving vastly improved efficiency.

Clutch Control.—Moving from left to right along the handlebar, we next find a lever similar in appearance to that which operates the brake, but in some cases having another small lever incorporated with it. This is the clutch-control, and its object is to provide the rider with a means of disengaging the engine drive from the back wheel. A more detailed description of the clutch mechanism will be given later ; for the present it is sufficient for the rider to imagine two flat discs pressed tightly together by means of a powerful spring ; power is supplied by the engine to one of the discs,

causing it to rotate. As this disc is pressed tightly against the other, friction will cause the second disc to rotate at the same speed as the disc driven by the engine. Connect this second disc to the back wheel by means of a chain and sprocket and transmission will be complete.

Now if by means of a control operated by the rider it is possible to exert pressure on the disc not connected directly to the engine, it will be apparent that this pressure, if applied in the right direction, will overcome the power of the spring and force the discs apart.

The disc, now released by this action and no longer being driven by friction, will cease to pass on engine power to the rear wheel. Briefly, this is the method by which one disconnects the engine drive from the rear wheel when the clutch lever is gripped. The small trigger sometimes incorporated is simply a convenience to relieve the rider of the necessity for holding the clutch lever depressed for extended periods, such as are likely to occur in traffic.

Compression Release Valve.—Again moving from left to right along the handlebar, we find that one more small lever remains on the left-hand side. This is the compression release valve control and, as the name implies, its function is to release the compression in the cylinder of the engine. This object is attained by the opening of a small valve in the cylinder head, against the pressure of a spring.

The main uses of this control are as follows: to assist in starting the engine by releasing the compression while the machine is being pushed or pedalled forward with the clutch engaged as described later, to stop the engine, or to act as an additional brake when descending a hill with the throttle closed.

The Throttle.—Passing to the right handlebar, we come next to the throttle control which regulates the supply of explosive mixture to the engine, much in the same way that one controls the flow of water from the kitchen tap.

By moving the control lever inwards, the supply of gas is increased and greater power is given out by the engine, resulting in increased speed or pulling power at the back wheel of the machine.

Horn and Lamp.—That completes all the usual handlebar controls, and is, in fact, all with which the rider need

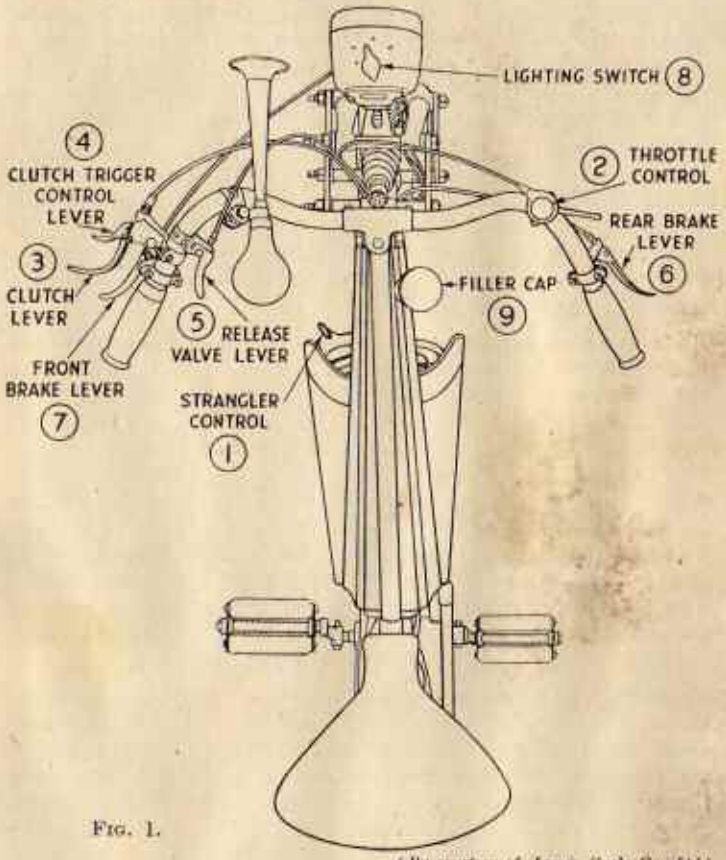


FIG. 1.

(By courtesy of James Cycle Co. Ltd.)

DIAGRAMMATIC VIEW, SHOWING THE CONTROLS OF A MODERN SINGLE-SPEED AUTO-CYCLE.

concern himself while actually travelling from place to place.

A normal bulb type horn is fitted as a general rule and, together with the lamp situated on the bracket in front of

the handlebars and controlled by a switch on top, supplies all that is necessary in the way of light and audible warning.

The "Strangler."—On the left-hand side of the machine, within easy reach of the rider's hand, will be found a small rod with a knob on the top. This is connected with the carburettor and its purpose is to adjust the mixture supplied to the engine for starting purposes. It does this by operating a plate which cuts off, or "strangles," the air supply to the carburettor, and the control is therefore called a strangler. Immediately the engine is firing properly, the strangler knob should be pushed down as far as it will go and left there until the next start from cold. Failure to do this will result in an over-rich mixture and consequent increase in petroil consumption.

Two-Speed Auto-Cycles.—Some makes of Auto-Cycle are fitted with a two-speed gear-box. There is no reason why the addition of a simple high and low speed gear should in any way confuse the beginner. Most of us have had some experience of pedal cycles fitted with a three-speed gear and have reason to be grateful for this very useful accessory. The advantages of a two-speed gear box are as follows: more power in low gear is available for hill climbing, and a more economical and higher cruising speed can be maintained in high gear, with corresponding saving in fuel consumption and general wear and tear of the engine. Provision of a neutral position enables the rider to handle the machine easily in traffic and when starting away on a hill.

Method of Handling.—The important factor to remember when driving a variable geared machine is that the gear lever should never be moved from one position to another, without first disconnecting the engine drive from the back wheel, by lifting the clutch lever. After very little practice, the novice will be able to judge when to disengage the clutch and just how much throttle opening to allow in order to produce a smooth and silent gear change. It should be remembered that when changing from low gear to high, the engine will not require quite so much throttle opening as when changing down. This will be clear when it is pointed out that the gears allow the rider to select a different ratio of engine revolutions, in relation to revolutions of the back

wheel of the Auto-Cycle. In other words, when in low gear, the crankshaft will have to revolve more times for each revolution of the back wheel than is the case when high gear is being used.

Gear Changing.—To change from low to high gear, proceed as follows: After reaching a speed of about 10 m.p.h. in low gear, slightly close the throttle and, at the same time, lift the clutch lever; when the clutch is disengaged, move the gear lever smartly into the "high" position and release the clutch again. Speed can then be controlled with the throttle. To change from high to low gear, lift the clutch lever and at the same time adjust the throttle so that the engine races slightly with the clutch lifted. Move the gear lever to the "low" position and gently release the clutch.

Stopping a two-speed model.—When it is desired to stop the Auto-Cycle, close the throttle and allow the speed to decrease before lifting the clutch. When the speed has fallen sufficiently lift the clutch lever, apply the brakes, and move the gear lever into the neutral position; the clutch may then be released. If it is desired to keep the engine running, open the throttle slightly before the engine stops and allow it to tick over gently.

Excelsior Super-Autobyk.—On this model the gear lever is situated on top of the cycle frame member above the petroil tank. The "low gear" position is selected by pushing the lever towards the tank, high gear is engaged by moving the lever away from the tank towards the rider. Neutral position lies midway between "high" and "low" and can be felt when the lever is moved. At no time is excessive force necessary to change gear, a gentle movement is all that will be required. If the gears do not engage easily when the machine is stationary, just rock the machine backwards and forwards and it will be found that low gear can then be selected.

Petroil Lubrication.—Let us assume the reader to have taken delivery of a new machine and to have familiarized himself with the position and functioning of the various controls already mentioned.

Fuel Filler Cap.—It will also be safe to assume that petrol and oil have been placed in the tank by the supplier, but in case this is not so, the fuel filler-cap will be found on the top right-hand side of the petroil tank. If this cap is unscrewed, a small measuring-cup will usually be found attached to the bottom. This is to be used for measuring the correct quantity of oil which has to be added to the petrol for lubrication purposes.

Importance of Correct Proportions.—All Auto-Cycles work on the petroil lubricating system, that is to say, the oil is mixed with the petrol and lubricates the working parts of the engine by oil mist conveyed through the medium of the petroil mixture fed to the engine. It cannot be too strongly emphasized that correct proportions and mixing of the petrol and oil used in such small engines are of paramount importance if the best performance and long life are to be obtained. In all cases the proportions are half a pint of oil to one gallon of petrol.

Use the Right Oil.—It is important that only oils recommended by the manufacturers should be used. Castrol XL is suitable for all makes of Auto-Cycle engines.

It is a good thing, if possible, to mix the petrol and oil in a can and then pour the petroil mixture into the tank. This method ensures perfect mixing and eliminates the possibility of the oil settling in the tank and incorrect lubrication or choking of the fuel feed resulting.

Starting up from "Cold."—Whenever the machine is to be started after it has stood for an appreciable time, the petroil mixture should be shaken up by rocking the machine from side to side.

It having been ascertained that the petroil tank is full, the tap at the bottom of the tank should be moved to the "on" position. Pull up the strangler knob and depress the small plunger on the top of the carburettor until petroil drips from the float chamber below. Release the plunger as soon as petroil begins to drip, or too rich a mixture may result. Open the throttle lever about one-third of its travel, lift the compression release lever, and push or pedal the machine forward.

When a speed of about five miles per hour has been reached, drop the compression release lever and the engine should fire. It is necessary, if this method of starting has been adopted, and the rider is pushing the machine, to disengage the clutch by gripping the clutch lever immediately the engine fires, as it will be understood from the foregoing that as soon as the engine starts, the machine will move forward under its own power unless the drive is freed from the back wheel.

When the engine is running, return the strangler control knob to the open or "down" position. If the engine commences to spit through the carburettor, raise the strangler knob for a short time, but return it to the "down" position as soon as possible.

Another Method of Starting.—There is an alternative method of starting, which can be adopted at the rider's wish. This differs from the method already described only in that the clutch is used for the start instead of the compression release lever, the latter being left untouched throughout.

After the preliminary adjustments already given in detail have been made, the clutch is lifted to disengage the back wheel from the power supplied by the engine. The machine is then pedalled forward until, at about the same speed as before, the clutch is gently released and the engine will start. This method has the advantage that the rider need not worry about disengaging the clutch to prevent the machine from running away from him.

Care of the Clutch.—It should however be remembered that the life of the clutch will be greatly increased if it is properly treated. The practice of suddenly letting go of the lever places undue strain on both the clutch and chains. It is recommended that the rider continue to pedal lightly for a few seconds after releasing the clutch, in order to reduce the load on that member whilst the drive is being taken up. With the engine running, the speed of the Auto-Cycle can be controlled by means of the throttle and brakes. To jam on the brakes to retard the machine is not only wasteful but is only partly effective unless the throttle has first been closed. This can be likened to a tug-of-war,

with the engine pulling one way and the brakes trying to counteract the pull.

To Reduce Speed.—The correct method of slowing the machine is first to control the speed by means of the throttle, then, if this does not reduce the speed quickly enough, apply the brakes as required.

Stopping the Machine.—Should it be desired to bring the Auto-Cycle to a standstill, close the throttle, apply the brakes, and when the speed is reduced to about five miles per hour, disengage the clutch, when the machine will come to rest with the engine stopped.

Traffic Stops.—If, as when pulling up in traffic, it is desired to keep the engine running, carry out the above procedure but, instead of fully closing the throttle, leave it open just enough for the engine to tick over slowly.

Emptying the Carburettor.—When putting the machine away for the night, or for a considerable time, the petroil should be turned off and the engine allowed to run until the carburettor is empty. This is best done when some hundred yards or so from home, as it will then enable the Auto-Cycle to be ridden to the door ready to put away, and will avoid the necessity for keeping the engine running to use up the fuel while the machine is stationary.

The object of running the carburettor dry is to ensure that petroil mixture will not be left in it long enough for the oil to separate from the petrol and possibly make the next start difficult, owing to too high a proportion of oil in the fuel.

Don't Coast with Clutch "Out."—Finally, never coast downhill with the clutch disengaged, as this practice is liable to cause excessive heat and may result in a burnt-out clutch.

"Running-in" the New Machine.—The principle of handling the machine on the road having been mastered, a few words might well follow on the subject of running-in the new model. Internal combustion engines are machined to very fine limits in order to obtain the high standard of performance of which they are capable. However fine the

finish on cylinders, bearings, etc., it is impossible, without careful running in, to obtain the perfect bearing surface.

Note.—During the first few hours of its life an engine is inclined to be rather stiff and, if not properly handled, may "seize," or, in other words, jam solid.

It requires no engineering knowledge to realize that metals when hot expand. From this it is but a step to the understanding that if, as already stated, very small clearances exist between moving parts, the temperature has only to rise a little too high for the expansion to become so great that all the clearance is taken up, and consequently parts which were intended to move can no longer do so.

This is rather stressing the point but, to take the reasoning one stage further, one knows that friction gives rise to heat, and it follows that excessive speed, and thereby friction, will cause excessive heat with its resultant evils. For this reason the manufacturers recommend the most careful attention to correct lubrication of the engine and all moving parts when a machine is new.

It should not be assumed from the above that one must necessarily expect trouble when running in a new machine; it is, however, as well to know what to avoid.

