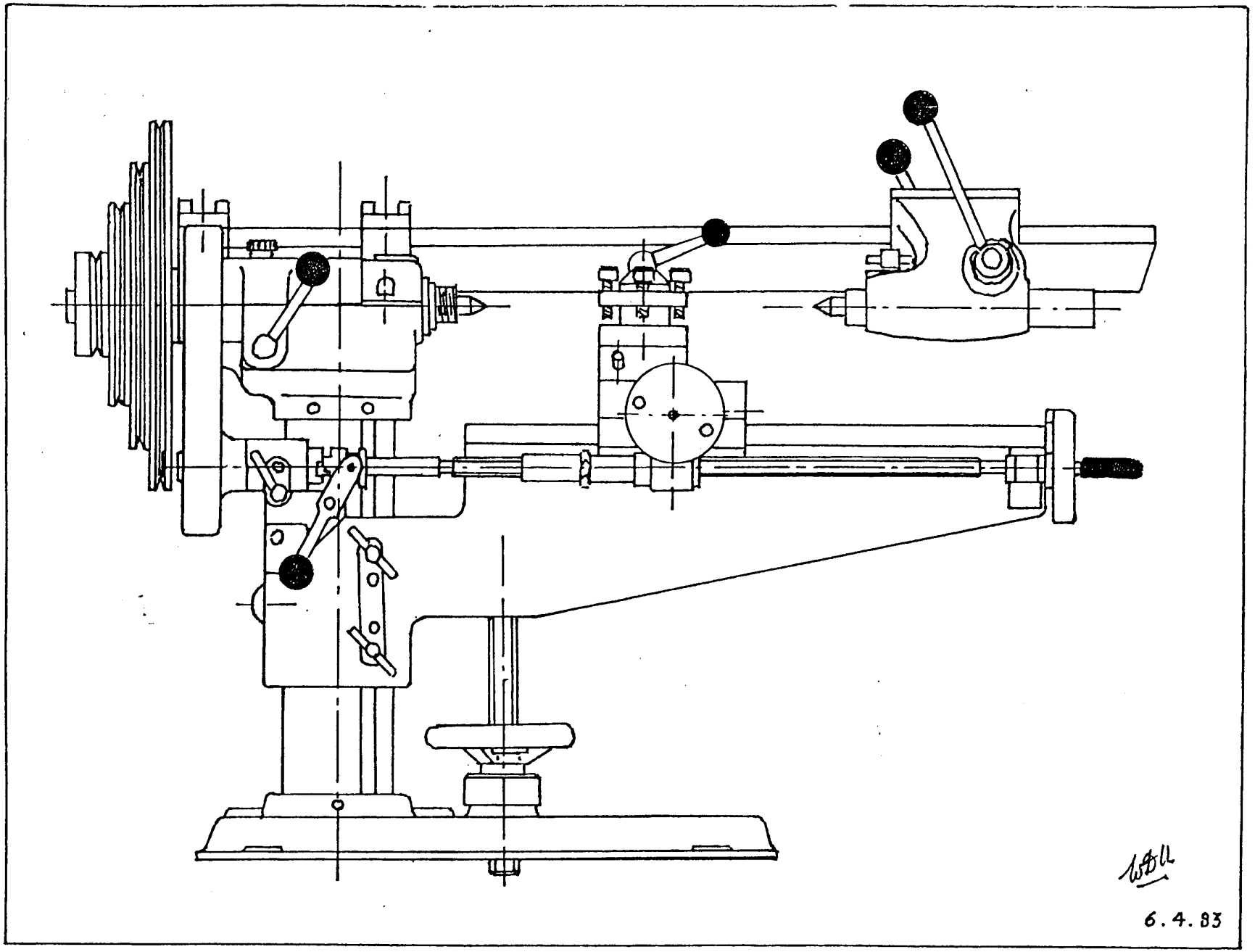
MASTER SET OF DRAWINGS.

METALMASTER.

A ZERO-TAPER MACHINE TOOL.

W. D. URWICK.
C ENG. M.I.MECH.E.

JULY 1982



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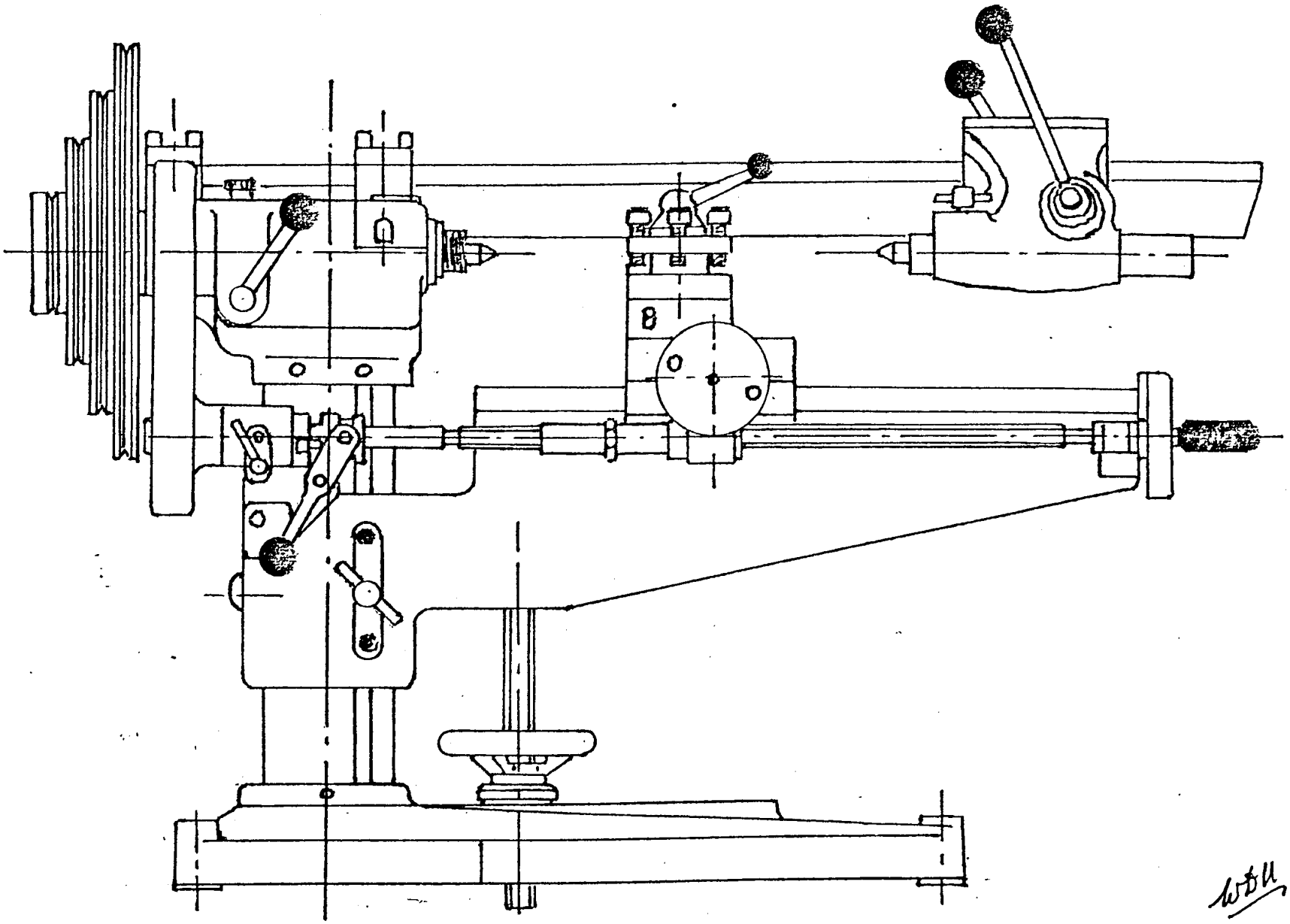

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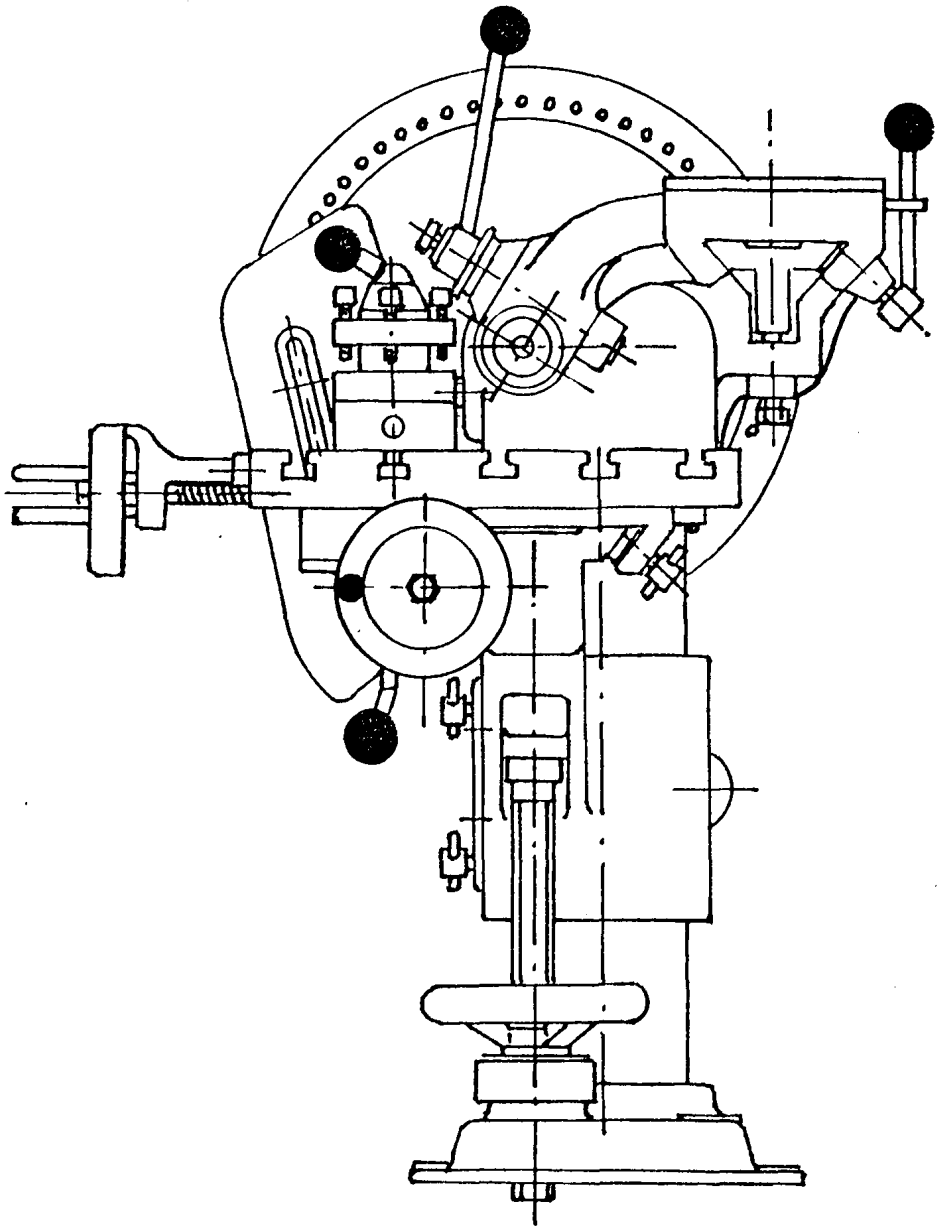

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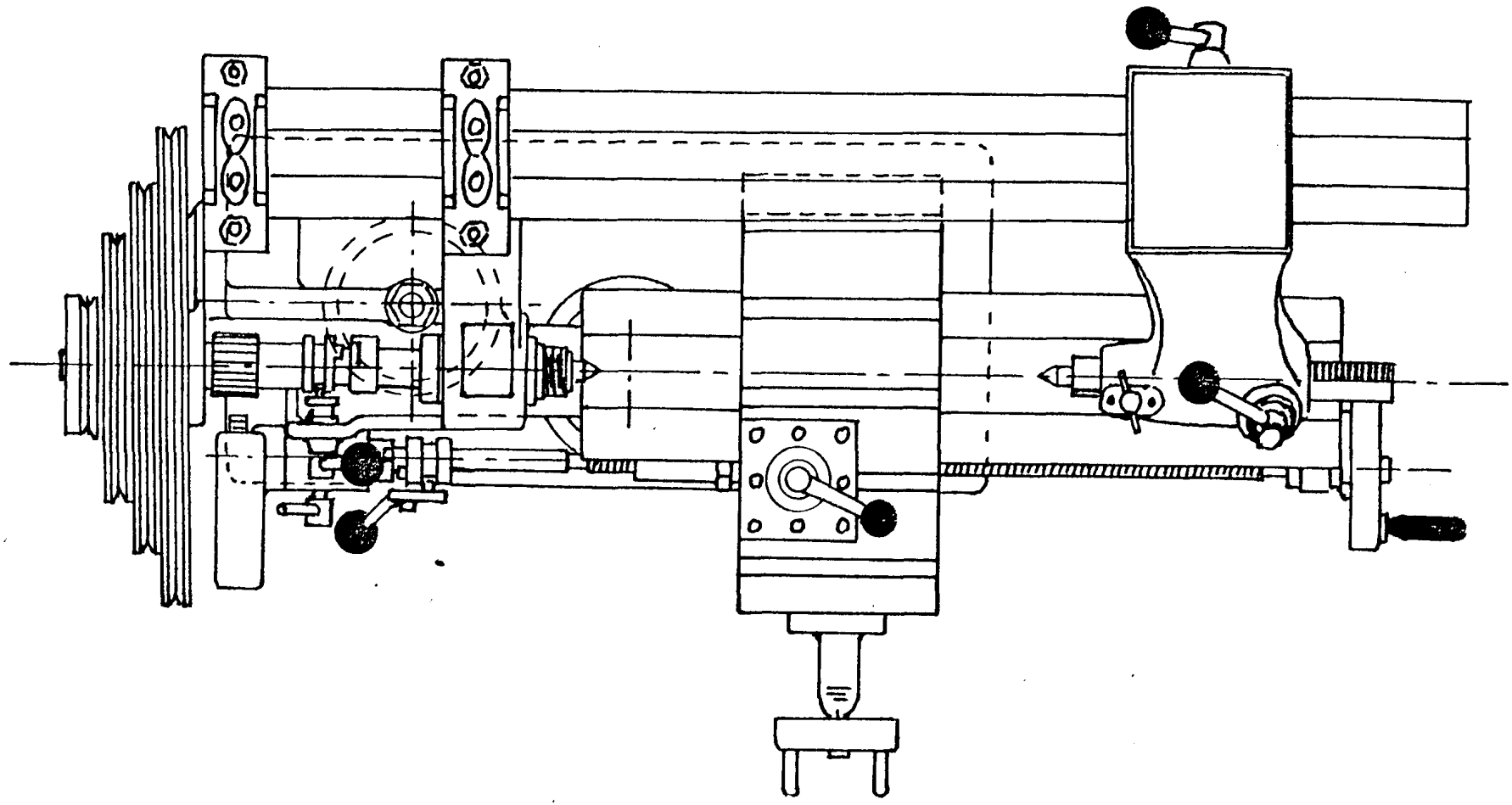

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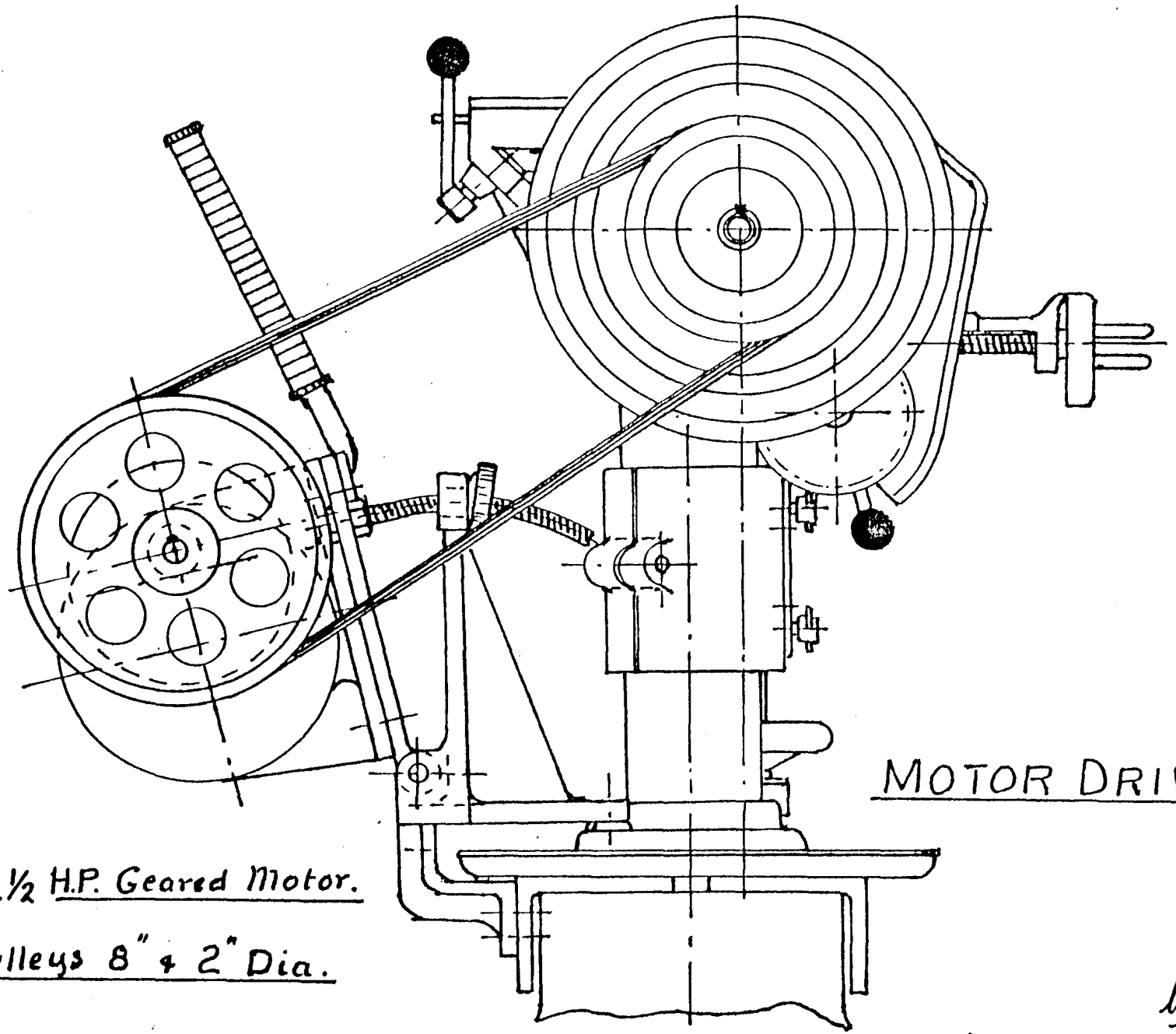

MOTOR DRIVE.

Higgs ½ H.P. Geared Motor.

