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PRESENTING

OUR OWN

Velocette SERVICE MANUAL

OUR OWN Velocette Service Manual

(Unscrewing the Inscrutable)

This treatise is intended to be a practical guide for maintenance and repair of all 350- and 500-cc bikes from 1954 to 1971, models MSS, VIPER, VENOM, SCRAMBLER, ENDURANCE, CLUBMAN & THRUXTON;
as well as the Clymer INDIAN-VELOCETTE, (power unit only
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THE FRONT WHEEL:

The front wheel was produced in two main forms: the MSS castiron hub with 7" inside diameter iron brake drum integral, (also used on the Scrambler), and the cast aluminum front hub with a separate bolt-on 7" inside diameter brake drum used on the other models, The 7 1/2" brake shoes are wider than the 7" shoes as well as being larger in diameter. The 7 1/2" brake is very powerful and, set a high standard of braking power for years on the road-sport Velocette models. When the Thruxton was introduced in 1965, the old 7 1/2" drum with alloy hub was retained with the addition of a twin-leading shoe brake plate made by John Tickle, an accessory firm. Some of the Tickle brakes use the same brake lining as the previous 7 1/2" Velo single-leading shoe design; others use a lining with a different rivet drilling pattern. In order to get the correct replacement linings on a Thruxton front brake, it is advisable to make a paper tracing of the old rivet pattern and include it with order. Any local motorcycle shop handling British bikes should be able to install new linings. The linings are jigdrilled and come complete with correct rivets. If difficulty arises, brake shoes can be sent here for servicing. The 7 1/2" brake is very good, both in normal and Thruxton forms. The 7" MSS - Scrambler front brake is adequate, but not impressive, in road use. In case of poor braking performance of any brake, look for grease or dirt on the linings, glazed Linings or moving parts that bind from lack of lubricant. If there is only a little grease on the linings it can be removed from drum and linings with lacquer thinner (beware of fire risk and toxicity possibilities of lacquer thinner) the linings roughed-up with medium sandpaper, all foreign matter removed from drum and backing plate, and the linings re-used. Do not use trichlorethylene to degrease brake linings as this may cause them to disintegrate. If grease has saturated the linings, replacement is the only cure All types of front wheels use the same wheel bearing, same on both sides, and same as the rear wheel. Because of their size, wear on the wheel bearings is very slow and replacement is rare except after very high mileage indeed. The factory does suggest, however, that they be cleaned, inspected, and repacked every 20,0000 mile intervals. Loosening of the bearing in its housing is very rare but has occurred. If this happens, the hub can be salvaged by salvaged by boring it oversize and fitting a steel sleeve so as to recover the original size This is a job for a machine shop; the reboring must, of course, be done true to the original' machining. Where clearance is slight say, not exceeding .004", Loctite "Nutlock" or "Lock'n Seal." can be used, but do not use Loctite of an excessive1v strong grade or you may not be able to remove the bearing the next time you went to service it. The success of Locktite depends upon the mating parts being properly degreased; the makers' spray can Locquic primer is very handy for this. Locktite, by the way, is a great boon to the modern motorcyclist. Used correctly, it absolutely prevents nuts and bolts loosening by vibration, a curse which has dogged cyclists for ages past.

Removal of the wheel bearings requires use of the tools described in the official Service Manual. These are used to drive the bearings out and back in, after removal of the threaded locknut on the left side with the peg spanner which should be in the toolbox - (same tool used to tighten axle main nuts). The same tools are used to service the rear wheel bearings. In the case of the rear wheel, the lockring also drives the speedometer gearbox, and the peg spanner is not used to undo it. Instead, a bar of steel, (say 1/811 X l" X 12"), is applied to the slots in the lockring which is unscrewed by turning clockwise as it is lefthand threaded. It is lefthand threaded so that the torque which drives the speedo gearbox tends to tighten the lockring.

It almost goes without saying that the positions of all the dustcovers in the hub must be noted and that they must be replaced as before when reassembling. Final tightening of the axle nuts sets all spaoers and bearings of the hub assembly in their correct places. A film of grease on any tight-fitting parts eases assembly.

BALL BAEARIING INSPECTION:

After dismantling, (note: there is no need to remove the brake side bearing from the hallow, spindle unless the bearing is worn and requires the bearings must be thoroughly cleaned, dried, and examined before repacking with automotive wheel bearing grease. Many operators use gasoline for quick cleaning of the old grease, but 'beware of the severe fire hazard from gasoline vapors indoors, Lacquer thinner is also good but quite hazardous Varsol is safe from fire hazard as its vapor won't flash until heated to a relatively high temperature, when exposed to a spark or open flame, gasoline or lacquer thinner vapor may flash into flame upon contact with a spark or open fire. Varsol is by far the best universally safe.solvent for home shop use. It cleans and degreases very-well., leaves no oily residue, gives a certain measure of protection from rust, is not too hard on most people's hands, and not generally toxic to breathe for most people though it should only be used in ventilated areas. Many hardware stores also carry it as "Dry Cleaning Solvent" for less than $1.00 a gallon. If compressed air is available, It is helpful for blowing the old grease residue out of the bearings while cleaning but failing this, the bearings can be cleaned with an automobile parts brush, (sold at auto parts supply stores), and one of the aforementioned solvents. Never spin a bearing dry with compressed air; always have bearings dry before re-packing with grease, Wear or damage of the bearings can be detected by turning them by hand, dry, and feeling a distinct roughness and vibration caused by the balls rolling over pitting defects in inner or outer races. Such pitting of balls and/or races will be visible to the eye. Do not be misled by the noise and rustling caused by the balls rotating in their cage; sometimes this sounds like bearing damage but isn't. Ball and roller bearings, in general, give long service if protected from corrosion by good lubrication.

If all is well with the wheel bearings, they can be repacked with good quality wheel bearing grease, reinstalled, and forgotten for at least 20,000 more road miles. It is worth noting that for racing purposes some riders use only a little grease in the wheel bearings, (which are serviced more frequently in this case), the object being to slightly reduce the rolling resistance and thereby gain a little more maximum speed. This is not particularly advisable on a road machine where the object is to get maximum economical service with minimum attention.

When repacking wheel bearings, nothing is gained by putting grease into any part of the hub-except the specific bearings themselves. Any excess grease on the brake side may find its way onto the brake linings.

Velocette front wheels have 36 or 40 spokes. When replacing rims, It is best to get genuine parts because of the importance of the drilling of the spoke holes being at the correct angles. Most private owners are capable of lacing-up their own rims after a careful study of what is involved. The rim must be laced-up central to the spoke flanges of the hub, not off to one side or the other. A little study will show which spokes need tightening and which need loosening to get the rim to run true to the hub. The forks of the bike can be used as a jig when trueing-up rims. The total error or "run-out" should not exceed 1/32" in either direction, measured at the rim, when the job is done. The real skill of the job is in getting the rims to run true. It is often found that new or used rims are not really round but have some irregularities. In this case, matters can sometimes be improved with a few well-placed clouts with a rawhide or wooden mallet. Run-out side-to-side (axial) exceeding 1/3211 will cause wiggling of the handlebars at low speeds, although the steering may be satisfactory at higher speeds if the error is not too great. Radial run-out, (in-and-out), will have the same unpleasant effect at medium and high speed as a tire imbalance.

To keep spokes from loosening up after initial use of the wheel, tap spoke heads sharply with a ball-peen hammer to seat them in the holes after the rim has been trued; then tighten each nipple just a bit more, equally to maintain trueness. Do not over-tighten spokes when lacing-up the wheel as this may result in spoke breakage in service; just snug them up firmly by use of a screwdriver In the nipple slots. Any protruding spoke must be ground off flush to avoid holing the tube, and a sound rubber rim strap always used.

TIRES:

The prescribed tires for all Velocettes except Scramblers and Thruxtons are 3.25 X 19 front and rear. A ribbed-tread tire should be used on the front, a universal-tread on the rear. A matched pair of "cling-rubber" Avon, or Dunlop tires gives the best all-around handling, safety, and mileage. Some riders use a 3.50 X 19 rear tire for slightly greater comfort and mileage. Rear tire will seldom give more than 5000 to 6000 miles of U86 in normal service; front tires give two to three times as much. The Thruxton uses a 3.00 X 19 ribbed front tire; again, it should be an Avon or Dunlop for best steering. The 3.25 or 4.50 X 19 K?O.DunloD or Avon again gives good results for all-around use on the rear wheel. Some Thruxton riders use a superb set of Avon tires comprising a standard Avon 3.00 X 19 ribbed front and a 4.10 X 19 Avon "Grand Prix" tire on the rear, this combination giving the very highest standard of cornering ability. For racing Thruxtons, a set of matched Dunlop racing tires and tubes can be obtained which are world-championship calibre, or the more expensive Goodyear racing tire fitted. A very new tread which is reportedly successful is the use of 4.10 X 19 Dunlop K81 "Trigonic" tires front and rear on production-racing Thruxtons.

Scramblers use 3.00 X 21 or 3.25 X 19 knobbies on front, according to rim fitted, and 4.00 X 19 knobby on rear: tread design to taste. Avon or Dunlop tires are first quality for this type of work also. See Service Manual or Owner's Handbook for tire pressure recommendations.

FITTING TIRES THE EASY,(RIGHT) WAY:

For removal, all that Is needed is to deflate the tube, push one side of one bead Into the central well in the rim, and carefully lever the bead off the rim on the opposite side, using tire irons. Use only motorcycle tire irons, never screwdrivers or other sharp-edged objects. The risk of damaging the tube so that a puncture occurs later has always to be kept in mind when using tire irons. Be especially careful when levering tire beads off or on aluminum rims: too much force may bend them. After removing one bead by using two irons and working around little by little, the tube can be extracted and the other bead removed same side as the first. Probably the best way to work on tires Is to lay the wheel on a pair of two-by-fours on the floor so the rim is supported on the wood and the central hub is protected from foreign matter and "graunching" on the floor.

INSTALLING TIRES AND TUBES:

First, inflate the tube a little so that it will have shape inside the tire which will tend to keep it from getting pinched by the tire irons when putting the second bead over the rim. Next, use rubber lubricant on inside and outside of both beads.. This lubricant can be obtained from Sears, Roebuck and elsewhere: a small can will last for years. Soapy water will also serve.: although not so well. Lubricant greatly eases beads over rims.

lay rim on your two-by-fours and place tire over it. Lever first bead onto it: it will go on easily. Push partly-inflated tube into tire and get valve stem down into its hole. Secure valve stem with nut. start bead onto rim and then lever carefully, taking small bites, using one iron to hold, the other to advance. Be careful to avoid pinching tube or bending aluminum rims. When part of bead is on, you will have to push it into the well of the rim to get enough "slack" to keep working the bead over the rim. Take smaller bites as you approach completion. Once the bead is all in place, inflate tube to correct pressure. The sidewall of the tire will have a line on it near the rim which must be checked to ensure that the tire is properly mounted. If so, the line on the sidewall will be concentric with the rim on both sides. If not, deflate, push it around, and try again.

WHEEL BALANCING:

This Is very desirable for smoothness at medium and high speeds, and certainly essential for racing. The front wheel is especialy important: imbalance here has been known to cause the wheel to rhythmically bounce off the road at speed, with attendant distress to forks and rider. Static balancing can be done easily by the owner: (motor cycle wheels are rarely ever balanced dynamically). It depends upon the simple fact that the heavy part of the wheel will naturally fall to the lowest point. 50/50 lead-tin solid 1/8" wire solder is available in rolls at hardware stores: this is what is used.

Support the wheel clear of the floor. Ensure that the brake is not dragging. Do not attempt to balance wheels immediately after repacking wheel bearings as there will be a resistance to rotation until the excess grease gets worked out of the bearing. An unbalanced wheel will turn until the heavy spot comes to rest at the lowest point. Mark this with chalk and note the spoke at 180-degrees from this point; this spoke will be the one to put a weight on. Try about 10" of solder wire, coiled tightly around the nipple and spoke next to the rim and pulled tight with two pairs of pliers, 'one at each end. When coiled tightly this way the solder will seldom come loose. Centrifugal force keeps it in place against the rim when running. After attaching the first coil of solder wire, turn the wheel so that the former heavy spot is at 90-degrees to vertical, release wheel, and it heavy spot returns to bottom more coils of solder wire on spokes adjacent to the first are needed. Do not place too much solder on any one spoke. Some experimentation may he needed as to amount and location of solder. Do not use said- or rosin-core solder because the core will pet out eventually and corrode the rim.

The object is to locate the weights so that there will be no heavy spot, and no particular spot will come to rest when the wheel turns. The wheel will then turn more freely and longer, and will be smooth-turning on the road. The rear wheel Is balanced in the same manner as the front except that here the rear chain, of course, must first be removed,

FRONT FORKS AND STEERING HEAD:

The front forks generally are of good sound design, Riving the rigidity so vital for rood handling at high speed on bumpy roads. Much of the rigidity derives from the design of the fork-ends where the front axle and hub clamps on. Wear is very low, and the need for replacement of the main tubes through wear Is very rare. Provided the correct grade and amount of good-quallty oil is kept in them, the front forks should give 50,000 to 75,000 miles service before replacement of the bushings and oil seal is needed. It is fairly common for leakage of front fork oil to ocour not, surprisingly, past the oil seals at the tops of the lower legs but often around the large nuts at the bottom of the legs which secure the damper assemblies. This can easily be cured by draining the, oil via the normal drainplugs, removing the nuts with the weight of the machine on the front wheel to keep the damper units In place), degreasing the multi washer, exposed stud, and surrounding area thoroughly and reassembling, with liberal application of 3M Super-Weatherstrip adhesive which will seal up everything nicely.