"Go Slow" with a New Machine.—The engine should not be run at full throttle under light load for the first 350 to 500 miles (this does not mean that full throttle may not be used when climbing a hill). It is likely that during the running-in period, owing to various factors, an excessive deposit of carbon will form on the skirt of the piston and, after completing about 350 miles, the cylinder should be removed and the engine decarbonized (as described in Chapter III).

Taxation and Third Party Risk.—When a new machine is received by the owner, it will probably already have been registered and taxed by the dealer. The law demands that all mechanically-propelled vehicles shall be taxed and insured against third party risk. The local County Council Motor Taxation department will always give up-to-date information to owners of motor vehicles, and in many cases this information can also be obtained from the Post Office.

When it is required to license a vehicle, an application form for a road tax licence should be obtained and the particulars required thereon clearly and correctly filled in by the applicant. Before an application can be approved, it is necessary to obtain a Certificate of Insurance covering the rider against third party risks, that is to say, against any damage or injury which may be suffered by a third party, caused by an accident in which the rider of the machine is involved.

Comprehensive Insurance.—This indemnity can be obtained from any reputable motor insurance company for quite a small cost, and the period of cover is usually one year. An owner who so wishes can, of course, insure his machine against fire, theft, and various other risks, on a comprehensive policy, details of which will readily be supplied by the insurance company.

Obtaining a Driving Licence.—Having obtained the insurance cover certificate, the owner should next obtain a form of application for a driving licence. This, too, is obtained from either a post office or from the County Council Motor Tax department. The driving licence can be obtained either by post or by personal visit to the licensing authorities, fee, five shillings per annum. If the applicant has not previously held a driving licence, a provisional licence will be issued, current for three months.

Road Tax Licence.—Armed with the insurance cover, dealer's delivery note, or receipt, and details of the engine and frame number, etc., of the machine to be taxed, there is nothing further to prevent the owner from obtaining a road tax licence, either by post or personal visit to the County Council Motor Taxation department. This licence may be taken out for a period of three months or one year (if applied for on 1st January) or the remaining part of the current year to 31st December, on payment of the appropriate fee.

If the applicant wishes to take out a licence for three months, the fee payable will be slightly higher than one-quarter of the annual rate. Details of rates of payment current at the time of writing are given below. It will be noted that the three monthly periods commence on

1st January, 25th March, 1st July, 1st October. Should an owner wish to take out a quarterly licence at some date falling between the fixed periods, this can be done on payment of a proportion of the three-monthly fee.

List of Road Tax Licence fees applicable at time of writing.

Full Annual Fee, 17/6.

If the licence is taken out on or after the dates given below (expiring 31st December) the fees are:

1st Feb.	1st Mar.	25th Mar.	1st May	1st June	1st July	1st Aug.	1st Sept.
16/11	15/4	13/10	12/3	10/9	9/3	7/8	6/2

Quarterly Tax, 4/10.

When issuing the first road tax licence, the authorities will provide the owner with a registration book in which are recorded all the details of specification and identification required by the law. Owners are reminded that they should sign both the registration book and their driving licence.

CHAPTER II

THE FUNCTIONING OF TWO-STROKE ENGINES

ALL British Auto-Cycles on the market to-day are fitted with "two-stroke" engines, and this chapter deals in an elementary manner with the basic principles of this type of power unit. It endeavours to give some idea of how

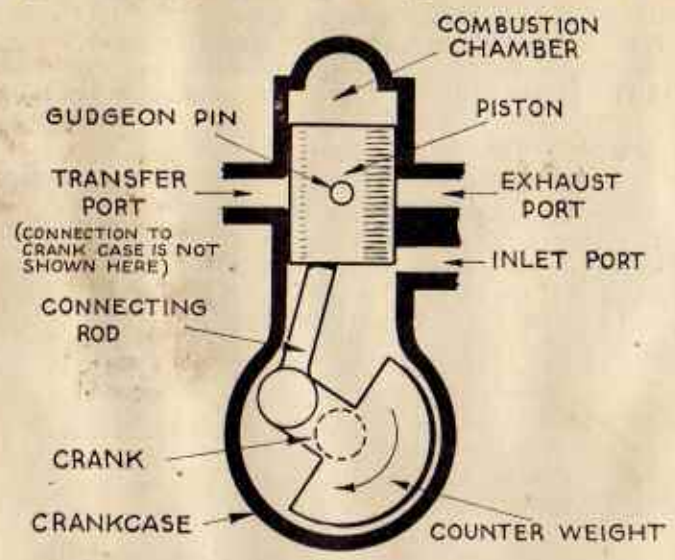


FIG. 2.
SHOWING MAIN COMPONENTS OF TWO-STROKE ENGINE.

the petroil from the tank is converted into power capable of turning the road wheels of the Auto-Cycle. First, we must grasp the fact that the engine is only an instrument for extracting the heat or energy from petrol and converting it into work, which can be passed by means of the transmission to the road wheels.

A two-stroke engine is really very simple, although the

principle upon which it works may at first sight be confusing to the novice. Let us therefore break it down into its component parts by degrees.

Piston—Connecting Rod—Crank.—There are only three basic moving parts in the engine, namely the piston, the connecting rod, and the crank. The piston is free to slide up and down in the cylinder (see Fig. 2) and is connected to the crank by means of the connecting rod.

The connecting rod can best be imagined as an arm attached at its top end to the piston and at the bottom to the crank. At both top and bottom it is fitted with a bearing which allows it freedom in certain directions, so that the piston may slide up and down the cylinder and the crank revolve. It will be seen by looking at the sketch that, if pressure is applied to the top of the piston, it will be pushed down the cylinder.

As the piston, in turn, is connected to the crank, it follows that the crank will revolve. For example, if the piston is at the top of the cylinder, and pressure is applied to it, it will move down the cylinder until it reaches the full extent of travel permitted by the crank. During this journey down the cylinder, the crank will have revolved one half-turn, and the crank itself, which can be imagined as a letter U, will also be at the bottom of its travel.

Now imagine that a turning force is exerted on the crank by some means which we have not as yet discovered. If this force is exerted in the same direction as that in which the crank is turning, it will allow the crank to continue its journey until it has completed the full circle and arrived back at the position from which it started.

Following the lines of our reasoning a step further, it will be seen that during its upward journey, the crank has by means of the connecting rod pushed the piston up to the top of the cylinder and one complete cycle of events has taken place involving two strokes of the piston, one down and one up the cylinder, hence the name two-stroke engine, giving one power stroke to every two strokes of the piston.

Explosive Mixture.—The next stage is to discover a means by which the piston can be driven down the cylinder

and so start the operation. It is well known that petrol when mixed with air in certain proportions forms an explosive mixture. If a piston is enclosed inside a cylinder in such a way that when the piston is at the top of its stroke a small clearance exists between the top of the piston and the head or roof of the cylinder, this space can contain a volume of gas.

Now imagine the piston at the bottom of its stroke, when there will be a lot of space between the top of the piston and the head of the cylinder. If we cut a hole in the wall of the cylinder somewhere between the two and introduce explosive gas through the hole into the space between piston and cylinder head, what happens as the piston comes up? Gas will enter the cylinder first until the space is, to all intents and purposes, full. As the piston ascends, its top will pass the hole cut in the cylinder wall, and at this stage the side of the piston will blank off the hole, allowing no more gas to reach the space and at the same time trapping the gas already there.

As the piston continues on its way up the cylinder it will, if it is a gas-tight fit in the cylinder, compress the gas until, at the top of its travel, all the gas which was in the large space will have been compressed into the small space remaining between piston and cylinder head.

The Flywheel.—If at this stage the gas can be made to explode, it is easily seen that the piston will be forced very rapidly down the cylinder through one complete half-turn. Now if to one end of the crank we fix a well-balanced, but heavy disc or flywheel, the reader will readily understand that as the piston is driven downwards by the explosion a turning motion will be imparted to the flywheel which will enable it to store up sufficient energy to return the piston to the top of the cylinder.

This, briefly, is the means by which the energy contained in the petrol is converted into a turning motion at the crank, but we have now to study the other operations which must take place in order that the sequence of events can be repeated indefinitely.

First, we must have some means of mixing the petrol with the correct quantity of air to form an explosive mixture and of supplying the resultant gas to the cylinder of the engine.

Petrol and Air Admixture.—The apparatus which performs this operation is called the carburettor, and its design and method of working are explained in a later chapter. The carburettor is connected to the engine by a pipe, which in turn allows gas to enter the cylinder through a second hole or "port" (see Fig. 3), cut in the wall of the cylinder slightly nearer the bottom of the piston's stroke than the port which feeds the combustion chamber in

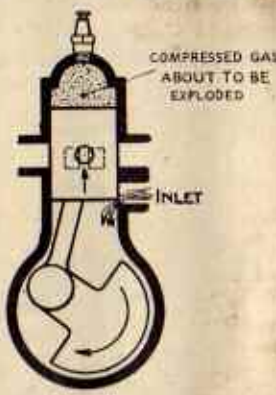


Fig. 3.

Showing inlet port, uncovered by piston.

which the explosion actually takes place. This second entrance is known as the inlet port.

The Crankcase.—When the piston is moving up the cylinder from the bottom, there comes a time when the side of the piston passes the inlet port, uncovering it and thereby allowing gas to flow into the space below the piston. This space, containing the crank and lower or big end of the connecting rod, is enclosed by a casting known as the crankcase.

The crankcase consists of two halves bolted together in such a way that the joint is air-tight. The incoming gas passes into this space aided by the depression caused when the piston moves up from the bottom of the cylinder. When the piston again descends, its side will blank off the inlet port and uncover the first or upper hole in the cylinder

wall. This is the transfer port, so called because it is connected by means of a passage with the crankcase and allows explosive mixture to be transferred from the latter to the combustion chamber.

The Transfer Port.—When the piston descends, uncovering the transfer port, explosive mixture from the crankcase will be pumped by the action of the descending piston into the space between the top of the piston and the head of the cylinder.

The Exhaust Port.—But what happens to the gas after it has been exploded by some means as yet unexplained? Another hole has to be cut in the cylinder wall; this is

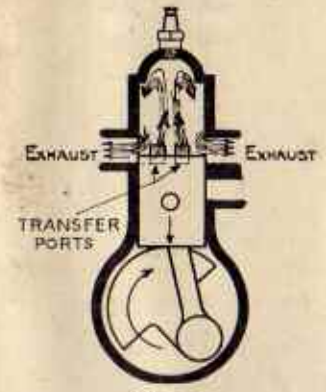


FIG. 4.

PISTON HAS BEEN DRIVEN PART OF THE WAY DOWN THE CYLINDER, EXHAUST GAS ESCAPES, AND A FRESH CHARGE OF EXPLOSIVE MIXTURE ENTERS THROUGH THE TRANSFER PORTS.

named the exhaust port, because its purpose is to permit the exhausted gas to escape into the atmosphere.

The position of the exhaust port is usually directly above the inlet port and slightly higher up the cylinder wall than the transfer port. This allows the side of the piston to uncover it a short time before it uncovers the transfer port, thereby allowing the exhaust gas to begin its escape before the fresh charge from the crankcase enters (see Fig. 4).

It is true that both the transfer and exhaust ports are uncovered at the same time for a short period during the downward stroke of the piston, but the exhaust gas, due in part to the downward surge of the explosion and the careful positioning of the ports in relation to one another, does in fact pass out of the exhaust port and not through the transfer back into the crankcase. This will be more readily understood when it is realized that the incoming gas is surging into the cylinder from one side whilst the flow of exhausted gas has already begun its exit on the other side, before the transfer port is uncovered (see Fig. 4).

The Deflector.—Actually, a small percentage of the incoming charge probably does leak out through the exhaust port, or becomes fouled by mixture with the exhausted gas, but this is a problem for the designer and need not trouble the owner.

To assist the correct flow of gases, some two-stroke engines employ a piston having a built-up or mound-like extension on the head called a deflector. This is so shaped that it assists in keeping the incoming charge and outgoing exhaust gases separate.

The fact of having this mass of metal on the head of the piston can, however, lead to distortion of the latter with possible seizure. More modern practice tends to do away with this type of piston and employ a "flat top" version, relying on careful disposition of the ports to overcome any loss of efficiency due to incomplete scavenging of the combustion chamber.

Throughout this explanation we have talked of one hole or port to perform a certain duty. Now the practice of some engine designers is to employ two or more ports on opposite sides of the cylinder wall to speed up each operation. The principle, however, remains the same.

Piston Rings.—To complete our understanding of these basic facts, we must study one or two other details. In order to obtain a gas-tight fit between the piston and the wall of the cylinder, grooves are machined around the side of the piston, and into these are fitted strong, springy rings which press outwards against the cylinder wall and, whilst allowing the piston to move up and down the cylinder,

ensure a gas-tight fit. These piston rings, usually two in number, are situated towards the top of the piston.

The piston in turn is attached to the connecting rod by means of a small steel tube or pin called a gudgeon pin. This pin is usually secured in the piston by two spring clips known as circlips, one on each side to prevent the pin from sliding sideways and damaging the cylinder wall. The gudgeon pin passes through the connecting rod at its top or small end, held in place by a bush or hollow metal tube, usually made of phosphor-bronze, inserted into the small end of the connecting rod.

