AUTOMATIC CROSS-SLIDE AND RACK AND PINION SADDLE FEED

Designed for Myford Lathes by J. L. Blacklock

MANY MODEL ENGINEERS who own Myford lathes must have on various occasions encountered jobs where a mechanical cross-slide feed would be an asset both from a point of view of finish and the saving of a lot of hand operation of the cross-slide screw. I experienced one such job when I replaced the 9 in. faceplate of my Myford lathe. No matter how careful I was, it was very difficult to obtain a good steady feed and although the job was eventually completed, it left much to be desired in the way of finish.

This set me thinking of a mechanical cross-feed which in turn led to ideas on a rack and pinion saddle feed and I finally decided to go the whole hog and see what could be done.

Regarding the saddle feed, 70 per cent of work on a lathe is carried out near the chuck and when the leadscrew is used for feeding, the leadscrew threads at this end become worn, and should it be required to cut a long thread a variable pitch will result. Another bad point on this method of feed is the dirt, small chips and dust which collect on the leadscrew and get carried into the nut forming a grinding paste which quickly wears the nut, causing considerable backlash. These conditions are especially prevalent if much work is done with cast-iron. With rack and pinion saddle feed the leadscrew is only required for screwcutting which is only a small proportion of a lathe's use, and before screwcutting is carried out the leadscrew can be thoroughly cleaned.

The first consideration was which method to use and whether to attempt to get the mechanism in the Myford apron, or start from scratch and make a new one. Two methods are normally employed to obtain rack and pinion feed to the saddle. One is by an additional shaft driven from the leadscrew by a pair of gears, the other is to keyway the leadscrew itself and mount thereon a sliding gear which travels with the apron. Some objection may be raised to the second method as the keyway in the leadscrew may have a tapping action in the leadscrew nut when screwcutting, but this method is in use on a number of production lathes in factories and is practically universal for driving the table leadscrew on milling machines. The first method was discarded for the Myford, as it was found impossible to get a second shaft through the apron past the leadscrew nut mounting. The second method was therefore used and, after much thought and work on the drawing board it was decided to use the Myford standard apron.

I was very keen that the modifications should be a sound mechanical job, not detracting from the appearance of the lathe in any way, and with no appearance of a gadget which had been tacked on afterwards. How far this aim has been achieved readers can judge for themselves by referring to photograph 1 showing a front view of the apron and saddle; photograph 2 shows a rear view of the apron. ***(The photographs will aptmar in the next issue.-Ed.)***

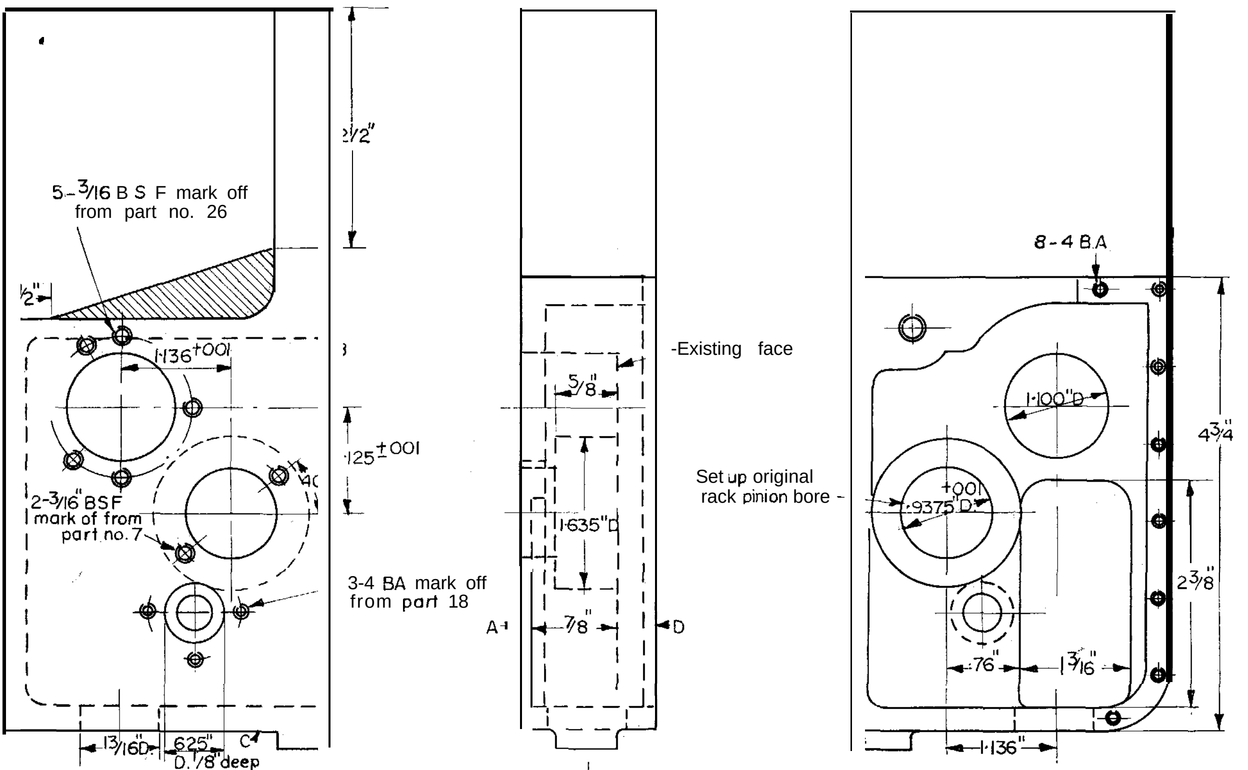
Before going into calculations, it would be as well to point out that these modifications apply to the Super-Seven, and whether the same figures apply to the ML 7 should be checked before anyone who thinks of carrying out the modifications does so. My Super-Seven is fitted with a quick-change gearbox, and the feed range on the rack and pinion feed is the same as that shown on the feedbox chart when using the leadscrew.