2 Pulleys 8" & 2" Dia.

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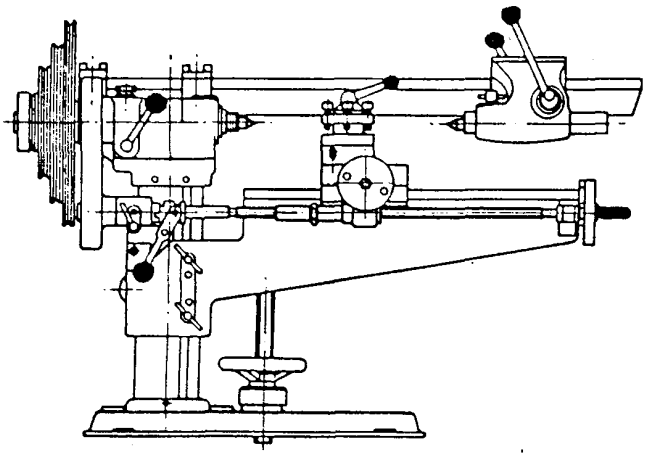
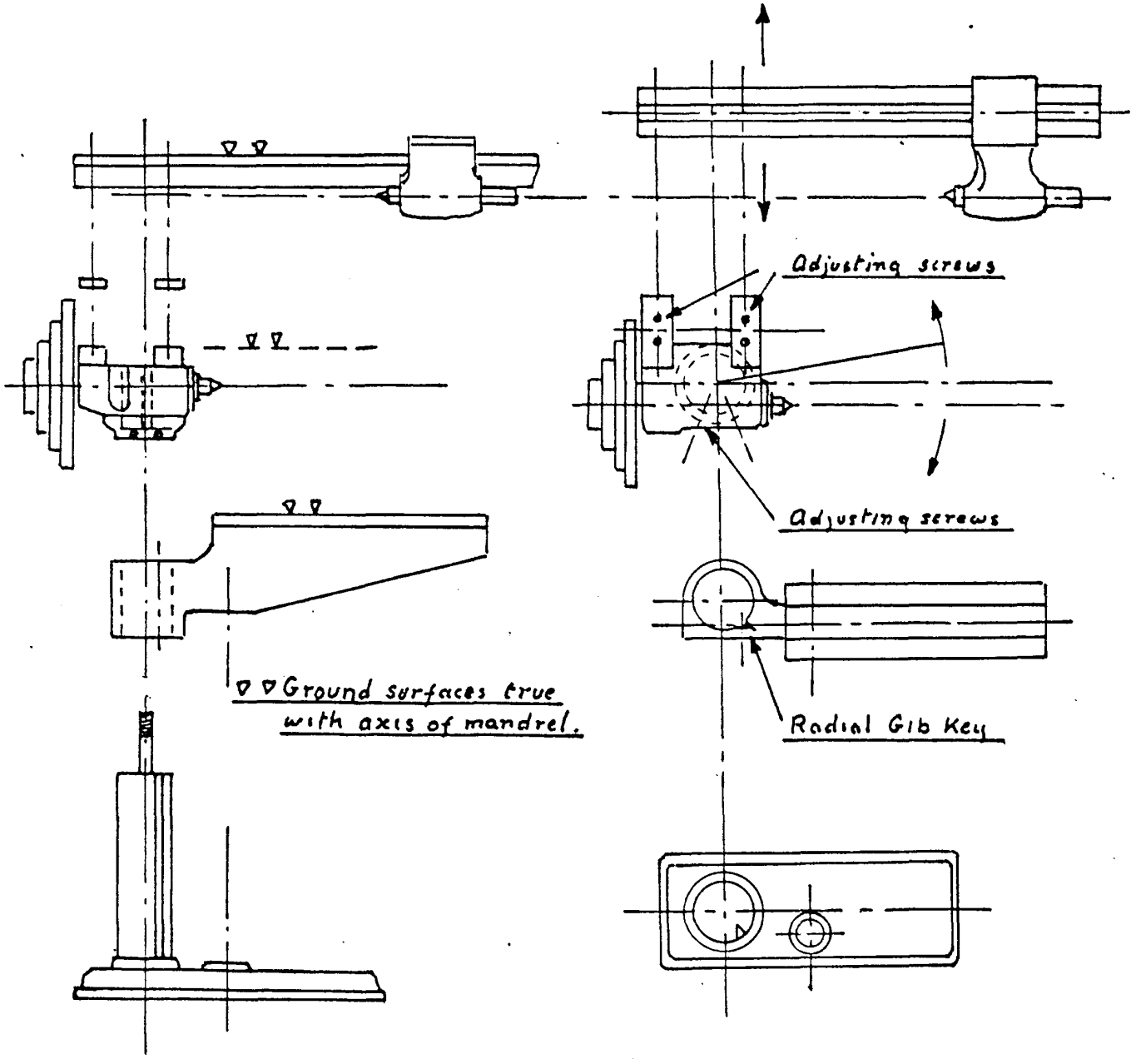




ELEVATION

PLAN

29.6.83

METALMASTER MACHINE TOOL

Schedule of Drawings

General Arrgt. Drgs./Elevation/End View/Plan

	Cast Iron	Mild Steel	Gunmetal
1. Column	x		
2. Base	x		
3. Headstock, 4 drawings	x		
3a. Arrgt. of adjusting screws	x		
4. Main Bed	x		
5. Keyway Detail	x		
6. Saddle	x		
7. Cross slide	x		
8. Secondary Tee Bed	x		
9. Arrgt. of Brackets			
9a. Straps (2)	x		
10. Spindle		H.T.	
11. Changewheel Carrier Arm	x		
12. Leadscrew		x	
13. Cross Feedscrew and Nut		x	x
14. Headstock Driving Pulley	x		
15. Headstock Cover	x		
16. Leadscrew Cover Tube and Locknut		x	
17. Leadscrew Nut			x
18. Carrier Arm Bearing Bracket	x		
19. Leadscrew Driving Spindle		x	
20. Leadscrew Driving Spindle Collar		x	
21. Mandrel Sleeve and Collar		x	
22. Changewheels		x	
23. Cross Slide Handwheel (graduated)		x	
24. Leadscrew Dog Clutch details		x	
25. Cross Slide Feedscrew Bracket	x		
26. Changewheel Studs		x	
27. Leadscrew Handwheel (graduated)		x	
28. Vertical Feedscrew		x	
29. (Leadscrew Clutch Lever		x	
(Tailstock Spindle Collar		x	
(Headstock Clutch Lever		x	
30. Vertical Feed Handwheel	x		
31. (Gibkey Locking Screw		x	
(Tailstock Barrel Locking Screw		x	
(Headstock Cover Locking Screw		x	
(Changewheel Carrier Locking Screw		x	

	Cast Iron	Mild Steel	Gunmetal
32. (Headstock Holding Nut		x	
(Tailstock Index Dial		x	
(Tailstock Operating Spindle		x	
33. Faceplate	x		
34. Tailstock	x		
35. 4-Way Toolpost details	x		
36. " " "	x		
37. Link Rod for Division Plate		x	
38. (Leadscrew Thrust Collar		x	
(Leadscrew Bearing			x
(Leadscrew Handwheel Nut		x	
(Tailstock Locking Screw		x	
39. Topslide Base and Nut	x		x
40. Topslide	x		
41. (Topslide Bracket		x	
(Topslide Feedscrew Handwheel		x	
(Topslide Feedscrew		x	
42. Tool Tray		Sheet	
43. Suds Tray		Sheet	
44. (Ground Test Bar		Stainless	
(Reducing Sleeve		x	
45. Tailstock Barrel and Pinion		x	
46. Dial Test Indicator Attachment Arrgt.			
47. Dial Test Indicator Attachment Details			
48. Machine Vice			
49. Vernier Index for Leadscrew Handwheel		x	
50. Racking Lever Attachment			
51. Ball Turning Tool			
52. Stand			
53. Clamping Jig for Small Parts			
54. Tailstock Dieholder			
55. Motor Drive Bracket			
56. Collet Set			

METALMASTER MACHINE TOOL

Boring Head - Schedule of Drawings

	Cast Iron	Mild Steel	Gunmetal
1. Body	x		
2. Slide	x		
3. Feedscrew		x	
4. Nut			x
5. Thrust Block			x
6. (Index Locknut		x	
(Thrust Locknut		x	
(Thrust Ring		x	
7. Handwheel		x	
8. Spider	Tufnol		
9. Arrgt. of Trip Pin			
10. Facing Tool Holder		x	

METALMASTER MACHINE TOOL

Special Advantages

1. Vertical movement of bed benefits all operations.

2. Machine will swing 8" dia. between centres or 14" over bed with tailstock and auxilliary bed removed.

3. Rack feed tailstock will pass right over saddle - no overhang.

4. Tailstock fitted zero setting depth gauge.

5. Pulley/flywheel/handwheel 11" dia. serves also as 60 hole dividing head with subdivisions to 360°.

6. Large slotted work table 10" x 4½" x 7½" cross travel.

7. Large indexing dials (3" & 3½" dia.) to crosslide and leadscrew.

8. In normal use a 4-way toolpost is used without topslide. No packing of tools is necessary.

9. Topslide for short tapers only.

10. Taper turning between centres for full travel of the saddle.

11. Hollow mandrel passes ¾" stock bar.

12. No. 3 Morse taper in mandrel nose accepts large collets.

13. A boring and facing head with auto feed can be used as in full scale horizontal boring machine practice.

14. An extra deep jawed machine vice can be fitted in view of the freedom of vertical movement and end mills, flycutters and slitting saws used as with a horizontal milling machine.

15. The machine can be used as a hand shaper for cutting keyways etc.

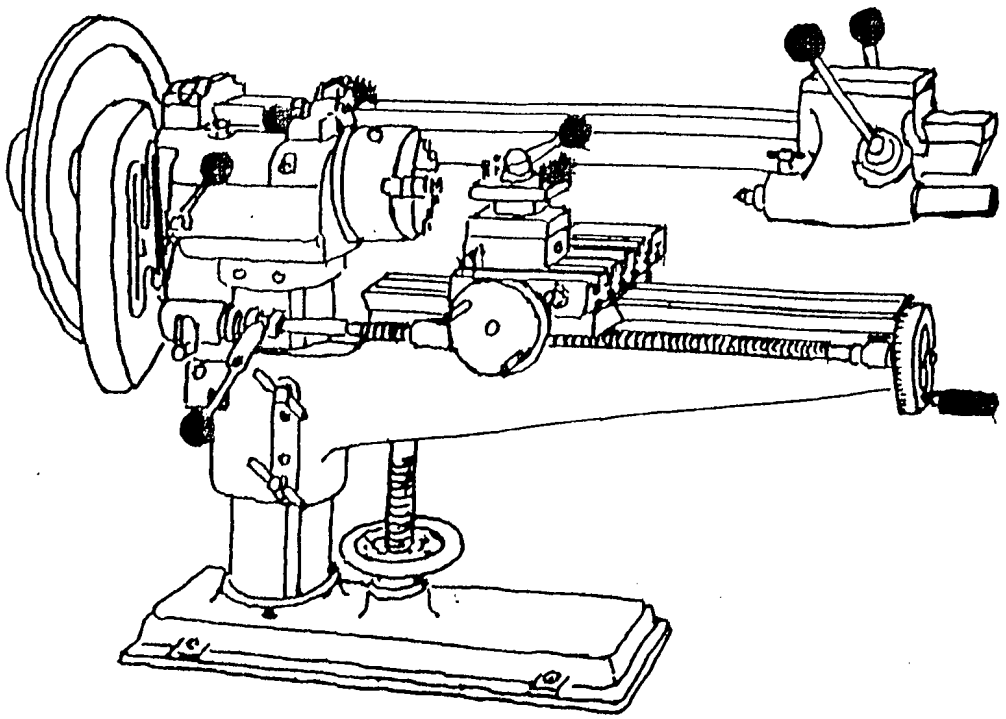
16. A special simple screwcutting system is used, providing a range of threads with elementary trains and a selection of metric threads to tolerable accuracy, also 19 T.P.I.

17. The use of a single dog clutch on the mandrel makes it impossible to pick up the wrong thread.

18. The accuracy of parallel turning is under the control of the operator. The bed is adjusted to a zero-taper condition.

19. A Dial Test Indicator mounted on the auxilliary bed is, at all times, available to check and align work in the machine, both round and flat.

20. The entire machine can be readily dismantled into handleable pieces, put in the back of an estate car, and reassembled elsewhere ready for work, very quickly.



11.7.81

The following notes should be read in conjuction with the Detail drawings to which they refer.

1. Column.

This consists of a length of 3½" diameter mild steel bar, preferably ground. The keyway for the triangular key is best machined with a 45° side end face milling cutter, making sure that the radial face of the keyway is truely on the diameter of the bar. Both ends of the column are drilled and tapped 5/8" BSF for a depth of 1½". The lower end is fastened to the base casting with a 5/8" BSF Hexc. headed setscrew and a 5/16" socket grub screw locates it in position, when the main bed has been finally lined up with the base casting. A 5/8" BSF stud of suitable length at the top end, passes right through the headstock casting and is provided with a special holding down nut. Detail 32.

2. Base

The recess for the foot of the column in the base casting should be machined an easy fit, so that the column can be rotated or extracted without difficulty and can bed down squarely on the bottom of the recess. For this purpose too, it is advisable to relieve the ends of the column for a few thous in the centre. as indicated. The smaller boss should be recessed to accept a suitable ball thrust race for the handwheel. A race say 1½" OD x 7/8" bore should be suitable and a 3/8" x 5 T.P.I. Acme screw has proved satisfactory as a jack, so that a hole should be drilled in the centre of the recess to clear this size. The main thing is that the screwjack shall not be stiff but easy in operation as the bed casting is raised and lowered. The four pads at the back of the casting can be used for the attachment of brackets for the motor mounting, if this kind of drive is adopted.

3. Headstock.

This casting is, of course, the heart of the machine. It is essential that the face of the recess, which rests on the top of the column, the bore of the mandrel and the four top faces of the brackets shall all be true with one another in the vertical plane. The top faces of the brackets should be ground true to close limits ±.0000", 2.25" above the mandrel axis.

The recess for the column head should be an easy fit to allow the head freedom to be rotated for alignment with the main bed. The dimension of 3" from the face of the recess to the mandrel axis is not critical. The casting should be spotfaced where the 5/8" stud emerges from the top of the column, to give a true face for the holding down nut.

The front bearing housing should be recessed to accept a thrust race 1 7/8" O.D. x 1 3/16" clear I.D. x 7/16" thick. Both casting and bearing shells should be split 3/32" for fibre packing strips and drilled for 5/16" setscrews.

3 A Adjusting Screws

Two radial holes into the recess at the base of the headstock casting should be drilled and tapped 3/8" B.S.F. as indicated. Before tapping, however, the headstock should be set up on the column and brought in reasonably accurate alignment with the main bed, correctly keyed to the column. The column may then be spotted with a tapping size drill through the holes. Subsequently five centre drill holes should be made approximately 3/64" outwards from the spotted marks. Socket grub screws pointed 60° will then provide a very fine rotary adjustment of the head as either one or other is turned. The holding down nuts must be just a trifle slack whilst the adjustment is being made and then be pulled down hard when the head is in true alignment, checked with the ground Test bar in the mandrel nose and a D.T.I. in the toolpost.

4. Main Bed.

The 3 1/2" bore through the body of the casting should be a sliding fit on the column, so that it may be clamped by means of a 3/8" setscrew through the lug, where it is split and adjusted for minimum sliding clearance, so that it can just fall under its own weight. The Vee slide ways should be ground and true with the bore and the column. The radial face of the triangular keyway must be truely on the diameter of the bore but the other face can have about 1/32" clearance and is not a bearing face.

Strengthening webs may be provided in the cored out part of the casting and a horizontal web as shown to take the thrust of the vertical feedscrew is necessary.

5. Arrangement of Key

The key is best made from an iron casting as shown in the sketch. It can be mounted in Vee blocks for machining the central portion and the square ends later removed. The two adjusting screws may be 3/8" BSF socket screws pointed 60° and fitted with locknuts, the centre drill dimples being spotted through with the key clamped tight. The two locking screws, also 3/8" B.S.F. should be finished flat. The sharp edge of the key may need rounding off to ensure that it locks down fully into the keyway on the column.

6. Saddle.

The lug on the underside of the casting is bored to take the leadscrew nut (Detail 17) and both sides spotfaced. The ℄ of the bore is immediately below the leading edge of the main Vee ways. The nut for the cross feed is made from a length of Phos. B or G.M. bar and cross drilled and tapped 10 T.P.I. for the feedscrew. It is then filed to fit and can adjust itself freely to the screw making for smooth

and accurate motion.

A rack traverse and split nut is not fitted to this machine. Because the tailstock is carried on a separate bed, the main bed is much shorter than on a conventional machine and the leadscrew handwheel is so much handier that it was felt that the complication of the rack feed could be omitted as an unnecessary expense. In fact, the practice with this machine is to use a 4 way toolpost direct on the cross slide and the leadscrew and crossfeeds only, without a topslide for all ordinary work. This tends to greater accuracy and the indexed handwheels are so large that readings of .001" can be read easily from a standing position in front of the machine.

A substantial gib strip 3/16" thick holds the saddle to the main bed and is located and adjusted by means of two pointed grub screws and lock nuts, with a third flat ended screw for locking the saddle to the bed ways, when required.

7. Cross slide.

In view of the milling capabilities of the machine, a large boring table or cross slide was desirable and this is 10" x 4½" with a travel of about 7½". The five Tee slots allow the machine vice to be placed in any position on the table and for other substantial pieces of equipment such as a dividing head to be mounted. Since the tailstock can be passed right over the boring table, there is no problem of overhang of the barrel and the width of the table could be increased to 5" or more with occasional advantage.

8. Auxiliary Tee Bed

Since the accuracy of the machine is dependent on the truth of this bed it should be ground on the machined surfaces of the Vee slides, which are angled at 45°.

When long slender work is turned between centres, there will be a tendency towards chatter, from the elasticity of the cast iron. This can be considerably lessened by means of a tie rod about 3/8" dia fitted so as to link the ends of the two beds. An even more rigid clamp can easily be made up to tie the tailstock barrel direct to a plate across the surface of the main bed. If the two are connected by means of a dog leg bush, the vertical feed can still be available, before final tightening of the bolts, for setting cutting work or tool to centre height.

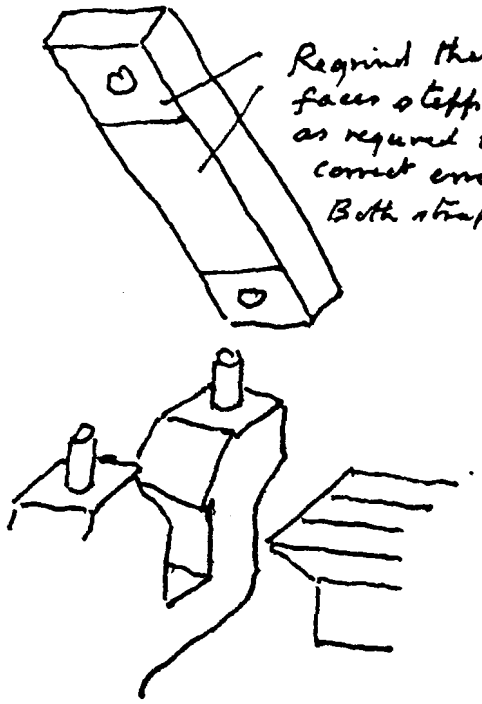
9. Arrangement of Brackets for Tee Bed.

As will be seen, the auxiliary Tee Bed is held up against the ground surfaces of the two straps by 3/8" BSF Hexe. headed set screws pressing upwards through the centre of each bracket. This takes care of the alignment of the Tee bed automatically in the vertical plane. Four socket grub screws 5/16" BSF project through the Tee Bed at 45° to each on the sides of the Vee brackets. A clearance gap of about 1/8" allows the bed to be positioned in the horizontal plane for the accurate alignment

SPECIAL NOTE Details 9A & 34

Alignment of centres in the vertical plane

Any small error in the machining of the tailstock casting to the critical dimension of 2.25" between the sliding surface and the bore of the barrel, will show up as a vertical misalignment of the head and tailstock centres. This can best be corrected by regrinding the faces of the two straps (Detail 9A) with suitable steps between the central portion, that bears on the top surface of the Tee bed, and the end portions resting on the brackets.



of the tailstock centre, in accordance with setting up procedure.

9 A. Straps - 2 off

The top surfaces of the strengthening ribs may be surfaced to provide a seating for the castings on the grinding machine.

10. Spindle

Material should be good quality steel such as EN 24 and given a good finish, preferably ground. The spindle runs in G.M shells 1 3/8" O.D. x 1 1/16" and 1 3/16" I.D respectively. Oil grooves can be provided. It has been found that occasional lubrication through ordinary oiling cups is all that is necessary and wear has been negligible over a period of 25 years. Thrust is taken by a large ball race in the mandrel nose bearing and a fibre washer and fine threaded collar on the spindle at the back end of the bearing shell allows for close adjustment.

The spindle is bored 3/4" plain running into a No 3 Morse taper, so that large stock material can be passed through and useful sized collets employed. A reduction sleeve to No 1 Morse taper takes normal centres, drill chuck etc.

Both bearing housings and shells are split 3/32" and fitted with fibre packing pieces, adjusted for running fit and clamped with 5/16" B.S.F. socket cap screws.

The flywheel pulley is keyed to the spindle with a key 3/16" x 1/8" x 1 a 5/16" BSF socket grub screw secures and seats on the key through the bottom of the smallest pulley.

