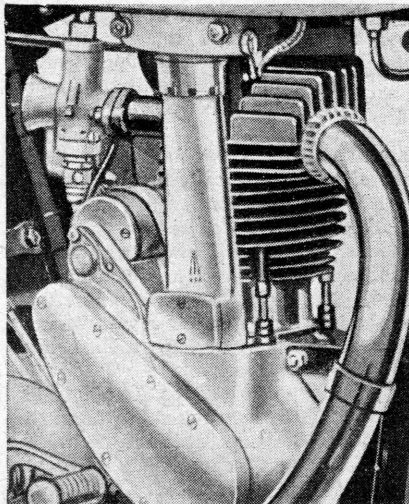


## SERVICE SERIES No. 4

# The 1938 "EMPIRE STAR" M.23 B.S.A.

## Engine Restoration Routine for a Popular Type of 500 c.c. o.h.v. Machine



*The "Empire Star" B.S.A. engine which is the subject of this article.*

**M**ODELS of the "Empire Star" pattern in the B.S.A. range of 1938 were developed from the standard o.h.v. machines current at that time and were light, sporting versions with a higher compression ratio and a valve timing with a larger valve overlap. They followed the well-known "Blue Star" range and served a similar purpose.

In some instances, special materials were employed, and it may be noted that the cylinder barrels were cast from a nickel-chrome alloy iron and were described as "air-hardened." These barrels gave extremely good service and a considerable mileage before reboring was necessary. With this cylinder barrel it is, however, necessary to use austenitic piston rings, for normal piston ring material does not give the same satisfactory service.

Commencing life as a sports engine, there still remains considerable scope for development in this unit and, indeed, it was from it that the famous "Gold Star" was evolved. Any owner who desires to improve

on standard performance capabilities can apply the tuning information applicable to the "Gold Star," remembering, however, that there are several major constructional differences, particularly where the valve gear is concerned.

### General

In the majority of respects, the "Empire Star" engine is basically similar to the current "B" group models. It employs a similar dry-sump lubrication system using an identical, dual gear-type pump. A very complete range of service tools is available from the factory and it is always preferable to use a tool designed specifically for the job in hand. The Magdyno pinion is a case in point; a proper extractor is far cheaper than a welding job on a broken timing case that may result from a carelessly applied tyre lever. So far as the engine is concerned, this and the mainshaft pinion extractor are the only extractors that need be purchased. Anyone who has any skill with hand tools can make an extractor for the little-end bush and the drifts for the valve guides.

One warning is advisable; do not unscrew the long cylinder-head holding-down bolts from the crankcase. These are held in by anchoring sleeves and the cylinder head must be removed by unscrewing the bolts at the hexagonal portion just below the cylinder fins.

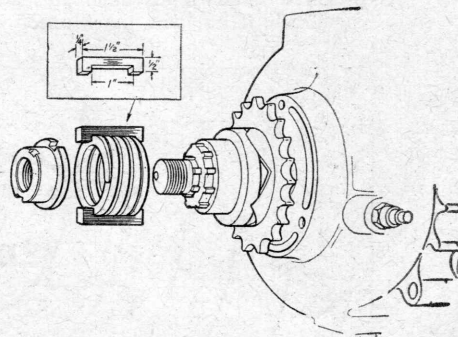
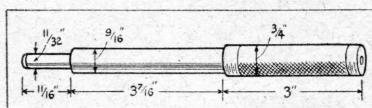
### Crankcase Assembly

The two crankcase halves are held together by a series of  $\frac{1}{4}$ -in. bolts and the crankcase can usually be parted quite easily after a few gentle taps with a mallet.

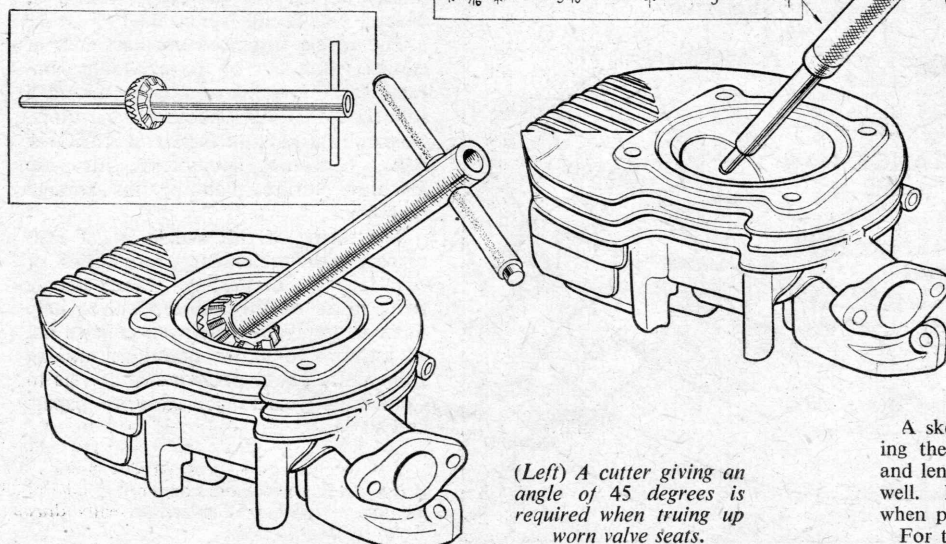
It is fortunate that all crankcase bearing assemblies can be replaced. It is suggested that work on the flywheels—the big-end assembly—be done by either the factory service department or by an accredited B.S.A. repair man. For those with facilities and the experience to re-align the flywheels, it may be said that new crankpins and bearing assemblies are obtainable from stockists. They are identical with those used in the 1953 B.33 engine.