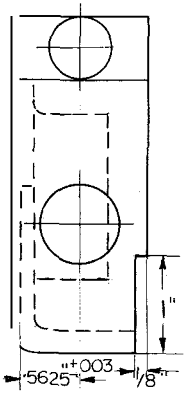
Referring to drawing A, this shows a schematic layout of the whole feed mechanism. As will be seen, a gear on the leadscrew drives a second gear mounted on the wormshaft which is mounted in the apron, and engages with a worm wheel which runs free on the rack and pinion shaft and is connected to this shaft by a friction clutch in the worm wheel. On the end of the worm shaft is a mitre gear which engages with another gear attached to a cross-shaft. This shaft carries a chain wheel which runs free on the shaft and has clutch teeth cut in the outer boss.

Keyed to the cross-shaft is a sliding dog clutch which can be engaged with the chain wheel.

A small chain drive is taken from the cross-shaft to another chain wheel mounted on the saddle, and this chain wheel is integral with a gear wheel which engages a sliding gear keyed to the cross-slide screw. It will thus be seen that engaging the friction clutch in the worm wheel operates the rack pinion and gives motion to the saddle, and engaging the dog clutch on the cross-shaft will operate the cross-slide screw.

Should anyone wish to fit cross-slide feed only, then the layout remains the same, with the exception that the worm and wormwheel and clutch are omitted. The reverse of course applies if only rack and pinion feed to the saddle is required, in which case everything is omitted except the worm wheel and clutch, but from experience in using the lathe



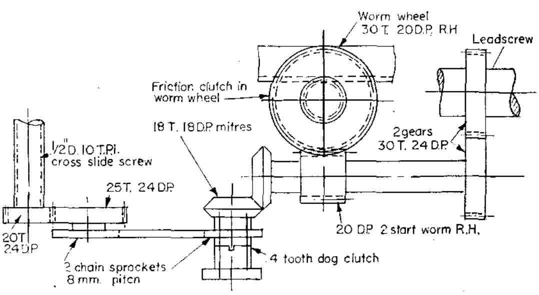


OPERATIONS

1- Fill in shaded portion
2- Bolt on face 'D: clean up face A removing all bosses
3 -Clean up face 'C'square with face B
4 - Bolt an face 'D'set dp true with existing rack pinion bore open out to '9375"D.
5 - Set at correct centre distance bore I~I00"D hole
6 - Turn. .625"0. recess on handwheel bore
7 - Clamp on face 'A'mill 13/l$'x 2%' face
8 - Clamp on face A' bore 13/16"hole in end face'c'
9 - Clamp on face 'A' bore 1.365"D. recess true with '9375" D. bore

Note-All small tapped holes marked off tram components

MODIFICATION TO APRON



SCHEMATIC LAYOUT FOR RACK AND PINION SADDLE FEED AND AUTOMATIC CROSS-SLIDE FOR MYFORD SUPER 7

after conversion, it is well worth while doing the whole job.

Feed rates

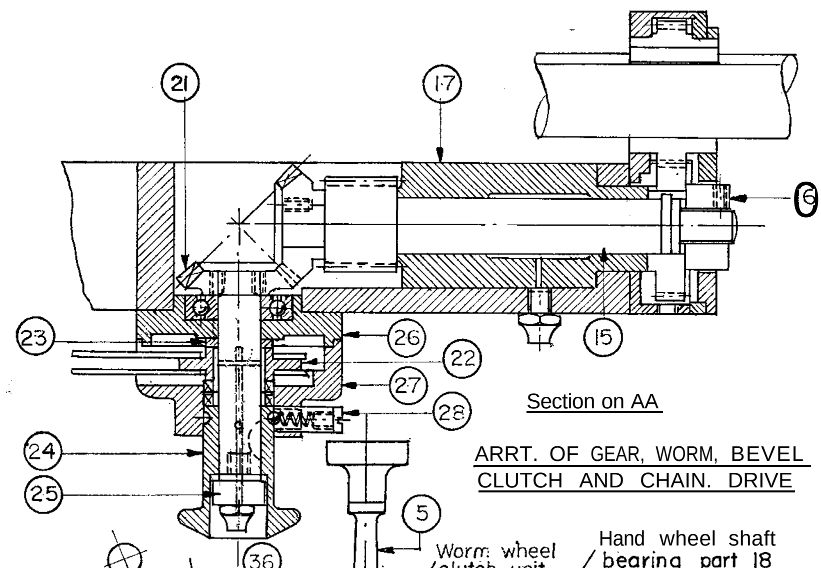
The rates of feed are the same whether using the leadscrew or rack feed, and the cross-slide feed is the same as the saddle feed. The leadscrew on the Super-Seven is 8 t.p.i. which gives .125 in. travel per turn of the screw. The rack pinion is 12 t, 20 d.p. which gives a pitch circumference of 1.885, so the gear reduction required is $\frac{1.885}{.125} = 15.08$ which is the gear ratio required to give the same feed by either method. For all practical purposes this can be taken as 15 to 1. The cross-slide feed is the same as the saddle feed. As will be seen on referring to the drawing above, all gearing driving the cross-slide screw is 1 to 1 with the exception of the gear driving the sliding gear on the cross-slide screw, this ratio being 1.25 up. The cross-slide screw is 10 t.p.i. so we get for one turn $.1 \times 1.25 = .125$ which is the same as the leadscrew.