The function of the sliding sleeve and pinion is described under screwcutting and Detail 21.

11. Change wheel Carrier Arm.

There is nothing calling for special comment with this component. The slots should be milled out to 1/4" to suit the plates on the changewheel studs. The central slot is opened up to 5/16" at one end to accept the attachment of the tailstock arm, when using the pulley for dividing purposes.

12 Leadscrew

The leadscrew is 5/8" diameter x 8 TPI square thread to suit the special screwcutting system and the 24 tooth pinion on the spindle sleeve. The leadscrew on this machine is very much in use but it is so easily removed, together with its nut, that a spare pair could be kept for special jobs, where great accuracy was required. However the long solid nut stands up well and I have not found the necessity for such a spare set.

13. Cross feed screw and nut.

The feedscrew is threaded 10 TPI × 1/2" sq thread. R.H. and operates in a self aligning Phos. B. or G.M. nut. This nut is made from a piece of 1" diameter material cross bored and threaded. It is a close working fit in a suitable vertical hole bored through the saddle casting and can therefore position itself in two directions to align with the placing of the thrust bearing. The screw is thus freely supported, lending itself to smooth and accurate duty.

14. Headstock Pulley Flywheel.

The design and operation of this pulley was adopted without modification from the Excel 3 1/2" lathe. It has proved an unqualified success and is a breakaway from traditional practice. It has the following merits.

a) The heavy weight (12 lbs) serves to give momentum to anything held in the chuck and helps to drive the work past the tool or visi versa and to eliminate chatter, particularly in parting off operations.

b) It serves as a Dividing Head, having 60 holes drilled in its outer rim, with a means of further subdivision to 360°

c) It dispenses with the need for back gear and is quiet. If a geared motor is used as the power unit a suitable range of speeds can be provided with a single V belt drive.

d) It is invaluable for turning the chuck for screwcutting by hand particularly for short threads up to a shoulder. and for the use of taps and dies in a tailstock holder. The rack feed to the tailstock is also of advantage in this kind of work.

15. Headstock Cover

This casting calls for no special comment. It is held in position by the knurled screws Detail 31

16 & 17 Leadscrew Cover Nut & Locknut. Leadscrew Nut

The leadscrew nut of Phos. B or G.M. passes through a hole bored through the lug provided on the underside of the saddle casting and is secured by the M.S. Cover tube acting also as a locknut. A small peg prevents rotation of the nut.

If the Cover tube is unscrewed, the leadscrew nut can be spun down to the far end of the leadscrew, leaving the saddle free to slide on the bed. A handlever can then be fitted with a link and fulcrum pin clamped to the bed by some suitable means, to convert the machine to a simple handshaper for cutting keyways or splines in work held in the chuck.

The leadscrew and nut are so easily removed from the machine, that a spare pair can be kept and fitted for special precision screwcutting or other work of particular accuracy.

18. Carrier Arm Bearing Bracket.

This casting is attached to the pad provided on the main bed casting by two 5/16" setscrews, so as to line up with the leadscrew. The casting is split and a clamping screw provided so that the carrier arm may be locked in any position to suit the changewheels in use. The head of the small column which carries the clutch lever should be finished to stand 1/2" forward of the centreline of the leadscrew to suit the sliding collar.

Dowel pins can be fitted to position the bracket once correct alignment with the leadscrew has been made. However, the 1/4" diameter spigot on the end of the leadscrew is purposely an easy fit in the hole in driving spindle, so as to avoid any strain on the leadscrew, no support being required at this point. The leadscrew should be freely floating on the nut and the thrust bearing only.

19 & 20 Leadscrew driving spindle and Collar.

The spindle should be a nice running fit in the boss on the carrier arm. A clearance of .020" allows the sliding collar and dog to move easily over the spindle when the clutch is operated.

21 Mandrel spindle Sleeve and Collar.

This sleeve combines the single dog clutch used for screwcutting with the 24 tooth pinion, which drives the changewheel train. The use of a single dog clutch makes it impossible to pick up the wrong thread and greatly simplifies screwcutting operations. Short lengths of thread up to a shoulder can readily be cut by hand, with the aid of the large pulley flywheel and with complete confidence.

22 Changewheels

This system of gears, where the numbers of teeth are in multiples of the number 3, instead of the usual 5, provides a very comprehensive range of screwthreads using simple trains only. The formula is very simple

$$\frac{\text{No of driven teeth}}{\text{No of driving teeth}} = 3 \times \text{T.P.I.}$$

A working chart for the changewheels trains is given in Table and this has proved to be adequate for everyday model making purposes. A single 38 tooth wheel is added to the range to enable 19 T.P.I. to be cut and also because this wheel gives a useful selection of metric threads to be cut with tolerable accuracy. An additional changewheel of 50 teeth would be required if it is necessary to cut a 25 or 50 ~~tooth wheel~~ T.P.I. screw.

An advantage of the system is that the largest wheel employed is only 72 teeth, keeping the whole train exceptionally compact.

23 Cross slide Feedscrew Handwheel.

The large and heavy handwheel is helpful in giving a smooth

and steady feed. The space between the indexing marks representing .001" is so large on a 3" diameter ring that they can be comfortably read with accuracy from a standing position in front of the machine. It would be a simple matter to provide this handwheel with a zero setting index ring and could be a useful refinement.

24. Assembly and Details of Dog Clutch.

The clutch collar is keyed to the end of the leadscrew and picks up the drive from the changewheels for autofeed to the saddle. It is left engaged during screwcutting operations.

25 Cross slide feedscrew Bracket.

This small iron casting supports the feedscrew and serves also as a thrust bearing. It should therefore be accurately spotfaced at both ends of the bore.

26 Changewheel Studs.

Three of these studs are normally in use, the fourth only being required for an extra idler when cutting L.H. threads.

27 Leadscrew Handwheel.

As with the cross feed handwheel this handwheel is of large diameter 3½" and is heavy to aid a smooth action. A small index number with Vernier scale can be fitted and is occasionally useful but otherwise a pointer made from sheet metal will suffice. Handle of Tufnol or similar. free to rotate.

28 Vertical Feedscrew.

This feedscrew of 5 TPI Acme thread has ground to be about right as a screwjack to raise and lower the bed. It is a comfortable lift without being too tedious, as a finer thread might be. It is as well to fit a steel cover under the handwheel to protect the ball thrust race from swarf. A zero setting pointer on this cover would be extremely useful as it would mean that the bed could be returned accurately to a previously used height. The D.T.I. can, of course, always be used for vertical micrometer movements within its range.

29 Clutch levers etc

These small parts call for no comment.

30 Vertical Feed Handwheel.

It may well be possible to find this item or one very like it as a stock pattern in a Foundry. The dimensions are not critical.

31 Various small Screws.

As the tailstock barrel locking screw is in continuous use, it is

best provided with a small G.M. pad or pin to seat on the face of the triangular gib key. The key will hold the barrel very firmly indeed, owing to its wedge action in the keyway.

32 Various Toolstock and other items.

The Toolstock holding nut should have an accurately machined seating face, since it is tightened down in collaboration with the two adjusting screws for aligning the head and will then need no washer.

The barrel rack feed is 8 teeth per inch, so that one revolution of the tailstock indexing dial represents 3" of travel and it may be given scale divisions accordingly. The central locking screw and pins provide a simple means of zero setting for the dial. For details of the 24 tooth pinion see drawing No 45

33 Faceplate.

With the vertical feed available, a faceplate is an almost unnecessary accessory. accessory. Work can be set up on the boring table so much more easily and accurately, with the aid of the DTI, and machined by means of tools in the chuck or on the boring head, that a faceplate will be very rarely used.

34. Tailstock.

This casting requires to be machined with particular attention to the vertical dimension of 2·25" between the top sliding surface of the auxiliary Tee bed and the centre line of the barrel. This dimension should be to limits of ± ·00001", but adjustment is possible. On the original prototype machine the tailstock barrel was bored in the machine itself, so as to remove any chance of error. No doubt if the machine were to be put into production a suitable jig could be set up to ensure that the castings were interchangeable.

The horizontal distance of 5" from the barrel centre line to the midpoint of the Tee bed is not so critical because allowance for adjustment is made in the brackets supporting the auxiliary Tee bed.

The barrel housing is drilled partially through from the back to provide a run out for the tool when cutting the triangular keyway for the key. Two setscrews and lockmuts can be adjusted to remove all shake and the barrel can be locked very securely with the central locking screw tightened down onto the key.

A valuable feature of this machine is that the tailstock can be passed right over the saddle and the boring table can therefore be as wide as may be found useful, with no problem of overhang of the tailstock barrel.

A simple sheet metal toolbox screwed to the flat top surface of the tailstock casting is very convenient for holding turning tools and spanners.

35 & 36 4 Way Toolpost

This toolpost is normally used on this machine for all general work, the topslide only being occasionally used for cutting short tapers or for feeding in the screwcutting tool at the threaded angle. No packing of tools to centre height is necessary with the vertical feed always to hand and the short main bed and longe feedscrew dials are more convenient to use than a topslide.

The tapered locking pin need only be sufficiently tightened down to prevent the toolpost moving about because the whole unit will be held down firmly when the main clamping arm is pulled down hard.

37 Link Arm for 60 hole Division Plate.

The link arm works on a fulcrum pin attached to the Carrier Arm and can pick up any of the 60 holes in the rim of the pulley flywheel and so lock the mandrel. The sub division device enables pieces of work in the chuck or on the faceplate to be divided into degrees of angle with considerable accuracy.

Movement of the Carrier Arm on its spindle allows a small amount of movement to a scribing tool picking up an initial zero mark on the work.

The register pin on the link arm should be tapered so as to make a close sprung fit in the 7/32" holes in the rim of the flywheel pulley.

38 4 Small Items

The leadscrew bearing can be made from 3/4" square Phos B or G.M. stock bar. The M.S. thrust collar bears on one side face of the bearing and the handwheel nut on the other, locking with the threaded hole in the handwheel itself and with a final locknut on the end of the thread.

These parts can be adjusted to provide working clearance for the leadscrew and smooth action. A single 5/16" bolt passes right through the main bed casting to hold the bearing against the pad provided.

The tailstock locking screw can be given plain cross pin for tightening purposes or it is better to fit a ball headed lever about 4 1/2" long which can project above the tooltray for easy access. The most convenient position for the thin lever when locked can be determined by adjustment of the length of the brass or G.M. pin. A small fixed pin in the back of the tailstock casting can limit the movement of the lever when in the unlocked position. If the lever is screwed into the head of the locking screw at an angle of about 55° it will comfortably clear the back of the casting with freedom to swing.

39 Topslide

A similar arrangement to that of the cross slide is used for the nut and feedscrew, the nut being made by cross drilling and threading a short length of 3/4" dia Phos. B or G.M. rod. This cylindrical piece of metal floats in a vertical hole bored in the casting and so can find

its axial alignment with the feedscrew and bearing. This results in a smooth and accurate action.

The whole topslide is clamped to the boring table by means of a taper pointed socket cap screw, which enters a recess of similar taper 60° in a special slot bolt. The recess is drilled 1/16" below the axis of the capscrew, so that as the latter is tightened it draws up the slot bolt and clamps the topslide. The topslide can therefore be fixed in any slot and at any required angle. A protractor can be laid against the machined face of the base casting for setting to any desired angle of taper.

40 Topslide

A solid section gib strip is used for this slide in view of the amount of overhang and the possibility of sprung with a thin strip. If two locating pins are provided, the adjusting screws can be flat ended to seat on the vertical back face of the gib key.

A substantial 3/8" post can be fitted with any sort of tool clamp desired. A small plate on the post with a light spring beneath it and an adjustment screw for height has served very well.

41 Topslide feedscrew bracket and handwheel.

The feedscrew is threaded 3/8" BSF so as to give 20 turns of the handwheel per inch of travel. The handwheel can then have 50 divisions each representing .001" and these on a 1½" dia dial will be about 3/32" apart and convenient to read.

The feedscrew bracket can be a small iron casting or milled from a piece of mild steel.

42/3 Tool Tray & Suds Tray.

These can be fabricated from sheet metal and one coat rustproofed and stove enamelled.

44 Ground Test Bar

This test bar is best made from 1" ground stainless steel and is an essential accessory. It must have accurate centres and one end should be No 3 Morse taper to fit the mandrel nose. It should be kept available at any time for use in lining up the machine or as a final check, when the auxiliary Tee bed has been removed to allow for a workpiece greater than 8" dia or when the main triangular bed has been removed for taper turning.

45 Tailstock Barrel.

The barrel is bored to pass 3/8" stock material and the nose is made to suit No 1 Morse taper centres, drill chuck, end mills etc. The keyway can be cut with a 45° side and face cutter, care

being taken to ensure that the radial face is truly on the diameter of the barrel. The rack feed is 8 TPI, which with a 24 tooth pinion, gives 3" of travel of the barrel for one revolution of the pinion. The dial can therefore be indexed in inches and the usual subdivisions.

46 Dial Test Indicator.

A good D.T.I. is a necessary accessory with this machine. It is required for use in conjunction with the ground test bar for setting up to the zero-taper condition. If an attachment is made to slide on the auxiliary Tee bed and it carries the D.T.I. on a universal arm, it can be kept in this position and will be immediately available to check every kind of work, whether round or flat, both in the chuck and on the cross slide boring table. The vertical feed can also be indexed by means of this attachment and, in fact, the top face of the auxiliary bed becomes a kind of fixed datum line in space, to which all measurements may be referred. It is well worth making this quick fitting device and the time taken in its construction will be rapidly recovered by its use.

47 Machine Vice

As there is no lack of room in the vertical direction, the vice can have good deep jaws with advantage. It will be much in use and should be capable of being bolted to the boring table at any angle. This can be achieved very well by fitting the vice with a circular slotted base plate as shown in the drawing.

Setting Up Procedure

The ground test bar and D.T.I. are used for this purpose as follows.

i) Insert the test bar in the No 3 taper mandrel nose. Ease off slightly the nut on the central stud emerging through the headstock casting. By means of the adjusting screws Detail 3A rotate the head on the column in the appropriate direction until no movement is recorded on the D.T.I. fitted in the toolpost as the saddle is traversed up and down the bed. Tighten down the nut on the central stud when this is so.

ii) Insert centres in headstock and tailstock and bring up the latter so that the two centres are touching. By means of the four adjusting screws seating on the inclined sides of the brackets Detail 9, bring the centres in true alignment with one another, at the same time keeping the Tee bed parallel with the main bed, sighting by eye.

iii) Slide back the tailstock and interpose the test bar between centres. Test with the D.T.I. in the toolpost and correct by means of the outermost adjusting screws only. When correct tighten up the locking screws underneath each bracket.

Once set, the accuracy of the machine will be retained indefinitely but the above procedure should be used for resetting after dismantling or for

checking if some particularly accurate long turning work is to be done.

In any case, only a few minutes are required to check the adjustment and the operator can feel that at all times he has the accuracy of the machine under his control.

Vertical Feed Adjustment.

i) Slacken all gib key adjusting and locking screws

ii) Tighten clamp bolt at the back of the bed casting, where it is split until the lifting screw can be lowered and the bed held suspended. Slacken clamp bolt until the bed just falls under its own weight.

iii) Tighten gib key adjusting screws individually, again adjusting until the bed can just fall under its own weight.

If properly fitted the triangular key will hold the bed in radial alignment to limits of the order of .001" to .002" in a length of say 12"

It is not necessary, in the ordinary way, to use the two locking screws to clamp the key, when work is being done anywhere near the chuck.

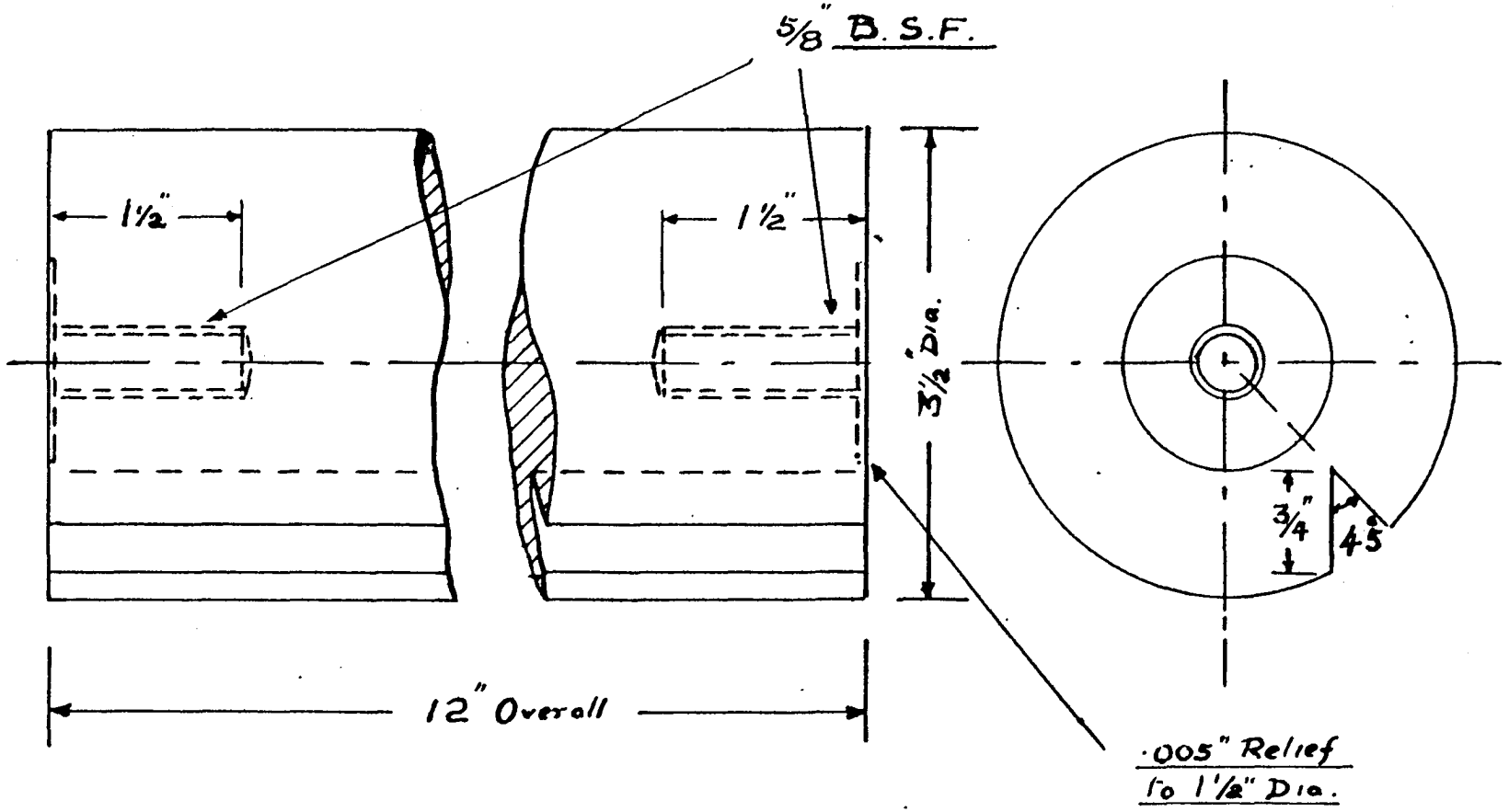
In fact, when using end mills and fly cutters, the vertical feed can sometimes be found preferable to the cross feed.

When parting off, it is quite feasible to raise and lower the bed and the tool, whilst actually making the cut, so as to find the most satisfactory position.