The lower fork leg being an assembly of a steel tube brazed into an apparently forged lug, it has happened that there would be a tiny void in the brazing which would permit oil to seep up between tube and lug, and thereby out. This can also be corrected by degreasing the leak area - ("Locquic Primer" in the spray can penetrates the tiny crack very well and degreases thoroughly)- and sealing the crack with paint or "Loctite Lock'n Seal". If oil is lost from the fork the damping will, be lost, which will affect handling. It is most important that the correct grade and quantity of oil be in the fork at all times for proper handling and prevention of wear in the moving parts. Any leakage will be evident by the appearance of oil around the fork-end or on the hub. Such evidence calls for immediate corrective action.

All standard models use forks with one-way damping - (only damped on the rebound stroke) - and this gives a very pleasant, comfortable, soft fork action. Each leg of these forks requires 3/10ths U.S. cup of good quality SAE 20 oil. All Scramblers, Clubmans, and Thruxtons use forks with two-way damping - (damped on both compression and rebound strokes) - which gives a slightly harder ride but better wheel control under highspeed racing, or scrambling conditions. Each leg of these forks requires 1/2 U.S cup of good-quality SAE 20 oil.

As mentioned above, no service is normally needed other than the replacement of bushings and oil seals after high mileage. In case of a crash, slight bending of the main tubes can be trued-up in a well equipped shop - but extensive bending means replacement as kinks will result which cannot be removed. Fork yokes may also get bent in a crash; they can similarly be straightened if not too bad. How much bending cap be straightened requires experienced judgement, bearing in mind the importance of safety.

Slightly bent fork are a common cause of subtle defects in handling and steering. They can be dismantled and the main tubes taken to's machine shop for checking and correction of any run-out with a dial indicator.

When assembling the front wheel into the forks, the clamp on the left-hand fork leg should be left loose until the main axle nut is fully tightened on the brake side, then the front forks bounced up and down once or twice before final tightening of the 5/16" BSF bolt, This permits the lower legs to align themselves properly with the main tubes, thereby avoiding binding. Do not overtighten the 5/16" clamp bolt because this may bend the fork end. Always have the internally toothed lockwasher in place under this bolt and pull up firmly .... but don't overdo it: you may bend the fork end or break the bolt. The fork springs settle down somewhat with time and usage but the need for replacement is rare.

<u>THE STEERING HEAD</u>:

Compared with most makes, the Velocette steering head bearing arrangement is quite superior in terms of long, trouble-free life and freedom from attention. It runs for very long periods without any perceptible wear or loosening-up which would require adjustment, but if looseness develops, adjustment is necessary. Looseness can be detected by supporting, the weight of the bike so that the front wheel clears the ground, grasping the fork legs, and pushing and pulling. If looseness Is present, it can be felt and seen as relative movement between frame and lower fork yoke. Do not be fooled by slight looseness of the lower fork legs on the main fork tubes.

To eliminate looseness, the 3/8" clamp bolt under the large nut atop the top fork yoke and the two 5/16" clamp bolts at the lower fork yoke are loosened, then the large nut is turned clockwise to tighten it. A certain delicacy of touch is needed here as the adjustment must be tight enough to eliminate play but not so tight that there is an excessive pre-load on the balls which will cause pitting of balls and races. Correct adjustment is when the fork will fall freely to the lock of its own weight but there is no perceptible play.

If, when free play is taken up, the fork turns lumpily instead of smoothly, it means there are defects in the bearing races, probably small dents caused by the balls hammering due to looseness. The fork has to be able to turn freely in order to give good steering. If races are damaged, there is no cure except replacement. Until replacements can be obtained, the adjustment can be backed-off slightly so as to get free turning with a little play, and the machine ridden this way. After adjustment, all clamp bolts must be re-tightened.

Races are interference-fitted In the frame head and can be tapped out carefully with a long drift working from Inside# Sometimes they are quite tight. Be careful not to broach metal away. If the interference fit is lost so that the reces are loose, "Loctite Lock'n Seal" will correct this the same as the wheel bearings. New races can be drawn into place with a bolt and heavy washers or the factory tools described In the Service Manual. Bearing cones on the steering column can be tapped on and off without difficulty. New races must be installed squarely into their seatings and be true to each other; otherwise, correct bearing adjustment will be impossible to obtain.

Some authorities state that ball-bearing steering heads permit unauthorized movement and flexing of the front forks. They believe that taper-roller steering head bearings set-up with a slight pre-load stiffen the pivot of the front forks and give better handling under racing or fast road conditions over bumpy surfaces. It is true that this arrangement was used on the Featherbed Manx Nortons which are renowned for their superb natural handling. Taper roller assemblies for the Velocette are available from the Reliable Cycle Shop.

THE FRAME AND SWINGING ARM - (except Scramblers):

The Velocette frame design and geometry is based on that of the KTT MK8 Velo which won several road-racing world championships. As all Velo riders know, it gives superb, effortless handling with a "low-center-of-gravity" feeling which inspires great confidence and is a pleasure to experience. This race-bred handling gave a Velocette Thruxton victory in the 1967 Isle of Man TT 500cc Production machine race. In service, the frame is very reliable; tube breakage is very very rare. Due to the power unit's weight, the most highly stressed part is the front downtube, extending from steering head to front engine plates. Very few cases are on record where this has broken, regardless of usage. In a bad crash, it is possible that the tubes may get bent. These can safely be straightened cold by judicious use of force. Velocette frames

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are made of Reynolds "531" chrome-molybdenum alloy steel tubing which has a tensile strength "as-drawn" of 100,000 pounds per square inch. This is the stronpest allloy steel tubing available in commercial quantities in England the best material available to British motor cycle manufacturers. Manx Norton and other famous racing bike frames were made of it. The tubes are joined by a combination of brazed lugs and welding, and repairs can be made by welding or brazing, as appropriate.

The Swinging Arm consists of two tapered arms clamped in the front to a hollow spindle which pivots in a pair of replaceable bushings in the frame crosstube. The condition of this bearing has a considerable effect on the steering and handling of the bike; looseness here permits the track of the rear wheel to wander relative to the front wheel, especially over bumpy surfaces or when the power is turned an and off. Unfortunately, It is very often found that periodic lubrication of' this bearing is neglected, resulting, in rapid wear. If the bearing is lubricated at intervals of say 1000 miles at the two fittings on the bottom of the crosstube with a good quality molybdenum di-sulfide chassis lubricant, (as sold by Sears Roebuck and elsewhere), the bearing will have an apparently infinite life, without obvious wearing developed upwards from 30,000 miles. To check for looseness put the machine on the center stand or a box so that the rear wheel clears the ground. Grasp the rear frame tube, left side, with the 'Left hand and the. rear of the back tire with the right hand: alternately push and pull the back tire sideways. If there is movement, it will be felt distinctly. The time-honored criterion for maximum permissible sideplay Is 1/8" - measured at the hub. Sensitive riders may detect a deterioration of handling before this limit is reached, especially since a properly-maintained Velocette rear fork has no play at all. This bearing can be replaced locally in accord with instructions in the Service Manual, or the job can be done at the Reliable Cycle Shop. The most critical operation is getting the two arms aligned true to the frame so that the rear hub axle will be accurately aligned with the fork spindle in the frame crosstube.

The rear suspension units are Girling or Woodhead-Monroe, varying year by year evidently according to what was available to the factory. Clubman, Thruxton, and Scrambler models were fitted with two-way dampened units of either make, working on the same principle as the front forks, which give a hard ride but are more suitable for high speed road or scrambles conditions than the one-way soft ride units used on the other models. All frames except later-model Scramblers have provision for an adjustment in the upper mounting of the rear suspension. when units are brought forward, effective spring stiffness is reduced; when backwards, stiffness is increased. The central position is about right for a solo rider of average (170 lb.) weight.

<u>SCRAMBLER FRAMES</u>:

The first Scramblers produced in the mid-1950's used a standard frame but later a special frame was produced for the special requirements of scrambling, This frame was generally similar to the road frame except in two major respects: (1), the rear sub-frame was detachable (bolt fitting) from the main frame behind the rear downtube, facilitating repairs or replacement; and (2), the top mounting, for the rear suspension units was fixed instead of adjustable. An additional point with Scramblers is that the upper fork yoke and both rear swinging fork legs are dowelled with threaded pins to their respective spindles to preclude twisting due to

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the severe shocks and stresses encountered In dirt racinig. The Scrambler frames have provision for neither center stand, side stand, nor pillion footrests.

STANDS:

All road frames are equipped with a side stand and, unless the machine comes standard with rearset footrests as do most Clubmans and, all Thruxtons, a center stand is provided. The rearset footrest equipment does not permit use of a center stand using standard parts because there is no provision for an anchorage for the stand spring. The factory wished to save the weight of the center stand on the sports/racing models, apparently With some ingenuity, a fixing pin for the spring which holds the center stand up can be devised and attached to the left side footrest plate in the correct position - but considerable care must be taken to fit this.

THE GAS AND OIL TANKS:

Current machines use one of three types of gas tanks: (1), Thruxtons only use the MAS63/7 tank Identified by the racing flip-up filler cap and the cutaway at the right rear for clearance over the Grand Prix Carburetor; (2), Scramblers end the Endurance machine use the MAS63/2 teardrop-sheped tank, chromed with painted panels. A few Clubman models were exported to the USA in the late '60s with this tank as the importer thought it would increase sales appeal; (3), all other models Use the MAS63/5 tank which holds 5.1 U.S. gallons. This tank was identified for years by the bright metal trim strip along the sides near the bottom, with plastic badges. In the last year or two of production, this trim strip was dropped and the tanks finished in solid colors with Fold lines and "Velocette" transfers In script similar to the Thruxton tank. All years of Thruxton tanks are the same, being, of course, a modified MAS63/5 tank. Thruxton and other tanks have gold trim lines generally following the outline of the tank as seen in side elevation. The factory used gold paint for these lines but this is not really good enough as it tarnishes after a year or two. The cure for this Is to have the lines applied in gold-leaf by a sign pointer. Gold-leaf being real gold, will not tarnish and will still look the same after 20 years provided it lies a protective coat of exterior spar varnish to protect against wearing off when washing, waxing, etc. The original finish was baked enamel in silver, dark blue, or black on the Thruxton models. This is a tough and durable finish. Should refinishing be necessary or dents need removal, a good honest auto body and paint shop can do the work - but be sure the operators are motivated to do a good job. Baked enamel is, usually not readily available in American but acrylic lacquer is also tough and durable and can be polished to a mirror finish. Most new American automobiles have acrylic lacquer paint jobs. It is advisable to make tracings of the outline and location of the gold lines before taking the tank for painting, to show the painter exactly where to put the lines. As mentioned before, gold paint can be used but it inevitably tarnishes; gold leaf is the best material to use.

The Velocette script tankside transfers are the "waterslide" type and very easily applied. Simply soak them in water for a few minutes and slide the transfer off the backing into position. Using a soft damp clean cloth, press the. transfer down, working from the center outwards to eliminate any air bubbles and assure 100% contact. After the transfer is fully dry, (several hours), cover it with one coat of exterior spar varnish which can be applied with a soft brush. Do not get the varnish more than 1/16" beyond the outline of the transfer. This will give good weather protection. After the varnish is dry, (24 hours), the entire tank can be

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waxed.In general, use soft paste waxes or the well-known Turtle wax; avoid waxes with abrasives in them like "Classic" unless the tank finish oxidizes and needs polishing to restore the shine.

GAS TANK LEAKS:

Whether caused by crash damage or just mysteriously-appearing, the way to make permanent repairs is by gas welding. The material, of course, is mild steel. Only a skilled welder should be entrusted with the job. There is a great risk of explosion and fire when welding a gas tank; tanks must be steam-cleaned or thoroughly flushed-out with water before welding. There must be no remaining gas vapors. Even after these precautions, some welders insist on filling the tank half-full of water before starting work.

With a Velocette gas tank, it is essential that the bracing strap that connects the tank halves at the bottom front be always in place - otherwise you will get a crack at the front of the top sooner or later. What causes this is the resonant vibration that will make the two halves of a "saddle" tank flex toward each other in a high-frequency vibration, which must result in fatigue of the steel in the middle. This is a characteristic of all saddle tanks, but the bracing strap is intended to take care of it completely.

Velocette gas tanks are not very prone to giving trouble with leaks. However, motorcycle gas tanks have always been subject to cracking, and alwavs will be. The main reasons for this are the ever-present vibration, the considerable weight of the fuel, and the possibility of slightly weak or thin welds due to carelessness or error by the original welder.

The gas tank must always be mounted so it sits entirely on rubber. Do not permit the tank to rub the rockerbox cover of the engine; it is very close on many machines. The rear rubber pad can be built up with sheets of rubber inner tube material glued-on with 3M "Super Weatherstrip Adhesive" if needed to bias the tank one way or the other. It is worth noting that emergency leak repairs can be made with fibreglas automobile body patching material of the "Bondo" type.