Modifications ***to the*** standard apron are ***as*** shown above. As the lathe will be required for machining operations, it is necessary to obtain from the makers a new apron completely machined to standard. The sequence of operations is given on the drawing. Referring to the shaded portion, it is necessary to do this operation first, and it can be carried out by fixing the piece shown in the comer with screws or welding, and it should stand above the face of the apron to be finished machined at a subsequent operation. The object of adding this additional piece is to fill the gap when the chain guard is subsequently fitted to prevent dirt and swarf accumulating inside the chain case. The rest of the operations are self-explanatory. The eight small holes in the base wall of the apron are to fix a plate to form an oil well which allows the bevel gear and worm to run in oil.

The remainder of the separate assemblies are shown as units with their various items fully detailed, as it was felt this would be clearer than making a complete general arrangement of the assembled apron, as it would be such a mass of lines as to be practically unintelligible with so much packed into so small a space.

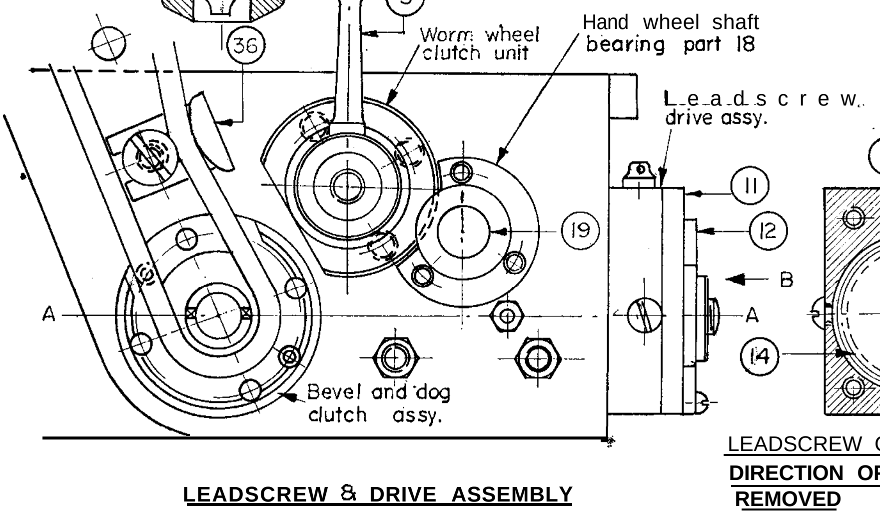
The drawing below shows a full-scale sectional arrangement of the leadscrew, bevel, clutch, and chain drive, and further drawings will give details of all the parts. Commencing at the leadscrew drive, the two gears are mounted in a small box fixed to the end of the apron, and particulars for setting this box will be given in the notes on fmal assembly. The method adopted to make this box was first to do all the outside machining on box and cover, then do all the drilling and tapping, and fnr the two halves together and fit dowels. The holes were then bored by mounting on the faceplate, and boring with holes at the correct centre, thus ensuring the bores in both parts are in line. The parts can then be separated and the recesses for the gears machined.

There is very little clearance between the gearbox and the bed casting, in fact I had to chip the bed away in several places, and this clearance should be checked for the full length of the travel. The driven gear mounted on the worm shaft drives through a ⅛ in. dia. soft brass shear pin.

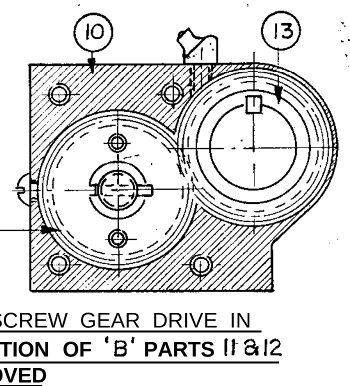


Section on AA

ARRT. OF GEAR, WORM, BEVEL CLUTCH AND CHAIN. DRIVE



LEADSCREW & DRIVE ASSEMBLY



LEADSCREW GEAR DRIVE IN DIRECTION OF 'B' PARTS 11 & 12 REMOVED

This is **a safety** measure to **prevent damage to** the mechanism should a jam-up ***occur,*** and should this pin shear it is quite easy to replace. Remove the cover, part No. 12, and adjusting nut, No. 16, the gear can then be withdrawn by using the two extractor holes for this purpose. The small screw on the front of the gearbox permits the use of a pin punch to tap the brass pin forward, the whole is then reassembled. The worm shaft bearing is bolted to the face previously machined inside the apron, and this is quite straighforward, as is the fixing of the cross-shaft and chain drive assembly.

Clutch assembly

In my next article I will show a full-scale sectional drawing and details of the clutch assembly. It is a little unusual and unorthodox but works very well, and an explanation of the operation may be helpful. The type of clutch is quite common on manufacturing production lathes, but is usually operated by a screw-up star handle. Owing to the confined space on the front of the apron, it was not possible to incorporate a reasonable size star handle, also it was in a most awkward position and inaccessible behind the apron hand-wheel, so it was decided to make the clutch lever operated. The steel housing, No. 6, is fixed to the front of the apron and provides a bearing for the worm-wheel 4.

To be continued.