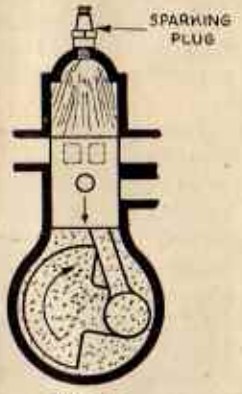


Fig. 5.

Showing piston descending just after explosion and about to uncover exhaust and transfer ports.

The bush is a floating fit in the connecting rod, and the gudgeon pin is made just loose enough for it to slide freely in the bush and so allow the connecting rod to swing in relation to the piston throughout the revolution of the crank.

The connection at the big end of the connecting rod between that member and the crankshaft is made by means of a roller bearing inserted over the crankpin and into the big end eye of the connecting rod.

Eliminating Vibration.—It will be easily realized that, in an engine running at the high number of revolutions per minute common to modern internal combustion engines, any unbalanced weight would soon result in damage due to excessive vibration, and for this reason small counter or bob weights are built into the crank to counteract the unbalanced weight of the piston and connecting rod.

The Sparking Plug.—If the reader has been able to follow thus far, it will now be necessary only to explain that the explosive gas compressed in the combustion chamber is fired at the correct moment by means of an electric spark provided by way of a sparking plug screwed into the cylinder head (see Fig. 5). How this electricity is supplied is explained in the chapter dealing with the ignition.

If, finally, we fix a sprocket on to one end of the crankshaft and connect this by means of a chain and further sprocket to the back wheel, the drive will be complete.

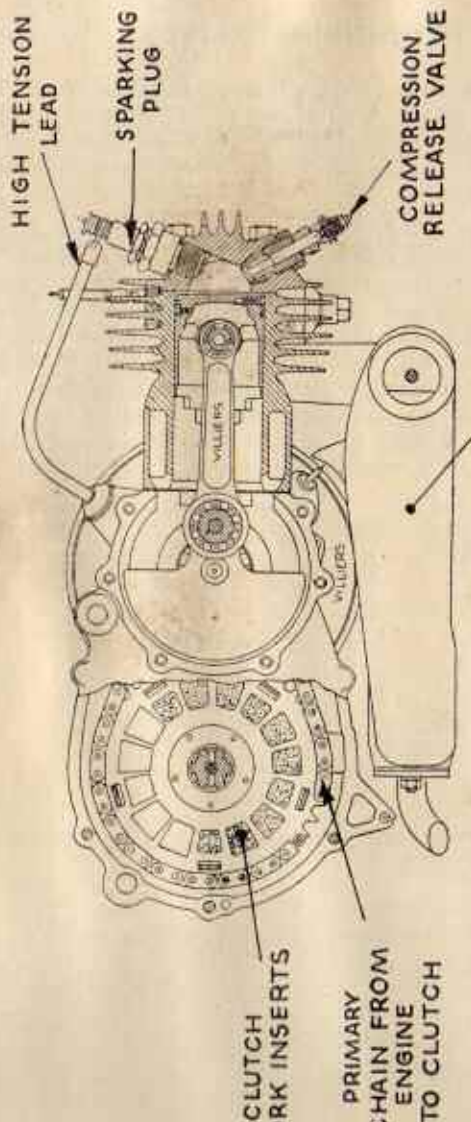


Fig. 6.

The Villiers Engine and Clutch Unit with parts "cut away" to show internal construction.

SOME DETAILS OF THE VILLIERS, SCOTT AND EXCELSIOR ENGINES: DECARBONIZING AND LUBRICATION

Two popular makes of two-stroke engines in use with modern Auto-Cycles are the Villiers and the Scott. The 98 cc. Villiers Engine (see Fig. 6), especially designed for use with this type of machine, is fitted to a large proportion of Auto-Cycles on the roads in this country.

THE VILLIERS ENGINE

The modern version makes use of a deflector-less piston on the lines described in Chapter II. The term 98 cc. refers to the cubic capacity of the cylinder and is by R.A.C. rating just under 1 h.p. The crank unit, clutch, and drive from engine to clutch, remain the same as on the earlier model which employed a deflector type piston, but the arrangement of the ports and the piston itself has been altered.

Detachable Cylinder Head.—The new engine employs a detachable aluminium cylinder head, secured to the cylinder barrel by bolts, and carrying the sparking plug and compression release valve. The cylinder head is drilled to allow the compression release to feed into the exhaust port. A rather long, flat-top piston, having two one-eighth of an inch wide piston rings and gudgeon pin bosses bushed with bronze, is carried on a plain tubular gudgeon pin which is secured in the piston by spring circlips.

In turn, the gudgeon pin is a sliding fit into a bronze bush located in the specially hardened eye at the small end of the connecting rod. This engine is said to have a markedly improved petrol consumption in comparison with the earlier model, and develops greater power at low revolutions.

Magneto-Dynamo.—A flywheel magneto-dynamo is fitted, which supplies the current for both ignition and

lighting purposes. The dynamo is of the three-pole type and feeds a 6-volt one amp. headlamp bulb.

The flywheel itself is an alloy casting riveted to a steel boss, which latter acts as the cam for the contact breaker. The crankshaft is carried on two ball bearings, and the primary drive to the clutch is by a totally enclosed chain, driven from a sprocket mounted on the crankshaft just behind the flywheel magneto which, in turn, is a taper fit on to the end of the crankshaft. The cylinder barrel is secured to the crankcase by four bolts and is easily removable for overhaul. The crankcase halves are bolted together and a gasket is employed to ensure gas tightness.

Action of the Clutch.—The clutch runs in oil and is housed in a separate compartment of the crankcase, access to which is obtained by removing the cover plate. The clutch itself is a two-plate cork insert type and is very smooth in action. It has a long life and requires a minimum of attention. Final drive to the back wheel is by a chain driven from an external sprocket mounted on the clutch shaft.

Maintaining Oil Level.—On the clutch housing just under the driving sprocket, will be found an oil level plug. It is important that the oil level should be inspected periodically and, if necessary, fresh oil added through the inspection plug. A cast alloy silencer is mounted underneath the engine and is attached to the latter by a bolt at the front and a retaining clip at the rear.

THE SCOTT ENGINE

The Scott engine fitted to Cyc-Autos employs a cylinder complete with built-in head. It is detachable from the crankcase by removing the four retaining nuts at the base of the cylinder.

Ignition and Lighting.—Ignition on the Scott engine is by flywheel magneto, but the lighting current is supplied by an external dynamo driven from the road wheel.

The piston has a T-shaped expansion split on one side and, when re-assembling the engine, care must be taken to see that the piston is fitted so that the split is on the left-hand side when looking towards the front of the engine.

Dry-plate Clutch.—The clutch is of the dry-plate variety, that is to say, it does not run in oil, as does the clutch on the Villiers engine. Access is gained by removing the clutch housing on the back of the engine.

Piston and Big End.—The piston is mounted on a hollow gudgeon pin which is a sliding fit in the small end bush; it is retained in position by means of circlips sprung into both sides of the piston. The big end of the connecting rod is carried on a stout roller bearing.

Primary and Final Drive.—Primary drive from engine to clutch is made by means of a worm and the final drive by external sprocket and chain. This method of primary transmission has the advantage of being easily and quickly disengaged from the final drive to the back wheel if at any time the rider wishes to use the machine as a pedal cycle.

Disengaging the Drive.—The method of disengagement can only be effected when the Cyc-Auto is stationary and is as follows. Whilst sitting on the saddle, give the right-hand end of the pedal crank axle a sharp tap with the heel. The crank axle will move a quarter of an inch to the left and the power sprocket will be pushed out of mesh. The machine in this condition can be pedalled as an ordinary cycle.

Re-engaging.—When it is required to engage the drive again, stand on the left side of the machine and push the left pedal to the bottom of its travel. Hold the machine by the handlebar and saddle and allow it to slope well to the right. Press firmly with the ball of the foot on the crank axle and rock the machine backwards and forwards to rotate the power chain sprocket into such a position that the dogs will mesh. This will allow the crank axle to move over to the right-hand side again.

Reserve Fuel Tank.—One other feature of the Scott machine is the reserve fuel tank, which holds sufficient petroil for about five miles. A division plate is fitted in the centre of the fuel tank and holds back a small quantity of fuel from the carburettor. When it is required to utilize this, simply lean the machine sharply to the right and the

reserve fuel will be transferred to the carburettor feed side of the tank.

EXCELSIOR GOBLIN ENGINE

This engine, whilst operating in principle on the lines already described in Chapter II, employs a rather different method of transferring the explosive mixture from the crankcase to the combustion chamber. Instead of the normal system of transfer port, giving direct access to the crankcase, the Goblin engine employs four transfer ports, two one above the other, on opposite sides of the cylinder. Explosive mixture is passed to the crankcase, through the inlet ports, in the normal manner and from there is "transferred" through two ports, cut one in each side of the skirt of the piston, which, at a certain period during the cycle, coincide with the two lower transfer ports in the cylinder. From here the gas is conveyed by ducts to the two upper transfer ports and thence into the combustion chamber. Into the top pair of transfer ports are fitted two detachable deflector plugs which control the direction of the incoming explosive mixture and materially assist in scavenging the combustion chamber and supplying an uncontaminated charge for the next power stroke. The deflector plugs are held in position by two bolts each and should be removed and polished periodically in order to maintain maximum efficiency.

Lubrication.—The primary chain is lubricated through the filler plug situated near the bottom of the chaincase, adjoining the flywheel magneto. After the first 500 miles and thereafter at intervals of 1,000 miles, engine oil should be added until the chaincase is full. This operation should be carried out with the machine in a vertical position. The gear-box should also be lubricated with engine oil and the level checked every 500 miles. A drain plug is provided underneath, and the old oil should be drained off and replenished with new, every 2,000 miles.

Flywheel Magneto.—A Miller flywheel magneto is fitted, and the contact breaker points should be adjusted to open ·010 in. The sparking plug points should also have a gap of from ·010 to ·012 in.

DECARBONIZING.

When to Decarbonize.—An accumulation of carbon on the piston and cylinder head, due to combustion of the fuel, will render it advisable to decarbonize the engine after a period of use. This should be undertaken with a new machine after the first 350 to 500 miles and thereafter at intervals of about 1,500 miles. Decarbonizing consists simply of removing the cylinder and cleaning all the carbon from the combustion chamber and piston. Cleanliness is the main essential, and the job should be carried out inside a garage or shed where the dismantled parts are not liable to become dirty or lost.

First, turn off the petrol at the tank, then, after removing the shields, give the exterior of the engine a good clean down with paraffin and rag.

Next, the sparking plug and high tension cable should be removed, and the throttle and compression release cables detached from the carburettor and cylinder head respectively.

The throttle control cable is removed by unscrewing the ring at the top of the carburettor and pulling out the plunger complete with cable attached.

Removing Compression Cable.—To remove the compression release cable, press the control on the handlebar; this will pull the two operating arms together, when they can easily be held with a pair of pliers while the cable is detached. It is a good plan to tie all loose cables to the frame of the cycle to prevent their getting in the way later. This done, the petroil pipe should be detached from the carburettor and the carburettor itself removed, after loosening the attachment bolt and detaching the strangler control.

Detaching Silencer, Cylinder Head, etc.—The silencer next claims attention, and this is removed by undoing the nuts holding it to the engine at the front and removing the attachment bracket at the rear.

When this has been done, the cylinder head bolts should be removed, the head lifted away from the barrel and placed in a clean spot for attention later. The cylinder barrel can

now be detached by unscrewing the nuts at the base and gently easing the barrel away from the crankcase.

On no account should the barrel be twisted to remove it, as this may cause the piston rings to break. As the barrel comes away, support the weight of the piston by steadying the connecting rod with the left hand. Directly the barrel is removed, wrap a piece of clean rag round the connecting rod to seal off the entry to the crankcase. This will prevent any foreign matter from entering.

Dismantling the Piston.—To remove the piston, a pair of taper-nosed pliers should be used to grasp the free ends of each circlip in turn. Press the jaws of the pliers together

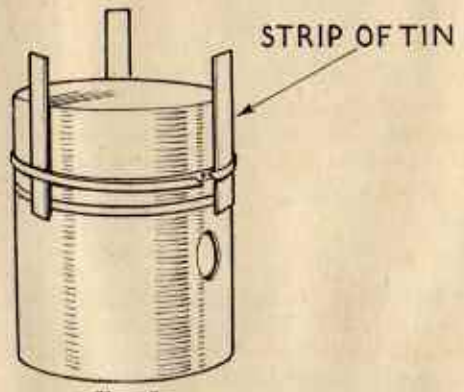


FIG. 7.
SHOWING METHOD OF REMOVING RINGS FROM PISTON.

and lift out the circlip. The gudgeon pin can then be pushed out and the piston removed. Now slide out the small end bush from the connecting rod, as otherwise it may fall out and become lost. Care is required when removing the piston rings, as they are very brittle and liable to break if roughly treated. The best way to remove the rings is to insert three small strips of tin at intervals round the circumference of the piston between the ring and the piston itself (see Fig. 7). This will lift the ring out of its groove, and with a little care it can be eased along the strips of tin off the piston.

To Aid Re-assembly.—When dismantling the engine, it is a very good scheme to place the components removed in some sort of order so that they can be replaced in exactly the same position. Piston rings for instance should always be re-fitted to their original groove.

Decarbonizing.—The actual process of decarbonization can now commence, and for a start the carbon inside the cylinder head should be removed. The best tool to use for this purpose is a blunt screwdriver or a knife having a fairly broad blade.