T.P.I. × 3 = $\frac{A \times C}{B}$

CHANGEWHEEL CHART

T.P.I.	A Wheel on Leadscrew	B Wheels on Studs Driver	C Wheels on Studs Driven	Idlers R.H.	Idlers L.H.
4	24	36	18	1	2
5	30	36	18	1	2
6	18	—	—	2	3
7	21	—	—	2	3
8	24	—	—	2	3
9	27	—	—	2	3
10	30	—	—	2	3
11	33	—	—	2	3
12	36	—	—	2	3
13	39	—	—	2	3
14	54	27	21	1	2
15	36	24	30	1	2
16	54	27	24	1	2
18	54	—	—	2	3
19	38	24	36	1	2
20	54	27	30	1	2
22	54	27	33	1	2
24	54	27	36	1	2
26	~~72~~ 54	27	39	1	2
28	72	18	21	1	2
30	72	24	30	1	2
32	72	18	24	1	2
36	72	18	27	1	2
40	72	18	30	1	2
44	72	18	33	1	2
48	72	18	36	1	2
52	72	18	39	1	2
56	72	18—27	21—54	0	1
60	72	18—24	30—36	0	1
64	72	18—27	24—54	0	1
Coarse Feed	72	18—21	39—54	0	1
Fine Feed	72	18—18	54—60	0	1
Pitch m/m		**METRIC THREADS**			
·5	72	18	38	1	2
·55	72	18—33	30—38	0	1
·7	54	21—27	38—30	0	1
·75	72	27	38	1	2
1·0	72	36	38	1	2
1·5	38	27	36	1	2
1·75	38	21	24	1	2
2·0	38	—	—	2	3
2·25	38	27	24	1	2
2·5	38	30	24	1	2
2·75	38	33	24	1	2
3·0	24	36	38	1	2
3·25	24	39	38	1	2
4·0	18	36	38	1	2

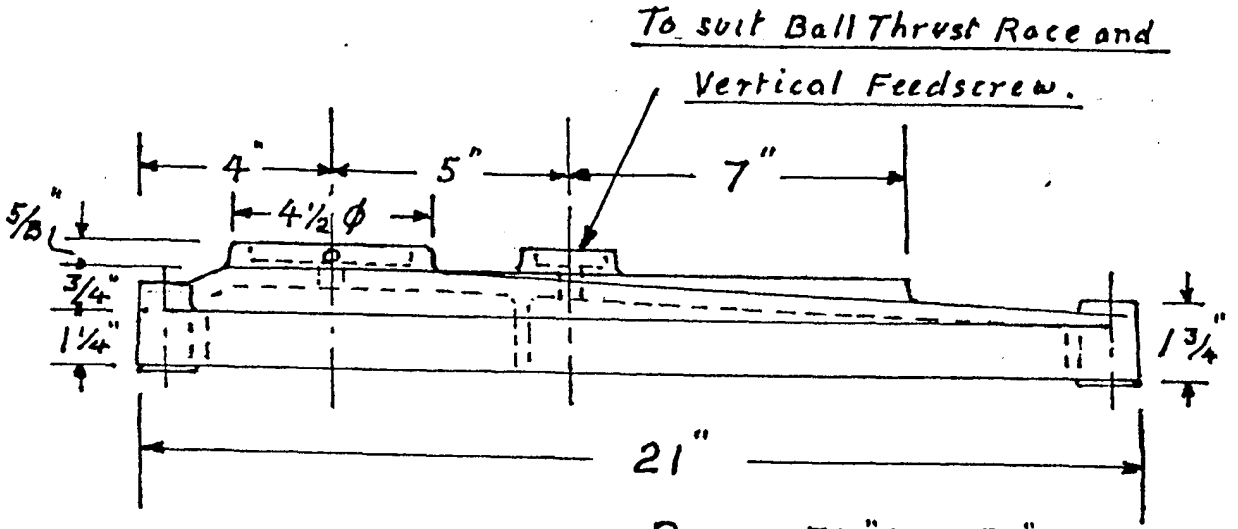


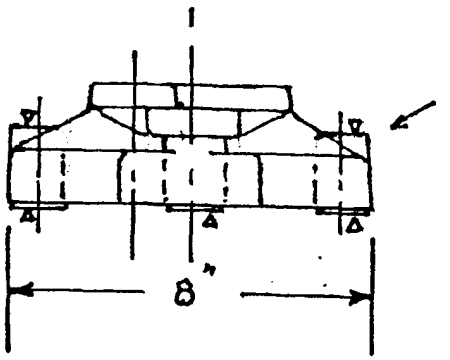
MATERIAL - M.S.

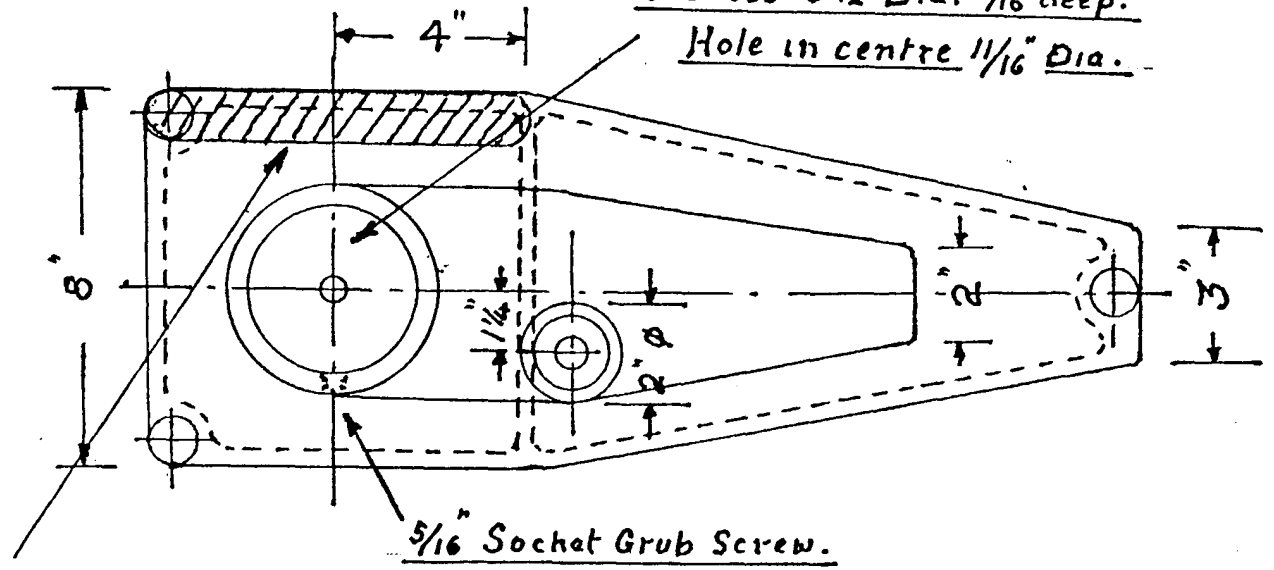
SPECIAL LATHE

DETAIL I - COLUMN

1.12.64







Material C.I.

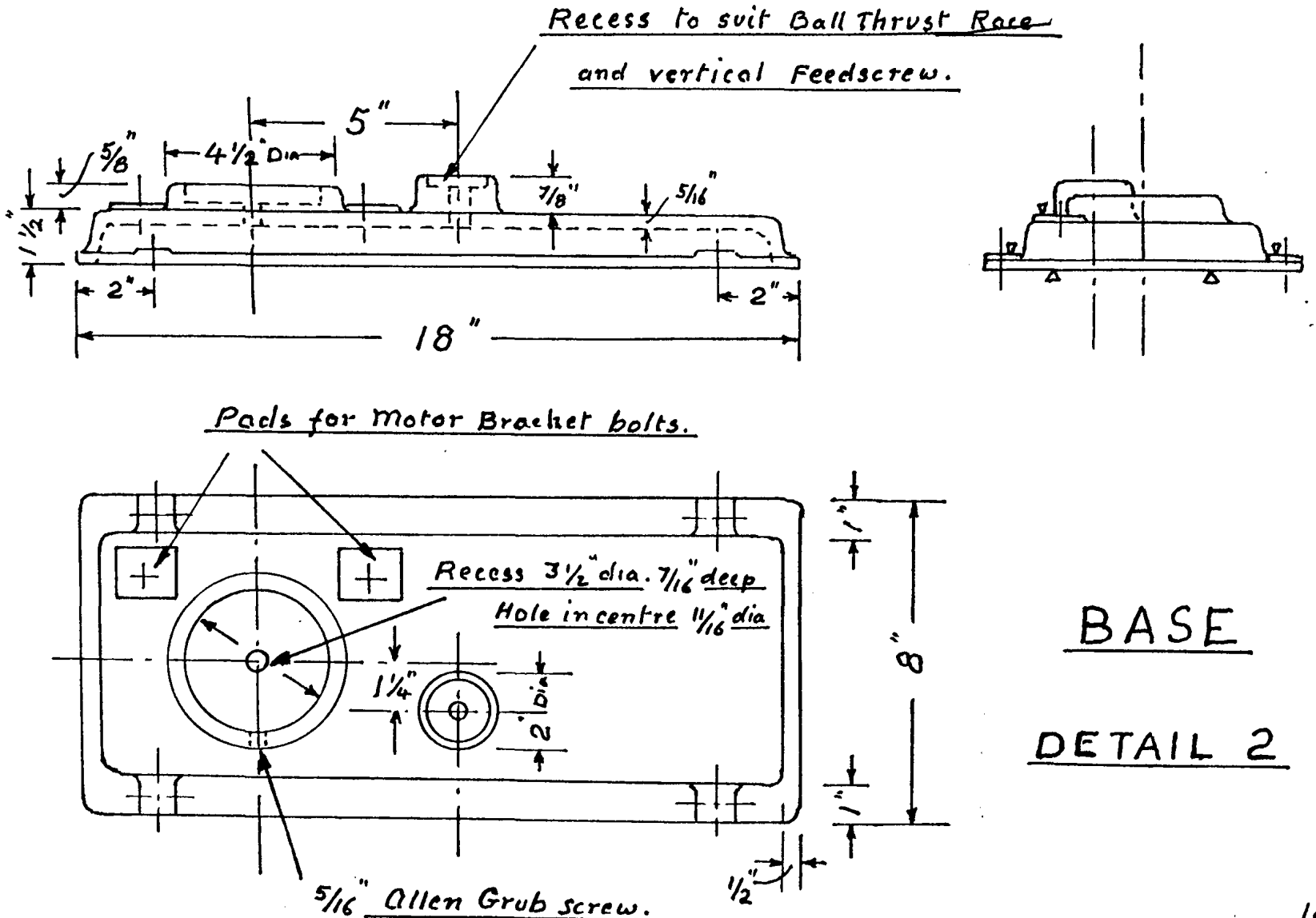
BASE.

DETAIL 2

Scale ¼ Full Size

WDH

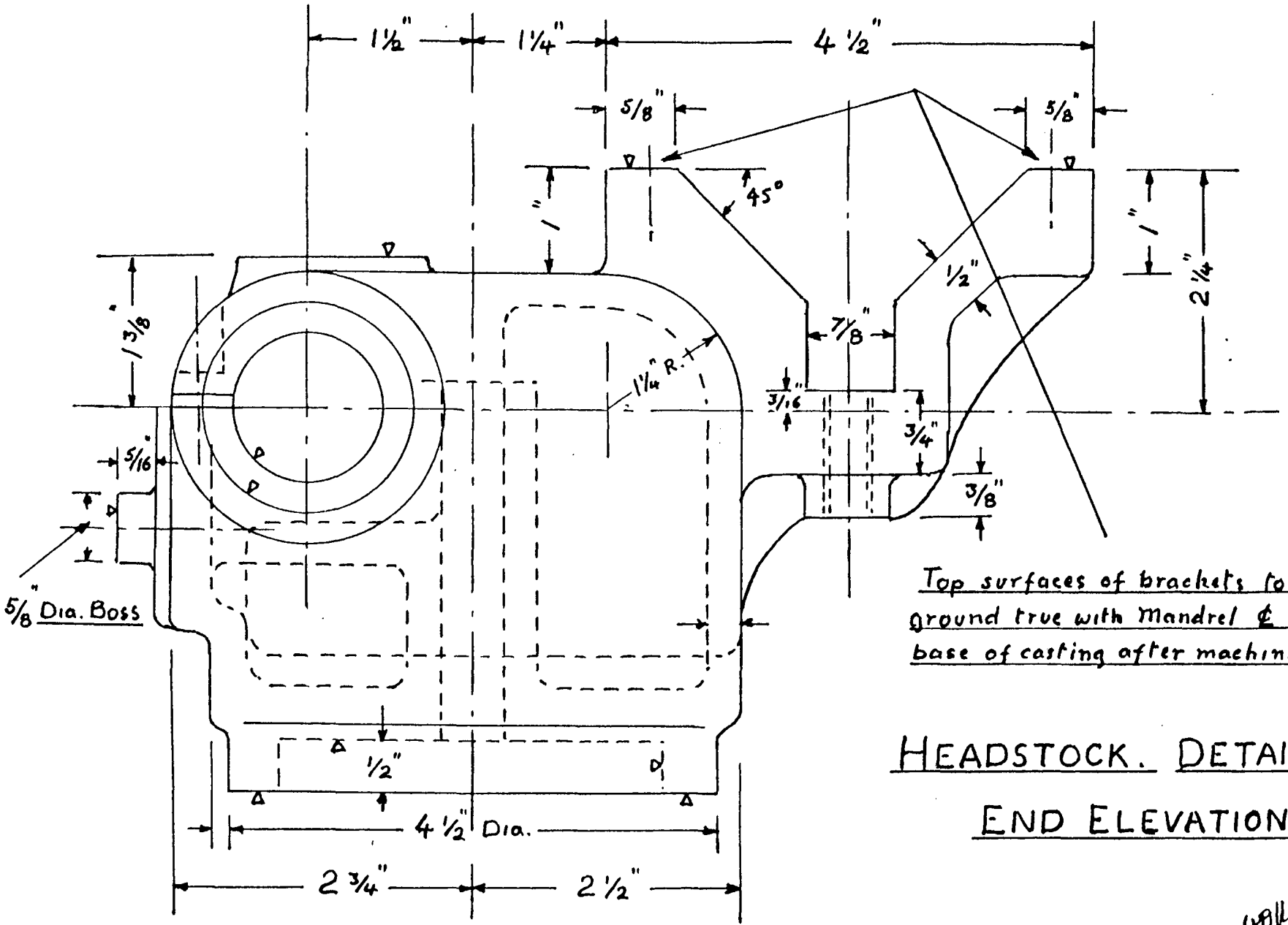
29.9.83



BASE

DETAIL 2

17.12.81



Top surfaces of brackets to be ground true with mandrel ℄ and base of casting after machining.

HEADSTOCK. DETAIL 3

END ELEVATION.

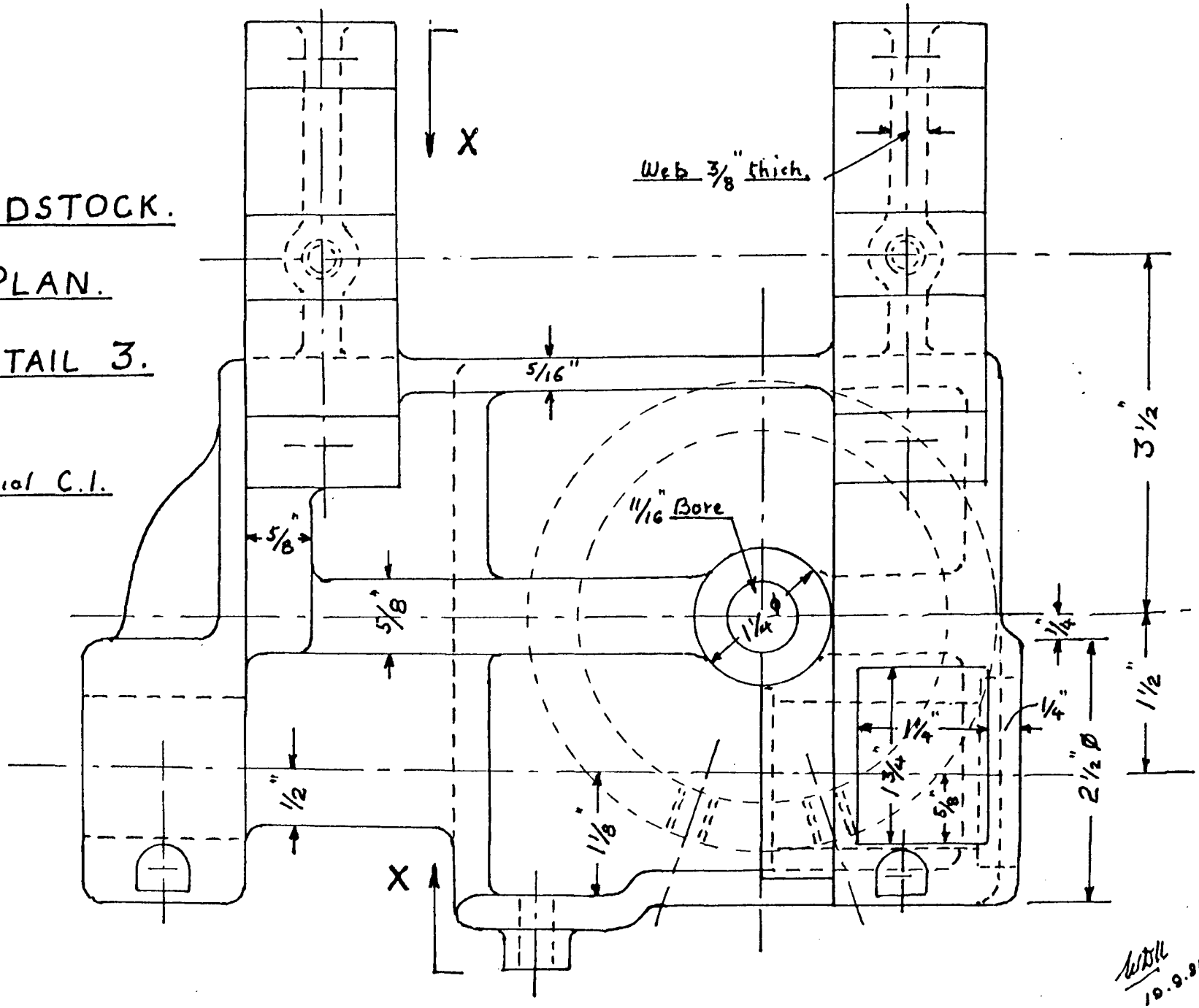
WBH
19.9.81

HEADSTOCK.

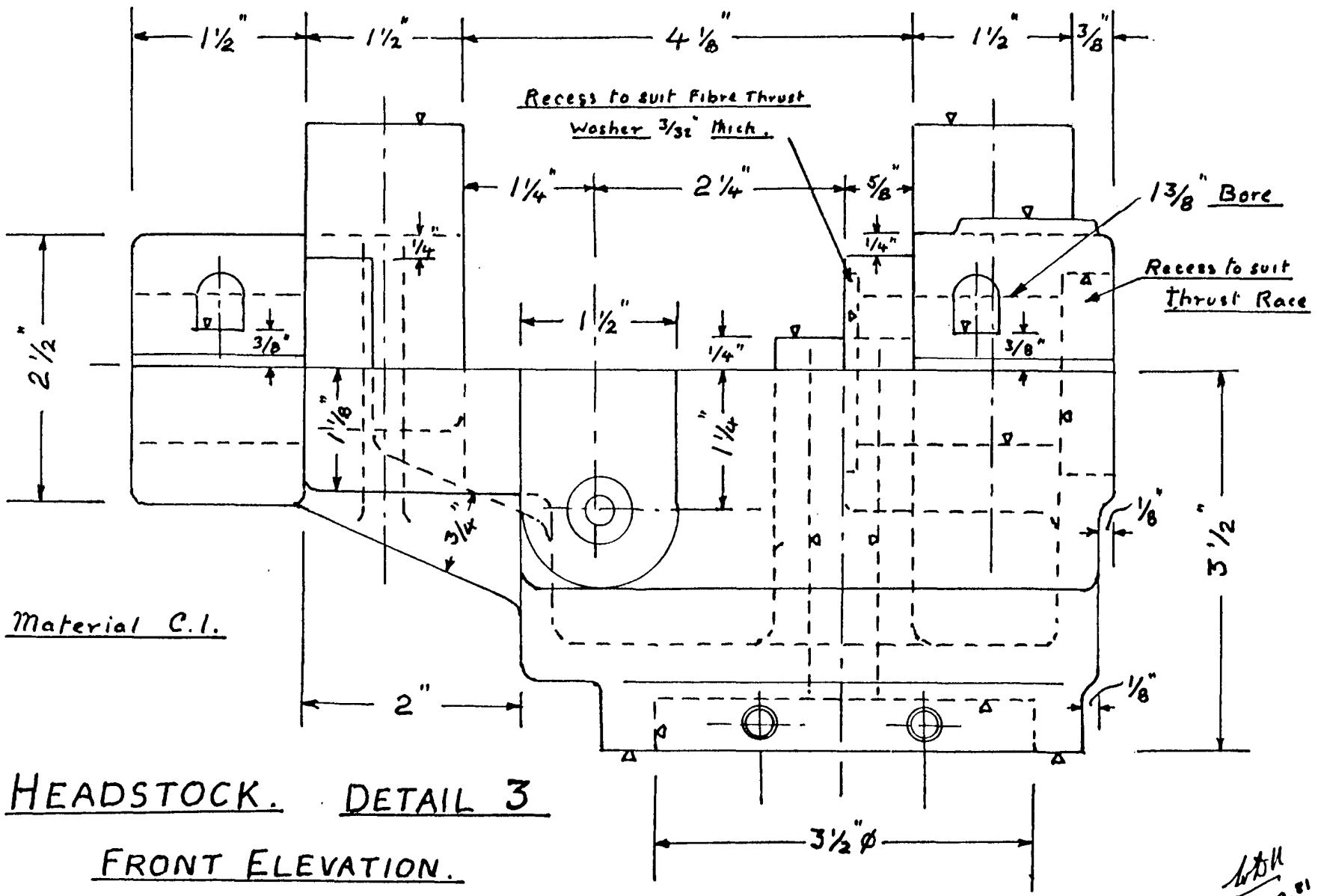
PLAN.