BEAM ENGINE

Continued from page 1052

required teeth and did not feel like buying them, when they would be used only once or twice at the most, I made fly cutters to cut the teeth. To make these cutters I first photographed one of the lathe change wheels on the “soot and whitewash” principle; that is the change wheel was held onto a piece of glass with Sellotape, a piece of greaseproof paper was placed behind the glass and the whole assembly propped vertically on the bench. A 60 watt lamp was fixed behind the glass screen and the change wheel was photographed (and almost indecently over-exposed). I then supplied the negatives to a photographer, since I do not do my own developing and processing, with a card on which I had drawn a circle representing the outside diameters of the spur wheel and pinion. In printing the photographs the print was reduced until the image of the change wheel just fitted in the two circles thus giving a reasonably accurate profile of the teeth. By cutting out one of these " teeth " to act as a template I turned two discs about $\frac{3}{4}$ in. dia. with the periphery profiled to the templates. The cutter discs were then bored eccentrically and cut **away locally** on one side, as shown in the photograph, to form a fly cutter. The cutters were then hardened and tempered and mounted on a spindle held in the three-jaw chuck.

The " Heath Robinson " dividing attachment was set up on the vertical-slide, a **20-tooth changewheel** and the pinion were set up on the spindle of the dividing attachment and the teeth in the pinion were cut. But' the spur gear has 90 teeth, and there is no **90-tooth** changewheel on a **Myford** lathe. I used a **45-tooth** gear, thus cutting every other tooth on the first revolution, following which the ***gear*** blank was shifted on the spindle by half the distance between two of the teeth and the second set of 45 teeth cut between the first set.

The bevel gears for the governor drive presented a little more of a problem. I am not entirely satisfied with these gears, but all I can say about them is that they work. The dividing attachment could not be used as it does not cater for bevel cutting. I therefore set the bevel gear blanks up on a stub arbor held in the three-jaw chuck and clamped the spring loaded plunger over the bull-wheel on the lathe mandrel, which has 60 teeth. Cutting the teeth was achieved by grinding a $\frac{1}{4}$ in. square tool bit to the required tooth form and clamping it sideways in the toolpost. The top-slide was then set over to the required bevel angle and by traversing the top-slide backwards and forwards, applying 2 or 3 thou cuts at a time, each tooth was -planed in turn. I started by winding the top-slide to and fro, but this became too tedious. I therefore removed the top-slide screw and fixed up a temporary system of links and a hand-lever so that I could operate the top-slide more rapidly and less tediously. Obviously this gave a parallel tooth form instead of the correct tapering tooth form. The taper, such as it is, was achieved by shifting the gear slightly on the mandrel after the initial cut had been taken all round the blank, and then completing by filing with needle tiles.

The final drive pulley was again cut from a piece of cast-iron in the same manner as the flywheel. The pulley on my engine is a little smaller than that called for in the drawing, simply because I did not have a full-diameter piece of iron to hand.

The modifications which I have incorporated are that I have eliminated, as far as possible, all hexagon union nuts and hexagon glands. The feed pump gland is circular, drilled for three 10 BA gland studs and all visible pipe connections are flanged and bolted.

I appreciate that the foregoing is a much abbreviated description of the methods which I adopted in building this engine and I have quoted very few dimensions; but I hope it will give some idea of what can be done without castings. ■

AUTOMATIC CROSS-SLIDE AND RACK AND PINION SADDLE FEED

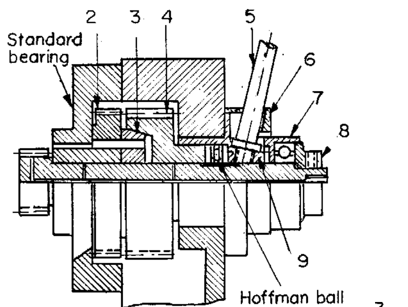
Part ZZ

Designed for Myford Lathes by J. L. Blacklock

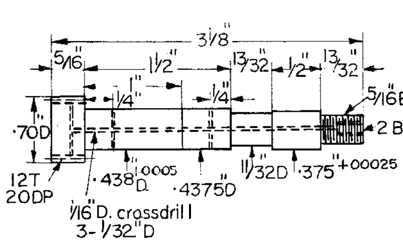
Continued from page 1059

THE OUTBOARD bearing at the rack pinion end and the large gear are standard **Myford** parts. At the opposite end, the spindle is supported by a single row ball race mounted in the steel housing. A coarse thread, in this case 12 t.p.i. Whitworth form, is cut in the steel housing and fitted with a bronze nut which is operated by a handle through a slot in the housing. The bronze nut is carried by the thread in the housing and is clear of the spindle. Between the face of the nut and the **worm-**wheel boss is a ball thrust, and at the end of the spindle an adjusting nut.

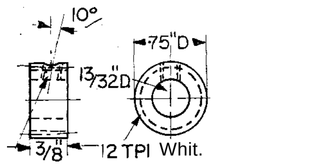
The operation and adjustment is as **follows:** The bronze nut should first be screwed back against face A, part No. 7, and when the adjusting nut is tightened, it will draw the whole spindle along until the cone on the gear engages with the cone in the worm **wheel,** and this in turn will be drawn against the ball thrust and bronze nut. The adjusting nut is then slackened off until the cones are just free. Now if the handle is operated in a clockwise direction, due to the coarse thread on the bronze nut, it will engage the two cone faces and release them when the handle is returned to the vertical position. As 12 **t.p.i.** gives **.0833** lead, 20