Bearing in mind the fact that both piston and cylinder head are manufactured from aluminium alloy, which is fairly soft, care should be taken not to remove portions of the metal in an over-enthusiastic desire to make a clean sweep.

Abrasive Cleaners Dangerous.—Never use emery cloth or sandpaper to clean an engine, as even the finest grades are likely to leave particles embedded in the components, which will very soon cause damage when the engine is run.

Remove all the carbon from the cylinder head and ports in the barrel, taking care not to damage the ports themselves. The piston crown should be carefully cleaned and the ring grooves freed from any deposit of carbon which may have accumulated behind the rings. It will be appreciated that the rings should be a good fit in the grooves, and therefore metal must not be scraped away with the carbon.

Testing for Play in Working Parts.—When all the surfaces are clean, attention can be given to consideration of permissible wear on the component parts. This will not, of course, affect owners of nearly new machines, but for those who have had their Auto-Cycles for some time, the following points should be checked. Turn the crank to the top of its stroke and, grasping the connecting rod firmly in one hand, test it for up and down play on the big end bearing. If the bearing is in order there will be no appreciable movement. It is important to remember that the check is for up and down and not side play. It is quite normal for the connecting rod to rock slightly from side to side.

Fitting New Rings.—Having checked the big end bearing, we should replace the piston and gudgeon pin and make a similar check on the small end bush. Again it will be found that the piston will slide a little from side to side, but there should be no up and down play. Next push the piston rings, one at a time, into the cylinder bore.

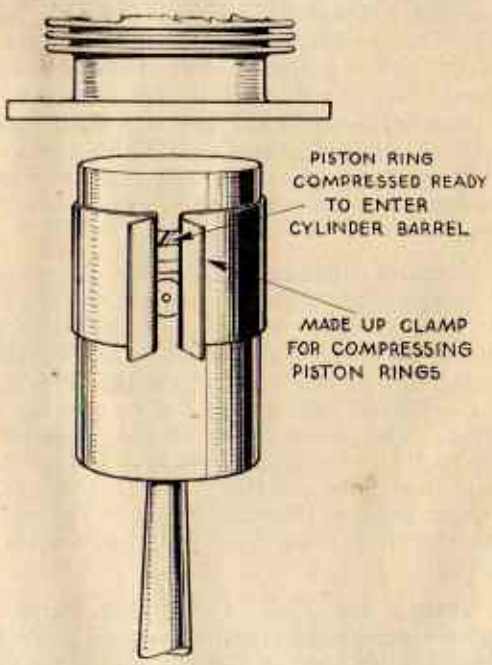


FIG. 8.
PISTON RINGS COMPRESSED IN CLAMP AND READY FOR INSERTION INTO CYLINDER.

The gap in each ring when properly placed level in the cylinder should be measured and, if this exceeds 1/32 in., new rings should be fitted.

Having made sure that the rings are serviceable, we should refit them to the piston. Most pistons have small pegs in the ring grooves and, in this case, the gap in the ring should be placed so that the peg is in the centre. The ring will then be unable to rotate on the piston. If no peg is provided, the rings should be replaced in such a way that the gap on each ring occurs in a different part of the circumference.

Re-fitting Cylinder Barrel.—The cylinder barrel can now be re-fitted, but before doing so, remove all traces of rag or other foreign material from inside the engine and smear the piston sides and cylinder walls with clean engine oil.

To help in replacing the barrel, a broad piece of tin can be wrapped round the piston rings, leaving enough tin at each end to enable the operator to pull the ends tightly together and thereby compress the rings to the same diameter as the piston (see Fig. 8).

With the clamp held in the left hand and the cylinder barrel with the right, it is a simple matter to slide the barrel over the piston, being careful to fit the cylinder in the same position as it was before it was removed. If a tin clamp cannot be made up, squeeze one piston ring closed at a time and slide the cylinder over carefully.

Most engines make use of a gasket to ensure a tight fit at the base of the cylinder. Care must be taken to see that this gasket is replaced or, if it is damaged, a new one fitted.

When tightening down the cylinder barrel, the retaining nuts should first be tightened by hand and then finished with a spanner, tightening each nut a little at a time and passing to the next until all are secure. This method will obviate the possibility of uneven stress and consequent distortion of the barrel.

Compression Release Valve.—Remove, clean, and if necessary, grind in the face of the compression release valve with fine carborundum paste, finally washing clean with petrol and re-fitting in the cylinder head. The barrel, having been replaced, the head can then be re-fitted.

Cleaning Silencer and Exhaust.—Attention should now be given to cleaning out the silencer and exhaust pipes as, if these become restricted, back pressure may be set up, with consequent loss of engine power.

Re-fit the silencer and exhaust pipes after cleaning and make sure that all nuts are tight.

Dismantling the Carburettor.—The carburettor should next be dismantled, cleaned and re-assembled in accordance with the instructions given in Chapter IV.

After re-assembly, the carburettor may be re-fitted to the engine and the throttle control cable and fuel pipe attached. The compression release cable can also be re-fitted and checked for correct operation.

Finally, the sparking plug should be cleaned and screwed tightly into the cylinder head, not forgetting to replace the washer. The high tension lead can then be connected to the plug.

Final Check-up.—After a final look over the engine to ensure that every part has been correctly assembled, the shields can be fixed in position, and the engine started up for a test run. The engine having been run for some time, all cylinder barrel and head nuts should again be checked with a spanner for tightness as, when the engine gets warm, it is often possible to take up another half-turn on these nuts.

On running the engine after decarbonizing, it may be found that the compression is not quite as good as it was before the overhaul. This is due to the fact that carbon deposits in the cylinder may tend to assist compression on a part-worn engine. This will soon rectify itself after the engine has been running for a while.

Removing Scott Engine from Frame.—Owners of Scott Cyc-Autos may prefer to remove the engine from the cycle frame to improve accessibility when decarbonizing. This is a very simple job and is carried out as follows.

Disconnect the compression release control cable, turn off the petrol, and detach the feed pipe and throttle control from the carburettor.

Loosen the clamp screw and remove the carburettor complete from the engine.

Detach the pedalling chain by taking out the spring link.

Insert a quarter inch B.S.F. box spanner through the hole at the right-hand side of the expansion chamber and loosen the pinch bolt at the front end of the bottom bracket.

Disconnect the clutch operating cable from the lever under the engine by slackening off the locknut on the cable adjuster and unscrew it to release the cable.

Loosen the top ends of the tubular silencer supports and remove the engine supporting bolt which passes through the lug on the down tube.

By prizing the engine forward an inch to extract the clutch housing from the front end of the bottom bracket, the complete power unit can be removed from the frame and placed upon a bench for stripping.

Re-assembling Scott Engine.—Re-assembly is carried out in reverse, and when entering the engine to the frame the flywheel should be rocked to enable the clutch driving shaft to mesh with the slot on the front end of the worm shaft.

When re-assembling the pedalling chain be careful to fit the spring link with its blind, or closed end facing the direction of travel.

LUBRICATION

A word or two on lubrication follow at this stage, as upon it will depend the life and proper functioning of both the engine and cycle parts. Money spent on good quality oil will always be an investment, as few things will damage a machine more quickly than poor oil. Manufacturers' instruction books contain details of the correct oils for each part of the mechanism requiring lubrication.

Suitable Engine Oils.—All Auto-Cycle engines will give good service on Patent Castrol XL mixed in the correct proportion with the petrol.

Villiers recommend that Castrol D be used to lubricate the clutch and this member should be inspected by removing the filler plug on the flywheel side of the engine just underneath the drive sprocket. This acts as an oil level and should be topped up about every 2,000 miles.

Lubricating Villiers-Engined Machines.—On Villiers-engined machines, the chains, brake joints and cables, bottom bracket and pedals should be lubricated with engine oil at least every month. The wheel hubs and steering head bearings should be greased every 1,500 miles.

Scott Machines.—On the Scott Cyc-Auto, the clutch thrust ring should be given every week two or three drops of engine oil through the top end of the clutch thrust yoke just behind the right-hand side of the cylinder base.

Bottom Bracket.—About a teaspoonful of engine oil should be added to the bottom bracket every 200 miles, using the dip stick provided as check.

Spring Forks.—The spring forks should be given one shot of engine oil from a grease gun every 250 miles.

Dynamo.—Two or three drops of engine oil should be applied to the dynamo through the spring lubricator every 200–400 miles. It is easier to do this if the dynamo is removed from the machine and held horizontally.

Chains.—The chains should be thoroughly cleaned by soaking in paraffin, and the wheel bearings given three shots of engine oil every 1,000 miles. At this stage the various control cables should also be cleaned and the exposed ends of the inner cable smeared with engine oil.

Free-wheel.—The free-wheel should be oiled every 500 miles at some convenient time when the petrol tank is empty, so that the machine may lie on its left side and two or three drops of oil be inserted at the notch marked "oil."

Moving Parts.—The pedals, stand, and in fact, all moving parts of any make of Auto-Cycle should be regularly inspected and lubricated.

CHAPTER IV

CARBURETTORS AND CARBURATION

THE carburettor is an instrument for mixing the petroil and air in the correct proportions (approximately 13 parts of air to one of petroil) to form a gas capable of being exploded by a spark when compressed in the cylinder. Basically it consists of a mixing chamber and a float chamber which acts in the nature of a front line tank to hold a small quantity of petroil from the main tank and pass it as required into the mixing chamber (see Figs. 9 and 10).

The Float Chamber.—Inside the float chamber is a small metal float, which rests on the bottom of the chamber until the fuel is allowed to enter from the main tank. As fuel enters the chamber the float rises until, at a predetermined level, the top of the float comes in contact with a toggle hinged to the lid of the chamber.

As the float continues to rise, it presses the toggle upwards. The toggle in turn presses upon a small needle valve which, when pushed upwards, shuts off the supply of petroil from the main tank.

As the level of the fuel in the float chamber falls, due to consumption by the engine, the float begins to fall again and allows the needle valve to re-open, whereupon more fuel enters from the feed pipe.

How the Carburettor Works.—Forming the top of the float chamber is a casting, which is held in position by a hollow brass centrepiece projecting through the centre of the float, and out of the bottom of the float chamber, where it is sealed and held rigid by a washer and nut.

In the lower part of this centrepiece is a jet, and fuel passes through two holes drilled in the sides of the centrepiece into the hollow centre and through the jet to the mixing chamber.

Included in the casting which forms the top of the float chamber is a pipe running at right-angles to the main body (see Fig. 9) which acts as the air inlet, mixing

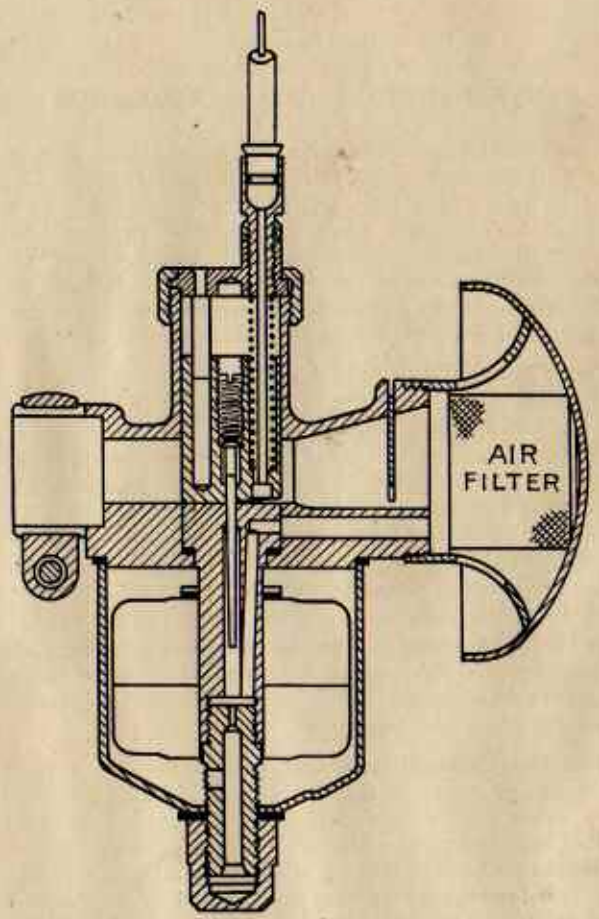


FIG. 9.

VILLIERS CARBURETTOR AND AIR FILTER.

chamber, and attachment to the engine respectively. The other cast-in tube, which continues straight up from the main body, and on top of which the throttle control cable is attached, acts as a guide for the throttle slide.

The Mixing Chamber.—Petroil from the jet and air from the intake are sucked into the mixing chamber by the depression caused in the crankcase of the engine when the piston ascends.

The "Tickler."—The float chamber lid carries a spring-loaded plunger which protrudes through the lid into the chamber and which, when pressed down, bears upon the top of the float and pushes it down against the lifting force of the fuel. This is the "tickler," and is used when starting the engine from cold to allow a slightly increased quantity of fuel to enter the float chamber and thereby the mixing chamber.

Throttle Slide.—Carried in the upright tube is the throttle slide, somewhat similar to a piston. On the bottom of this slide is a tapered needle which is located in the hollow tube at the top of the centrepiece.

Cable Control.—Attached to the other end of the throttle slide is the cable control to the throttle lever on the handle-bar.

When the throttle is closed, the slide and needle connected to its lower face are at the bottom of their travel and consequently the needle has projected so far into the centre-piece that, owing to the tapering, it has completely closed the orifice, thereby cutting off the petroil from the mixing chamber.