GAS TANK TAPS:

When replacing, old taps, the best replacements are the late Triumph type which have locknuts on the 1/4" BSP (British Std. Pipe) threads so that the taps can be positioned as desired, then the nuts tightened up. Use some "Permatex" on the threads and the right tap gaskets to get a proper non-seeping, fit., The Triumph taps directly suit only Thruxton models, but Velos using Monobloc or Concentric carburetors can use these superior, taps to replace their "push-pull" taps by obtaining Some pipes and gas lines to suit - (obtainable from Reliable Cycle Shop). All Velocette, tanks are tapped the same: 1/4" BSP thread.

THE OIL TANKS:

Oil tanks fall into two main categories; (a), the standard rigidly mounted tank fitted to all models except the Thruxton, and (b), the rubber mounted Thruxton oil tank. A variation of. (a) is the Scrambler oil tank; which is mounted on the left side to allow room for a large air cleaner. All tanks are the same basic shell. Starting about 1965, all oil tanks have a pipe which takes a crankcase breather hose from the engine, (under the magneto flange). A separate hose vents the oil tank and is clipped

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to the, torque staybolt on the rear brake plate so that oil mist will not, (hopefully), get on the tire. Oil tanks should not be refilled with more then about 2.0 U.S. quarts of oil. If too much all is put in, it will be blown out the oil tank vent pipe. On the other hand, top-up the oil- tank when it gets about a U.S. pint low. The vibration that accompanies hard driving tends to crack the mounting ears of the ririd-mount oil tanks. Welded repairs are satisfactory for this tank same as for the gas tank.

The rubber-mounted Thruxton, (and some Clubman), tank is set back to allow more carburetor clearance. It is pretty well proof against cracking regardless of speed. Its rubber mounts deteriorate In time and must be replaced. The nuts that secure it tend to vibrate loose and should be Loctited. The tank should not be In metallic contact with any adjacent part.

Replacing the oil filter calls for care and the use of new gaskets to ensure a reliable, oil-tight job. Everything to do with oil tank and lines deserves extreme care as the lubricant delivery is of such vital importance to the engine. Standard oil line fittings loosen in time, and then the hoses tend to leak. Replacement can be made with the originals, (expensive!), but a good job can be done by replacing only the hoses.. The new hose must be best-quality plastic tubing, must fit the old end fittings tightly, and should be secured by the correct size of worm-drive hose clamp. Before assembling, degrease thoroughly and dry the metal end fitting, and assemble with 3M Super 'Weatherstrip Adhesive" for a permanent air-tight seal. The banjo bolts and A37/7 washers into the crankcase must also be cleaned and carefully sealed. It is, vital that <u>all</u> fittings in the oil feed line be absolutely airtight at all times: otherwise, a proportion of air will be drawn into the delivery pump, reducing the all-important volume of oil flow. if you are sucking, 50% air into your oil pump instead of 100% oil, your engine is <u>hurting,</u> especially at high RPM when you can easily seize something for lack of oil. Inattention to this critical point is often noted.

All plastic oil lines are subject to deterioration with age. They must be inspected frequently and replaced when necessary. If your feed line falls off just as you change into high gear at 99 MPH, your engine will probably seize solid immediately and you may be badly hurt, not to mention costly damage to the bike. Whenever feed lines are disturbed, they must be primed, (preferably with a pressure oil can), so that the' oil pump sucks up the oil and pulls the ball valve off its seat. Always beware of air locks at this time. As a routine check on oil circulation, always check the oil return in the oil tank whenever starting the bike from cold. Never take chances about oil circulation. Be certain that the oil lines are clipped-up where they cannot touch the exhaust pipe.

<u>GRADES OF OIL TO USE</u>:

Our shop generally follows the factory's recommendations except that we believe Multi-Grade oil should not be used because of the risk of its thinning-out under the high temperatures and severe stresses encountered in American service. For the same reasons, more protection against weer will be obtained in summer driving by the use of SAE-50 oil instead of SAE-40, in the engine. Only the best quality <u>detergent</u> oil should be used. Based on many years experience, we recommend

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"D-A SPEEDSPORT" oil. Valvoline Racing and Quaker State Racing oils In SAE 50-weight are also good. Hard driving should not be attempted until the oil tank warms up, Indicating the oil is warm and circulating well. High RPMs with cold oil results in premature wear and possible damage to the engine.

THE SEAT:

Seats on Velocettes are generally well made. The metal base is adequate for the job it does. Repairs to the base can be made by gas welding; the material is mild steel. Three seat cover patterns have been used: (1), MAS89/8 for all machines up to 1962, identified by flat bottom line, not following the frame contour In the front portion. This seat also used on the scramlbler and endurance models to the end of production; (2), MAS89/9, all machines from 1962 to end of production except as noted. Base formed with a Vee on the front side portions, following frame contour; (3), MAS89/10, a modification of (2) above, fitted to the Thruxton from 1965 to 1968. This is the seat with the "bump" at the rear which was a fibrerglass construction bonded to a regular seat base. The last Thruxtons produced did not have this seat, probably due to some supply problem affecting the bump seat.

New standard covers are available for all seats at moderate cost which will make the seat look like new, They can be installed with little difficulty. The cover can be secured with use of 3M "Super Weatherstrip Adhesive", using spring type clothespins to clamp the cover in place until the adhesive is fully dry.

FENDERS AND STAYS:

Both fenders and stays are prone to breakage due to vibration. Being made of mild steel, they are repairable by gas welding. Fenders can sometimes benefit from reinforcement around the mounting holes, by the use of large fender washers, or other rivetted or welded reinforcement. Refinishing of such parts after repairs can easily be done by anyone with the use of wet sanding, primer, and paint in spray cans available at all hardware stores.

THE ELECTRICAL SYSTEM:

This is a common source of defects and difficulties - not because the original equipment is inadequate, particularly, but because minor repairs and servicing are often so poorly carried out by owners and/or shops. On other than nearly new machines, botched-up electrics are the rule rather than the exception.

Miller electrical equipment was standard on all models until 1965 when Lucas equipment came into use, except that during 1965 and 1966 some machines were fitted with Miller 50-watt generators and regulators mated with an otherwise Lucas-equipped system. The Miller equipment wag always of good quality and workmanship with minor exceptions such as a voltage regulator of rudimentary design which does not really control charging, under varying conditions of current voltage as it should. The Miller generator is reliable and gives at least 20-25,000 miles of service between overhauls, but is made in such a way that field repair attempts are unlikely to be successful. Spare parts for the Miller

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system are practically unobtainable in, America though readily available, through supply channels in England. Wiring looms, headlamp assemblies, et cetera, are available new; generators and regulators must be exchanged for a factory-reconditioned unit. Miller systems can be exchanged for Lucas systems with very little difficulty. The wiring circuits are plainly set forth in the Service Manual. The same generator pulley, generntor strap, and Vee belt are used with the Lucas generator as with the Miller.

In our opinion, the best system is the late model Lucas. It will provide (a), a 60-watt generator instead of a 50 watt; (b), a 30-watt headlamp which is entirely safe and sufficient for night riding; (c), a good bright brake and taillight assembly; (d), a voltage regulator that works and is worthy of the name; (e), ready parts supply; and (f), good design which gives long service with little attention.

All models, both old and new, should use the Lucas PUZ7E-II battery which is standard equipment, fits all Velocette battery carriers, and will give long service if properly tended.

Any wiring repairs must be made with soldered joints, using rosincore solder to avoid corrosion, and any exposed wire must be carefully wrapped with 3M electrical tape. Wires merely twisted together and taped inevitably lead to higher resistance causing poor lights; corrosion sets in to eventually cut the circuit.

<u>THE ENGINE</u>:

We now come to the most interesting and challenging part of the machine, the part that demands the most meticulous care and exacting knowledge. The Velocette engine is a thoroughly well designed and proven one, each part of which has been patiently and honestly developed and improved over the years by honest men who wanted to bring honor to themselves, their factory, and possibly even their country. In view of this, and our own experience with the machine, it is, in our opinion, <u>always</u> best to follow factory practice, policy, and recommendations unless there is a very sound reason to do otherwise. Do not be deceived into believing that you can "hop-up" your engine or discover unknown secrets to fabulous power increases. It has often been tried ... but it does not work! You have been warned. Now let us tackle the various components in turn:

<u>THE CYLINDER HEAD</u>:

Of the machines covered in this manual, all 350cc engines use the same die-cast cylinder head: all 500cc engines use the same die-cast head except Thruxtons which use a sand-cast head differing from the standard head in that it uses a 1-3/8" intake port with 2" intake valve instead of the 1-3/16", intake port and 1 3/4" valve of the standard 500co head. Velocette's 1961 24-hour/IOO MPH record bike used a standard diecast head with a 1-3/16" part and GP carburetor. Subsequent to this success, the factory produced the special large valve head which was offered as an option for 500cc racing for a few years, then fitted as standard to the Thruxton when produced for the 1965 season.

Both types of 500co engine use the same intake and exhaust valve guides, and the same exhaust valves. The Intake valves differ. The rest of the cylinder head equipment is the same. The 1967 and later heads are machined to suit the O-ring seal for the upper end of the one-piece pushrod cover.

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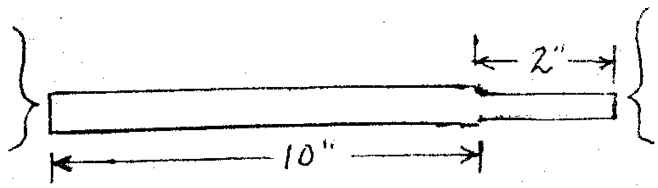
Care is necessary when installing valve guides to avoid broaching out the orliginal guide bores in the head. New guides must be chamfered slightly to round-off the leading end and to avoid plowinq-up the soft aluminum of the head during installation. The head must be heated to 212-degrees before removing or replacing guides.Work from the combustion chamber side using suitable piloted drifts.Heating the head first in boiling, water is a satisfactory procedure. Drifts have to be made to suit the guides as follows:

This end .030” less than guide outside diamete r



This end .005” less than the guide inside diameter
Material: case-hardened steel

The new guide must protrude .343" from the boss of metal surrounding the guide on the top side of the head. The oil scraper end is up, of course. If dealing with a head that someone has botched so that a new valve guide is loose in the head, two courses of action are open: (1), the bore can be measured and a good machine shop can easily produce an oversized valve guide of phosphor bronze identical to the standard item except, with the outside diameter sized to give an interference-fit in the existing bore; or (2), "Loctite Bearing Mount" can be used to retain the valve guide successfully.

After installation, the guides must be checked for clearance on the valves and reamed if necessary. Factory-recommended clearances are .00125"-to-.0025" for intakes, .00225"-to-.0035" for exhausts. It is advisable to work toward the wide clearances for racing unless there is opportunity to run-in the engine, otherwise the valves may seize in their guides and stick open which may result in bent pushrods. It must be remembered that the valve and guide form a plain bearing which is but ill-lubricated and, especially with the exhaust, runs tremendously hot. Valves and guides, therefore, require a break-in period before driving bard, just as do pistons and rings.

Valve guide life depends somewhat upon conditions of use, but in normal road use life will be 20-25,000 miles before replacement. when clearance amounts to .003 over the original sizes, replacement should be effected. Loose guides increase valve seat wear by permitting the valve to slop sideways excessively when seating and, on the intake side, will permit the entry of oil into the combustion chamber. After replacing guides, the valve seat inserts will need trueing-up on their 45-degree faces only. Do not remove more than a bare minimum of stock. If reusing old valves, they should be refaced 45-degrees and then lapped into their seats with fine valve grinding compound. New valves should also be lightly lapped into their seats to ensure a good fit.

To lap Valves into their seats, proceed as follows: obtain a valve grinding, tool with suction cups on the ends as sold by auto parts supply dealers. The suction cups should be of a size to suit the valves. A wire brush is used to remove old carbon from valves. Do not drop the valves as they may get bent from rough handling, making it almost impossible to get good seatings with them unless refaced. Clean valves and guides with Varsol, Oil the valve stem. put a thin, even layer of fine valve grinding compound on the valve face where it contacts the seat. Do not let grinding compound on the valve stem. stick the suction cup onto the valve head. Place the shaft of the suction cup tool between

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the palms and rotate it back and forth. After each two or three strokes lift the valve slightly and turn it about 90-degrees. repeat frequently. Turning the valve each two or three strokes ensures that the seat and the valve will get evenly ground and mated to each other. Wiping off the valve face and seat, and examining them as the work progresses, will show when smooth even surfaces free from pits begin to develop. Fresh grinding compound may be added as you progress; a little oil added to the compound will hasten cutting and provide a better finish. The finished mating surfaces should be approximately 1/16" to 3/32" width for intakes, and 3/32" to 1/8" for exhausts. After grinding valves, all traces of compound, must be removed. You wouldn't want to grind your cylinder walls,~rings, or piston! Clean all parts in Varsol preparatory to reassembling.

DECARBONIZING:

This is a matter which creates universal confusion among Velocette riders, the lack of attention to which is responsible for much incurably poor performance. The writer believes it fair to say that an MSS Velo with its 7-to-l compression ratio does not need periodic deoarbonizirig, because the maximum carbon build-up that will ever take place does not raise the octane requirement to the point where the classic symptoms will arise when using premium gasoline. All the other engines, using compression ratios of 8-to-1 or over, do need it; the Thruxton with its full 9-to-1 compression needs it most of all.