Part 2
Standard gear
tight press fit

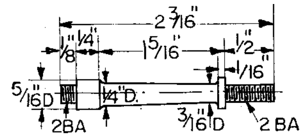


PART I RACK PINION BMS

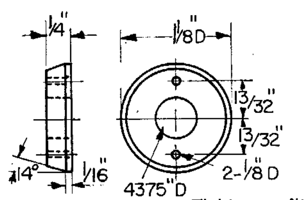


2 BA mark off from pt 7 with nut screwed to **face A**

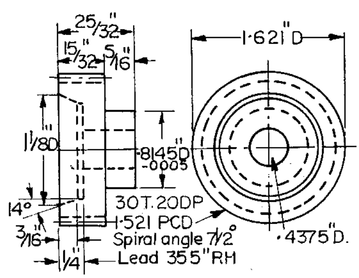
PART 9 CLUTCH OPERATING NUT
P. BRONZE



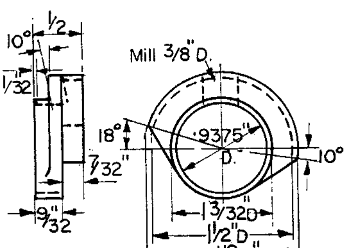
PART5 CLUTCH HANDLE BMS



PART 3
MALE CLUTCH BMS

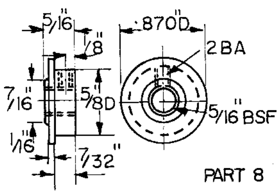


PART 4 WORM WHEEL P. BRONZE



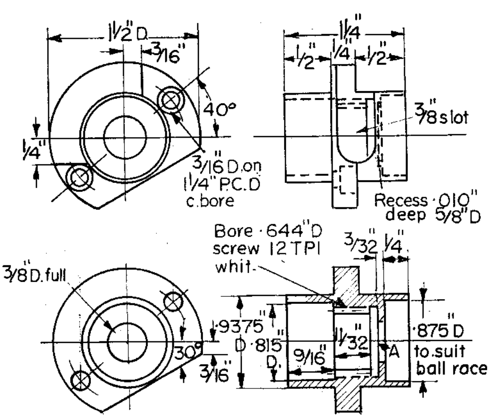
PART 6

CHIP GUARD BRONZE



PART 8

CLUTCH ADJUSTING NUT
P. BRONZE



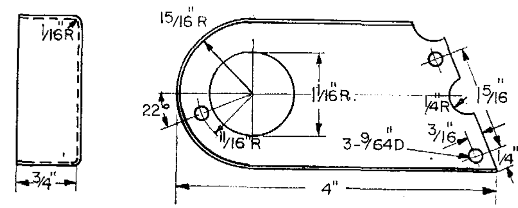
PART 7 OPERATING SCREW HOUSING BMS

deg, movement of the lever will advance the nut .016 in. which is more than sufficient to clamp the two cones together. The end thrust on the spindle is taken by the adjusting nut against the small ball race and, whilst this is a bit unorthodox, it functions without trouble. The thrust is not heavy and the revs. are very low. A revolving chip guard is fitted over the slot in the steel housing. The clutch mechanism fouled the apron hand-wheel, and it was necessary to extend the apron bearing, part No. 18, and also the hand-wheel pinion shaft, part **No.** 19.

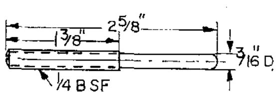
Cross-slide screw drive

The final chain drive to the cross-slide **screw** is shown on drawing **"G"** and, before explaining same, I would point out that the lathe to which this modified feed is fitted, has also been fitted with a ½ in. dia. cross-slide screw, whereas the standard size is ⅜ in., and this will affect the bore of the cross-slide screw sliding gear, part No. 32.

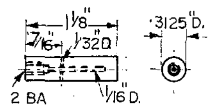
An extension piece had to be fitted to the saddle to provide a bearing for the cross-screw gear, and also a support for the intermediate gear spindle. This extension piece, part No. 31, is shown on the drawing and entails careful and accurate fitting. A safety shear pin is fitted in the intermediate gear and drives in a slot in the boss of the **chain** wheel, which is a running fit on the boss of the intermediate gear.



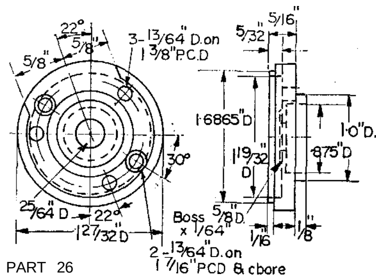
PART 38
CHAIN CASE 20 G.BMS



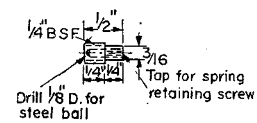
PART 39
EXTENDED SADDLE GIB ADJUSTING SCREW BMS



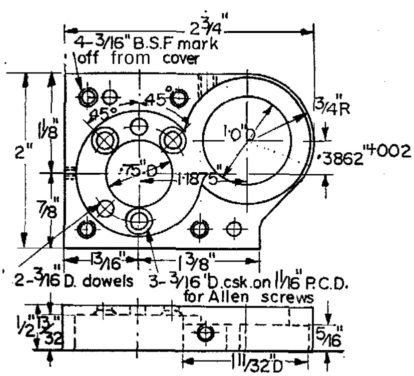
PART 35
SPINDLE SILVER STEEL



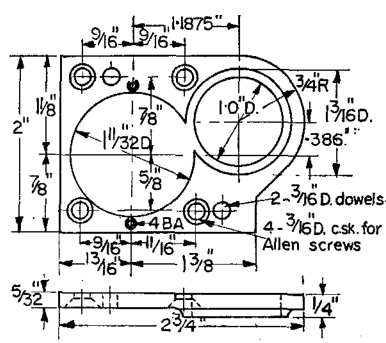
PART 26
BEVEL SHAFT INNER BEARING P.BRONZE