As the throttle is opened, the needle rises and, again due to the tapering, progressively opens the jet, allowing more and more fuel to pass through as it rises.

The throttle slide itself, when at the bottom of its travel, will close the pipe which feeds the engine, thereby cutting off supplies of explosive gas from it.

When the throttle is being opened, larger quantities of gas are being fed to the engine at each opening movement of the throttle. It will readily be understood that, as the taper needle is withdrawn from the jet, more and more

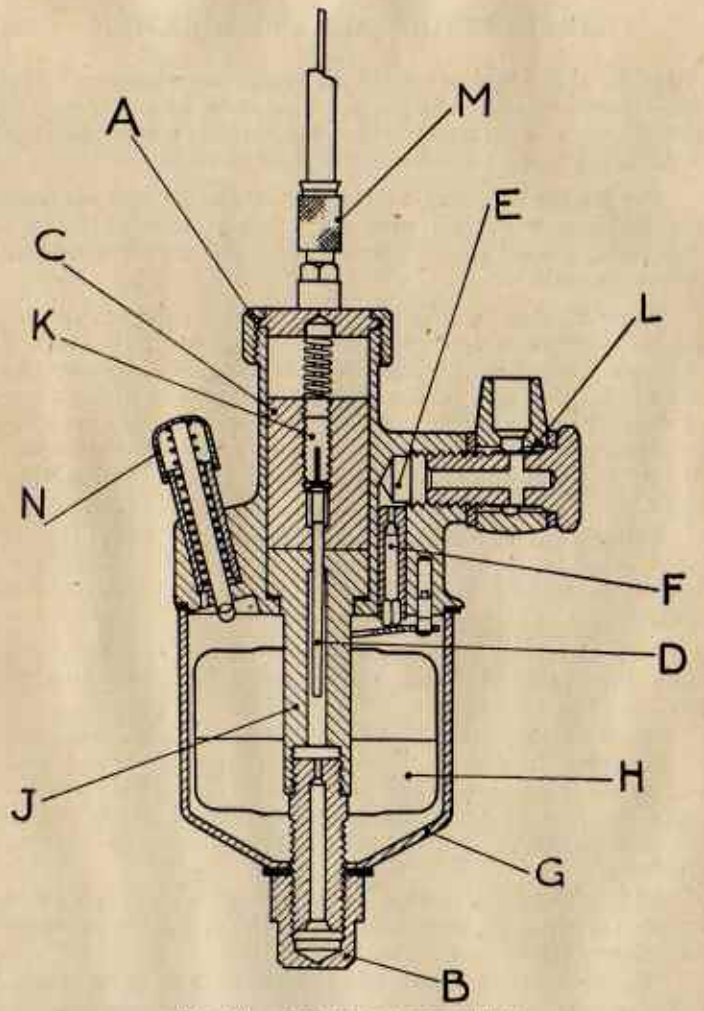


FIG. 10. VILLIERS CARBURETTOR.

A. Screw top of throttle slide tube.
B. Locknut on bottom of centre tube.
C. Throttle Slide.
D. Taper Needle.
E. Hollow Union Nut.
F. Needle Valve.
G. Float Chamber.
H. Float.
J. Hollow Centre Piece.
K. Adjustment Screw for mixture control of needle.
L. Petroil Inlet from Tank.
M. Throttle Control Cable Adjuster.
N. Tickler for flooding Carburettor.

petroil is allowed to pass through into the mixing chamber to compensate for this.

Filters and Strangler.—On the outer end of the inlet pipe is fitted a gauze air filter and the strangler or mixture control used for starting purposes. This latter device consists of a flat plate pivoted at one end which, by means of the control mounted on the side of the fuel tank, can be moved over the air intake, blanking it off from the outside air and consequently allowing a much richer mixture to reach the engine.

Petrol Filter.—Contained in the banjo connection, where the main fuel pipe joins the carburettor, is a gauze petrol filter which effectively prevents dirt from passing into the float chamber and blocking the jet or needle-valve.

It is a very simple matter to strip and clean the carburettor, and this should always be carried out when the engine is decarbonized, and more frequently if there is any likelihood of dirty petrol having been used.

Adjusting the Mixture.—When the new machine leaves the factory, the mixture is set a little on the rich side in order to improve running in, and it may be necessary therefore to adjust the setting after the first 500 miles. Once the correct setting has been found, very little adjustment should be necessary.

To adjust the mixture, it is necessary only to alter the setting of the projecting needle underneath the throttle slide. To do this proceed as follows.

Unscrew the knurled ring at the top of the throttle slide tube and pull out the slide and needle complete.

Loosen-off the locknut attaching the throttle control cable to the top of the slide tube and remove the cable end from the slide.

On top of the slide will be found a screw (see Fig. 11). This screw alters the position of the taper needle. The most difficult part of the whole operation is to decide by how much the mixture requires to be altered, and to determine this, one must proceed in easy stages until the best setting has been discovered by trial and error.

Weakening the Mixture.—To weaken the mixture the screw should be rotated in a clockwise direction by no more than one full turn at a time, the slide being replaced and the engine tested after each adjustment. One should aim for a steady tick-over of the engine at idling speed, with no tendency to cut out. If the engine tends to "hunt" or

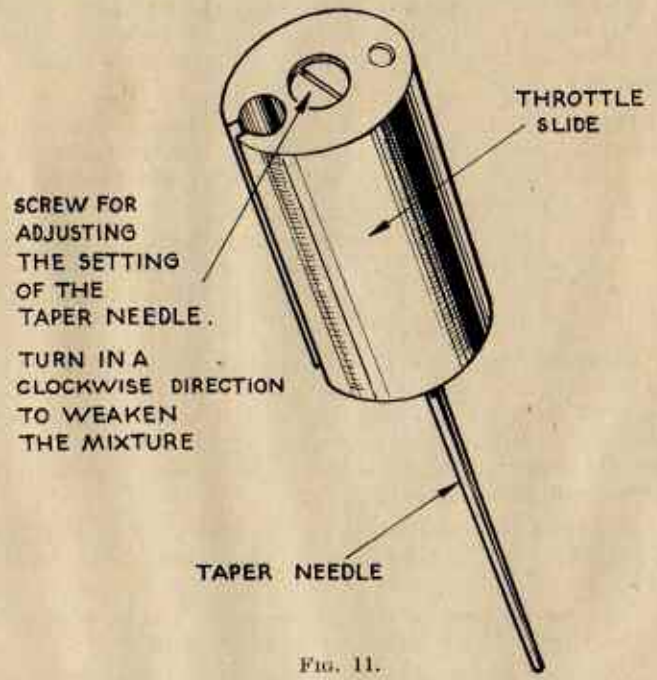


Fig. 11.
Throttle slide.

to run in an irregular and jerky fashion, probably the mixture is too rich.

Stripping the Carburettor.—To strip the carburettor, the instrument should be detached from the engine and the petroil and air filters removed.

Unscrew the nut at the bottom of the float chamber and remove the float chamber, complete with float.

Take out the float and clean the inside of the chamber with a piece of cloth soaked in petrol, making sure that no fluff or material is left inside.

Hold up the float and shake it close to the ear to make sure it is not punctured and allowing petroil to get inside the capsule.

If petroil is heard swilling about inside the float, scrap it and fit a new one.

To solder the puncture is seldom of any use, as it is very likely to upset the weight of the float and affect the running of the engine.

Remove the small screw at the side of the tickler on the float chamber head; this allows the hollow centrepiece to be pressed upward and removed.

Removing the Needle-Valve.—Swivel round the brass toggle and take out the needle-valve for cleaning. It is important that the washer which goes round the centrepiece should not be lost, nor must the toggle supporting the needle-valve be either removed or bent.

Clean the components in petrol, dry them off, and re-assemble in the reverse order, taking care to replace the washer at the base of the float chamber, otherwise a bad petroil leak will result. It is not necessary to use excessive force when doing up the nuts and bolts on the carburettor, as they can easily be damaged.

When re-attaching the carburettor to the engine, make sure that the whole instrument has been pushed right home on to the inlet connection, and that the attachment bolt is tight. If an air-leak takes place here it will upset the mixture supplied to the crankcase.

If the Carburettor Floods.—If at any time the carburettor floods, when the petroil is turned on without the rider having depressed the tickler, it is probable that a speck of dirt has lodged in the needle shut-off valve from the main supply, and this should be dismantled and cleaned.

Scott Carburettor.—On the carburettor fitted to Scott machines the mixture setting is adjusted by means of the taper needle at the base of the throttle slide, but, unlike the Villiers, adjustment is made by moving the needle to

one of five possible settings, indicated by notches on the needle.

To do this, remove the throttle slide and, to weaken the mixture, raise the adjustable washer which carries the needle.

To enrich the mixture, lower the washer. The jet needle is released by compressing the throttle spring. The adjustable washer can then be pressed off.

Amal Carburettor.—This carburettor consists of a separate float chamber and mixing chamber, joined together at the base by a " jet cap." Instead of a toggle and separate needle-valve for shutting off the main fuel supply, a needle-valve is built in as part of the float itself. The float is located in the chamber by a needle running through its centre. This needle is tapered at the top and, when the float rises, enters a needle seat situated in the float chamber cap, and seals off the petroil supply from the tank. Fuel passes from the float chamber, through a main jet, which meters it into the mixing chamber by way of a further jet, and tapered needle, attached to the throttle slide. The needle is attached to the slide by a circular spring clip held down by the throttle spring. This clip locates in one of five grooves on the taper needle and mixture adjustment is effected by raising or lowering the needle to any one of the grooves. The first groove, nearest the top of the needle, gives the weakest setting, and the mixture will be progressively richened as the remaining four grooves are selected.

CHAPTER V

IGNITION AND LIGHTING SYSTEM

THIS chapter deals with the electrical installation on Auto-Cycles and has been made as elementary as possible, consistent with giving the reader a working knowledge of the subject. In the interests of simplicity no attempt has been made to explain how the electricity is generated by the magneto or dynamo. It is not necessary, and might tend only to confuse the reader, so take it for granted that the magneto and dynamo do generate the current. It is often difficult for owners to understand the electrical circuit on their machines owing to the fact that one is unable to see electricity. It may help if the reader imagines it as a fluid and the wiring system as a series of pipes which conduct it from its source to the point where it is required. (It should, perhaps, be pointed out that in fact electricity is not a fluid, neither are the wires pipes—the description has been used merely to aid beginners to grasp the underlying principles.)

Conductors and Insulators.—Some materials, of which the best is copper, will allow electricity to pass more easily than will others, and these are termed " conductors." Other materials, such as rubber, will not permit the passage of electricity at all; these are known as insulators. If, therefore, we feed a current of electricity to a piece of copper wire in the correct way, the current will flow along the wire until it comes in contact with some other conducting substance, whereupon it will be diverted from the wire.

If, however, the copper wire is covered with a rubber coating, or some other insulating material, the current will flow along the wire, prevented from escaping, or short circuiting as it is called, until it reaches the end of the wire which is connected to the apparatus it is desired to operate.

Electric current will flow only if the circuit is complete and the current can pass by way of the wiring and electrical accessories back to earth. It is therefore necessary to pass the current from the source of supply to one side of the

equipment which it is required to operate, connecting the other side to earth, or, in an Auto-Cycle, to the frame.

For instance, electric current passes from the dynamo through the wires to one side of the headlamp; it then passes through the wiring in the lamp bulb, thereby causing it to become incandescent and give off light, thence out of the other side of the light bulb to the frame of the cycle.

It is desirable that the reader should understand the meaning of one or two simple electrical terms. Like a fluid, electricity will always flow from a source of high pressure, which in our case is the dynamo, to a lower pressure, the earth connection.

Volts.—Electricity is generated at different pressures according to the job it has to perform, and this pressure is expressed in volts. Imagine a 2-lb. weight placed on one's hand, it would be correct to say that a pressure of 2 lbs., in addition to normal atmospheric pressure, was exerted on the part in question. Compare this with the force behind the current of electricity which would be measured, not in pounds, but in volts.

Amperes.—Again, with a fluid, one expresses units of quantity in gallons, etc., but a *quantity of electricity* is expressed as so many *amperes*. From this the reader will see that if an electrical component, such as a bulb, is marked as being 6 volt, 1 amp., it means that it is made to operate from a system employing an electric current of 6 volts, and that the bulb is designed to pass current at the rate of one amp. It is therefore important, when making replacements, to ensure that the correct type of bulb is fitted as, if not, it will either burn out, give insufficient light, or no light at all.

THE IGNITION

We have digressed somewhat in an endeavour to grasp the elementary principle of the subject, so let us now return to the question of ignition, by which is meant the ignition of the compressed explosive gas in the cylinder at the moment when the piston is at the top of its stroke.

From the facts already given we know that an electric current will pass along a conductor from one point to another. If that conductor is broken, and a small gap left

between the two points of the conductor, provided that the pressure or voltage in the circuit is sufficiently high, the current will jump across the gap and continue on its way to earth.

The Spark.—At the point of jump, in other words the gap, a spark will occur as the current passes. It follows that if an electric circuit can be introduced into the combustion chamber of the engine, and if current can be passed at sufficient voltage through the circuit in such a way that it jumps the gap situated in the combustion chamber at the precise moment that the piston is at the top of its stroke, a spark will occur capable of igniting the explosive mixture, which in turn will drive the piston down.