When installing new main bearings, remember that between the two drive-side journals there is a distance piece. Connecting-rod location and end-float are controlled by the shock absorber, which pulls the two bearings and the distance piece together. Omission of this spacing collar will produce an odd result when the shock absorber is assembled!

Do not mislay the key which locates the engine-shaft pinion, nor forget the tab washer that secures the nut holding this pinion.



*Details of a compressor to aid the fitting of the shock absorber spring on the engine mainshaft.*



*(Left) A cutter giving an angle of 45 degrees is required when truing up worn valve seats.*

*(Left) Dimensions for a drift for removing worn-out valve guides.*

A sketch of an extractor used for removing the little-end bush is given, but a bolt and length of suitable tube will serve equally well. Do not forget the oil hole in the bush when pulling the new part into place.

For the benefit of those embarking on the

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tricky waters of big-end refurbishing, it may be said that the minimum end-float of the assembly is .008-.010 in. If the thrust washers are worn, new ones may be obtained from the factory.

#### Oil Pump

The oil pump used in current B.33 engines is identical with that employed in the M.23. The only wear likely to be found is on the gear spindles and, as service replacement pumps are available, the common sense system would be to take advantage of this scheme.

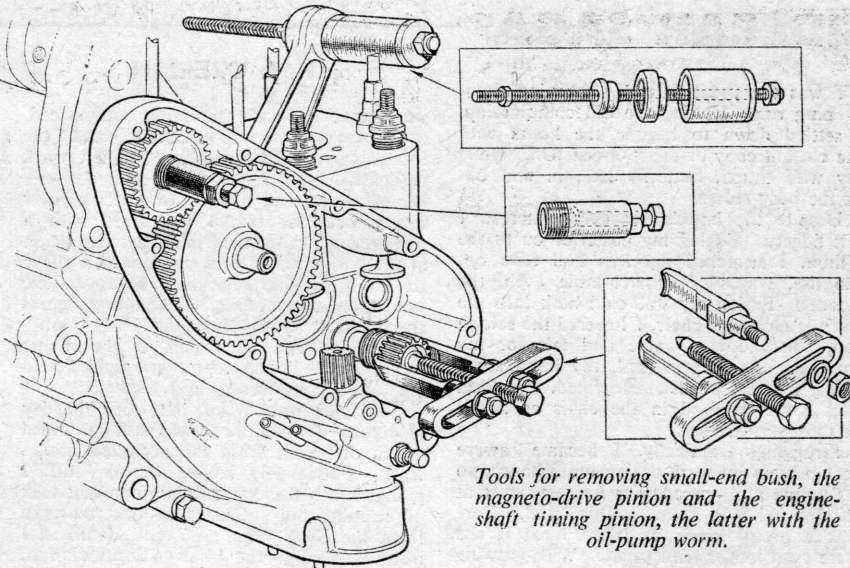
Oil to the big-end is delivered from a jet pressed into the timing case. Wear is most improbable and carelessness the only reason for breakage. A pressure-release valve is located at the base of the timing cover; this consists of a 3/16-in. ball, a spring and the cap. It is necessary only to reseal the ball by tapping it lightly with a small hammer and suitable punch. Worn gear-pump spindles, or a leaking pressure-release valve, may cause seepage of oil from tank to crankcase.

A flap-valve breather is located to the rear of the drive-side main-bearing boss; ensure that this is clean and that the valve is able to move within the breather body. Replacements can be made from modern parts. On the scavenge side of the pump, the oil is picked up in the sump from beneath a gauze filter; do not forget this gauze when replacing the sump base-plate.