The key words to understanding the need for decarbonization are OCTANE REQUIREMENT. With any engine there is a limit to the compression ratio you can use with a certain fuel, such as 100-octane premium gasoline, beyond which detonation will arise. Detonation is the "pinging" or "knockinp" one hears in an automobile engine when the gasoline is not high enough in octane rating. Technically, detonation is the explosion, rather then smooth controlled burning, of the mixture in the cylinder during the last twenty to thirty degrees of piston movement before the exhaust valve opens on the power stroke. The explosive shock of moderate detonation increases cylinder pressures by three or four times normal which increases piston, ring, cylinder, and bearing wear a like amount. Severe detonation quickly leads to overheating, pre-ignition, power loss, and possibly valve or piston burning.

The high-compression pistons create an octane requirement which is close to the limit of available gasoline octane. This is done purposely because power increases as compression ratio increases, up to the limit where detonation arises under unfavorable conditions of use such as hot weather, hard pulling up grades, strong headwinds, heavy loads, et, cetera. Velocette engines with high compression ratios are satisfactory under all road conditions and give very high performance without overheating or detonation until carbon builds up to a certain quantity in the combustion chamber. Whether the carbon build-up provokes detonation and overheating, by the increase in mechanical compression ratio or by the deposits glowing, red-hot is not certain; perhaps a combination of both. What is certain is that severe detonation must not be tolerated. 'When it starts the head must be removed without delay and the carbon scraped from the piston top and the hemisphere of the cylinder head, using an aluminum scraper to avoid scratching. There is no need to disturb the cylinder barrel or the valves durinr the initial decarbonization: just remove the carbon. If you desire, the valve sealing can be quickly checked by putting Varsol in the

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ports. Slight seepage past the valves doesn't matter, but excessive leakage indicates need for attention.Under normal road use conditions, symptoms of carbon build-up will appear in about 2000 miles from new or after installing new piston rings, but thereafter the symptoms will not reappear for some 7000 to 8000 more miles.The reason for this is that during the initial 2000 miles the piston rings pass more oil while they are bedding down then they do later, which hastens the carbon build-up.

When carbon build-up develops to the point of causing detonation land the heed for decarbonizing, no amount of adjusting the timing, richening the fuel mixture, or other expediencies will help the matter. Decarbonizing alone will correct matters and restore the previous smooth performance of the engine.

Quite a few Velocette owners over the years have fitted 10-to-1 pistons in an effort to get more power, but under American conditions of sustained high speeds and tropical summer temperatures we cannot recommend it. The engine is on the ragged edge of severe detonation and overheating all the time, and feels distressed and unpleasant, unlike a smooth, punchy Thxuxton engine in good standard form. On the other hand, for short-distance work such as hill climbs, drag racing, and sprints, the 10-to-1 ratio might show a slight power gain over a 9-to-l on 100-octane gasoline. If alcohol is used for fuel, with its great cooling effect, of course, a 10-to-1 ratio can be used with safety and should give about a 10% Increase in power compared with the same engine on gasoline. The use of alcohol requires much richer carburetor settings.

Very high ratios or the use of nitro fuels should be approached with caution; after a period of use they may result in fatigue failure or stretching of the threads in the crankcase that hold the cylinder studs. One effect of this will be head gasket failure. According to an eyewitness, (although never admitted by the factory) this condition caused failure of the factory's attempt subsequent to the successful 1961-24hr 1OO MPH record to duplicate this success with a 350cc engine with a very high ratio a year or two later. Be that as it may, when the Thruxton was producedin 1965 it featured a crankcase which was heat-treated for extra strength, perhaps especially in the region of the studs. This may be more of a precaution than a necessity, but Thruxtons have been successfully raced all over the world in long-distance events as have all other Velocettes.

It may be desirable to clean the cylinder heed casting at the same time one decarbonizes. The best means of getting the casting clean is by "glass beading". This process is similar to sand blasting except that it removes no metal; rather, it has a peening effect on the metal. All tapped holes In the head will need to be cleaned out thoroughly.

On cylinder heads other than Thruxton, the exhaust pipe stubs have been known to work loose occasionally. They can be replaced and permanently secured with "Loctite Retaining Compound" or a set-screw as used on Thruxtons.

New gaskets and seals generally ensure that there will be no oil leaks around the head. A higb-quality heat-resistant sealer like Aviation Permatex Super 300 should be used on all gaskets except the cylinder head and base gaskets. Particular care must be taken with the rocker box oil feed pipe banjo joint as oil is under pressure at this point and will readily leek out if not sealed carefully. The early two-piece telescopic pushrod cover is prone to leakage, but the later type one-piece cover with O-Ring seals is leakproof.

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A persistent leak from the rockerbox/cylinder head joint can be permanently eliminated by grinding both mating surfaces really flat on a piece of plate glass with fine grinding compound as used for valves. Oil will leak down the 3/8" cylinder studs and out the head-barrel joint unless the O-Ring seals under the washers are renewed whenever disturbed. Torque the 3/8" cylinder head nuts 25 foot-pounds evenly. Pull the 5/16" rockerbox bolts down only until they are firmly tight; these fine threads strip out of the aluminum head rather easily if forced, but this catastrophe can be repaired with a Helicoil insert.

SPARK PLUGS:

Plugs are another area of misunderstanding among Velocette owners. Especially with high compression ratios, the correct plug is critical: the wrong plug can result in a holed or seized piston. A plug that runs too hot may start glowing red-hot and fire the charge too soon, (pre-ignition), that is, ignition may occur at 50 to 90 degrees before top dead center instead of the prescribed 36 or 38 degrees. Obviously, this will cause overheating and gross malfunction.

MSS models with standard 7-to-l compression ratio use the Champion N4 or equivalent. Venoms and Vipers use Champion N3 or equivalent. Scramblers use N3 or N4 depending on how fast the track is: if the engine works hard enough to get well heated, the colder N3 would be the choice. Clubman/Thruxton models in road use should be equipped with the KLG FE220; in racing use with the KLG FE280 or equivalent. The NGK B77EC is satisfactory in place of the KLG FE220 and costs slightly less. Never use anything other than a 14mm 3/4"-reach plug.

The classic rule on spark plugs is to use the coldest plug that will function without danger of fouling, in the prevailing conditions of use. The Thruxton and Clubman get very hot in road use and need a cold plug like the KLG FE220 or NGK B77EC, which is also satisfactory in all-around use, including town running. If a Clubman or Thruxton were used for very slow running and idling a lot, however, the cold KLG FE220 might foul because the engine did not develop enough heat to keep the plug burned clean. In this case it would be necessary to try a hotter plug like the N3. Beware of hard fast road use without a cold plug in a Thruxton; it may upset running and cause slight preignition and/or detonation even without causing obvious distress.

CYLINDER HEAD STEADY:

The "steady" is the brace running from frame to rear of cylinder head. It is important that it be always in place correctly and be firmly tight. Its purpose is to reduce vibration of the engine by bracing the head against the vibratory torque reaction set up as the engine tries to twist clockwise in the frame, (viewed from the primary chain side), in reaction to the firing impulses of the flywheel assembly which turns counterclockwise. If this brace comes loose or is omitted, a very unpleasant vibration will be set up which will be quite noticeable to the rider. It should be remembered that an irregular torque equal to the crankshaft torque - (roughly a maximum of 30-ft.lbs. torcue for any 500ce engine on gasoline), is applied to the frame via the crankcase mounting bolts when the engine is running at full throttle. This "steady" may also help to reduce the stresses on the frame tubes by reducing the amplitude of the vibration.

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Vibration itself merits more than passing notice. It results from both balance and torque reactions in a single-cylinder engine such as the Velocette and cannot be entirely eliminated. It can only be minimized by clever mounting and factory experimentation with balance factors. It has been very much minimized In the Velocette, and the machine is generally free from any RPM-periods where severe vibration is encountered. In part, this is due to carefully designed and accurately jig-drilled mounting plates and frame holes which give a close-fitting power unit that stays tight and doesn't work loose in time provided the 3/8" mounting bolts are kept tight. In case of vibration occurring, the first thing to check is the cylinder head steady brace, and then the 3/8" mounting bolts for the power unit mounting plates. Loctite Nutlock will keep these tight although they are not very prone to loosening in any event being originally provided with internally-toothed lockwashers. On Thruxtons, the lower oil tank mounting 3/8" bolt, (which doubles as a power unit mounting plate securing bolt), tends to come loose and should be permanently secured with Nutlock. Prior to about 1966, 3/8" power unit mounting bolts had CEI threads; later on, BSF threaded bolts were used.

EXHAUST VALVES:

On all current Velocettes except the MSS model, exhaust valves were originally made of Nimonic-80, a special alloy originally developed for the blades of jet turbines. This is the highest quality material available for extreme heat conditions. Valves made of this alloy are, however, very costly and frequently are not readily availAble for replacements. The MS valves are made of KE965 material which was the previous standard exhaust valve material developed, the writer believes, for British aircraft engines before WW-2. If Nimonic-80 valves are not obtainable, KE965 (V112) valves can be fitted at a savings in cost. The main difference is in the rate of erosion of the valve face under extreme heat conditions, when the KE965 burns away a little faster then does the Nimonic-80. The KE965 was used for years in racing Velocettes before the Nimonic-80 became available. Under non-racing conditions there should be little difference in service life. All valves should be replaced when the edges become thin and/or stem wear becomes obvious or excessive.

When assembling, the valves and springs in a Velocette head, clean and oil all parts before assembly. The valve springs have a long service life and, except possibly for racing use do not need Periodic replacement unless worn under the valve collar say 2~% of the original diameter, (leaving ?5% remaining.)

When assembling the springs, shims are to be placed under the lower spring, retainer "washer", (M38/4), so that a measurement of .542"/.562", is obtained between the top of the washer and the bottom of the loop of the valve spring where it is assembled into the K4/6 outer collar. This can easily be measured with a 6-inch steel rule. This compensates for variations in valve faces and seats, and ensures that spring pressure is sufficient to give correct valve control throughout the RPM range.

On occasion. owners experiment with other valves and springs in their Velocettes but this is altogether dangerous and can result in wrecking the whole top half of the engine if a valve head comes off. Such experimentation is not recommended.

Factory policy is to "red-line" the 500cc engines at 6200 RPM and the 350ce at 7000. These limits should not be exceeded because of the risk of floating valves into each other, which will bend them and stop

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the engine for lack of compression, The factory limits RPM's in this way because over-revving gives no more speed or power, only increases stress and wear on the moving parts, especially the con-rod big-end and the piston.

When checking compression with a compression gauge, the 7-to-1 will show about 100 lbs.PSI, the 9-to-l ratio 130-135. Hold throttle wide open when testing. Higher readings mean carbon build-up or, in extreme cases, a higher-ratio piston than you thought! Lower readings indicate leakage past rings, valves, or (rarely) the head gasket. The compression tester is a quick and easy way to determine internal engine condition. A Velocette engine is very sensitive to the compression pressure being correct as well as the carbon build-up, (except the, MSS engine), and performance deteriorates very obviously if compression is below par or if decarbonizing is needed as mentioned before.

BARREL AND PISTON:

Prior to the early 1960s, 350cc and 500cc models used an aluminum barrel with an iron liner bonded-in by the "Alfin" process. Later, only castiron barrels were fitted, probably as they were cheaper to produce and have proven to give satisfactory cooling with the 9-to-1 ratio in the Thruxton. That well-known British engineer, Doug Hale, with decades of Norton and Triumph factory design experience behind him, has been quoted as saying that as much power is lost by the distortion of an aluminum cylinder barrel with an iron liner under thermal stressing as is gained by the slightly-improved cooling, compared with a comparable all-iron barrel which retains its shape better under heating conditions.

Factory practice with the Velocette barrel was to re-bore only twice, to .020" and .040" oversizes, but for many years British Velocette dealers have found it safe to re-bore to .060". It should be noted that factory policy was that re-boring was unnecessary until the taper or wear was in excess of .008". This gives longest service and economy. Compression loss and blow-by past the rings increases as taper increases, and for greatest efficiency the barrel must be true. A Velocette usually gives 20- to 25,000 miles road use before wear begins to approach the point where a re-bore is necessary.

Especially with Thruxtons, the piston will develop a relatively large clearance fairly quickly, even exceeding .030" skirt clearance, but running is not affected except for increased clatter; just renewing piston rings will restore pep. In Thruxtons, the piston rings should be renewed after 8or 9,000 miles when they will be found to have greatly increased end-gaps, be worn, and "tired". They lose their tension due to heat and stress and no longer seal properly.

None of the Velocettes except Scramblers come with air cleaners but in road use this omission does not seem to greatly accelerate wear. However, much usage on dirt roads would call for fitting of a cleaner. This is not easily done because of the proximity of the oil tank. Air cleaners tend to richen fuel mixtures and may require a re-jetting of the carburetor.

The original-equipment pistons are Hepolite, with split skirts in ratios 7- and 8-to-1; these were fitted with only about .002" clearance and run quietly. The split should always be on the front side of the barrel, (the non-thrust side). It permits the piston skirt to expand under heat without seizing. The 8.75/9.0 Hepolite piston has a solid skirt which requires fitting with more clearance to allow room for heat expansion: approximately .005". Hepolite pistons have the correct clearance when fitted to cylinders that are re-bored and honed to the nominal size that is, a /.020" Hepolite piston requires a cylinder size of 86MM (3.3858") plus .020", or 3.4058", with a tolerance of

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-.000" to /.001". The size can be /.001" but must not be smaller than the nominal 3.4058".