The Magneto.—For this purpose we use an instrument called a magneto which generates electric current and passes it to the cylinder head by means of an insulated wire conductor. At the cylinder head the wire is connected to a sparking plug. This latter item, as its name indicates, is a plug which can be screwed into a hole in the cylinder head having direct access to the combustion chamber (see Fig. 12).

The Sparking Plug.—Briefly the sparking plug consists of a central electrode or conductor which is insulated from the main body of the plug. At the bottom of the plug, where it screws into the cylinder head, there is a small gap, roughly 18-thousandths of an inch, between the central electrode point and a second point attached to the main body of the plug, which, in turn, is connected to the frame of the machine by way of the engine. The current is so timed that it jumps across the plug points at the moment the piston is at the top of its stroke.

The Contact Breaker.—The timing of the spark and the boosting up of the pressure or voltage to that sufficient to jump across the plug points, are controlled by a part of the magneto called the "contact breaker." This consists of a pair of points, one of which is movable, connected to the circuit in such a way that when they are closed, the circuit is completed and the current can flow to earth.

The points are opened by a rotating cam driven from the engine which bears upon a fibre heel attached to the movable

point. When the cam opens the points the circuit is broken and the current can no longer return to earth through the points.

The sudden breaking of the circuit induces a very high voltage in a secondary coil which is led directly from the

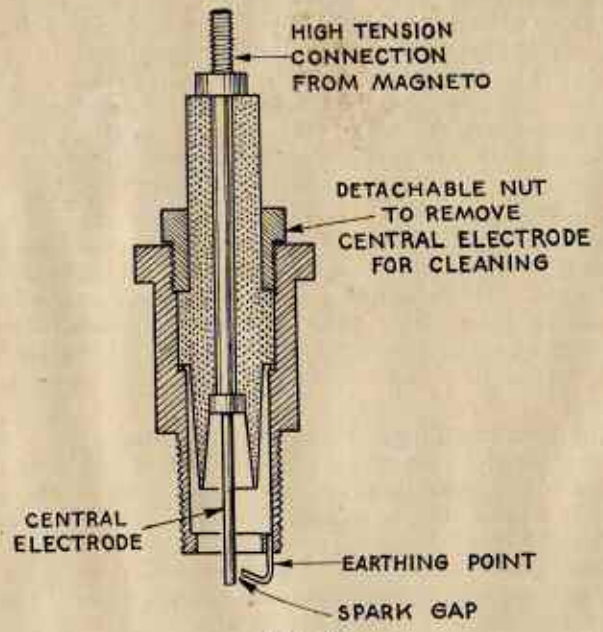


Fig. 12.

Sectional view of a sparking plug. Dotted central portion indicates insulation.

coil to the central electrode of the sparking plug from where it jumps across to the earth point and causes a spark. The movable point on the contact breaker is fitted with a return spring to close it when the cam has passed (see Fig. 14).

The Condenser.—To avoid excessive sparking of the contact breaker points when they open, a condenser is fitted in the circuit. This assists the rapid breakdown of current and prevents the points from burning away.

Timing.—It will be apparent that the contact breaker points must be timed to open when the piston is at the top of its stroke. Actually, owing to the speed at which the engine runs, and to the fact that a slight time-lag occurs between the spark and the exploding gas generating its maximum power, the points are set to open when the piston is a few degrees before the top dead centre position. This ensures that the greatest possible power stroke is obtained, as if the spark occurred when the piston was directly at the top of its stroke, it would be some way down the cylinder before the explosion had properly developed and consequently a great deal of power would be lost.

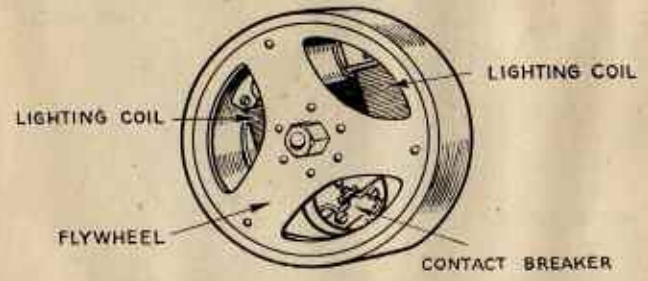


Fig. 13.

Flywheel magneto with cover removed.

The re-timing of the ignition will not be necessary unless the flywheel magneto has been removed, an operation which should not be undertaken unless essential.

Replacing the Flywheel.—If, however, it has been proved imperative to remove the flywheel, two timing marks will be found etched, one on the flywheel itself and one on the armature plate.

Turn the engine shaft by hand until the piston is at top dead centre and fit the flywheel on the shaft so that the two marks are in line. This will ensure the correct position being obtained, and the cam on the drive shaft will commence to open the contact breaker points just as the piston is approaching the top of its stroke.

Finding Top Dead Centre.—To find top dead centre of the piston, remove the sparking plug and insert a pencil through the hole; it will then be quite easy to feel when the piston is at the top of its stroke.

When this has been found, and the flywheel marks lined up, tighten up the flywheel retaining nut. After tightening up the flywheel, the timing should again be checked by inserting the pencil in the spark plug hole and finding top dead centre. Now inspect the contact points and, if the timing is correct, they will just be open.

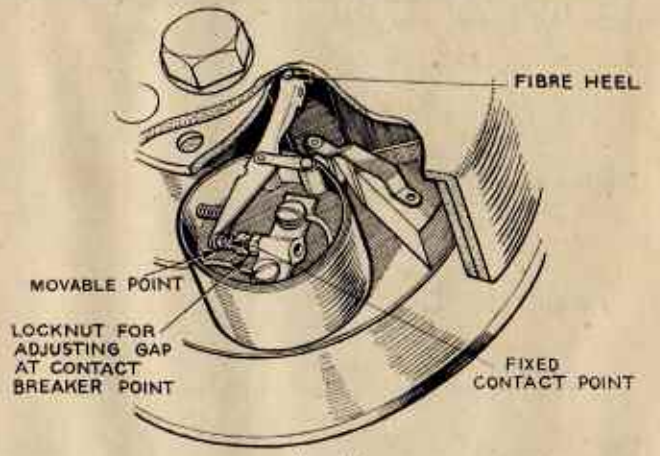


Fig. 14.

Cutaway flywheel showing contact breaker with cover removed.

Adjusting the Contact Breaker Points.—The fixed contact point can be adjusted by means of a locknut and screw in order that the correct gap can be obtained when the points are opened.

To adjust the gap, loosen off the locknut with a special magneto spanner and screw the point either in or out as required, finally re-tightening the locknut (see Fig. 14).

To test the gap, the flywheel should be rotated by hand until the cam bears upon the fibre heel of the movable point and forces it away from the fixed one. The gap should be 1/64th of an inch when the heel is on the top of the cam, and is measured by inserting the special feeler attached to the magneto spanner between the points.

The feeler should just slide in without forcing the points any further open. It is necessary to check the gap from time to time, especially after the first 500 miles, as the fibre heel often beds down on a new machine, causing the gap to require adjustment.

The contact breaker is situated inside the flywheel and is covered by a circular brass cap held in position by a spring clip (see Fig. 15).

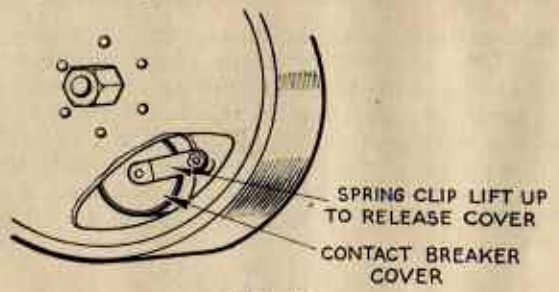


Fig. 15.

Contact breaker with cover and clip.

Inspecting the Points.—To inspect the points, the magneto cover plate, held to the outer face of the flywheel by three screws, should be removed, and the flywheel turned by hand until one of the holes is opposite the contact breaker cover plate. It is necessary only to lift the spring clip upwards with a screwdriver to enable the cover plate to be removed and the contact breaker exposed.

To Clean Contact Points.—If, as sometimes occurs after extended use, the points have become pitted and dirty, they should be dismantled and cleaned with petrol, then polished lightly with oilstone. On no account should the points be filed, as they are only very thin platinum or tungsten discs and can easily be ruined by harsh treatment.

Owners of Scott Cyc-Autos should remove the rota or flywheel proper when wishing to adjust the breaker points.

This is done by unscrewing the nuts which hold it in position. On Scott machines the contact breaker is mounted on a plate behind the flywheel, and removal of the flywheel will not upset the ignition timing.

Sparking Plugs.—Modern sparking plugs are the result of much research, and those fitted to Auto-Cycle engines are specially designed for the job they have to carry out. It is, therefore, most undesirable to use any plug, other than a type recommended by the makers. The correct plug for use with Villiers engines is Lodge C.B.3. The plug should be dismantled and the points cleaned from time to time with petrol and a wire brush and the gap reset to ·020 in.

Repairs to Insulation.—In view of the possibility of the electric current shorting from the plug lead between the magneto and sparking plug if at any time the insulation of the lead breaks down, it is advisable to inspect occasionally for cracks or deterioration due to oil. If any defect is discovered, the affected portion should be carefully wrapped with insulating tape, or if very bad a new lead should be fitted, as failure here will cause the engine to cut out.

LIGHTING

Lighting Current.—On machines fitted with Villiers engines current for the lights is supplied from coils housed in the flywheel magneto (see Fig. 13). The bulbs used are as follows: Main headlamp, 6 volt, 1 amp. (single contact), which latter means that the bulb holder itself acts as the second or earth contact; headlamp pilot bulb, 4 volt, ·3 amp. (screw-in type); tail lamp, 4 volt, ·3 amp. (screw-in type). Current is supplied from the dynamo only when the engine is running, and a 4 volt dry battery is fitted into the back of the headlamp case to operate the pilot light when the machine is standing or being wheeled (see Fig. 16). A switch is mounted on top of the headlamp by use of which either main or pilot light can be selected.

Lighting Cables.—The current is fed from the lighting coils in the flywheel magneto by means of an insulated cable to the headlamp switch, and a further cable leads it from the headlamp to feed the rear light.

When the switch is turned to the "on" position, the circuit is completed and current flows through the filament of both head and rear lamp bulbs to earth on the frame, *via* the lamp casing.

A connection is provided in the lighting cable a short distance from the magneto end, covered by a rubber sleeve. Whenever it is required to remove the engine from the frame of the cycle, this connection should be detached. On no account should the lighting cable inside the magneto be interfered with.

Keep Connections Clean.—It is important to see that all electrical connections are kept clean and tight, especially

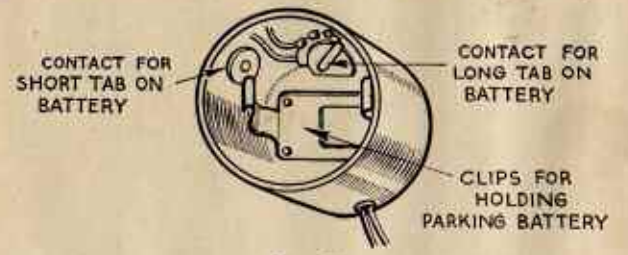


Fig. 16.

Showing head lamp with front removed and housing for parking battery exposed.

the earth from the lamp to the frame of the cycle, since, if this becomes inoperative, it might cause the bulbs to fuse.

Remembering how easy it is for the electricity to escape from the path it is intended to follow should the insulation break down, inspect all wires frequently for chafing and cracks, wrapping any that may be found with insulating tape.

Renewing Dry Battery.—The dry battery which operates the pilot light will require renewal from time to time as its supply becomes exhausted after prolonged use. Make sure that the correct replacement is fitted.

Lucas Dynamo Lighting Set.—The Scott Cyc-Auto is fitted with a Lucas Dynamo Lighting Set, which is a completely external unit driven by contact with the road wheel

of the cycle. An "off" position is provided by springing the dynamo back out of contact with the wheel.

Parking Lights.—As with the Villiers set, parking lights are supplied by means of a dry battery contained in the headlamp case. No trouble is likely to be experienced with either method of lighting, providing the few precautions already described are adhered to.

Light Failure.—If the lights should fail, it is wise first to inspect the bulbs themselves. If the filament is still intact the most likely source of trouble will be a broken or dirty contact, a bulb loose in its holder, or a faulty connection in the wiring.

CHAPTER VI

THE CYCLE PARTS, CONTROLS AND ADJUSTMENTS

THE Auto-Cycle wheels and hubs are of similar design to those employed on normal pedal cycles. Very little attention is required, other than an occasional adjustment of the hubs to take up any excessive side play. To test for this, lift the wheel that is to be tested from the ground and, grasping the outer rim, check for side play at the hub.

If considerable play is apparent, tighten up the cones with a spanner in the same way that one would adjust an ordinary cycle wheel. The wheels run on ball-bearings, and apart from periodical lubrication, no attention to these is required.

Brake Adjustment.—The brakes are of the internal expanding type, and adjustment for wear is made by tightening-up the nut on each control rod or cable.

The adjusting nut is situated at the brake end of the cable (see Fig. 17). When re-lining becomes necessary, the wheel must be removed from the frame and the hub dismantled in order to take out the two shoes from each brake.

It is always the best policy to hand in the old shoes complete to a dealer and obtain a replacement set already lined, as the riveting and countersinking are rather tricky jobs.