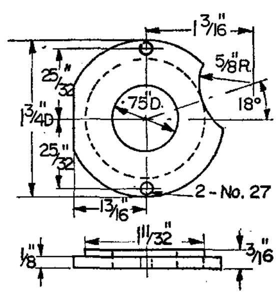
PART 28
BALL PLUNGER HOUSING
BMS



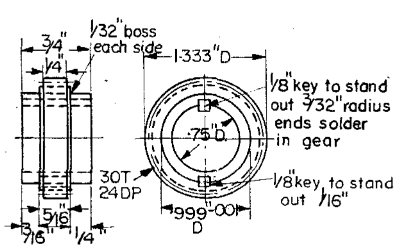
PART 10 GEARBOX I OFF BMS



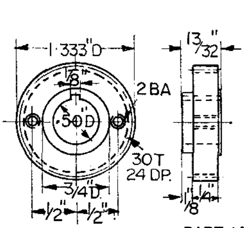
PART 11 GEARBOX COVER I OFF BMS



PART 12 OUTER COVER I OFF BMS

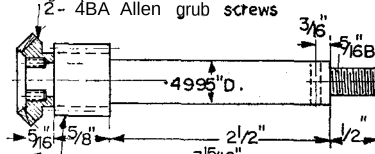


PART 13 LEADSCREW GEAR I OFF BMS
BORE 1·00"D. PRESS IN BRONZE BUSH



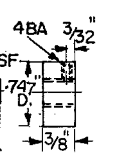
PART 14
WORM SHAFT GEAR
I OFF BMS

18 T. 18 DP mitre wheel bore ·375" tight press fit on shaft fix with 2- 4BA Allen grub screws



Worm 20 D.P. ·850 O.D. ·750 P.D. 2 start
Spiral angle 82° 30' lead.310 R H

PART 15
WORM AND BEVEL SHAFT
I OFF BMS



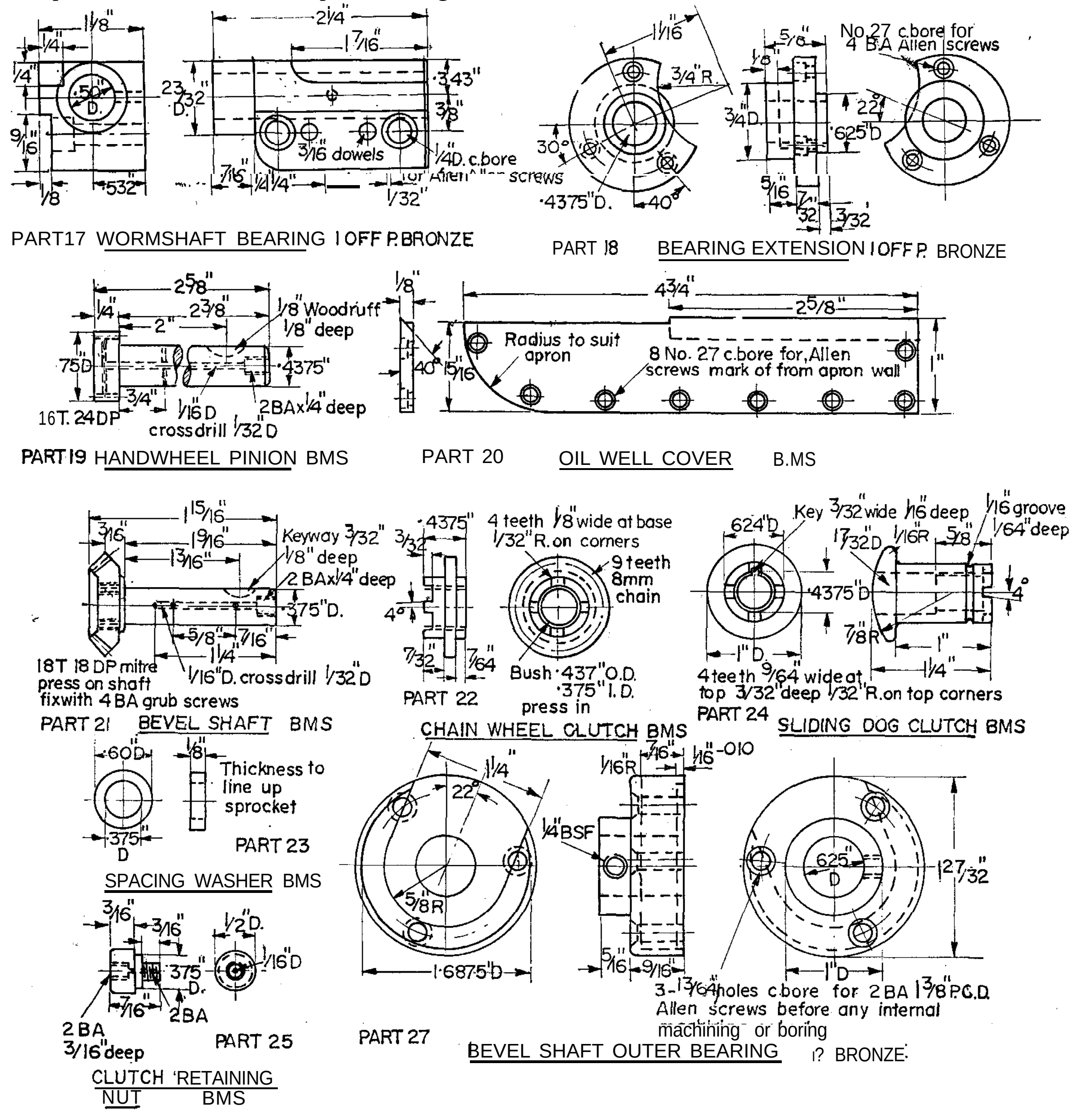
ADJUSTING NUT I OFF
P. BRONZE
PART 16

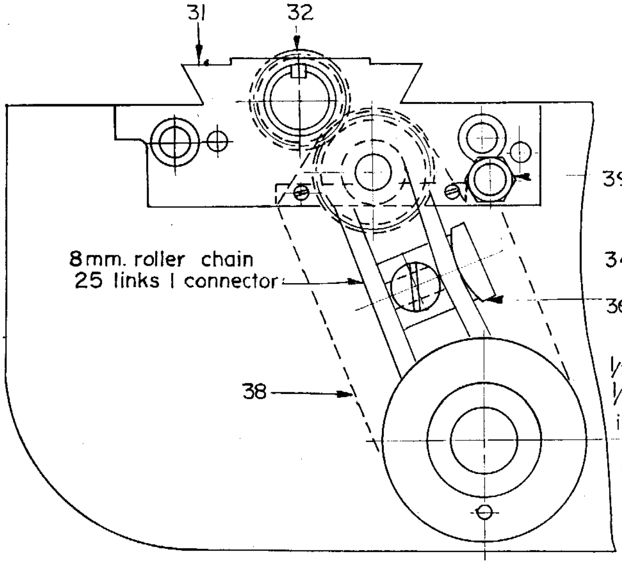
Final assembly

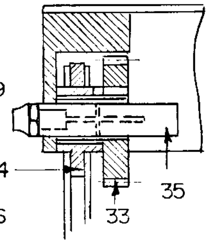
This work must be carefully carried out to bring all the gears into correct mesh, and the following sequence was adopted. The worm-wheel and clutch housing should be fixed to the apron, and the assembly completed in position in the apron, followed by the worm-shaft unit which should be screwed to the apron to give correct meshing with worm and wheel. Do not dowel at this stage.

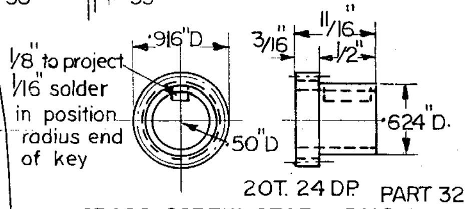
The apron should then be bolted to the saddle in its correct position, and the gearbox with leadscrew sliding gear in position slid on the leadscrew and clamped to the end of the apron. The gearbox should have some clearance round the boss of the worm-shaft bearing which projects through the end of the apron. Fit the worm shaft gear, and adjust the gearbox until the two gears are correctly meshed. Drill the fixing holes and dowel holes for the gearbox, and fit screws, and dowel the box in position.

The apron can now be removed from the saddle, and the inner bevel shaft bearing, with ball race and cross-shaft fitted, fixed to the apron at the correct angle. The meshing of the bevels can now be checked, and any adjustment which may be necessary must be made at the face where the worm