#### Camshafts

Both camshaft spindles are carried in phosphor-bronze bushes in the crankcase and timing cover. These are in stock at the factory and should be replaced if worn. An extractor is necessary for the bushes, located in blind holes in the timing cover, and it may be advisable to have these removed with the correct tool. When the new bushes are fitted, assemble the crankcase half and timing cover and ream, preferably with a 1/2-in. pilot reamer.

Both tappet guides are screwed—right-hand thread—into the crankcase. These can be taken out and, if worn, replaced with new guides. Similarly, wear on the tappets themselves must be followed by replacement. These parts can be supplied by the factory. Although camshaft pinions are available—they are pressed on to the camshaft—this cannot be said of the camshafts themselves. Serious wear will have to be dealt with on a "make do and mend" principle by re-



*Tools for removing small-end bush, the magneto-drive pinion and the engine-shaft timing pinion, the latter with the oil-pump worm.*

building and regrinding. This is a difficult job, not to be undertaken lightly and certainly not without a valve-displacement diagram.

Valve timing is facilitated by the fact that all three pinions involved are marked. With the piston at T.D.C., mate the punch mark on the exhaust cam with the punch mark on the mainshaft pinion, and the scribed line on the inlet cam with the scribed line on the mainshaft pinion. Valve-timing details are given in the accompanying panel as a final check after assembly.

#### Cylinder Head

Wear in the cylinder head assembly is likely to be confined to valves, guides and valve springs. All are obtainable from the factory. A suitable drift for removing the valve guides is illustrated, and can easily be made up.

Some wear may be noticed on the striker pads of the rockers; this can be overcome by a Stellite deposit reground to contour. No stock of rockers or spindles is held at the works but it is unlikely that either will be found to be seriously worn.

Valve seats should be recut if badly pitted and always if new valve guides are fitted. Most garages have equipment for this job and the cost is small; a seat grinding stone will possibly make a better job of a valve seat than will a blunt cutter. Seat angles for both valves are 45 degrees. Badly pocketed seats will have to be dealt with by cutting back and blending with the head, or by welding. The method will depend on the amount of pocketing. Wear on the exhaust valve lifter mechanism is unknown at the factory so it is unlikely that there will be any reconditioning to do here.

When reassembling the rockers and spindles, note that the two springs are fitted on the nearside of the rocker box.

#### Cylinder Barrel

As mentioned earlier, the cylinder barrel was made from a nickel-chrome casting. It is an extremely hard material and is apt to damage the tipped tools used in the average boring bar. If wear makes an oversize piston necessary, the barrel will have to be honed and it is advisable thus to warn

the repair shop undertaking the work. Pistons in .020-in. and .040-in. oversize are in stock at the factory. Remember, also, the earlier note concerning the piston rings; they must be of austenitic iron.

No gasket was used between cylinder head and barrel, for the two components mated on ground surfaces. Any suspicion of distortion or poor seating must be dealt with, for a leaking joint will surely follow if this precaution is omitted. Valve grinding paste—smooth if the surface appears in reasonable condition—must be used until both surfaces show an even matt surface all the way round. Do not forget to remove all trace of the grinding compound when the work is finished.

#### Reassembly

Some difficulty may be experienced in getting a feeler gauge between rocker and valve stem. It may be said that the clearance is sufficient if, when the engine is cold, the tappet can be rotated freely with only just perceptible up and down movement.

Oil is taken to both rocker spindles by a small diameter pipe which feeds from the return side of the oil pump. Replace this in the correct oil line for there is no pressure in the delivery line to the pump. Make sure that the rubber sleeves in the oil system are in good condition and replace any that are at all doubtful.

Finally, remember that good, oil-tight joints can only be made by employing gaskets in good condition between flat surfaces. A complete set of gaskets can be obtained from the factory and a surface free of burrs ensured by careful use of a fine file.

All the trials machines of the 1938 period were developed from the "Empire Stars" and it is possible that these machines are still serving the sporting rider. Although the M.23 was fitted with a piston that gave a compression ratio of 6.8 to 1, it is possible to use the piston from the M.22 engine in which the compression ratio was 6.2 to 1.

Modifications of this type are well within the average owner's capabilities but an inquiry to the manufacturers is advisable before doing "tuning" of a really drastic nature.

#### MODEL M.23 500 c.c. B.S.A. "EMPIRE STAR"

Tappet Clearance (Cold) Inlet ... .003 in.  
Exhaust ... .003 in.

#### Valve Timing

(With .003-in. clearance)

Inlet opens 45° before T.D.C. (21/32 in.)

Inlet closes 70° after B.D.C. (1 1/16 in.)

Exhaust opens 65° before B.D.C. (55/64 in.)

Exhaust closes 35° after T.D.C. (27/64 in.)

#### Ignition Timing (Fully advanced)

Points break 1/2 in. before T.D.C.