Rectifying Chain-Stretch.—The rear driving chain should be kept free from grit by an occasional wash in paraffin. Stretch in this chain is taken up by a screw adjuster at each side of the rear wheel spindle (see Fig. 17).

The spindle nuts should be loosened before adjustment to allow the wheel to move back. After having carried out this operation, it may become necessary to re-adjust the brake cable.

Adjusting the Pedalling Chain.—The pedalling chain has an adjuster at the bottom bracket of the cycle in the form of an eccentric, which can be turned with the special C spanner provided in the tool kit.

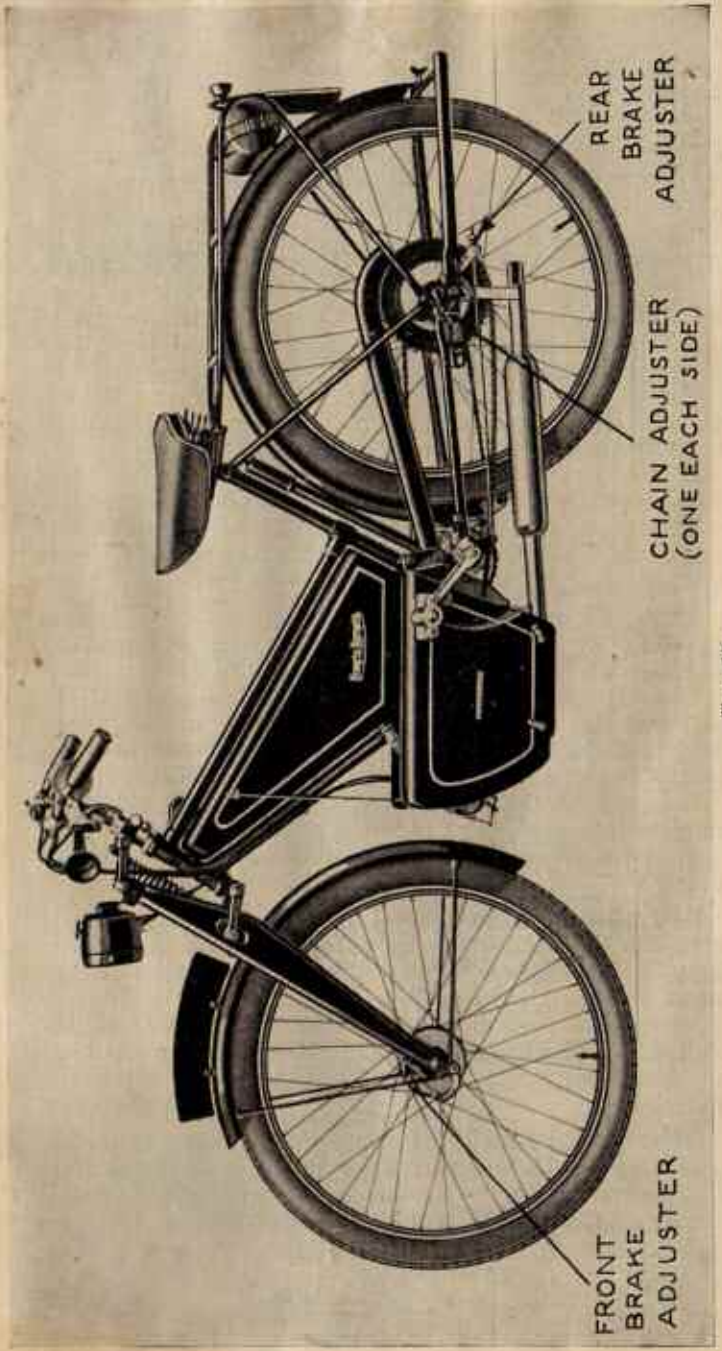


FIG. 17.
SHOWING POSITION OF BRAKE AND CHAIN ADJUSTERS.

Some pedalling chains have a jockey tensioner, in which case no other adjustment is required.

Engine Primary Chain.—The engine primary chain will require no adjustment, as it is pre-stretched before fitment.

Both external chains should have about half an inch up and down movement in the centre.

Handlebar Play.—The cycle ball head on the handlebar column requires very little attention; it is a ball-bearing and should be checked periodically for up and down play in the following manner.

Lift the front of the machine by the handlebars, and as the weight is taken, any play in the ball race will show itself by upward movement at the point where the handlebar column enters the lug.

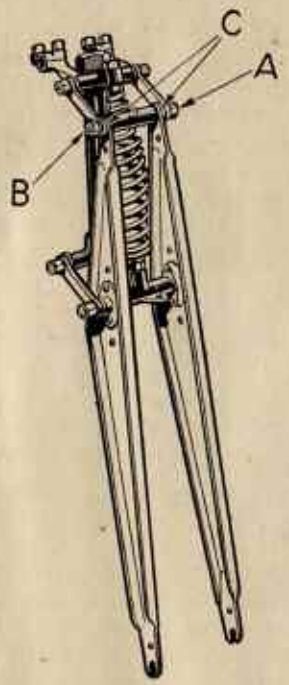
If play is detected adjustment can be made by slackening off the expander bolt at the top of the handlebars and tightening the locking nut above the lamp bracket until the play is taken up.

Finally, re-tighten the expander bolt. Be careful not to tighten the locknut too much or the balls may lock themselves and prevent proper movement of the handlebars.

Front Forks.—The front forks on most models are of the motor cycle type, having a coil spring and fork links. If excessive play develops in the links they should be adjusted by loosening the locknut at the left-hand side of the fork (A in Fig. 18) and turning the spindle bolt head B in a clockwise direction, afterwards re-tightening the locknut. Each spindle should be adjusted separately. A knurled washer C will be found on each fork shaft and, when the adjustment is correct, it should be just possible to revolve the washer.

The front fork on the 1947 Excelsior machine is of new design and combines the normal link action, with an additional rubber suspension. Each blade is a single taper tube, having normal fork links and spindles but instead of a coil spring, a steel roller surrounded by a rubber roller is mounted on the steering column, and a similar set of rollers is attached to the fork blades. Carried on these two roller units are

four rubber suspension bands. Two bands are side by side, one set on top of the other, to form inner and outer pairs. These bands take the load that is normally absorbed by a coil spring. Rubber buffers are fitted round the arms of the steering column lug and, at extreme depression, make



By courtesy of Messrs. H. C. Webb & Co., Ltd.

FIG. 18.

SHOWING FRONT FORKS AND POINTS OF ADJUSTMENT.
A. LOCKNUT. B. SPINDLE BOLT HEAD. C. WASHERS.

contact with the fork tubes. This also serves as a safety measure should the suspension bands become unserviceable. The fork spindles are carried in renewable "OILITE" self-lubricating bronze bushes, and therefore require no attention other than periodical inspection for excessive side play.

Bottom Bracket.—Any slackness in the bottom bracket can be taken up by the cup and lock ring in the left-hand side of the bracket shell.

Loosen the ring by unscrewing in an anti-clockwise direction.

Tighten up the cup and refasten the lock ring.

Scott Machines.—The bottom bracket on the Scott Cyc-Auto is rather different from others, for it houses the worm drive from engine to clutch.

The worm shaft is mounted in two replaceable phosphor-bronze bushes, the front one being pressed into the bottom bracket casting and the rear bush pressed into the thrust race housing.

The worm wheel is pressed on to the centre of the shaft, which also carries the two worm wheel centre cones.

The bearings are carried by balls in the worm wheel centre cups. These cups are fitted with shims, ·005 in. thick, which can be removed to take up wear.

When adjustment is required, the lock plate should be removed and the cups screwed outwards not more than one-eighth of an inch.

The shim can then be removed and the cups screwed up again and re-locked. If this proves insufficient, the cones should be removed from the worm wheel centre and a special packing washer fitted behind them: this will bring the cones further outwards. The correct number of ball-bearings in each worm shaft bearing is twenty, making forty in all.

Curing a Slipping Clutch.—It will be necessary at times to adjust the clutch. If, on opening the throttle, the engine speed increases whilst the road speed does not, it is likely that the clutch is slipping, owing to the slack on the operating cable being taken up. This can be remedied by adjusting the small screw at the hand-lever end of the cable. The screw should be adjusted until there is one-sixteenth of an inch slack movement on the cable, before it operates the clutch rod on the housing (see Fig. 19).

If the Clutch Sticks.—If at any time difficulty is experienced in freeing the clutch, the clutch adjuster, situated on the left-hand side of the machine, near the top of the clutch operating lever (on Villiers engines) and underneath the engine (on Scott) should be reset so that there is one-eighth of an inch play in the clutch lever at its bottom end.

The clutch is freed by the operating pin to which the cable is connected, bearing against a rod which runs through

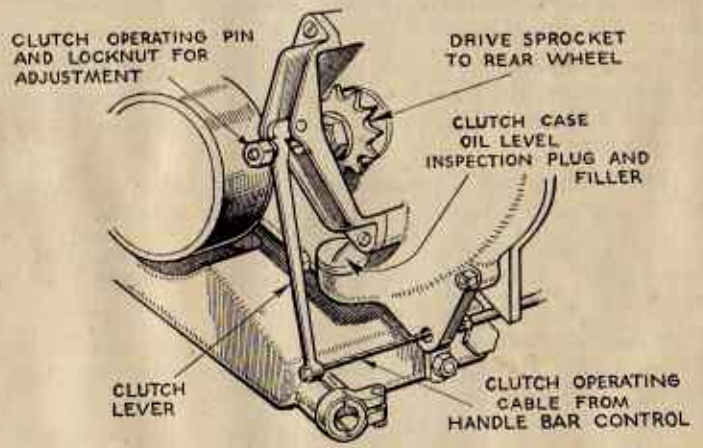


Fig. 19.

Showing clutch adjustment points.

the centre of the clutch. This rod, when pressed in, forces against the clutch plate, overcoming the power of a spring holding it in contact with the driving plate.

When Thinner Oil is Indicated.—Should difficulty be experienced in freeing the clutch and, after checking, it is found that the correct clearance exists at the operating lever, a slightly thinner oil should be used in the clutch-casing.

Care of Tyres.—Nothing much need be said about the tyres, except that they should be inflated hard and periodically examined for cuts and embedded stones.

MAINTENANCE AND INSPECTION SCHEDULE

Recommended inspections to be carried out every—

100 miles.	Check all cycle and engine bolts for tightness.
250 miles.	Check tyre pressures, lubricate chains, bottom bracket, brake joints, control cable ends and pedals.
500 miles.	If machine is new, decarbonize engine. Check contact breaker points and reset gap, if necessary. Remove and clean sparking plug. Check chains for stretch and re-adjust if required. Remove petrol and air filters from carburettor and clean. Check all electrical wires for signs of wear. Test all controls for correct action and, if necessary, adjust brakes and clutch control cables. Go over the tyres and remove any foreign matter which has become embedded in them.
1,000 to 1,500 miles.	Decarbonize engine. Clean out silencer. Clean carburettor. Check all cycle bearings for wear, and adjust if necessary. Replenish clutch-case oil with Castrol D (Villiers engine). Check all light bulbs for broken filaments or loose holders. Go over the cycle frame and touch up any rust spots with enamel.
5,000 miles.	Check engine components for signs of wear. Strip and examine brake shoes and fit replacements if required.

CHAPTER VII

FAULT FINDING

It is inevitable that the owner of any vehicle will experience minor troubles from time to time and Auto-Cycles are no exception, although, owing to their simplicity, the seat of the trouble is unlikely to be difficult to trace. This chapter deals with some of the snags which may crop up and suggests how to rectify them as quickly as possible. Half the battle is won if a quick and accurate diagnosis can be made, and, before anything is dismantled, a few moments spent in analysing the symptoms of trouble will be well repaid.

When the Engine Will not Start.—To begin, let us assume that on our going to the machine the engine will not start. First check that the petroil is turned on, and if this is in order make sure there is fuel in the tank.

When both these points have been checked and found correct, by depressing the tickler on the carburettor, it will be a simple matter to test whether or not the fuel is reaching the float chamber.

If no fuel drips out when the tickler has been held down for a few seconds, it will be obvious that either a stoppage exists somewhere in the feed line between the main tank and carburettor, or the small vent hole in the main tank cap is blocked, thereby causing a partial vacuum and preventing fuel from flowing along the feed pipe.

If these points are in order, check that the needle-valve in the float chamber head has not stuck in the "shut" position. If fuel is reaching the float chamber, make sure that the source of the trouble is not an over-rich mixture.

Too Rich a Mixture.—Care should always be taken not to flood the carburettor unduly. If an over-rich mixture is suspected, the throttle should be shut, the compression release lifted, and the machine wheeled along for a few yards; this will tend to drive the rich mixture out through the exhaust. An attempt can then be made to start the

machine without again flooding the carburettor and with the strangler partly or fully opened.

Draining-off Raw Fuel.—If the machine still does not start, the drain plug at the bottom of the crankcase should be removed and the machine tilted over to allow any accumulation of raw fuel in the engine to drain away.

If this does not seem to be the cause of the trouble, the fuel side of the question should be left for the time being and attention given to the ignition.

Make an external check of the high tension lead from the magneto to the sparking plug and ensure that it is not broken or shorting to earth through a visible breakdown of the insulation.

Testing the Ignition.—Next, remove the sparking plug from the cylinder and, leaving the high tension lead connected, lay the plug on the cylinder head in such a way that only the body, and not the top or central electrode, is in contact with the cylinder.

Turn the engine by hand and note whether a spark is visible at the plug points. If it is, rule the ignition out as a possible source of trouble and revert once again to the fuel system.