The various Hepolite pistons use different ring sets, and the compression ratio or type must be specified when ordering. 8.75/9.0 ratio Hepolite pistons are frequently not available for rebores due to supply problems in the motorcycle industry. ASSO pistons, (Italian made), are available and normally stocked here for rebores. These are similar in design and quality to the Hepolite 8.75/9.0 pistons. The ASSO pistons, come in sizes 86.5mm, 87mm, and 87.5mm rather than 86mm plus, .020", .040", and .060", but these two dimensions are interchangeable.

The .005" clearance is correct for solid skirt ASSO or Herolite pistons in normal road sport service, using the regular break-in procedure. There will be moderate piston clatter with this clearance compared with the split skirt Pistons. For racing or other extreme duty, it may be, advisable to increase initial clearance to .010" to ensure that there will still be running clearance under extreme heat conditions. This will markedly increase clatter but noise, itself, matters little under racing conditions.

<u>PISTON RINGS - MINIMUM END GAPS</u>:

MSS	VENOM	All 350's	THRUXTON,CLUBMAN,500 SCRAM.		
Compression Rings		.015"	.010"	.010"	.020"
Oil Rings	.015"	.010"	.012"	.020"	

<u>RING SIDE CLEARANCE ALL MODELS</u>:

Compression Rings .001" to .003"
Oil Rings .0027" to .0047"

Ring end gaps are checked by removing the rings from their pistons and placing them squarely in the unworn part of the cylinder. then measuring with a feeler gauge. If the gap is too small, it can be increased by careful filing. End gaps left too small may result in breakage in service.

When installing or removing rings on pistons, it is preferable to use one of the tools made for this purpose. When installing pistons into cylinders, it in almost essential to use a "Terry" ring compressor, otherwise you may trap and break a ring.

The factory-fit of the wrist pin, ("gudgeon pin"), in the con-rod,bushing is .001" clearance. In general, this bushing stays tight for the life of the big-end bearing and doesn't need replacement until the flywheel assembly needs servicing as well. This is fortunate because it is quite difficult to satisfactorily remove, replace, and size the bushing with the rod in the cases. Up to .005" clearance can be allowed in the bushing, but clearance over the original push-fit produces a loud mechanical rattle which will be very annoying in road use.

Pistons will generally require a little heating to permit the pin to be removed or replaced freely. This can be done with a LP gas torch, which is also handy for soldering and is available at low cost at most hardware stores, The piston needn't be heated hot enough to burn you, as a rule. All parts should be liberally lubricated for assembly. The wrist pin cirolips should be installed so the open ends are at the top or bottom to reduce the possibility of developing a resonant vibration that results In jumping out of their groove.

When cylinders are rebored, they should be honed to remove the tool marks and bring them to correct size. A "mirror finish" Is popular in

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England but U.S. reconditioners do not observe this practice because it retards ring seating and increases oil consumption during break-in without affording any other real benefit. Chrome rings, especially, seat in better and faster on a cylinder wall which has a honed finish with fine stones, but not a polished finish. When replacing rings only, however ' it is not essential to hone the cylinder unless it is desired to hasten ring seating. Rings marked TOP must be fitted right side up.

In regard to piston ring seating: it must be understood that a new ring does not really bear evenly against the cylinder wall, but heavily at some locations, lightly at others, and not at all at still others. This Is despite the fact that it looks like it bears evenly to the naked eye. Until the ring wears and settles down to 360-degree contact with tho cylinder wall, it passes both oil and gases under running conditions. Ouch passages is minimized when the ring settles down. Later, after thousands of miles use, gas and oil start passing again due to wear end tear. Ring replacement is indicated.

<u>BREAK-IN PROCEDURES</u>:

When new engine parts are fitted, especially valves and pistons, they require a break-in period to allow parts to wear-in to each other, polish down high spots, and generally bed down. In the case of pistons, a 1000-mile period is prescribed; starting at 45 MPH or so and gradually working up speed as mileage increases. The object is to avoid hard driving which builds up heat which may cause piston seizure if the piston doesn't get a chance to mate-in to the cylinder. If new piston rings only are fitted, they need no break-in. If desired for racing purposes to break-in piston rings prior to running so that they will be mated-in from the start, it can be done by putting the piston with new rings in the cylinder with "Brasso" or similar fine metal polish, and, working it back and forth over the whole bore until the rings show full 360-degrees contact on their working faces. All Brasso, (or other polish), must be washed out with solvent, without removing the rings from the piston; otherwise the desired "set" will be lost and they will have to settle in again.

<u>PAINTING CYLINDERS</u>:

The original silver paint on iron barrels soon falls off and rusting begins. At an overhaul stage, the barrel can be cleaned by wire-brushing and scrubbing with Varsol, or by glass-bead blasting, and painted with one or two coats of black Sapolin Radiator and Range Enamel. By painting cylinders black, cooling is slightly improved. The Sapolin enamel is durable and can stand the heat, but no finish, including baked enamel, is entirely permanent in this application because of the heat and weathering.

<u>RELINING CYLINDERS</u>:

When cylinders (either iron or alloy), are worn beyond the third rebore, they can be replaced. If replacements are not available, it may be possible to have the original bore machined-out and a flanged liner shrunk in place. We have a contact In Great Britain that undertakes this work at slightly less than the cost of a new cylinder.

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STABILIZING ACTUAL COMPRESSION RATIO:

Because of variations in all the parts which, together, establish this actual mechanical compression ratio, the factory method is to check each engine individually and adjust the ratio by shims under the cylinder base to get the desired figure. To check the ratio, the piston is brought to top dead center, the gap between piston and bore sealed with grease, and the head installed, (with valves in place), with the normal gasket. The head is torqued down normally and the machine tilted so that the spark plug hole is vertical. light engine oil, (10- or 20-wt), is then poured from a 100cc or l00 ml graduated cylinder container marked in one cc. or one ml. increments into the combustion chamber until the oil comes just up to the bottom thread of the spark plug, hole, with no air bubbles present in the combustion chamber. If the graduate was originally filled to the 100 mark, the amount remaining will show the amount in the combustion chamber. The correct volume of the combustion chamber is as follows,'

For 500ce engines, 9-to-1: 63cc; 8.75-to-l: 64-65cc; 8-to-l: 68-69cc; 7-to-1: 86cc.

For 350cc engines, 9.3-to-1: 42cc; 8.5-to-1: 47-48cc.

Add 2cc for each oversize; that is, for example, 9-to-l plus .040 piston would be 67cc instead of 63cc.

It is probably best to err on the low side for road use. An 8.9-to-1 ratio will give better running than a 9.1-to-1 ratio which may result in detonation.

If the combustion chamber capacity is too small, the compression willl be too high. The capacity will be increased by installing a compression plate, available in .010" and .031" thicknesses, at the cylinder base. The least number of plates used, the better; i.e., one .031" plate gives a firmer foundation for the cylinder barrel then three .010 piates. Factory practice is to use but one paper cylinder basegasket, on top of the crankcase mouth, without sealer, even though two compression plates are used.

After checking the capacity, the oil is best removed with the least mess by turning the crankshaft so that the piston moves down the cylinder.' Then the. ~head can be removed and the oil bailed and wiped out.

When simply reboring and fitting an oversized piston, operators often replace the original compression plates and get satisfactory results as variations in the piston crowns is not usually great. But the meticulous operator who wants to know exactly what his ratio is, and wants to avoid a possible source of trouble, will check the actual ratio and adjust, if necessary, just as the factory did originally.

FINDING TOP DEAD CENTER the "POSITIVE STOP" WAY

The stage of engine work where the cylinder head is assembled but the rocker box is not, is the ideal time to verify or reset ignition and/or valve timing. To attain any real accuracy with these settings takes skill and care. The ignition timing, in particular, is critical and, if too far advanced, will cause detonation, overheating, pre-ignition and possibly piston failure. It is practically impossible to determine piston Top Dead Center (TDC) accurately by observing or feeling the piston movement because movement is so slight near TDC that errors of up to 5 or more deCrees are virtually undetectable. The positive stop

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"Method" enables TDC to be found quickly and accurately. A "Stop" can be made of an old spark plug body with the center portion removed, (beware of flying porcelain particles when removing), and a steel rod about 1/4" in diameter brazed into the center of it, protruding about 1 1/2" out of the combustion chamber side of the plug (which can subsequently be used universally on other motors). The brazing, must be done carefully so that the body can still be screwed into the plug hole. The protruding end should be rounded to avoid marking the piston. Proceed by mounting a suitable timing disc or degree wheel on the drive side crankshaft end, removing the dynamo belt pulley and shock absorber spring and parts, and using the special nut to retain the timing disc. Before inserting "Stop" in head bring the piston to TDC visually and set an indicator, (a piece of sheet metal with a pointed end pushed into some old innertube rubber material, between two cylinder fins is quick and convenient), so that the timing disc reads TDC, (0-degrees), when the piston is at TDC.

Next, using a socket wrench on the nut on the timing side mainshaft, (after removing timing cover), turn the crankshaft approximately ninety degrees clockwise and install the "Stop". Carefully turn the crankshaft counterclockwise until the piston comes up gently but firmly to the "Stop". The crankshaft must be controlled with the wrench or else, due to the balance factor, etc., the shaft may turn unexpectedly and slam the piston up into the "Stop" which will mark the piston top if nothing else. Note the reading on the disc, which may indicate, say, 50-degrees before TDC. Now, turn the crankshaft clockwise back through approximately 260-degrees until the piston once again comes gently but firmly against the "Stop". Note this reading on the degree disc. If it is 50-degrees before TDC also, it means our disc is correctly set so that disc TDC is the same as piston TDC. Piston TDC naturally is equidistant between the two stop positions.

More than likely, the second reading will not be the same as the first because our visual estimate of piston TDC will be inaccurate. If the second reading turns out to be say 46-degrees, it means our disc is 2-degrees out and needs a slight readjustment on the mainshaft so that both readings at the stop then become 48-derrees. Readjust and check the readings until the disc reads exactly the same at both stop positions, then by removing the "Stop" you have a disc which shows TDC exactly at piston TDC - and you can proceed to verify ignition or valve timing to an accuracy of 1/4 degree if you care to. Be sure that both indicator and disc are secured so that they do not subsequently move and give false readings. For all timing purposes, the best method of moving the crankshaft is with a socket wrench on the timing side mainshaft nut which has lefthand threads. Using this nut to carefully turn the crankshaft will not loosen it. The factory method of tightening or loosening this nut is to put a rod of aluminum into the crankcase mouth to jam the con-rod big end and thus prevent crankshaft rotation.

One must proceed with caution if it is desired to find TDC with the "Positive Stop" method when the rocker box is on so that the valves are opening, and closing when the crankshaft turns. The valves may strike the top at maximum lift and bend themselves, the stop, or the pushrods. It may be possible to back-off the tappet adjusters so that the valves do not open far enough to strike the stop, but BE CAREFUL. The valve lift can be observed through the spark plug hole.

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FLYWHEEL ASSEMBLY: CONNECTING ROD, FLYWHEELS, MAINSHAFT:

Being designed to the highest standards of the motorcycle industry, and proven good enough to last 24 hours at 100-MPH, the flywheel assembly has an infinite life in road service; the need for repair is very rare. The narrowness of the flywheel assembly, the narrowness of the crankcase between main bearings, the design of the big-end bearing, and the large flow of oil all contribute to this happy state of affairs.

The assembly is press-fitted together without nuts similar to the, flywheel assembly of a Harley-Davidson 250-350cc "Sprint" or the 250 350-450 Ducati. Should service be required on a Velocette assembly through running without oil, etc., new parts can be obtained for the big-end bearing and the job of replacement entrusted to a good Harley or Ducati mechanic. The bearing should be set up so that about .001'' clearance is present, for racing, little looser so that the cage can be pushed around with the fingers when the rod and bearing are assembled into one flywheel.

The flywheel assembly must be trued so that both mainshafts run true to each other within .001" of complete accuracy. When the big-end bearing needs service, the connecting rod amall-end bush will also need replacement and sizing to .8245" inside diameter, (+.0005", -.0002").

The big-end bearing's condition can be routinely checked when the cylinder is off by pushing and pulling vertically on the rod. Slight perceptible play is normal, but if clearance exceeds about .003" up and down, replacement is indicated.

After replacing the big-end, the main bearing pre-load will have to be verified when reassembling the crankcases. The main bearings also give infinite service and rarely need replacement. It is not necessary to disturb them to replace the big-end, but they will need washing with solvent, drying, and oiling before refitting to eliminate foreign matter.

The correct main bearing pre-load is .004" with the crankcase assembled. This means that when assembling the cases and tightening up the nuts and studs evenly, at the point where the flywheel assembly just starts to turn stiffly in the main bearings, there will be a .004" gap between the case halves all around, measureable by feeler gauge. If the fit is incorrect, shims are added or subtracted behind the outer main bearing race, which have to be jarred out of the cases by heating to approximately 212-degrees by torch or boiling water. Time will be saved by measuring the excess, (or inadequate), clearance by dial indicator or feeler gauges and calculating the shimming alteration required.

Main bearing inner races are a slow taper fit on the shafts, as is the crankpin in the wheels. The flywheels are made of high-tensile steel rather than the usual mild steel, to avoid stretch in the crankpin holes. The main bearing inner races can only be removed from the shafts by splitting with a high-speed grinder used with skill and care. Service to the flywheel and main bearing equipment is a job for experts and, unlike many of the other jobs, should not be attempted by the inexperienced.