DETAIL 3.

Material C.I.



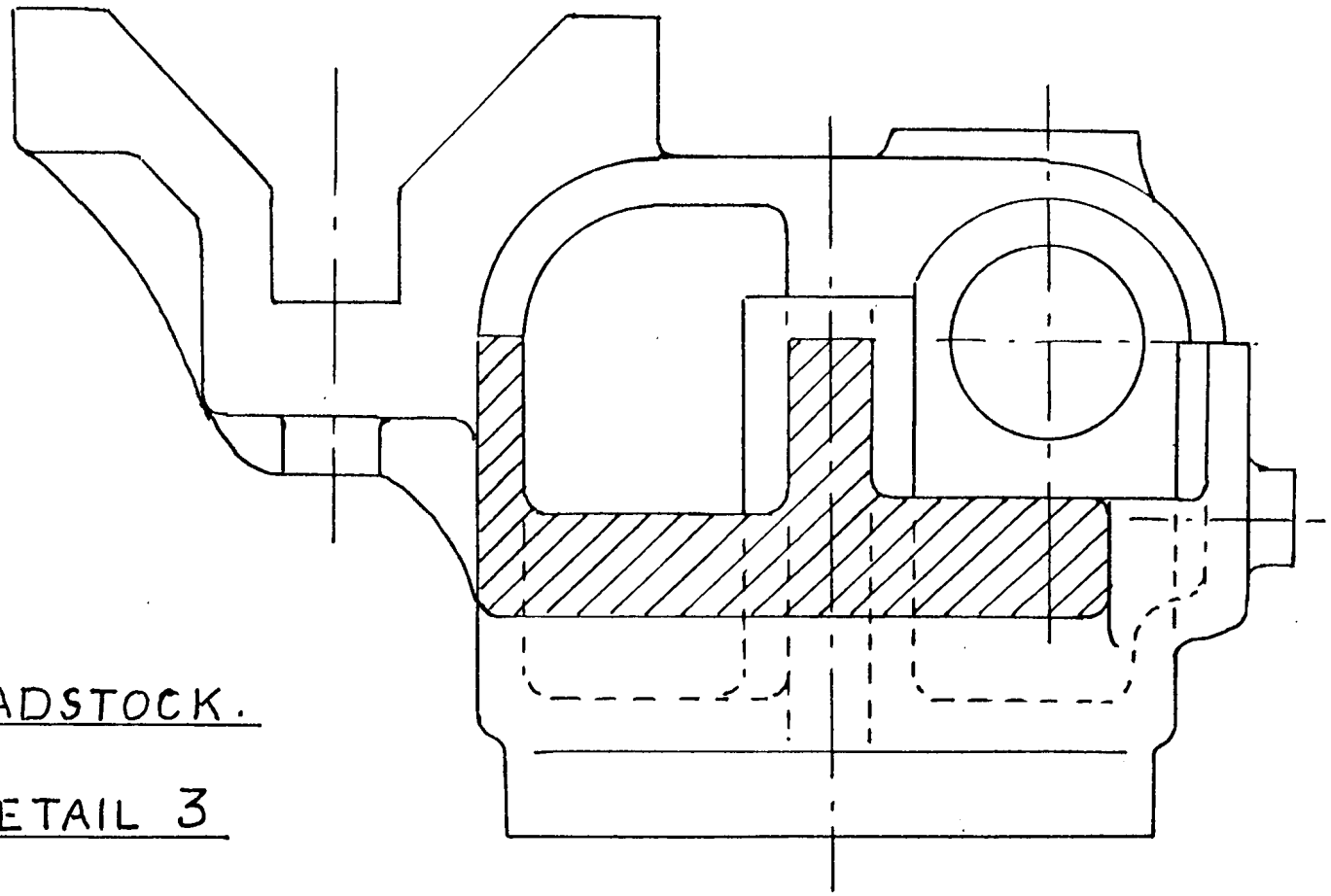
10.9.81



HEADSTOCK. DETAIL 3

FRONT ELEVATION.

18.9.81

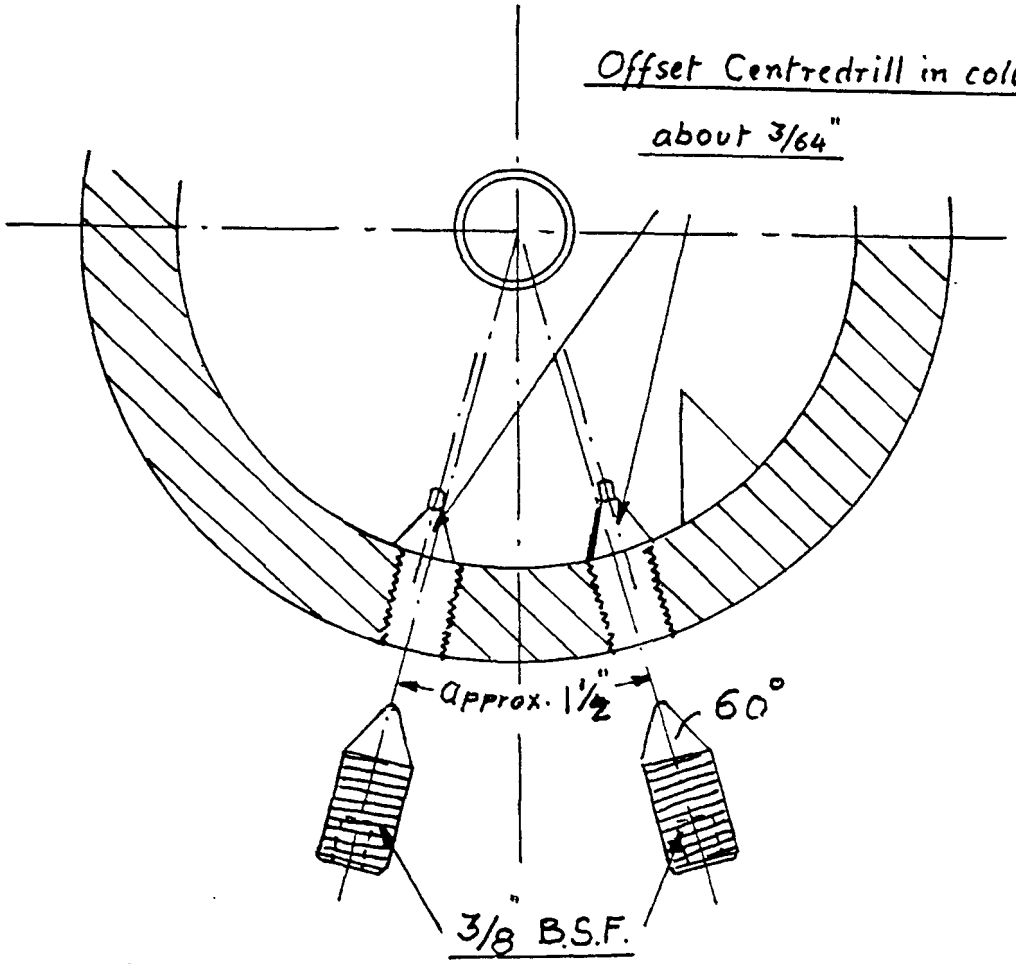


HEADSTOCK.

DETAIL 3

SECTION ON XX

WBH
19.9.81

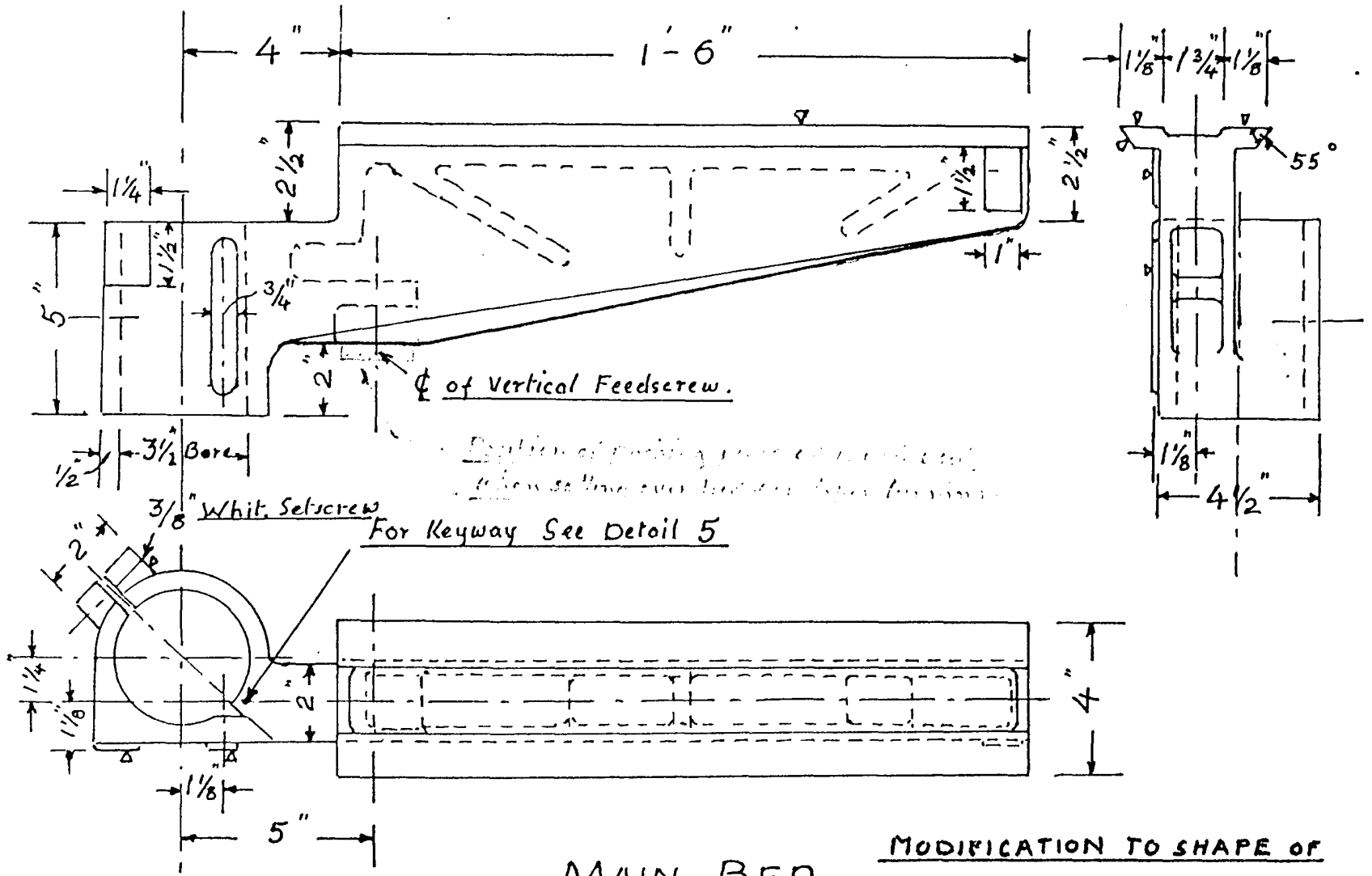


ARRGT. OF ADJUSTING SCREWS

FOR HEADSTOCK ALIGNMENT.

DETAIL 3A

16.7.81



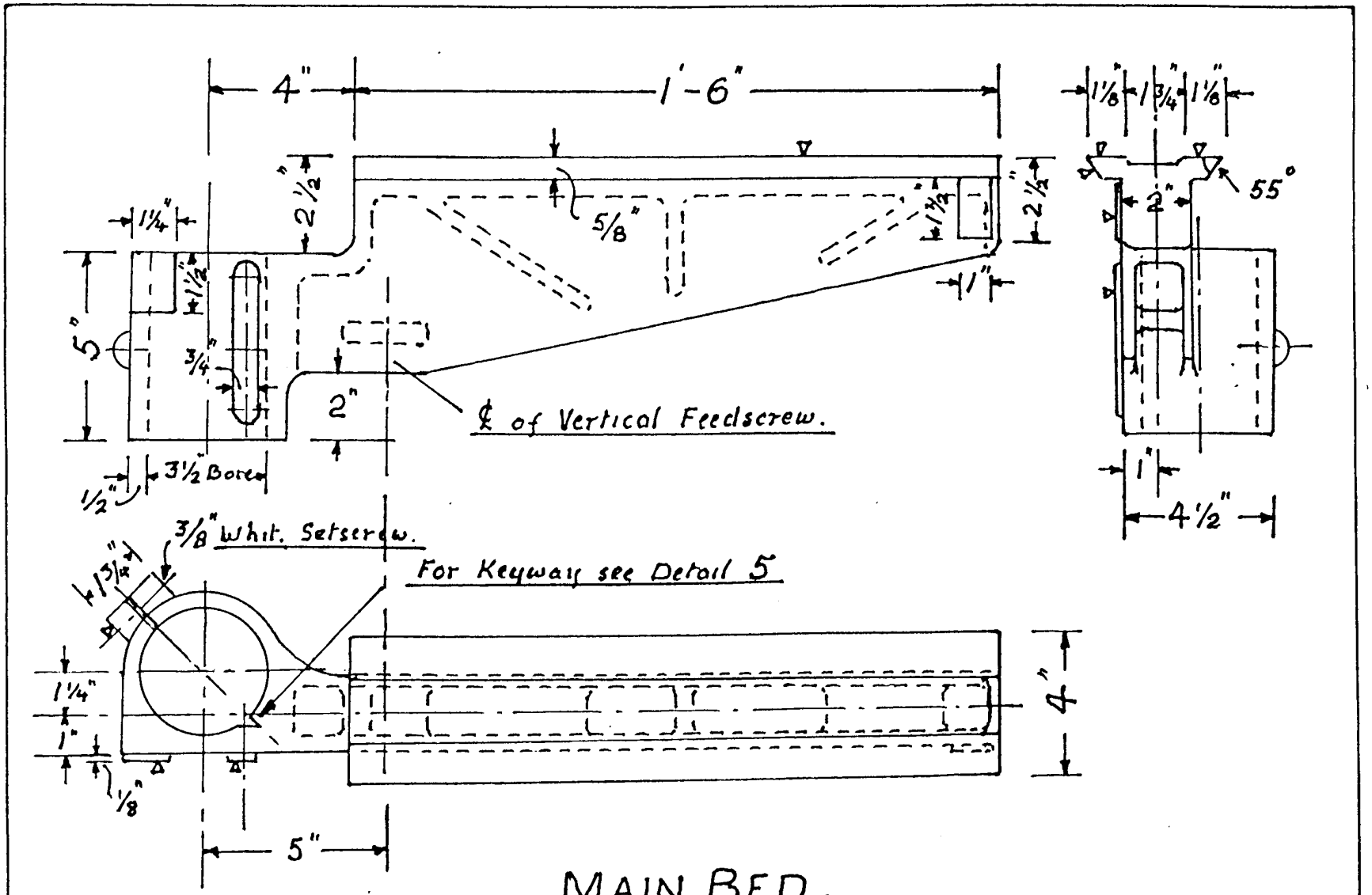
MAIN BED.

MODIFICATION TO SHAPE OF MAIN BED CASTING. 2.4.83

Material. C.I.

DETAIL 4.

17.10.82

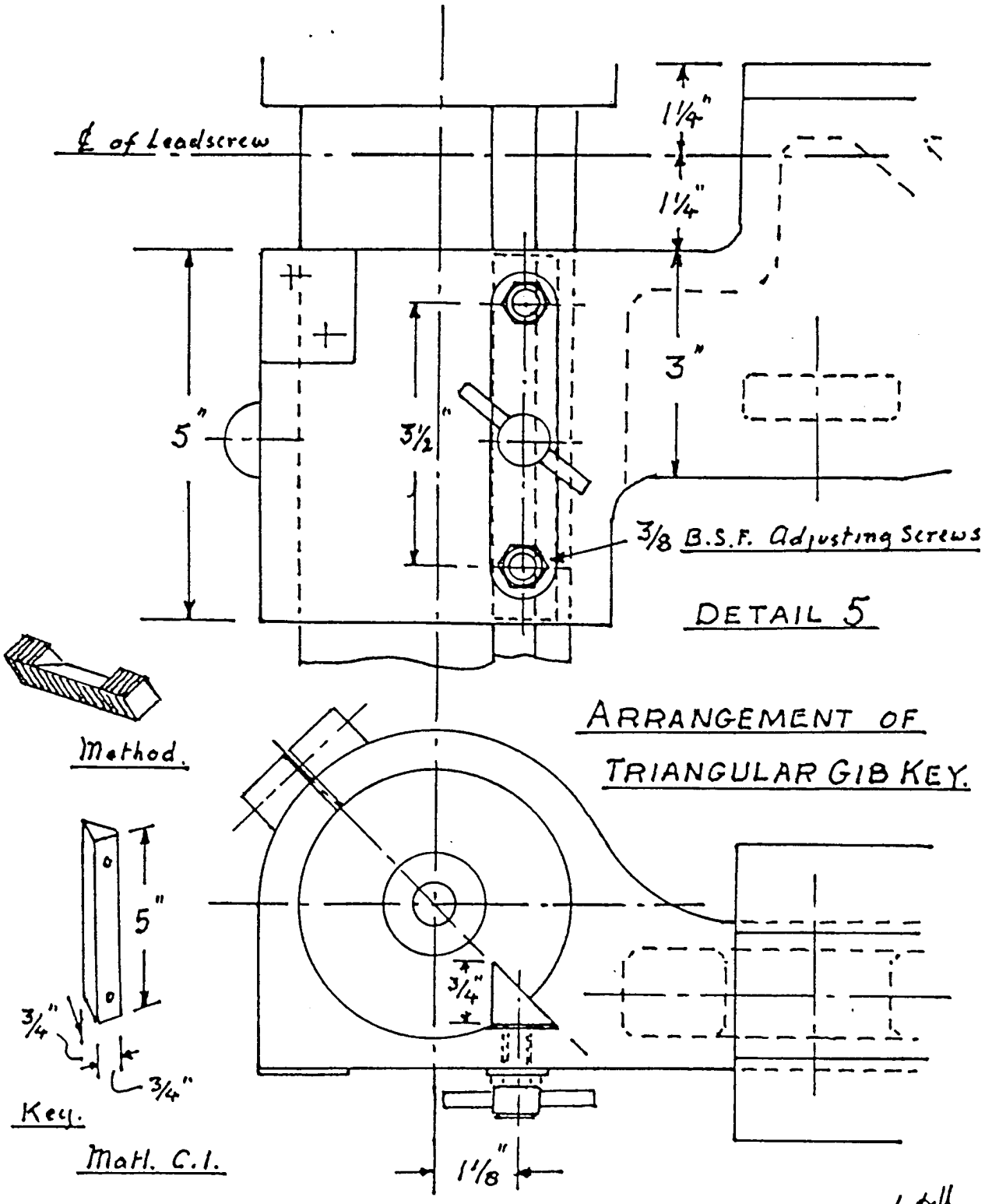


MAIN BED.