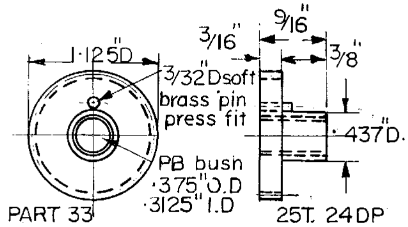




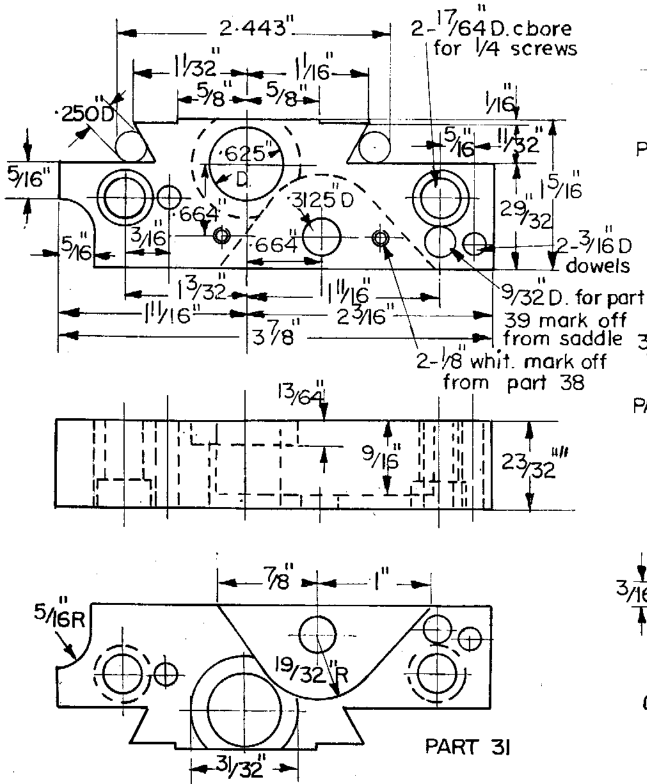


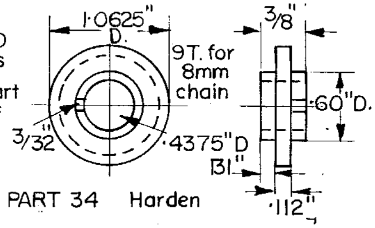
CROSS SCREW GEAR BMS

ARRT. CHAIN & GEAR DRIVE TO CROSS SCREW

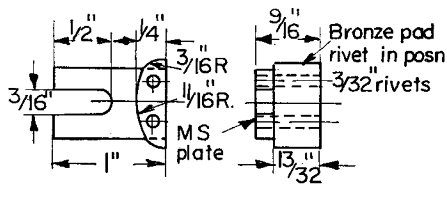


INTERMEDIATE GEAR BMS





CHAIN SPROCKET BMS

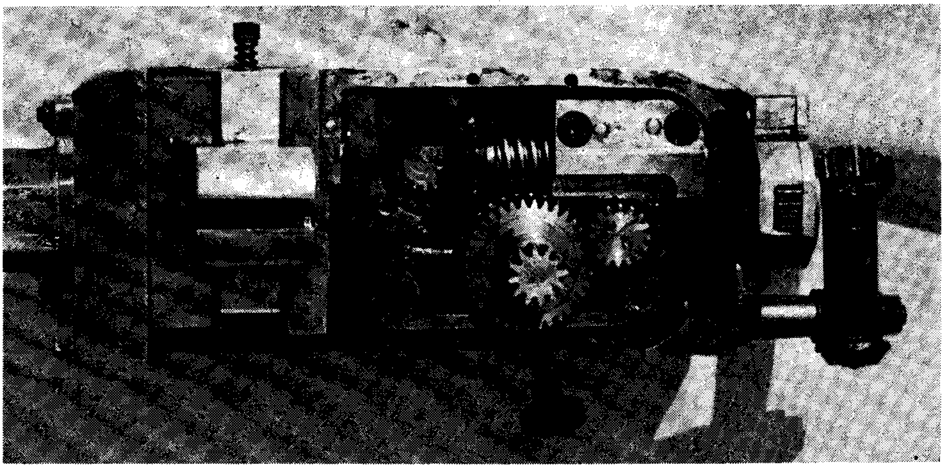


CHAIN ADJUSTER

SADDLE EXTENSION PIECE

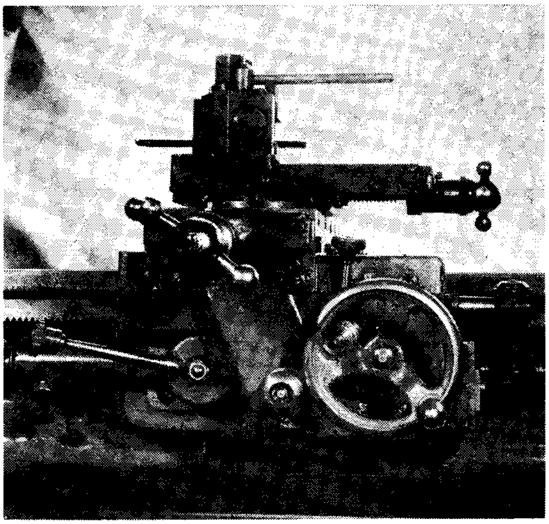
bears against the worm-shaft bearing, and between the back face of the cross-shaft bevel and the ball race.

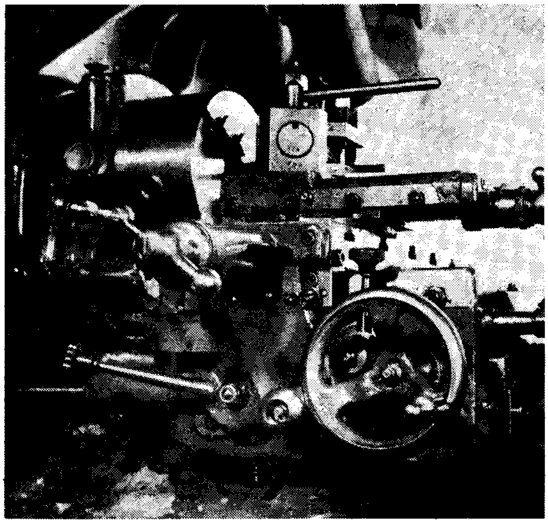
The extension piece is next fitted to the saddle, complete with gears and chain sprocket. The chain is then fitted together with the chain adjuster, and checked for alignment with the chain sprocket on the cross-shaft. Any adjustment necessary can be carried out by alteration in the thickness of the spacing washer, part No. 23.



Rear view ***of*** *the* modified ***apron, showing*** gearing.

The outer bearing of the cross-shaft, Part No. 27, can now be fitted and the dog clutch assembled. The apron can then be **fixed** to the saddle, the boring table and cross-slide screw fitted for a trial run. If everything is in order, the apron should be dismantled, and the dowels fitted in the **worm**-shaft bearing. Oil well cover plates are fixed, and the whole job cleaned up. Finally, fit the apron, try it out, and then fix the chain guard. A special long screw is required, part No. 39, to reach through the extension piece for adjustment of the saddle front gib. One of the original screws has been omitted as this fouled the driving chain.





Final notes

All the work was carried out on the **Myford** lathe with the exception of the following: The **keyway** in the leadscrew and cross-slide screw, and the cutting of the teeth in the worm and **worm**-wheel were done by an outside source from blanks supplied.

The leadscrew drive gears, bevel gears, intermediate gear and cross-screw gear **were** standard gears obtained from Messrs. Muffet of Tunbridge Wells and modified. The 8 mm roller chain and sprockets were supplied by Messrs. Bonds of Euston Road.

These modifications have proved very successful, and the clutch drive will take any feed the lathe will stand, and there is only one point on which they fall short. Due to the very cramped space, it has so far not been possible to incorporate any form of interlock to prevent two feeds being engaged together, and perhaps some reader may have a neat bright idea on this point; but so far I confess myself beaten although I keep trying. The absence of any interlock is the reason for the two safety shear pins. The feeds are also arranged so that should the cross-slide feed be accidentally engaged whilst turning, the tool would withdraw and the work would not be spoilt. To achieve the same effect when boring, the tool is used upside down on the far side of the bore.

Should any reader think of adding these **modifications** to his **Myford,** I would be very pleased to give any assistance I can, if he cares to write to the ***Model Engineer.***