After the serviced flywheel assembly is re-assembled into the cases, (Aviation Permatex Super 300 applied thinly to the case joints which have previously been cleaned and de-greased is good for oil-tight joints), the con-rod small-end needs checking to verify alignment. To do this, have an .8235" diameter mandrel made to fit the small-end bush, long enough to rest on the halves of the crankcase across the mouth. Turn the crankshaft carefully until the mandrel rests on the sides of the crankcase mouth. It should meet the case equally on both sides. If there

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is a gap, the rod will need to be bent by another longer bar of the same .8235"-diameter used as a lever through the small end; bend carefully and then recheck with the checking mandrel until alignment is obtained. The piston will drag heavily on the cylinder wall if the rod is misaligned.

Fatigue failure of the connecting rod is practically unknown, to the factory's RPM limits. For road use, the con-rod will last for a lifetime, almost without question. For racing, the rod can be checked at overhaul intervals for fatigue cracks by the the magnaflux process, but need for replacement is rare so long as the rev limits are observed. Fatigue failure of the flywheels or mainshafts is also exceedingly rare. The entire crankshaft assembly is made of the best materiels available and is very very durable.

CRANKCASES, TIMING COVER, AND REV-COUNTER DRIVE:

Little or no trouble is ever experienced with the crankcase castings. The screws that secure the timing cover are a bit too short and may strip the crankcase threads if frequently removed as for Thruxton tappet adjustments. They are 3/16" BSW threads. If the tapped holes strip, a longer screw as used at the rocker box cover can be used as the holes, are tapped sufficiently deep. It is well to replace the original timing cover screws with a set of the longer ones, or a set of Allen-head screws which are 1onger and generally better. The Allen-head screws are available here: likewise, we can repair the holes, if necessary, With Helicoils.

The timing cover and case gasket surfaces are commonly found to have flatness errors in them, and the timing cover may warp a little in service. The timing cover can be ground flat on a plate glass as explained for the rocker box, but be sure all abrasive is washed away, especially out of the oil gallery in the cover. The secret of getting oil-tight joints is to thoroughly clean and dry the mating surfaces as well as the screws and their recesses and holes in the cover; also the tapped holes in the case. Use a high quality sealer like Aviation Permatex Super 300 with a thin coat on both mating, surfaces, a coat on both sides of the new paper gasket, and some sealer on the screws. Caution: do not block the oil supply hole in the cover with sealer! It takes time and care to get oil-tight joints. It should be remembered, however, that permanently oil-tight joints have never been a matter of much concern to the British factories, and some seepage is more or less inevitable after a period of service. Goodyear's "Pliobond" is useful for external sealing of a seepage area without dismantling. It requires the usual cleaning and drying before application. Pliobond is obtainable at most hardware stores and makes permanent repairs.

The rev-counter (tachometer) drive gearbox mounts on the timing cover With two 2BA (fine) thread screws. This location frequently seeps oil, either around the gearbox or through it, and requires careful assembly and sealing. Plain timing covers can be exchanged for revcounter types, and other rev-counter parts supplied through the Reliable Cycle Shop. All coil-ignition Velocettes can fit rev-counters without much expense if not originally so equipped but, if an automatic advance magneto type, extensive outlay is required because the automatic advance magneto must be converted to manual control - (if conversion parts can be obtained) or replaced with the early Thruxton competition magneto, the automatic advance mechanism discarded and replaced-with a solid steel gear, et cetera.

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TIMING GEARS and OIL PUMP

The Velocette timing gear set is known for its exceptionally silent running, (due to the' use of small helical gear teeth), and long service life. The only possible adjustment for mesh is the idler gear, (between cam rear and crankshaft gear), which can be moved horizontally into a closer mesh with Its mating gears if excessive play develops after loosening its securing bolts which are accessible through the holes in the idler rear. Need for this adjustment is rare; it is primarily intended for assembly purposes. If it is reset, make sure that it is not set too tight, and remains free-turning in all positions; otherwise it will whine. Virtually all timing gears of all makers have a little eccentricity due to distortion in heat treatment, etc., which means that they may be tighter in mesh in some positions than in others.

The fibre rear of the automatic timing device, (ATD), for the standard magneto is heavily loaded from the weight and inertia of the magneto armature, and only lasts about 20,000 miles on machines ridden fast, after which replacement is advisable to avert stripping of the gear. The solid steel magneto gear used with manual-retard magnetos and coil ignition sets is entirely reliable. Conversion to one or the other is probably well advised for hard riders of automatic advance magneto equipped machines. The steel gear requires a special extractor which we happen to have available, but the fibre gear ATD is self-withdrawing. If tight, a light tap on the head of the nut will often pop it loose. Do not force the self-withdrawing nut as it may then strip. If this happens, the three nuts holding the magneto flange must be backed off and the magneto moved back until the gear contacts the inside case wall when it can be jarred off by light taps on the central nut which has beer, screwed back on the armature spindle. Beware of damaging the threads; If the timing gear needs removal from the mainshaft, a puller must be made up locally. The gear is tapped 2BA for removal.

CAMSHAFT AND FOLLOWERS:

These are the best-designed and most wear-resistant in the industry. Provided the correct oil is used, very little wear occurs in the cams over a long period, but they do need the thicker oils recommended to maintain lubricant film under the heavy loading here. If multi-grade or thin oil is used, wear seems to increase at this point. The oil jet runs a stream of lubricant constantly on the cams during operation which contributes greatly to their longevity. The cam followers have a shoe of hard facing, (Stellite?), material brazed onto their working faces; need for replacement is rare. Both followers are the same in all except Thruxtons which use special ones to give an altered valve-opening diagram. The camshaft bushing is supplied with oil under full pressure, providing long life.

All engines except the MSS use the M17/8 cam which gives radical timing and high lift, actually of racing type. This accounts for the generally uneven idling qualities of these engines except the MSS which has a milder cam and will idle better. Both camshafts have long ramps to open and close the valves quietly: this means it is essential to set tappet clearances only at the prescribed points. Set intake valve tappet clearance .006" at the point where the exhaust valve is just about to open - (exhaust valve pushrod cannot be turned with fingers). Set the exhaust valve tappet clearance .008" at the point where the intake valve has just closed - (intake valve pushrod Just can be turned by fingers).

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The foregoing instructions apply when turning the engine in the normal direction rotation, of course, (clockwise looking at timing side.) A handy way of doing this is to support the rear wheel off the floor, set top gear in gearbox, remove spark plug, and rotate engine by turning the rear wheel forward by hand. Engines other than Thruxtons, and some Clubmans, can have tappet adjustment checked by measuring clearance with a feeler gauge at the loose fitting on top of the pushrod. Thruxtons have one-piece pushrods which are more reliable under real racing conditions of continuous peak revs, and in this case tappet clearance must be measured between cam and followers with a feeler gauge after removing the timing cover. The steady plate supporting the timing gearspindles need not be disturbed for this. Engines must be cold whensetting tappets. Correct tappet clearances should be maintained always.

<u>CHECKING VALVE TIMING OR CHANGING CAMS</u>:

Fit a degree plate on the drive side mainshaft using the "Positive Stop" method of finding Top Dead Center. Remove rocker box and extract exhaust pushrod only. Replace rocker box using normal gasket. Set tappet clearance at .053" on Inlet pushrod in usual way. Turning engine with wrench on T/S M/S nut, inlet pushrod will tighten (opening point)at 45 degrees before TDC and release (closing point) at 55-degrees after Bottom Dead Center (BDC). Remove rocker box again, install exhaust pushrod, remove intake pushrod, re-install rocker box, set exhaust tappet clearance at .052"; when turning engine should give readings of opening 65-degrees before BDC and closing 35-degrees after TDCIt is difficult to accurately set these large tappet clearances with Thruxtons where clearance has to be measured between cam and follower. In this case it is better to obtain a dial indicator showing one inch of travel in .001" increments, and mount this on the cylinder head with rocker box removed. Set this so that the dial reads Zero with follower on base circle of cam and foot of indicator rod in the pushrod top cup. Turn engine and observe degree readings when rise and fall of pushrod measures .053" above Zero Intake and .052" exhaust, which will be opening and closing points. This procedure, if done carefully, will be faster and more accurate than the others.

<u>POINTS TO WATCH</u>:

Due to manufacturing tolerances and/or wear of the parts that affect timing, theoretical figures above, (or 19-49 49-19 timing given by MSS M17/7 cam also used in Vipers before VR1261), will never beobtained in practice. A compromise will have to be effected, bearing in mind that accuracy of the intake valve timing is the more important of the two. Cam timing can only be advanced or retarded by changing tooth engagement with the idler gear. Moreover, the original timing marks are only accurate for the original cam and may be wrong for a replacement, even of the same type. Therefore, each camshaft should be checked and set to give the best timing. Since both cams are on the same shaft, no variation of the timing between them is possible. There is normally an error of 5- to 8-degreas which canot be eliminated regardless of what tooth-meshing is used but, particularly if the bias of error is directed toward the exhaust valve, running will not be affected

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As a rule, engines are not nearly so sensitive to precise valve timing as to precise ignition timing.

<u>THE OIL PUMP</u>:

This component Is very long-lived, "outlasting ten engines sometimes", according to Jack Peasant, the Veloce development engineer and builder and mechanic of the successful 24-HR/100-MPH record Clubman. It delivers a large volume of oil which contributes to the general stamina and the durability of the whole unit.

About the only failure to which the pump is subject is if a large chunk of metal, (too large to "digest"), goes into the return side of the pump and jams the gears, which, in turn, breaks the pump worm drive and simultaneously cuts off the vital supply of oil to the engine. The early engines had a filter plug in the return passage to prevent such chunks passing, but later this was replaced with a small blanking plug, apparently to increase return oil flow. Therefore, If using an engine of the later type, beware of using the engine after a component failure such as piston breakage which may scatter dangerous particles. If such are present it may be advisable to split the oases to remove them. Thenecessity for such action is a matter of judgement.The oil pump has to be removed before the drive worm and gear can bemoved so that the cases can be split. The oil pump is held in by four screws - (note their lengths and positions) - and is a tight fit in its bore. The metal around the pump <u>must</u> be heated before attempting totap out the pump from the top. Do <u>not</u> tap the gear spindle. An LP torch is handy for this but be careful not to overheat the metal. The oil pump should not be disturbed if it is working freely. It should only be serviced by an expert as it is so vital to the engine's and rider's well-being. We can provide exchange units which have been serviced in England by experts using special alignment tools. The crankcase must be heated before replacement. Use a new gasket when replacing. The filter plug or blanking plug In the return passage, (bottom of engine), must be air-tight when fitted.

<u>IGNITION TOPICS</u>:

Three diffferent types of ignition systems were used in the engines described here: magneto with automatic advance (ATD) unit; hand-controlled competition-type magneto; and the coil ignition set fitted starting in early 1969. Service and maintenance of each type will be discussed in turn. The Lucas K2F magneto used with the Lucas ATD unit is generally well made and gives long reliable service with but little attention. At 6000-mile intervals, the contact breaker points should be checked and cleaned or replaced. They will usually last at least 12,000 miles. Rapid burning of the points indicates condenser failure. The condenser is located inside the armature near the drive and, and can be serviced by a self-confident owner. But if facilities and experience are lacking, it is probably better to fit a now armature or exchange the magneto for a reconditioned model. The condenser usually lasts at least 25,000 to 30,000 miles, often much longer. The high tension pickup unit atop the magneto has a carbon brush under it which should be checked at about 6000-mile intervals and replaced

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when worn so the shoulder is less than 1/8" long where it bears -on the slip ring. If oil appears on the slip ring, replacement of the oil seal at the drive end is indicated. These oil seals normally last a longtime.

The magneto can be extensively serviced without removing the casting from the crankcase. To proceed, remove the contact breaker assembly from the end of the armature by removing the central screw. Remove the high tension pickup and the earthing brush at the drive end of the casting. Remove the screw and bolt retaining the contact breaker - (containing the cam ring and outer bearing race), and pull this-away. The armature can now be withdrawn. The bearings rarely need replacement;, do not disturb them without reason. A <u>small</u> amount of <u>high</u> <u>temperature</u> grease can be added to them before reassembly. The oil seal is retained by the drive end outer bearing race which will push out. Clean the armature and slip ring if oil has gotten onto them. Note that the outer bearing races must have the paper washers under them for insulation. The best way to reassemble the armature and bearings into the casting is to assemble the outer bearing race, paper insulating washer, and oil seal onto the armature, then push the whole assembly home. The oil seal spring side faces outward, (toward threaded end of armature spindle) The oil seal retains the bearing race which otherwise will fly out of your fingers and onto the cast-in magnets in the casting.

Replace the original shims under the contact breaker housing. These, are for adjustment of end-play. The armature is supposed to have only .001" end-play which means no play perceptible to the fingers but free to turn. If the bearings are heavily pre-loaded, they may get pitted and worn. If the assembled armature has end-play, remove one of the shims and try again. The paper washers under the outer bearing races give a little resilience. If end-play is present, it causes variation in ignition timing because the contact breaker assembly wobbles in relation to the cam ring.

Some Scramblers, Clubmans, and all early Thruxtons use the hand controlled racing magneto, normally Lucas, but with a few BTH magnetos sprinkled in for good measure, depending on what the factory could get at different times. Lucas parts are readily available in stock, BTH parts, other than points, are not in stock but can be obtained.