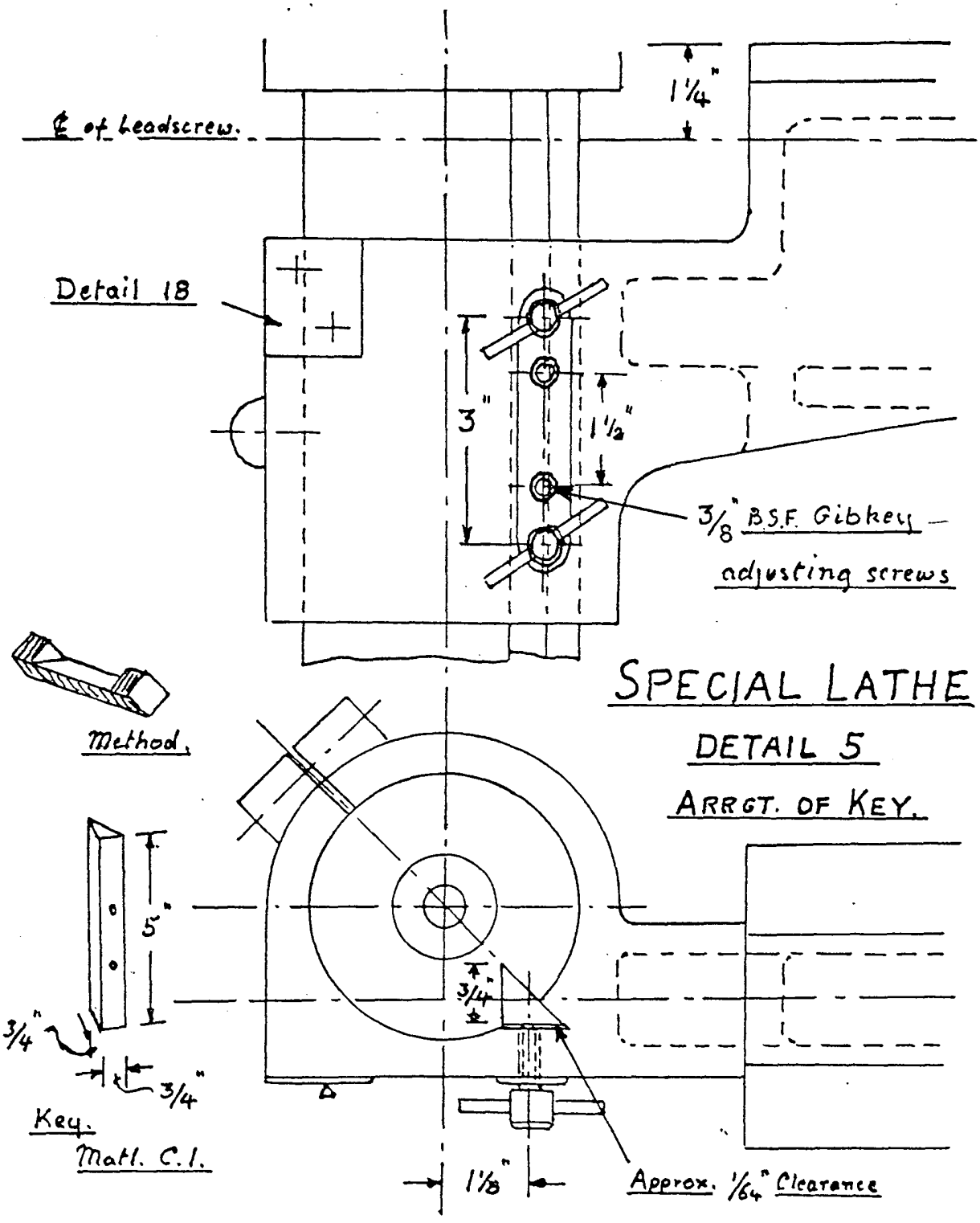
DETAIL 4

Material C.I.

21.4.83


℄ of Leadscrew
1¼"
1¼"
3"
5"
3½"
3/8 B.S.F. Adjusting Screws
DETAIL 5
Method.
ARRANGEMENT OF
TRIANGULAR GIB KEY.
5"
3/4"
3/4"
Key.
Matl. C.I.
3/4"
1⅛"

21.4.83

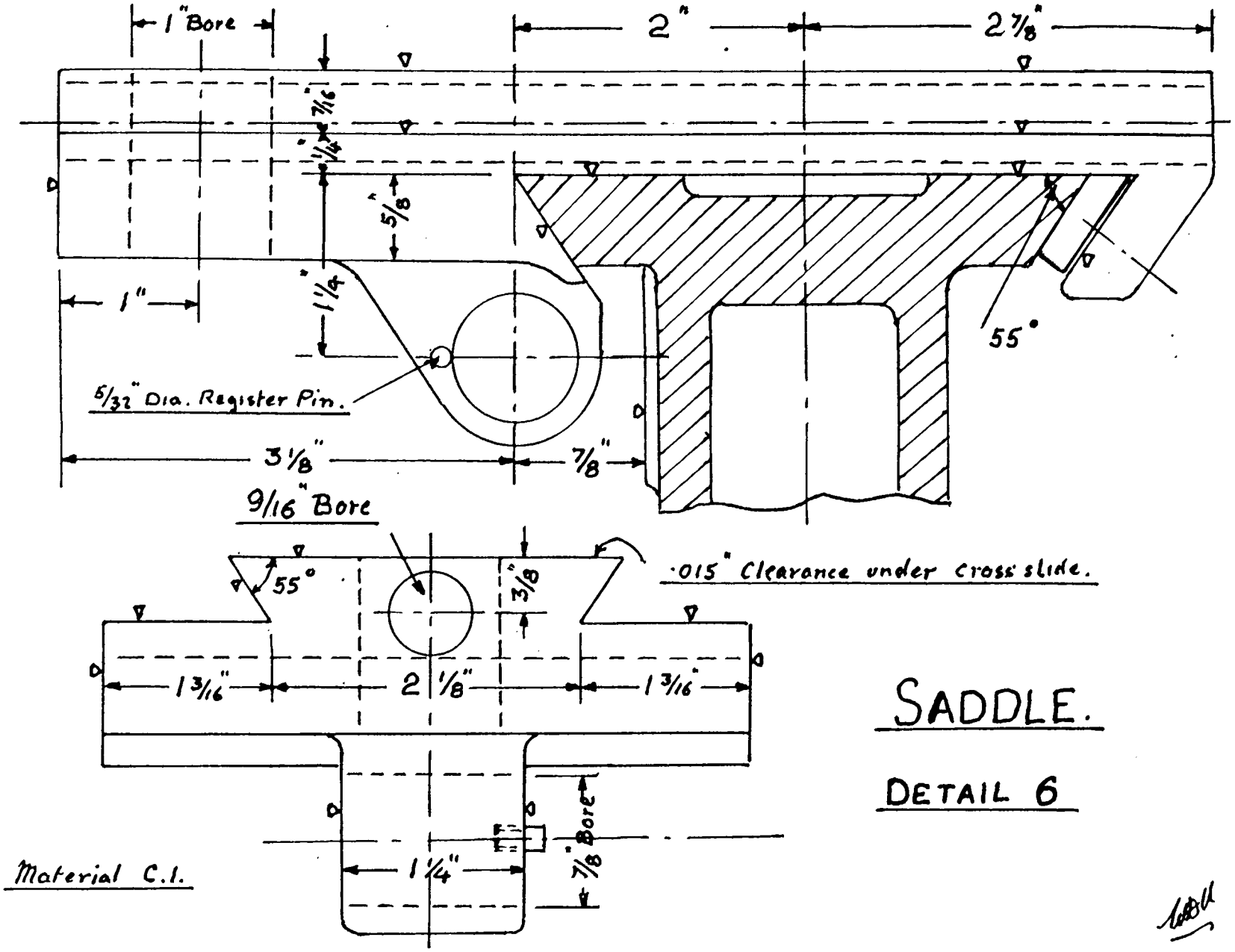


SPECIAL LATHE

DETAIL 5

ARRGT. OF KEY.

10.7.81

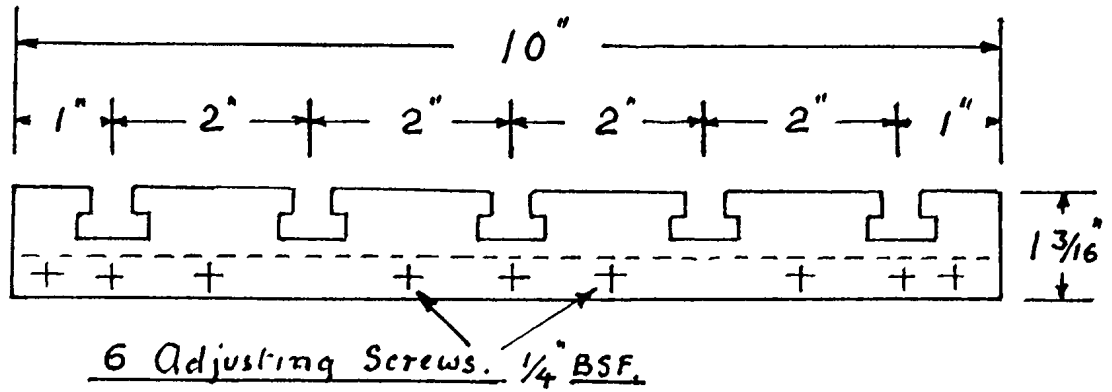


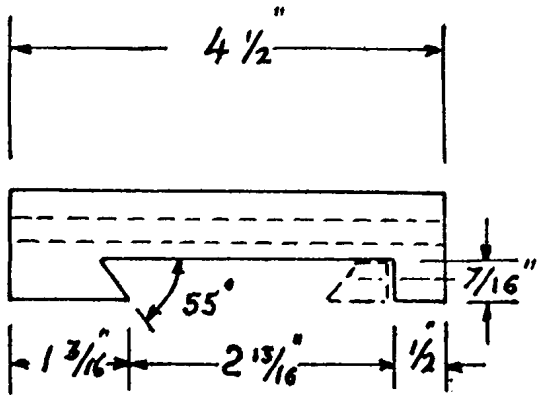
SADDLE.

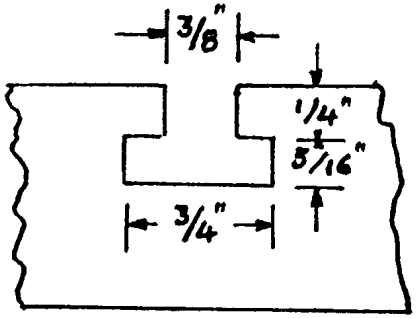
DETAIL 6

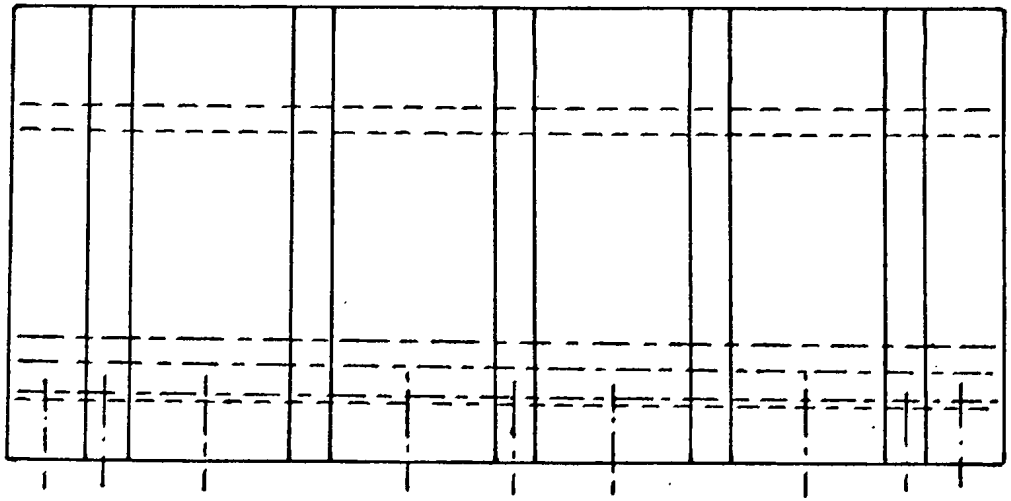
Material C.I.

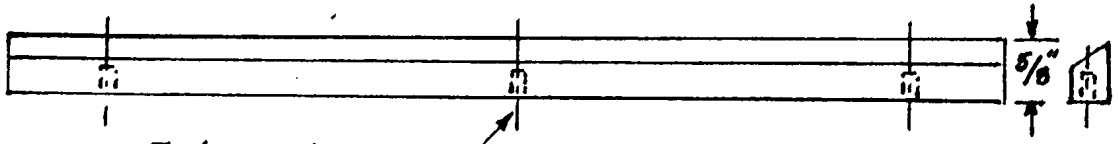
23.10.81







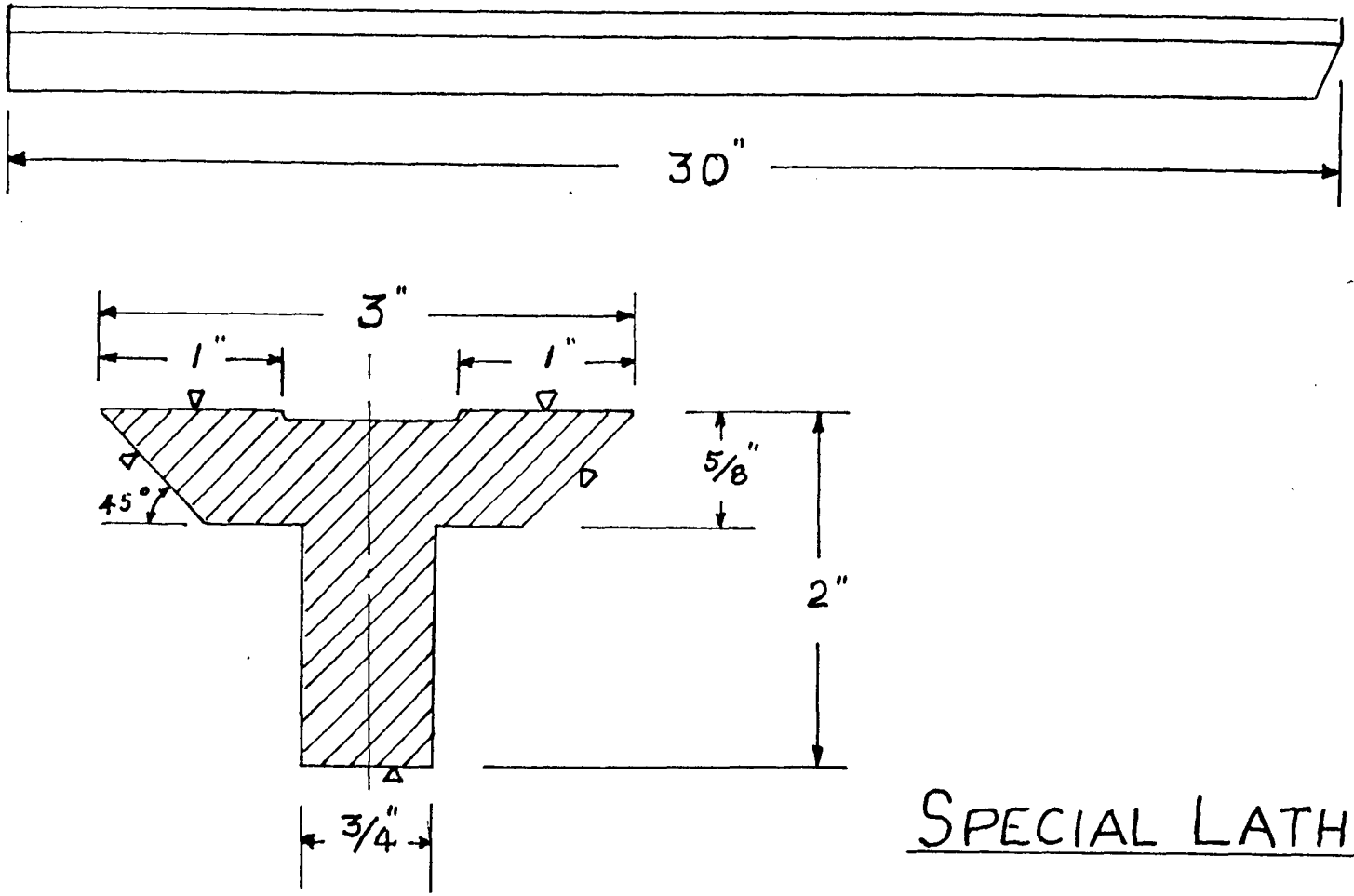




CROSS SLIDE.

DETAIL 7

7.11.81

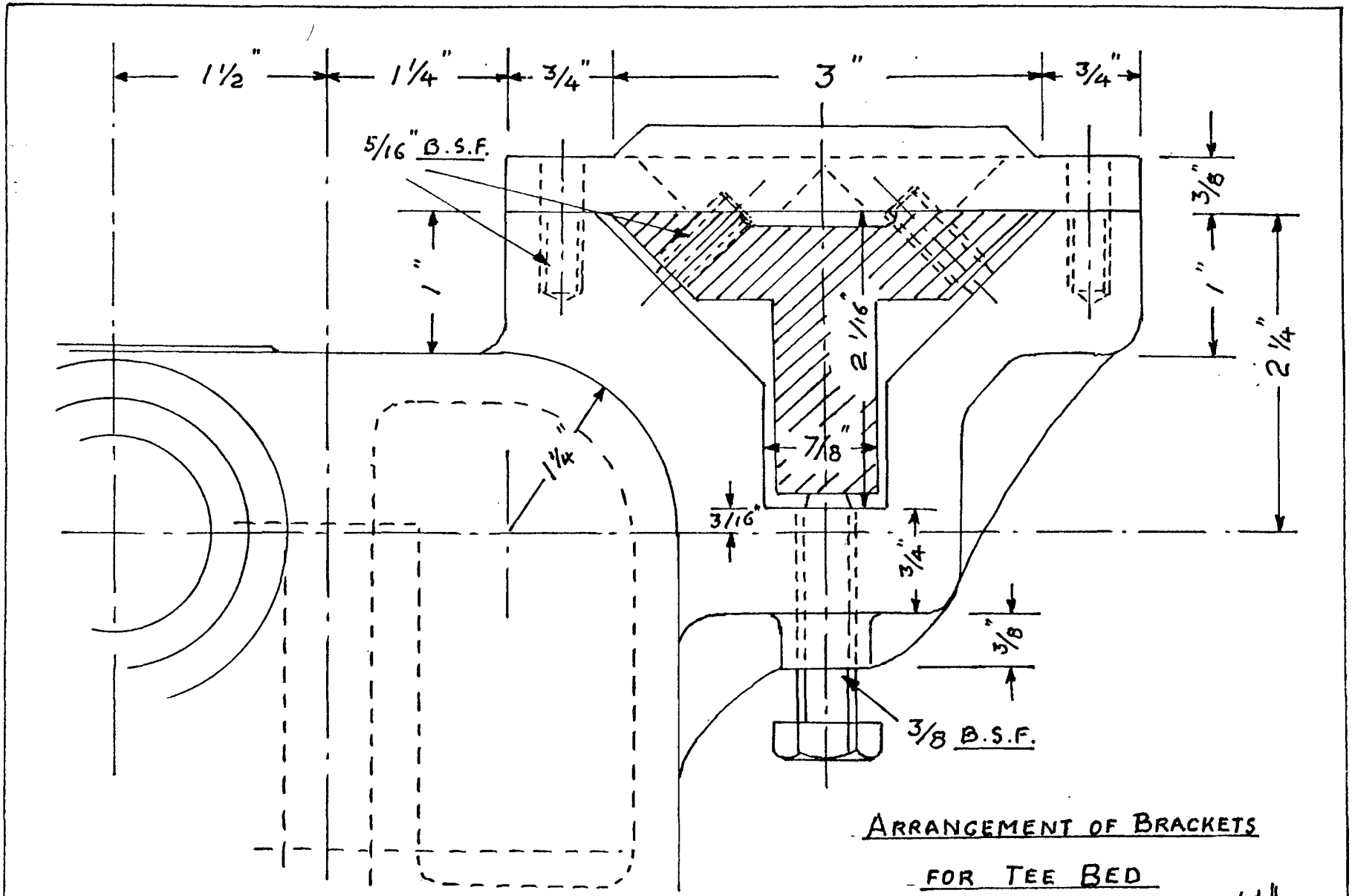


SPECIAL LATHE

DETAIL 8 SECONDARY TEE BED

Material. C.I.