When there is No Spark.—If no spark is visible after making quite sure that the top terminal of the plug or the metal end of the high tension lead is not shorting on the cylinder head, remove the plug and, holding the high tension lead by the rubber, bring the metal connection to within about 1/32 in. of the cylinder head.

Again turn the engine and note whether a spark jumps from the lead to the cylinder. If it does not, then the trouble is either a faulty high tension lead (which should be replaced) or trouble in the magneto.

Examine the Contact Breaker.—The contact breaker should be examined to make sure that the points are not dirty and are opening to 1/64 in. The brass contact at the end of the high tension cable should be examined, as it may be broken or loose.

A "Sooted" Plug?—If a spark does jump from the lead across to the cylinder, the trouble lies with the sparking

plug. It should be cleaned and the points re-adjusted to ·018 in. or a fresh plug fitted. It is most unlikely that anything other than the contact breaker points will be at fault in the magneto.

Further Tests.—Having checked the ignition and found it in order, return to the fuel side of the problem and, by removing the air cleaner, check that the throttle slide is lifting when the handlebar control is moved to the open position.

Removing the Float Chamber.—If this is working properly, remove the float chamber from the carburettor and examine the interior for dirt, water in the petrol, or an accumulation of sludge due to the petrol and oil having separated out.

Water in the Petrol.—If there is water in the petrol, it will show itself clearly as separate globules and it will be advisable to clean out the whole of the fuel system and drain the main tank.

Filter for Petroil.—Filter the petroil through a chamois leather to remove the water, and replace it only after making certain that the fuel tank is clean. It is almost certain that by this time the trouble will have been located, but if it has not, make sure that the exhaust pipe and silencer are not clogged with dirt or carbon.

Testing Mechanical Parts.—The time has now come to test the mechanical parts of the engine.

Wheel the machine along with the compression release lifted, make sure that the engine is turning freely, and that no " expensive noises " are coming from the moving parts. If they are, then the engine will have to be dismantled.

Fuel Feed Blocked ?—If the engine starts but does not run properly after warming up, make sure that the fuel feed system is not partly blocked, that a good spark is occurring at the plug points, and that the silencer is not creating back pressure owing to an accumulation of carbon.

Air-Leaks.—If all these points are in order, it may be that air is leaking into the crankcase through a faulty joint

at the carburettor or the trouble may be due to considerable wear in the engine bearings. Such wear will not be found on nearly new machines.

If an air-leak is suspected, a rag soaked in petrol can be placed on any doubtful joints while the engine is running slowly.

If a leak is taking place it will soon become apparent by an alteration in the engine note when the petrol vapour from the rag mixes with the air leaking into the crankcase.

Too Rich a Mixture ?—By far the most likely cause of difficult starting is an over-rich mixture, and readers should fully satisfy themselves that this is not the trouble before they proceed to a lengthy diagnosis.

Feeble Sparking.—It is as well to remember that a plug which will show a poor spark out of the cylinder may not fire at all when subject to the compression in the combustion chamber. A good, healthy spark should have a tinge of blue in it.

Kinks in Control Cables.—Never allow sharp kinks to occur in the control cables, as they are liable to cause jamming of the controls.

Should the Carburettor Flood.—Should the carburettor keep flooding at any time when the fuel is turned on, examine the needle-valve for traces of dirt on the seating. If this is not the trouble, suspect a punctured float and carry out the check described in Chapter IV.

Lighting Troubles.—In the event of the lights failing, the trouble will most likely be traced to a broken connection or faulty earthing. It is an easy matter, if a visual check fails to disclose the source of the trouble, to test the wiring by detaching the lead from magneto to headlamp at the connector near the magneto end of the cable and joining in a fresh piece of insulated wire, which can be temporarily fixed with insulating tape to the cycle frame. Connect the other end of the wire to the headlamp terminal and run the engine with the lamps switched on. If the lights work, it will be obvious that the original cable is faulty and should be replaced.

If the headlamp lights but the rear does not, the trouble will either be in the cable from the headlamp, in the rear lamp earth connection, or in the rear bulb itself.

Flickering.—If at any time the lights keep flickering, it is fairly certain that an intermittent short is taking place, due to a fault in one of the external wires coming into contact with the cycle frame from time to time, possibly due to engine vibration.

Blown Bulbs.—Should an occasion arise where a bulb has blown and, on fitting a replacement, that in turn fuses, it is useless and expensive to fit more bulbs until the cause of the short has been discovered.

Conclusion.—If the reader pays attention to his machine from time to time in accordance with the instructions contained in the section on Maintenance, and does not drive the engine too hard, a very considerable mileage can be confidently expected with no trouble at all.

CHAPTER VIII

HINTS ON BUYING SECOND-HAND MACHINES

It may be that some prospective owners are considering the purchase of a second-hand Auto-Cycle and that, having little or no previous experience, they are fearful of buying a "dud." As has been previously stressed, when new all modern Auto-Cycles are reliable and a safe investment, but unfortunately not all owners pay sufficient attention to the few essential overhauls necessary to ensure lasting service.

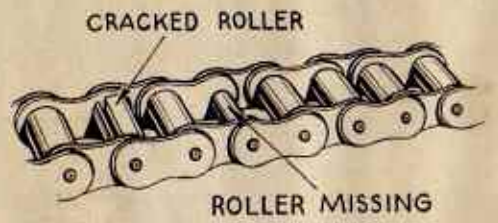


Fig. 20.

Cracked and missing rollers in the chains are certain to cause trouble.

In view of the war years, and the consequent shortage of new machines, many Auto-Cycles on the road to-day are of considerable "vintage," making it all the more desirable that a careful check should be made before purchase. One cannot, of course, expect a dealer or private seller to stand by while a prospective buyer strips the machine to make sure that it is all right, but if he has nothing to hide, the seller will usually be willing to allow the purchaser to carry out fairly extensive visual checks. It is with the latter that this chapter is concerned.

Examining the Machine.—Take one part of the machine at a time and examine all components thoroughly before passing on to the next section. Start at the front of the machine and first examine the front wheel. Check the

spokes for loose or broken members. Lift the front wheel off the ground by the handlebars and spin the wheel.

Wheel Out of True.—Keep an eye on the small gap between wheel rim and front fork; if the wheel is true there should be no wobble or alteration in the gap throughout a complete revolution.

Hubs and Brakes.—While the front wheel is off the ground, check the hub bearings for excessive play and the brake drum for distortion and binding. Finally, check the tyre for large cuts, badly worn tread and cracks.

Too Much Side-Play.—Passing to the front forks and steering, examine both forks for cracks and the links for excessive side-play. Grasp the handlebars and jerk the forks up and down to check their freedom of movement and test the steering head ball race for up and down play.

FIG. 21.

WORN AND BROKEN TEETH ON A SPROCKET WILL CAUSE CHAINS TO WEAR BADLY AND POSSIBLY JUMP OFF.

Move the handlebars from side to side and make sure there are no rough spots in their travel.

Testing the Controls.—Try the levers on the handlebars and make sure that they are actually operating the controls in question. Push the machine against each brake in turn with the clutch disengaged.

Spokes, Tyres and Sprockets.—Pass now to the rear wheel and again examine spokes, tyres, etc.; check the rear hub bearings and examine the sprockets for broken or worn teeth. All the teeth should be the same length and should not be worn away to humps.

Freewheel and Chains.—Try the freewheel by spinning the pedals backwards (except, of course, on machines fitted with pedal-operated rear brakes), and examine both driving and pedalling chains for cracked or missing rollers (see Fig. 20).

The Engine.—After viewing the rear forks for cracks, pass to the engine. With the petrol turned off and the throttle closed, lift the rear of the machine and turn the road wheel in the direction of drive.

Compression Test.—If the wheel is turned fairly slowly a good idea of the engine compression can be gained by the "feel" or resistance transferred to the wheel.

After testing in this manner, push the machine along for a few yards with the clutch engaged. If the compression is normal a somewhat jerky motion will be the result, or the rear wheel may tend to skid. This latter check will also give some indication of the state of the clutch. Now turn the petroil on at the main tank and check with the tickler that it is reaching the carburettor.

H.-T. Lead.—Examine the high tension lead from magneto to sparking plug and scrutinize all control cables for signs of wear.

Engine "Knock."—At this stage, if the reader has not yet learnt to ride, it would be as well to ask the seller to start the engine. Have the throttle adjusted until the engine is running quite slowly with the clutch disengaged and listen for any obviously excessive rattle or knocking in the engine itself. Glance at the exhaust outlet and note if the exhaust gas emitted has just a trace of blue in it. If clouds of blue smoke are coming out, either there is too large a proportion of oil in the fuel or something is wrong with the engine.

A Test Run.—If the reader is experienced, and the seller will permit, a short ride on the machine at this stage will go a long way towards proving whether or not it is satisfactory.

If, however, the reader is new to Auto-Cycles, it is far wiser not to attempt riding the machine just yet. In any case, the question of one's legal standing regarding insurance and possible damage to the machine must be borne in mind.

Checking the "Revs."—Assuming that a road test is not to be made, ask the seller to open the throttle slowly

and, as this is done, check that the engine responds with a corresponding increase in revolutions per minute.

Have the throttle returned to its original setting and then opened up quickly. The engine should respond at once, without cutting out or spitting back. Should the engine falter and spit back through the carburettor, it is a fair indication of a weak mixture (which can, of course, be adjusted).

Excessive Oil.—Always examine the outside of the engine for excessive oil both before and after running, and thoroughly investigate any suspicious accumulation.

Trying-out the Lights.—While the engine is running, switch on the lights and see that they are working properly from the dynamo.

Engine Cut-Out.—Before stopping the engine, lift the compression release for a second or two and make sure that the engine tends to cut out. Do not, however, let it stop completely; in other words, let go the compression release lever before the engine has stopped. It should then pick up again and allow the reader to close the throttle completely, whereafter it should stop.

Parking Battery, Cycle Parts, etc.—Test the lights next on the parking battery and, when satisfied, make a thorough examination of all the cycle parts, mudguard attachments, etc.

When to Buy.—Having satisfied oneself on all the foregoing points, and having previously ascertained from other sources that the price is in keeping with the current second-hand value, it is fairly safe to buy. The reader will not of course expect to buy a second-hand machine on which nothing requires attention, unless it is almost new.

Budget for Replacements.—When working out one's budget prior to buying, it is as well to leave a pound or two in hand for the purchase of necessary replacements.

Friendly Advice.—It is not intended to convey the impression that a machine is not worth buying if any one, or even more of the "snags" mentioned are discovered.

It is all a question of what is wrong, how much it will cost to put right, and how much is being asked for the machine. These are points which the reader must decide for himself, and it is, of course, much better if a friend, experienced in such matters, can be persuaded to accompany the buyer and act as adviser.

Failing this, a prospective buyer can always be sure of the honest advice of any reputable dealer who, after all, lives on his reputation for service and is not likely to jeopardize it by selling machines which he knows to be unroadworthy.

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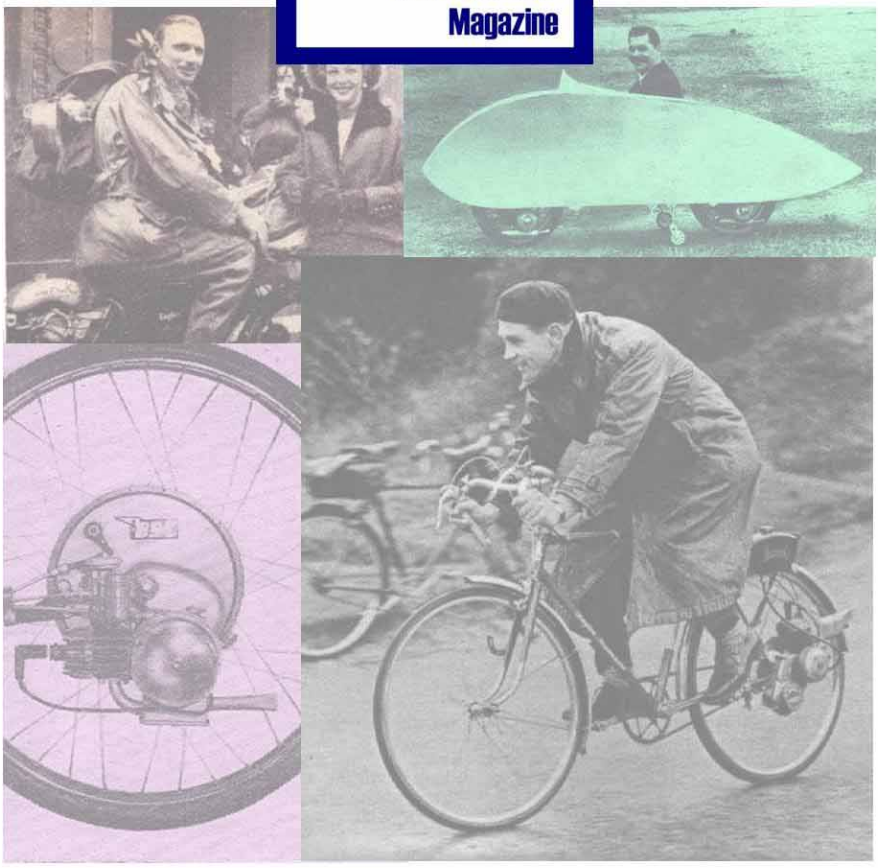

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