The Lucas and BTH racing magnetos are similar, and serviced same as the normal magneto described above except that the cam ring is movable via a cable control in the housing to retard the timing for starting and a solid steel driving gear is used instead of an ATD. A few of the Lucas racing magneto parts differ from the standard parts to provide a little better spark.

<u>POINTS TO WATCH OUT FOR WITH MAGNFTOS</u>:

(1): always solder the washer onto the end of the spark plug cable where it-screws into -the high tension pickup. Corrosion or high resistance at this point may cause premature electrical damage to the armature.

(2): It is sometimes found that the contact breaker assembly does not run true to the cam ring so that the standard .012" -.015":point gap varies as the rubbing block runs over the cam surface. This may be paused by the contact breaker assembly not seating squarely in the end of the armature, or the contact breaker housing may be machined eccentric to the axis of the armature, as a manufacturing tolerance or error. It is important that the points remain open for the "dwell" period intended

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by the cam ring design and, if necessary, the point gap can be increased slightly if, through eccentricity, the gap closes before the rubbing block leaves the cam ring.

(3): water In the contact breaker assembly or in the high tension pickup may result in no spark. Waterproof them.

(4): in case of ignition trouble, check the spark plug first. If wetted or fouled, it will short out and permit the spark to run down the insulator instead of jumping the gap as it should. If the end of the high tension cable held 1/8" from the head gives a regular fat blue spark when operating the kickstart with the plug removed, the magneto is OKay.

THE COIL IGNITION SET:

Fitted to all models starting early In 1969, this Lucas equipment incorporates an automatic advance and therefore uses the steel drive gear which simplifies fitting of a tachometer drive.

The contact breaker gap is .014" - .016" in this case. The cam spindle of this equipment is rather sloppy, which causes timing to "wander" under running conditions, but no correction for this is possible except replacement with a magneto - (available here). The spindle in this case has a special lubricant and must not be oiled, which may cause eventual seizure.

SETTING IGNITION TIMING:

In all models, timing must be set at full advance with the slack and backlash removed from the timing gears to simulate running conditions, and the point gap correct. Automatic advance magnetos are locked at full advance by temporarily wedging the ATD unit open with something like a small piece of wood. Hand-controlled magnetos; slacken the control lever, of course. Full advance is when the control cable is slack. With coil ignition, the cam is turned to full advance and temporarily locked by use of a washer with 7/16" internal diameter under the central bolt and existing washer.

The degree plate is set up via the Positive Stop Method previously described, and the engine turned by wrench on the timing side mainshaft. Ignition timing is correct when the contact points Just open - (can be checked by a thin piece of paper between the points, when this comes free), at 36-degrees before Top Dead Center on the MSS, and 38-degrees on all other models. Timing can be adjusted by moving the point plate on coil ignition models; magneto models require pulling the drive gear off its taper with the self-extractor built into the ATD, or with a special puller, (available here), on the hand-controlled magneto with steel gear, resetting, rechecking, and tightening. Always verify the timing after final tightening of the gear retaining nut or breaker plate screws as it sometimes creeps a-little.

VELOCETTE CARBURETION:

There is quite a variety of carburetors and jettings for the various models and for different usages. We will first make a few general remarks on the salient points: refer to the official Service Manual for factory recommended settings. It is always best to start with those settings which have been found correct for elevations reasonably near sea level. At elevations over 5000-feet, the original settings might be a little

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rich. If they are, be very careful not to lean them too much. Air cooled engines do depend upon slightly rioh fuel mixtures for a part of their cooling. For this reason, be sure to enrich the jetting if raising the compression ratio of any engine over the ratio the carburetor was previously set for. Higher ratios need more fuel to keep the engine cool. The factory-recommended settings were obviously established by experts and invariably are found to give just the right blend of smooth progressive throttle response, a mixture at all stages just rich enough to give good cooling, and lean enough to give desirable economy and mileage. Do not deviate from the standard settings with a standard engine without due consideration of this fact.

The float level of the Monobloo and Concentric carburetors is fixed and generally not adjustable, but the Grand Prix carburetor fitted to all Thruxtons except the last few fitted with 38mm Concentrics has a remote-mounted float. It is essential that the GP float be mounted so that the fuel level is level with the bottom of the circular ring on the plug at the base of the air control chamber on the left side of the mounted carburetor. This can be verified by use of a piece of transparent hose In place of the black rubber hose, which will show fuel height with taps turned on. The float chamber is adjustable for height.

If converting an MSS to a high-compression piston and retaining the original 1-1/16" carburetor, remember to enrich all jetting; even the pilot jet size must be increased from 25 to 30 because of the effect of the pilot jet on mixture at cruising speed with small throttle opening. It is altogether possible to overheat the engine at cruising speed if the fuel mixture is too lean.

<u>THE PRIMARY DRIVE AND CLUTCH</u>:

The drive side mainshaft shock absorber is of simple design, entirely trouble-free in service, and rarely if ever requiring replacement parts. This shook absorber is intended to permit a slight flexibility in the drive system under severe shock loading such as a violent clutch start or when down-shifting. It reduces the stress on all driveline parts, particularly the gearbox gears and chains.

A special wrench (#A229) is essential to remove and replace the four-notched round nut at the driveside mainshaft end. There is no need to tighten this nut overmuch; just pull it up tight and snug by hand. It is secured by a cotter pin. If it is battered tight every time with a hammer on the A229 wrench, threads will soon give way as it is a mild steel. The mainshaft is hardened alloy steel; its threads are generally not subject to damage.

The Vee-belt pulley on the mainshaft calls for little comment except to see that its notches are aligned so that the two halves of the pulley are correctly aligned to drive the Vee-belt properly. The dynamo pulley must be aligned with the mainshaft pulley and the Vee-belt tightened just enough that turning the dynamo pulley turns the crankshaft, (not necessarily over compression, of course). Over-tightening the Vee-belt may cause premature failure of the dynamo drive-end bearing.

The primary chain is 1/2" X 5/16", 68 pitches. Original equipment is an "endless" chain made up in one piece, requiring the laborious removal and replacement of the clutch assembly. It has been found satisfactory to replace this with a chain with master link as was normal

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factory practice with other makes of singles and vertical twins, including Vincent and Norton. The master link permits removal of the original chain with a chain tool, and replacement without disturbing the clutch. In serious racing, extreme stresses and vibrations in the chain create a possibility of master link failure. In this case, it may be preferable to use the endless chain.

Even though meticulously lubricated, the primary chain wears fairly fast. It will not usually exceed 10,000-12,000 miles service without starting to shed its rollers unless the machine is driven very easily. The rear chain usually lasts only half so long, regardless of make, even when carefully lubricated. Fast cruising at 65-70 miles per hour rapidly consumes chains and rear tires. The rear chain life can be prolonged by positive lubrication. The oil tank breather can be utilized for this but It is difficult to control the amount of lubrication and if excessive, it oils the rear of the machine and rear wheel.

LEAK-PROOFING THE PRIMARY CHAINCASE:

This is practically impossible to achieve. The late "pin-joint" chaincase - (screws around the periphery instead of a single band) - seals better than the early type, but it is unrealistic to expect no seepage from the primary ohaincase even if the main gasket makes a perfect seal with front and rear case halves. The dynamo drive pulley location is open to the outside and some oil mist is bound to emerge here. The felt ring over the clutch outer plate only gives, at best, an indifferent oil seal. This felt ring is sometimes made a little oversize and is too big for the circular groove in the outer chaincase. If so, out it and bond It into the thoroughly-cleaned groove with "3M Super Weatherstrip Adhesive". Do not just jam it in; it may disintegrate, bunch up, and prevent the clutch lifting, resulting in severe clutch drag.

"Permatex" is usually used on the peripheral chaincase gasket, and comes unstuck fairly easily later on when It is next desired to dismantle the case. "M Super Weatherstrip Adhesive" seals better but may be more difficult to break loose later. Be careful not to bend the sheet metal outer case during removal, nor overtighten the screws. The chaincase appears a bit flimsy on first acquaintance, but actually it is soundly designed and will last forever if not abused. The designer evidently wanted a serviceable case with minimum weight where slight seepage was not a major concern.

THE CLUTCH AND THRUST BEARING:

This is undoubtedly the most misunderstood and accursed part of the entire machine. We would, however, point out first that the basic design is sound, much better than the usual short-life, cheap and dirty, multi-plate clutch. Quality and durability of the Velocette clutch were proved beyond question in the 24 hour/100 MPH Record and in the 1-2 Victory in the 1967 Isle of Man 500ce Production TT race where a Thruxton propelled by this clutch was timed at over 120 MPH.

The design of the clutch is evolutionary; torque capacity has been increased over the decades from the basic design by addition of more plates and stronger springs. In the Thruxton, the clutch is fully up to the job but well-stressed, requiring that all adjustments be correct and kept that way at all times.

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So long as oil is kept in the primary chaincase, wear on the clutch friction Inserts is negligible and they can easily last for 30,000-40,000 miles or more. Nothing is gained by replacing the inserts before they are worn almost flush with the plates. Due to the design, the ears of the plates do not batter notches in the drum as is common with multi-plate clutches. All in all, there is nothing to prevent a service life of at least 30,000-40,000 miles before replacement of the clutch parts.

From our experience, we know that all clutches except the Thruxton, when correctly serviced, broken-in, and adjusted, will neither drag nor slip, or have any unpleasant characteristics at all provided the thrust bearing is in good condition. The Thruxton clutch differs only in having 20 springs instead of 15, but even when very carefully serviced and adjusted this clutch does have a slight tendency to drag. This is evidently a result of the extra spring pressure which resists full disengagement of the outer plate and possibly causes slight compressing and flexing of all the components that transfer the hand lever motion to the outer clutch plate. We have been unable to completely lick this problem, although a heavy duty clutch cable helps. So far as we know, no one else has solved this tendency of Thruxtons either. If any of our readers has, we'd appreciate hearing about it. New clutch plates or fitting new inserts will tend to create a certain amount of drag until the inserts get broken in.

We believe the basic reason for this drag-tendency in the Velocette clutch is that because of the design even under optimum conditions the outer plate is not lifted very far, and if any maladjustment is present it will not lift far enough so that the components can move freely relative to each other. This can be verified by pulling in the clutch lever and opperating the kickstart when, if any drag is present, it will be felt. With other makes of multi-plate clutch, as in pre-Commando Nortons, the design is such that the outer plate is lifted a long way by comparison, so that the clutch parts have plenty of clearance to each other and are fully free to move in relation to each other. This is not a criticism of the Velooette clutch which, except for Thruxtons, can be made completely drag-free, but must be appreciated when attempting to get the best clutch performance.

<u>ADJUSTING THE VELOCETTE CLUTCH</u>:

The clutch cable must first be in correct adjustment before the free play can be set in the -1ifting mechanism by adjusting the spring holder under the sprocket The spring holder should be adjusted finally so that there is exactly i/32" free Dlay in the outer housing of the cable measured at the fitting atop the gearbox- (best place to check). Exact procedures for clutch adjustment are as follows:

(1), slacken clutch cable adjuster completely or remove nipple from handlebar lever;

(2),tighten spring holder by turning (turning rear wheel is the easiest way) clockwise - (gearbox in neutral) - with adjusting tool engaged in holder notch through sprocket hole, until clearance in thrust bearing is taken up and clutch <u>just</u> slips when operating the kickstart, throttle open and adjusting tool removed. if correctly set, clutch will be felt to <u>just</u> slip when piston comes up against compression.

(3), Unscrew clutch cable adjuster (after replacing nipple in lever if removed) until all play is <u>just</u> taken up, but do not force it as

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this will upset adjustment. Play can best be checked at the gearbox fitting as you unscrew the adjustor. When the play is just taken up, tighten the adjuster locknut lightly.

(4),Now, loosen the clutch spring holder by turning it the opposite way to (2) preceding. It takes only a little loosening to produce the desired 1/32" play in the outer cable housing. You now have a condition where there is freedom in the thrust bearing so the clutch will not slip nor the thrust bearing "run" which causes premature wear, and all but 1/32" of the handlebar lover movement will be exerted on the clutch outer plate so that it will lift the maximum amount possible, giving the least possible drag to its components. If other than Thruxton models show clutch drag after meticulous adjustment as outlined, look for one of the following:

(1)- Sleeve gear bearing worn, permitting whole clutch assembly to move outward when clutch lever is operated. Replace, noting the instructions in Gearbox Section.

(2)- Sleeve gear bearing lockring has core loose, permitting whole bearing and sleeve gear to move outward. Refit, noting instructions in Gearbox Sections.

(3)- Felt ring seal in outer chainaase has disintegrated and bunched up, preventing outer plate from lifting freely. Replace.

(4)- Outer chainoase is bent and/or fits too closely over clutch, preventing outer plate from lifting freely. Bend out carefully for more freedom.

(5)- Incorrect handlebar clutch lever allowing insufficient cable movement.

(6)- An error in the adjustment procedure; it must be done just so!

In the event you are starting with a. badly-slipping clutch or have a clutch spring holder which is very tight in the outer plate so that the normal procedure does not move the holder in the plate, engage second or third gear when, (assuming you have been turning your spring holder with the rear wheal via the chain, which is the easiest way), turning the rear wheel the opposite way to usual will have the effect of mechanically moving the spring holder relative to the outer plate; that is, to unscrew (loosen), the spring holder, engage third gear and turn the rear wheel clockwise.