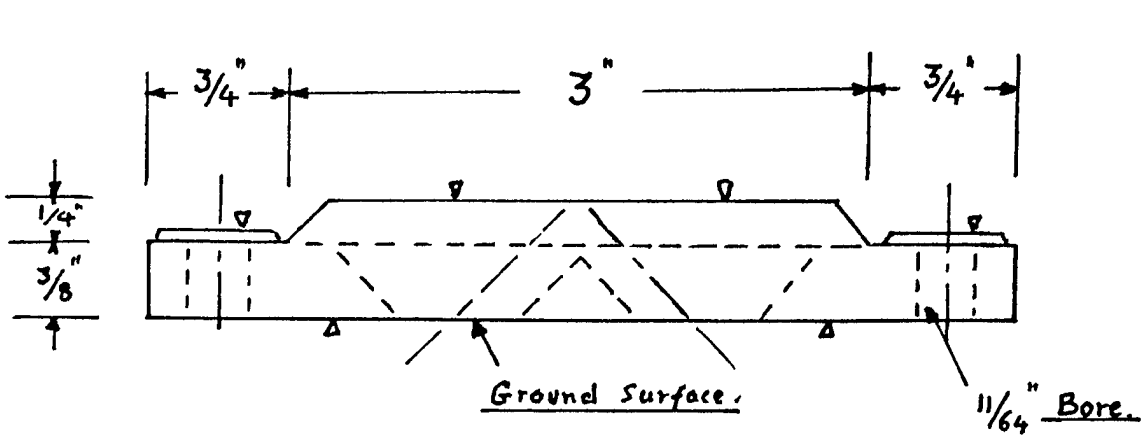
27.8.81

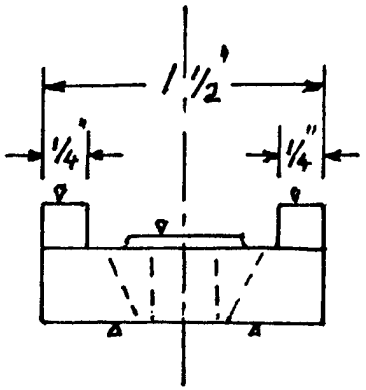


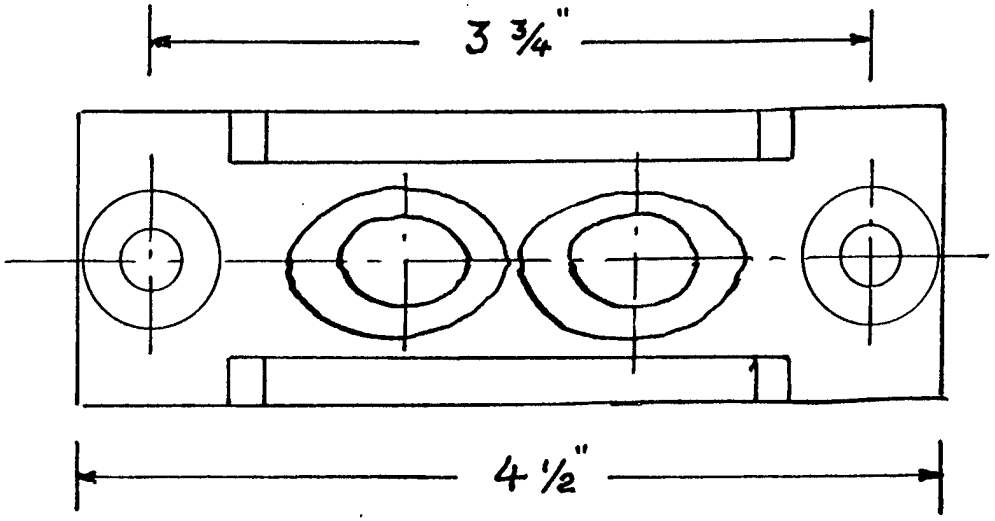
ARRANGEMENT OF BRACKETS FOR TEE BED

DETAIL 9

21.2.82





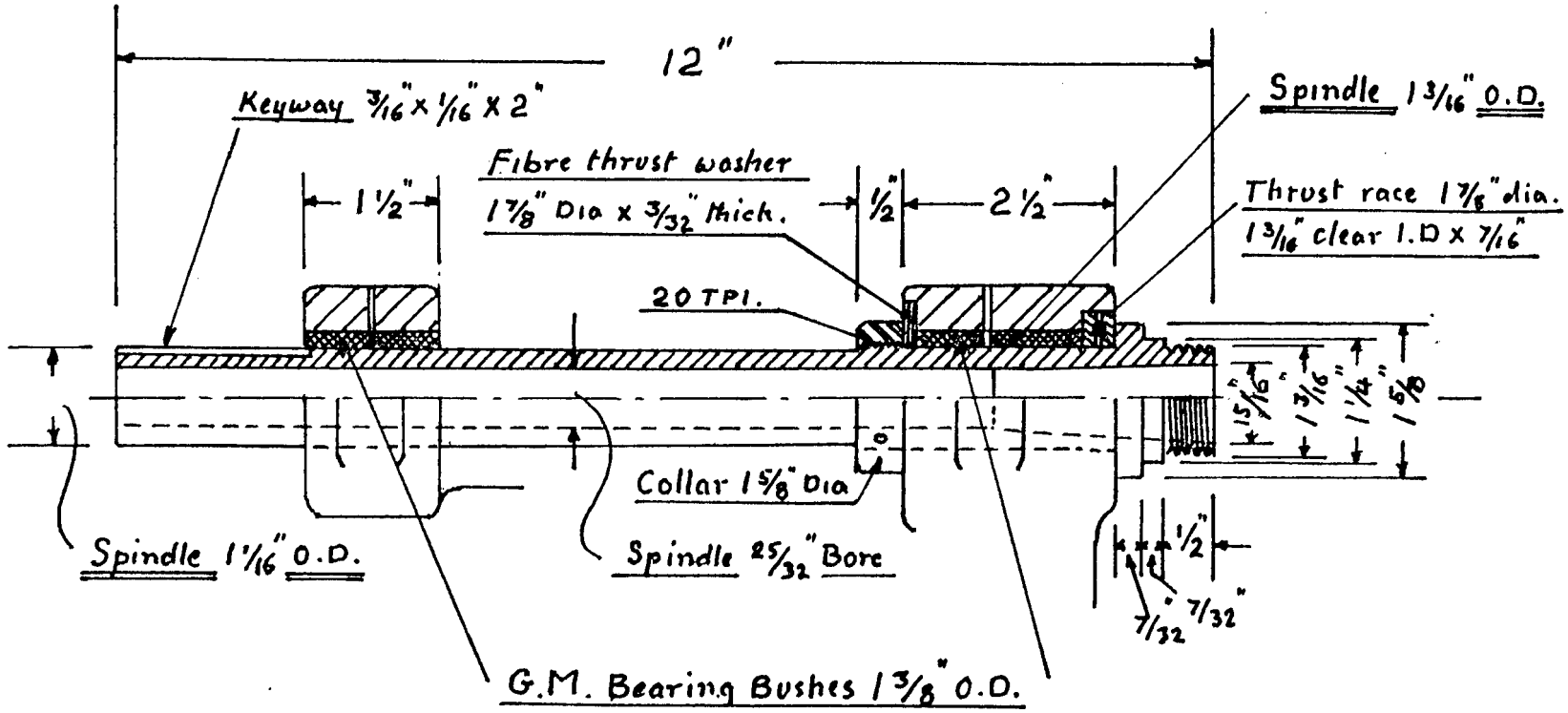


STRAP - 2 OFF.

DETAIL 9A

Material. C.I.

24.10.81



Spindle Material EN 24

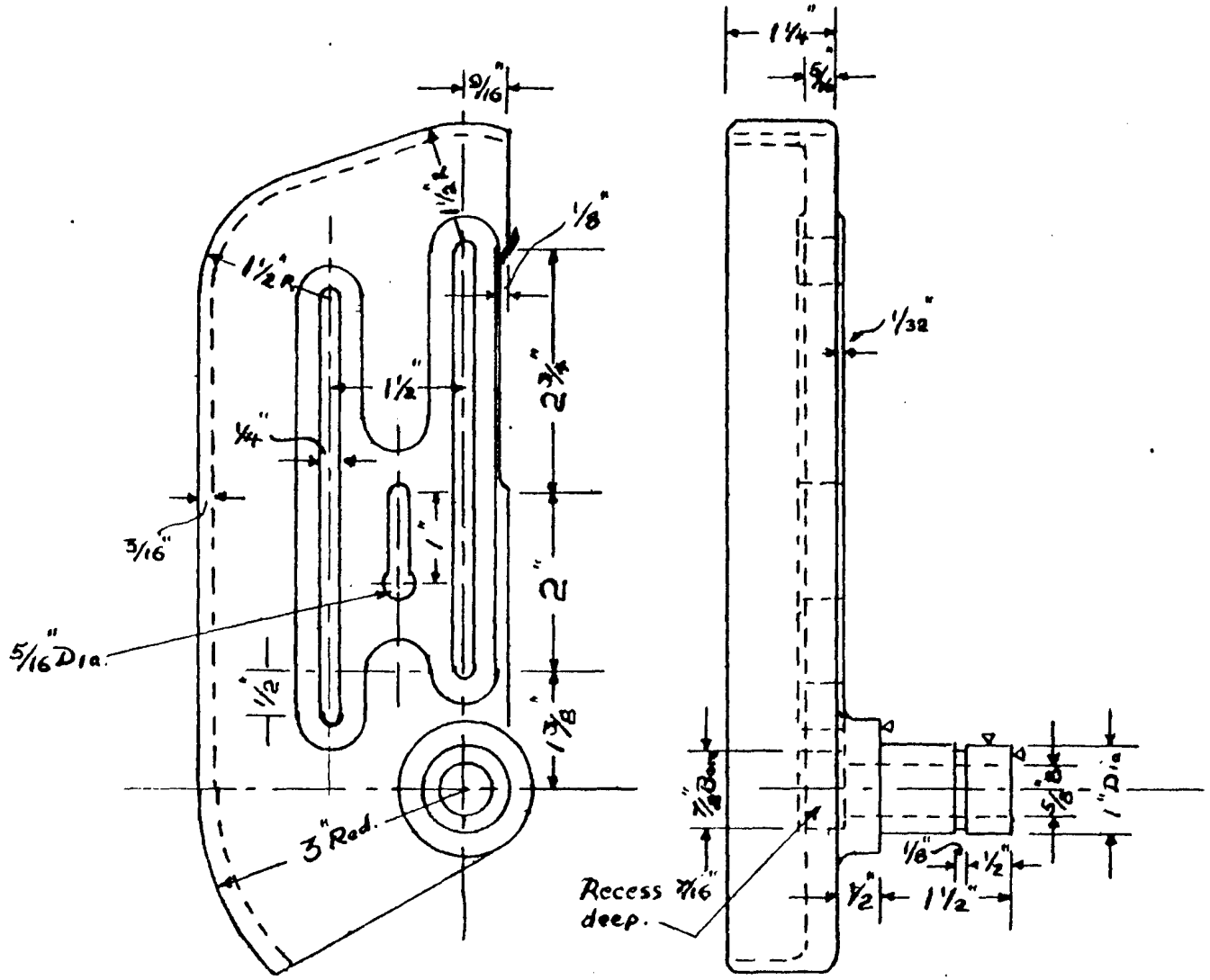
NOSE NO 3 MORSE TAPER

12 T.P.I.

SPINDLE.

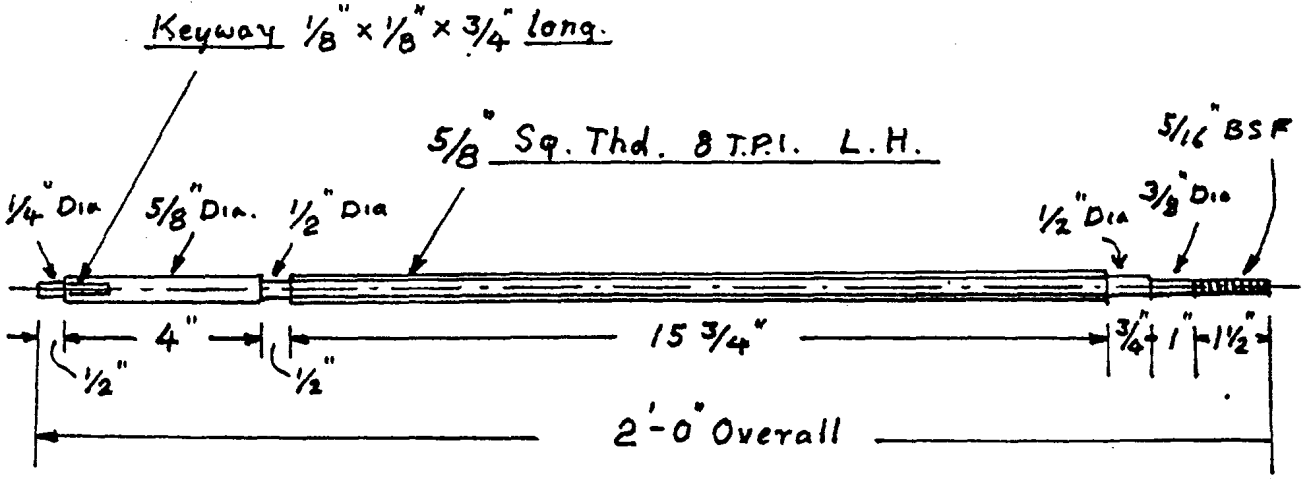
DETAIL 10

26.10.81



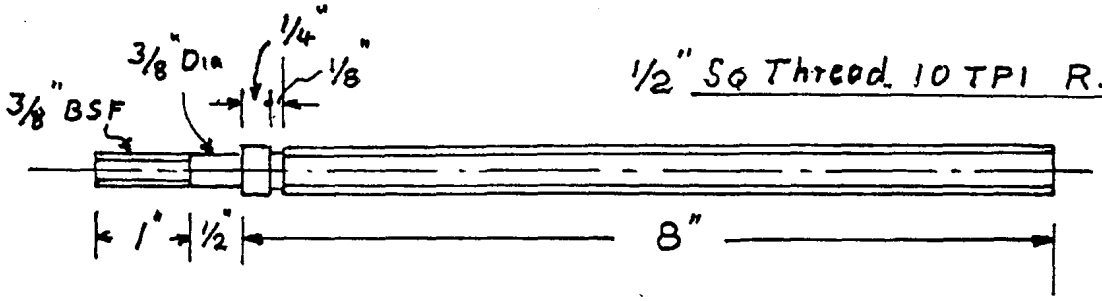
DETAIL 11 – CHANGE WHEEL CARRIER.

8.6.55

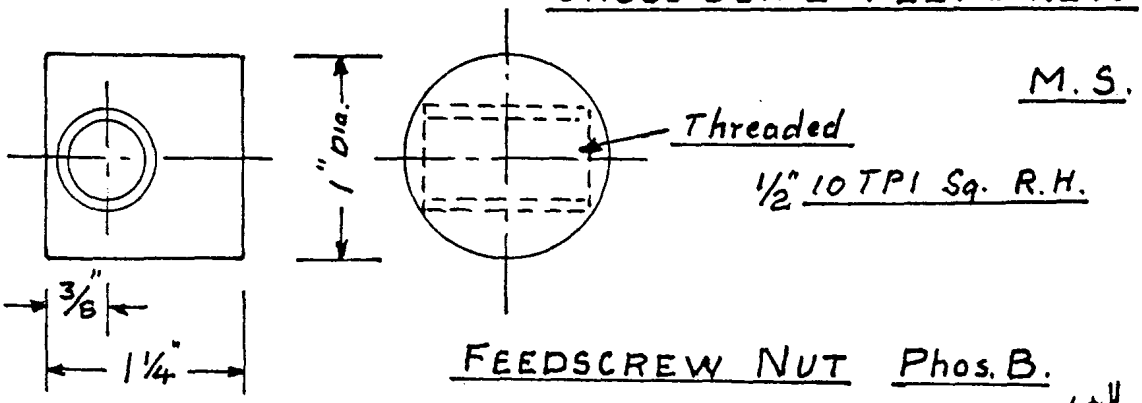


LEADSCREW M.S.

DETAIL 12



CROSS SLIDE FEEDSCREW

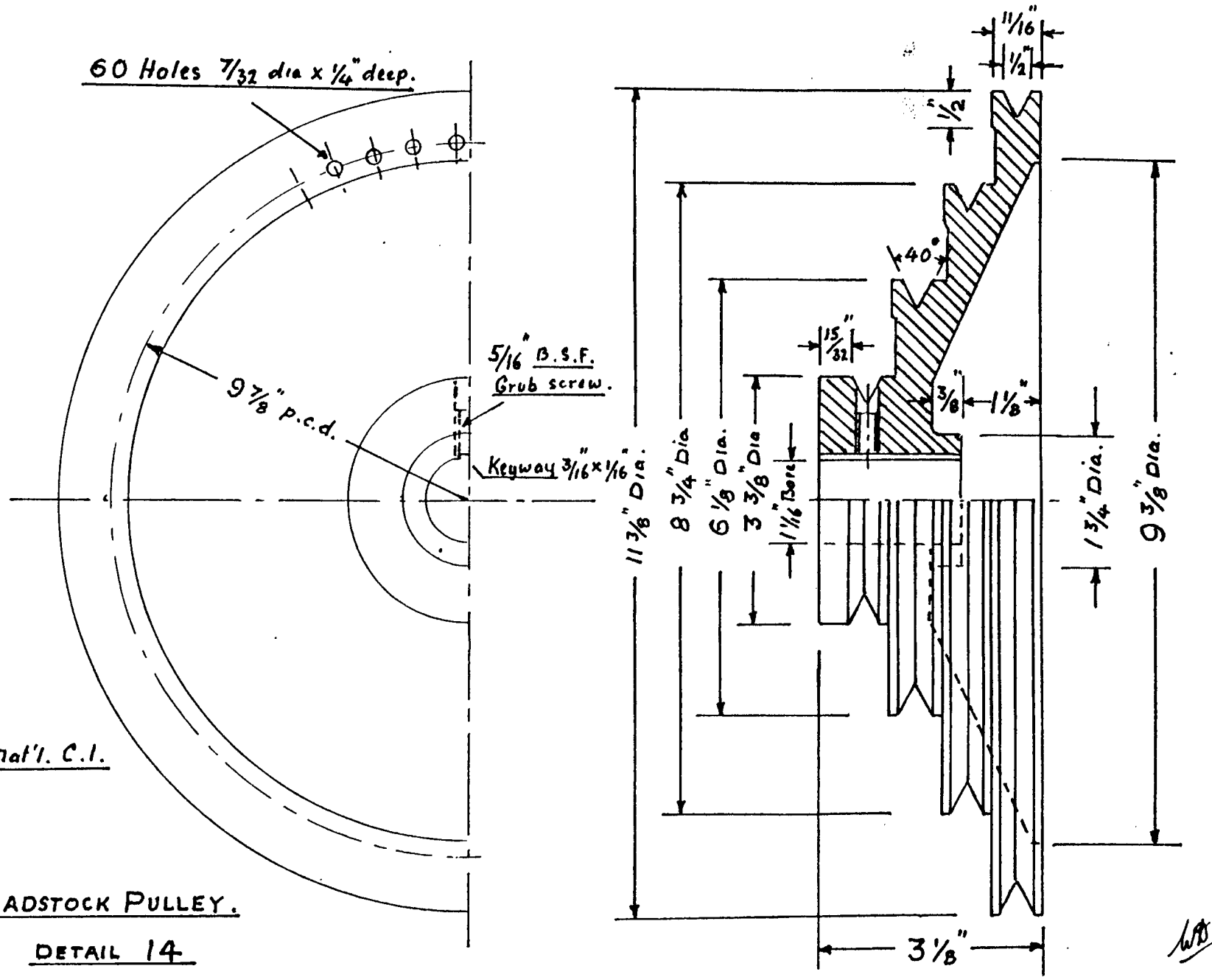


M.S.

FEEDSCREW NUT Phos. B.