DISASSEMBLY AND ASSEMBLY OF CLUTCH THRUST BEARING AND CLUTCH:

Unscrew Item B34 and its lockplate jhich secures the clutch assembly on the sleeve gear. Using Peg Spanner #A61/2AS, unscrew the threaded ring, ("sleeve gear nut"), normally with R.H-thread. It may be necessary to tap this with a small hammer to start it. Naturally, the whole clutch will attempt to turn when you try to loosen the threaded ring. Some means has to be found to jam this, such as leaving the primary chain in place and stuffing a rag between clutch sprocket and chain. When the sleeve gear nut is off, the complete clutch assembly will come away easily; it is not tight on the splines. The clutch thrust bearing assembly is then removable for inspection.

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Clean the three members of the thrust bearing. It should be replaced as a unit if the races are heavily marked OR the ball bearings are worn undersize or irregular. When installing a new assembly, clean the parts, dry them, and pack with wheel bearing grease before assembly onto the sleeve gear.

INSPECTING CLUTCH PARTS:

The inserted plates need not be replaced until the inserts are worn almost flush with the faces. The inserts should be firm in the plates, though looseness is usual and does no harm so long as the inserts do not have large gaps around them so that they are falling out. New inserts are obtainable, or complete Inserted plates. New inserts may need some beveling before they will press into alternate sides of the plates or sprocket.

The sprocket is hardened steel and has a long life. The large ball bearing should be checked for cracks, as should the sprocket around the windows. The bearing must be tight in the sprocket -(Loctite Bearing mount will cure it if not) - but free on the central member, otherwise the clutch will drag. The sprocket must be able to move freely outwards to release the inner plates when the outer plate is lifted. Oil the bearing with engine oil before assembly. Clutch springs only rarely need replacement.

To reassemble, an old sleeve gear is very handy to build the component up into a pack. Study the construction carefully before starting; it is unusual, and the parts must align and engage with each other correctly in order to work later. The bent ears on the inserted plates face away from the sprocket.

The three small Pins which transmit the motion from thrust bearing to outer plate must be in place and held with a little grease while the complete clutch pack is carefully pushed home on the splines of the sleeve gear. The sleeve gear may tend to push back into the gearbox when trying to fit the clutch pack, but this can be minimized by engaging top gear in the box. If an endless chain is being used, this must be simultaneously fitted with the M/S sprocket. All this is quite a feat, but it gets easier with practice.

With some individual clutches, it is occasionally found that the sleeve gear nut has to be pushed against the clutch springs to engage the threads on the end of the sleeve gear, which makes it very difficult to start on the threads, resulting in a bit of cursing and struggling on the part of the operator. To provide for this eventuality and to reduce the risk of "customer dissatisfaction", the factory produced Tool X2959, Gear Nut Adaptor, which is fitted between the sleeve gear nut and the gearshaft sprocket nut. Tightening the gearsheft nut will compress the clutch springs slightly and ease staring the sleeve gear nut on its thread. Tool X2959 is turned with Peg Spanner #A61/2AS as is the sleeve gear nut. The sleeve gear nut must be locked up tight by applying a few hammer blows on the peg spanner, and the lockplate is essential to prevent loosening in service, Use "Loctite" on the small screw for the lockplate to keep it in place. If disturbing the clutch thrust bearing parts other than the bearing members proper, note that the components are selectively shimmed originally to get the optimum alignment. This shimming should be carefully duplicated.

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After assembly of the primary case and contents, it should be filled with 3/10ths cup (U S) of engine oil, of a weight according to season. Due to the inevitable slight seepage, It is advisable to keep a small piston oil can handy to give the chaincase a couple of squirts every week or so. Excess oil in the chaincase does no harm; it just leeks out a little faster.

Always keep oil in the case, not only for the chain's benefit, but because if the clutch Inserts are initially run oily they must continue to be run oily. If they dry off, they will still function but when later oiled again they may permit clutch slip which, in this case, can only be corrected by replacement of the inserts with new.

The primary chaincase oil is subject to considerable contamination from condensation, metal, and insert particles. In view of the small amount of oil involved, changing the chaincese oil at 500-mile intervals is a good practice, certainly at not less than 1000-mile intervals when the engine oil is changed. There is a drain plug but no level plug.

THE VELOCETTE GEARBOX:

Developed like other components from World Championship road-racing experience, the gearbox is very well-designed and reliable, and functions beautifully, being quite capable of instantaneous gear-changing with complete confidence. The box does have certain demands if it is to give of its best, like all things mechanical. There are three ratio gearsets used in the models under discussion, all of which use the same basic die-cast gearbox shell: (1), Prefix No.14, used in MSS and Scrambler models - wide ratio type for easy starting in traffic or with sidecar. Lower overall gear ratios also good for dirt racing; (2). Prefix No.12, used as standard in all other models. A sporting olose-ratio gearbox without being extremely close ratio: no particular clutch-slipping needed to start In low gear; Prefix 12, Suffix R. TT close-ratio gearbox, with ultraclose ratios not generally suitable for road use; requires great deal of clutch slipping to start the bike in first gear. Intended for road racing where gearbox is used continually as a brake - (highly tuned engines give better acceleration when the spacing between gears is close). It is doubted that very many of these gearboxes exist in America.

Gear breakage is rare in the Velocette gearbox, although layshaft or mainshaft first gears occasionally break if extremely abused. It should go without saying that any breakage should immediately be fixed. If run with jagged chunks floating around, it is quite possible to destroy the gearbox shell and its entire moving contents.

DISMANTLING AND SERVICING GEARBOX:

If kickstart springs and ratchet are functional, there is no need to remove them or the gear pedal from the cover. First, remove the small cover above the kickstart bearing. Using a Whitworth socket wrench, unscrew the 1/2" BSF Nylock Nut from the end of the gearshaft. Hold the rear wheel with the rear brake while doing this - the output sprocket is at the other end of this shaft. Both ends have ordinary RH-threads on them. The gearshaft with sprocket can then be removed from the clutch side after detaching rear chain.

Next, drain oil from box and remove the 1/4"-perimeter oapscrews, noting their relative positions. The cover will now come away, possibly by tapping it lightly while pulling. Never pry it off with screwdrivers or the like, at the joint. The two shafts on which the shift forks move will be seen at left of center, one over the other, with grooved ends. A ViseGrip tool is handy for pulling these out, but any burrs must be cleaned off the shafts before refitting. After these are

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removed, the mainshaft low gear,. MIS sliding double gear, and complete layshaf; assembly and the two shift forks will come out of the gearbox easily. Note that layshaft clutch-end gears in Prefix 12 gearboxes only clear the sleeve gear In one position. The sleeve gear, with clutch mounted, will remain in place. This can be inspected in place, and the sleeve gear bearing checked for roughness or play. This bearing should turn smoothly and have no perceptible play in it, either axially or radially.

In most cases, all gearbox bearings and gears can be serviced without removing the shell from the frame. The only exception to this would be if a sleeve gear bearing was so tight in the housing that it required removal by a press. If the sleeve gear bearing needs renewal, the clutch and thrust bearing must be removed. With the clutch removed, the sleeve gear will push into the gearbox.

The sleeve gear bearing is secured by a lockring which can usually be removed and replaced by <u>very</u> carefully tapping it with a punch ground so that, it can be turned without butchering it. It is locked by peening metal lightly into the grooves and this may need clearing away before the ring will come loose. When replacing the ring, make sure it is locked up tight so it cannot loosen, if in doubt, use "Loctite Nutlock". There are round shims on both sides of the bearing to retain gearbox oil. These <u>must</u> be in good condition and centralized. With lockring removed, the bearing may push out of the housing or, it may be tight, requiring heat and tappIng to remove it or, as a last resort, removal of shell from frame and pressing out. The gearbox, engine plates, and engine must oomeout of the frame as a unit if it comes to this:pass.

Always be careful in handling ball bearings; they can be easily ruined by wrong hammer work. Care is essential when fitting them, and housings must be heated if bearings in them are tight. The layshaft ball bearing can usually be extracted and replaced without much difficulty, being not too tight in its housing. As elsewhere, if bearings are loose in their housings, this can be cured with Loctite. The ball bearing in the gearbox cover also comes out by heating and jarring the cover after circlip removal.

Rusting, due to not changing gearbox oil contaminated with condensation is the main hazard to the gearbox ball bearings. machines left out all night are subject to this condensation as well as having rain running into the clutch cable fittings and need more frequent gearbox oil changes.

Inspect gears for badly-rounded engaging dogs which will permit jumping out of gear. Minor rounding is normal and inevitable and does not seem to matter much.

Reassembly is the reverse of dis-assembly, noting once again that the layshaft gear can pass the sleeve gear dogs in one position only in Prefix 12 gearboxes. All gears and bearings should be well lubricated before assembly.

The only problem that ever arises with the shifting mechanism is that the motion rod running fore-and-aft in the gearbox cover transmitting foot pedal movement to camplate gets twisted if the gear lever is stomped or abused, rather than being pressed home as intended. This is deliberate factory policy, on the "weak link" principle that it is better to twist this rod then to break or bend the shifter forks or gears when abusing the gearbox. The effect of this twisting is to upset the camplate movement sequence so that the gears jump out or are missed. It must be understood

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that the camplate must move from detent to detent on its circumference when the foot pedal is operated and, if it does, all will be well. If the camplate moves from first gear detent to a position between neutral detent and second gear detent, second gear will not be correctly engaged end will jump into neutral under load. The affect of a twisted motion rod is to not move the camplate sufficiently before the rod comes to the limit of its movement.

The camplate, ratchet, and pawl mechanism is generally foolproof. With Thruxton, or Clubman remote control gear pedals binding of the gear pedal on its pivot, (due to lack of oil lubrication), may upset the ratchet operation because the binding may interfere with the centralizing of the mechanism after a shift.

When replacing the cover, note that the motion rod arm must engage properly with the camplate ratchet slot. Use a new cover gasket and "Permatex" to avoid oil leeks. Do not overtighten the 1/4" BSF capscraws in the cover; they strip out rather easily.

Note that Clutch Drag spoils the nicety of shifting in this as well as any gearbox, and must be minimized. Failure to keep the gearbox lubricant up to the level plug is all too common. It holds about 1.2 U.S.Pints of engine oil and should be checked at intervals of from 500 to 1000 miles depending on the seepage factor of any particular box. Neglect of the lubricant can result in expensive, needless, gearbox damage or can easily result in a gearbox seizure at speed, causing a heavy crash if the rear wheel looks up. For this reason, gearbox work must be done very carefully.

<u>THE REAR WHEEL</u>:

For the machines discussed here, rear wheels came in three forms:

(1)9 the Full-Width Hub type where spokes are laced to a large aluminum hub casting which, however, contains nothing and was made only for looks. This wheel is normally fitted to all models except the MSS and Scrambler. It uses the same brake drum as the MSS with three nuts securing the hub to the brake drum for quiok-detachable purposes. The wheel can be removed by unscrewing the three nuts Inside the three deep holes in the hub, then the solid axle from the muffler side. The wheel can be removed, leaving the brake drum, brake plate, and chain undisturbed. A special wrench is needed to unscrew the three nuts; A61/2AS Peg Spanner fits the central axle nut.

(2), the MSS type, with small diameter castiron hub, using the same brake drum and plate as the full width and quickly detachable.

(3), the Scrambler type similar to MSS except it has six securing Q-D nuts and studs instead of three to take the severe shocks of dirt racing. Scrambler rear sprocket is 60-Tooth bolt-on instead of one piece, with same brake drum used on other models, except as noted.

All hubs use the same bearings and hollow axle. In this case the (LH) threaded lockring Is on the speedometer gearbox end and is removed with a bar, (say 3/16" X l" X 12" mild steel), turning clockwise as it is a lefthand thread. The bearings are serviced as are the front hub bearings, using the same drivers.

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Speedometer gearboxes cannot be repaired - only replaced. Note that machines produced starting in 1967 use a different speedometer drive gearbox from earlier models, and the two are not interchangeable. The early type Is noticeably flatter in form than the "styled" later type.

It is of critical importance to tighten the "Quick-Detachable" nuts and axle adequately. After replacing the Q-D nuts and riding a mile or two, recheck them. If the axle is not tightened, the speedometer cable may break, wrap around the hub, and look-up the wheel at 60-MPH. This is what happened to one of our customers. He was able to ride the bike to a stop with the rear wheel looked without dropping it, but you may not be so fortunate!

The rear brake shoes and linings of all models are identical to the 7" MSS brakes, and are serviced as described for that model. Rear brake rods should be adjusted so that shoes just do not drag but there is no excess play.

Rear chains can be adjusted so that one run midway between sprockets has from 1 1/4" to 1 1/2" slack in it with the rear wheel off the floor. Err on the slack side with chains, never on the tight side which overloads the chains, wheel and gearbox bearings.

Rear wheel alignment can be verified by sighting from the rear and manipulating the adjusters until the rear wheel is visibly true with the front. A straight-edge can also be used, such as a straight steel rod. Misalignment causes the rear of the bike to steer to one side or the other.

For racing, sprockets should be checked for alignment as well as the wheels. Subtle defects in handling are traceable to wheels being out of plane to each other, rims or tires not running true. Wheel building takes skill and care, and a rim which is round to begin with. Considerable errors are frequently found in rims other than of Dunlop manufacture.

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