DETAIL 13

30.1.82

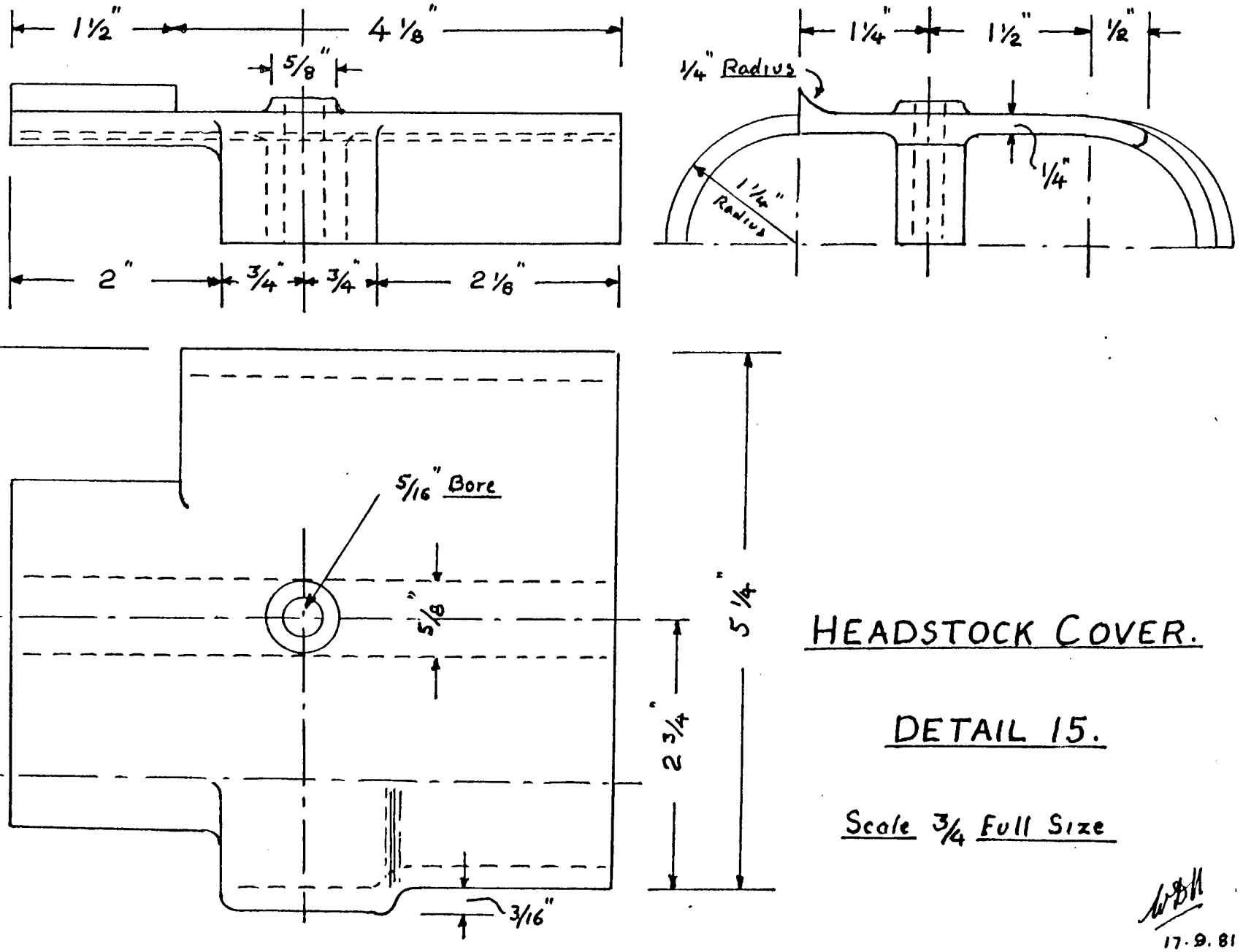


Mat'l. C.I.

HEADSTOCK PULLEY.

DETAIL 14

26.10.81

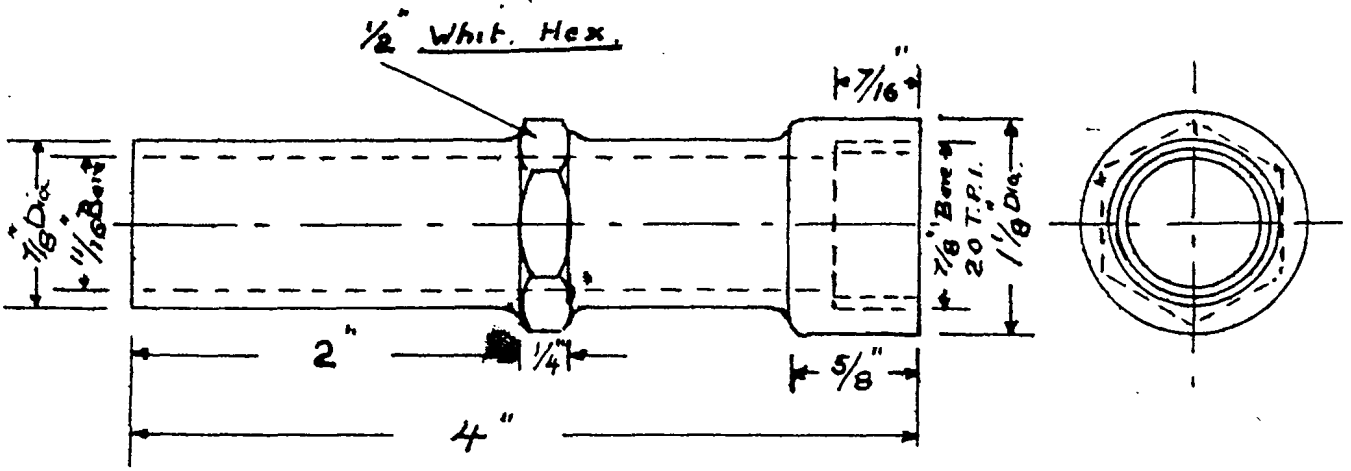


HEADSTOCK COVER.

DETAIL 15.

Scale ¾ Full Size

17.9.81

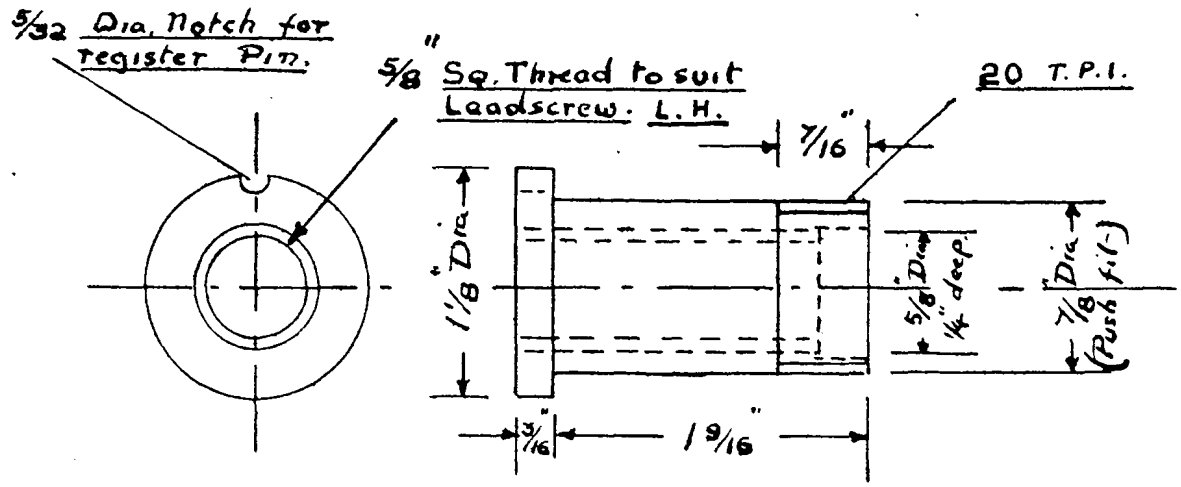


LEADSCREW COVER TUBE AND LOCKNUT.

DETAIL 16

MATERIAL M.S.

22.10.55

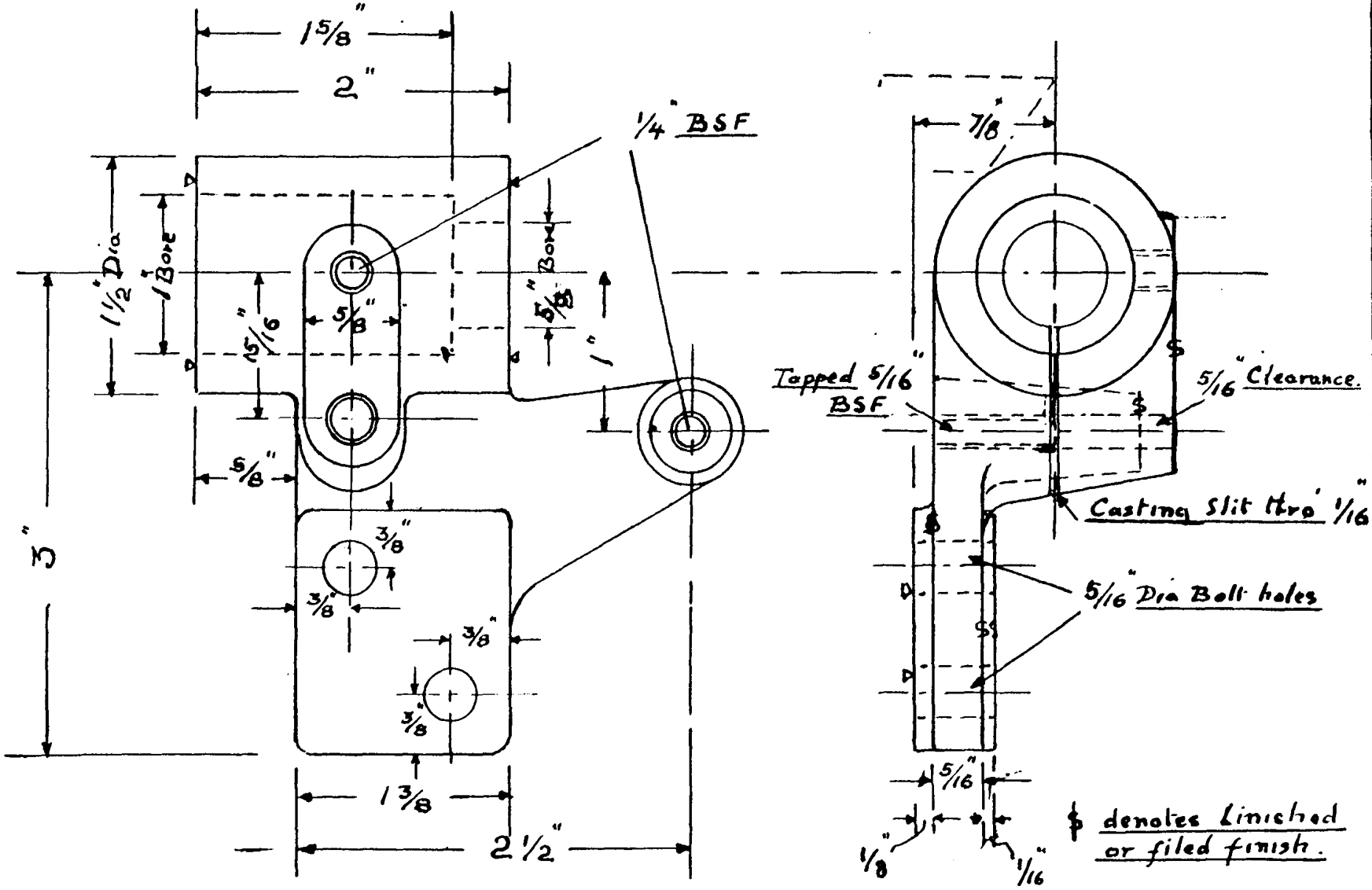


LEADSCREW NUT

DETAIL 17

MATERIAL. GM

22.10.55

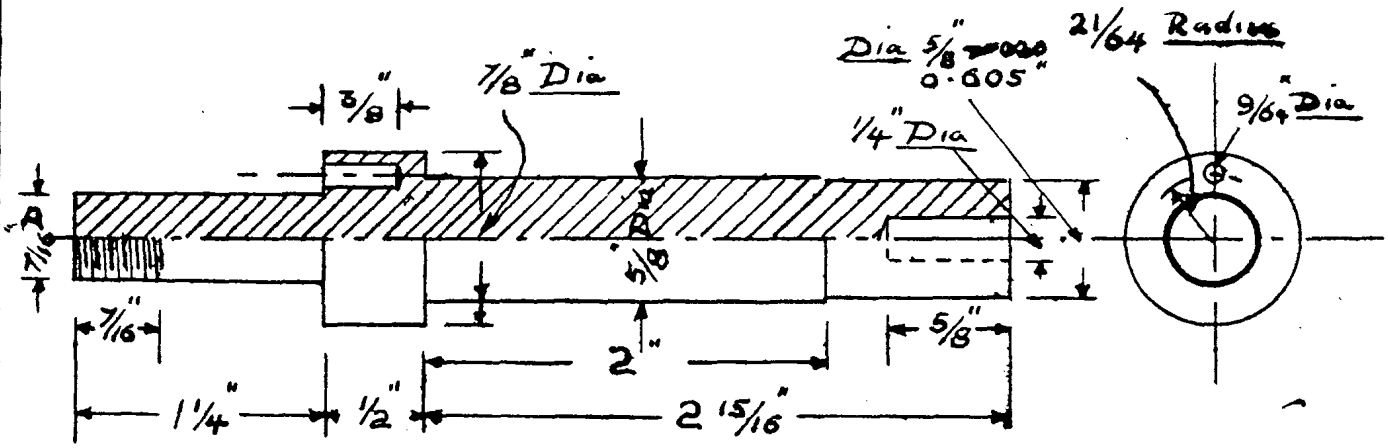


CARRIER ARM BEARING BRACKET

DETAIL 18

MATERIAL C.I.

22.10.55

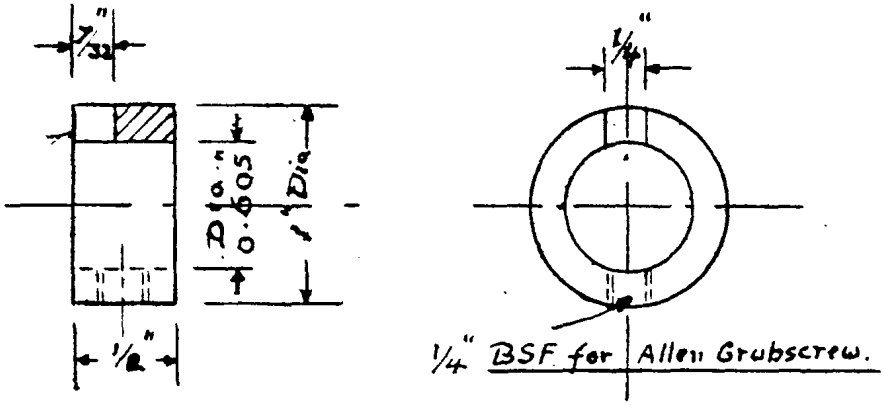


LEADSCREW DRIVING SPINDLE

DETAIL 19

MATERIAL M.S.

22.10.55

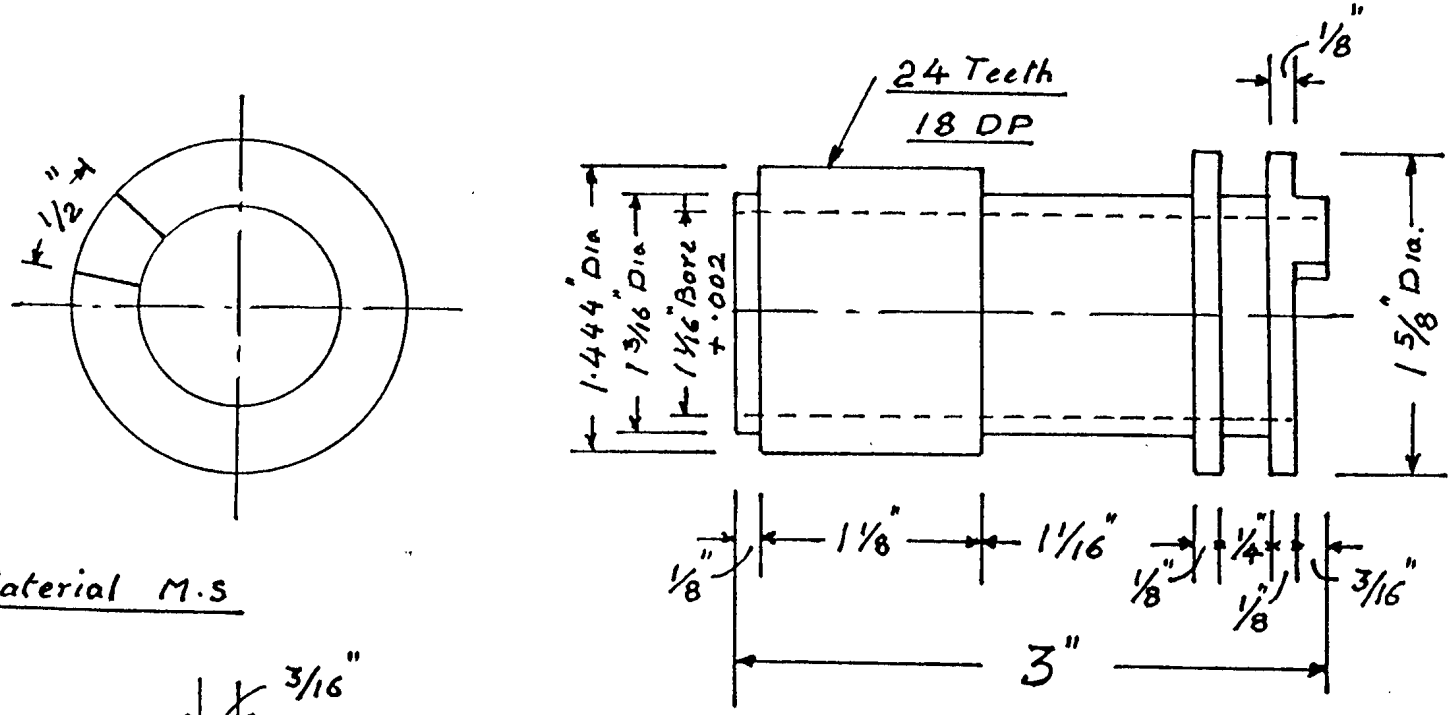


LEADSCREW DRIVING SPINDLE COLLAR

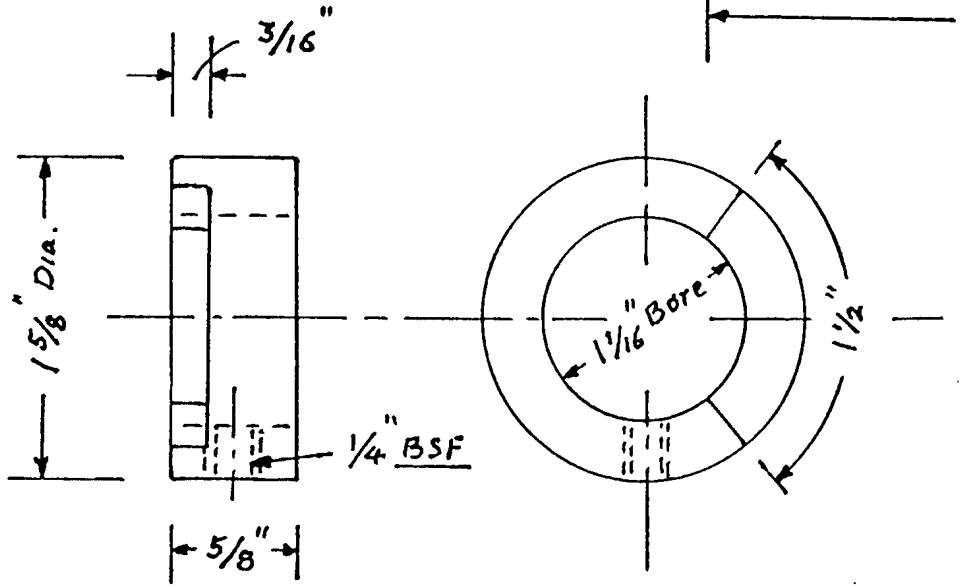
DETAIL 20

MATERIAL M.S.

22.10.55



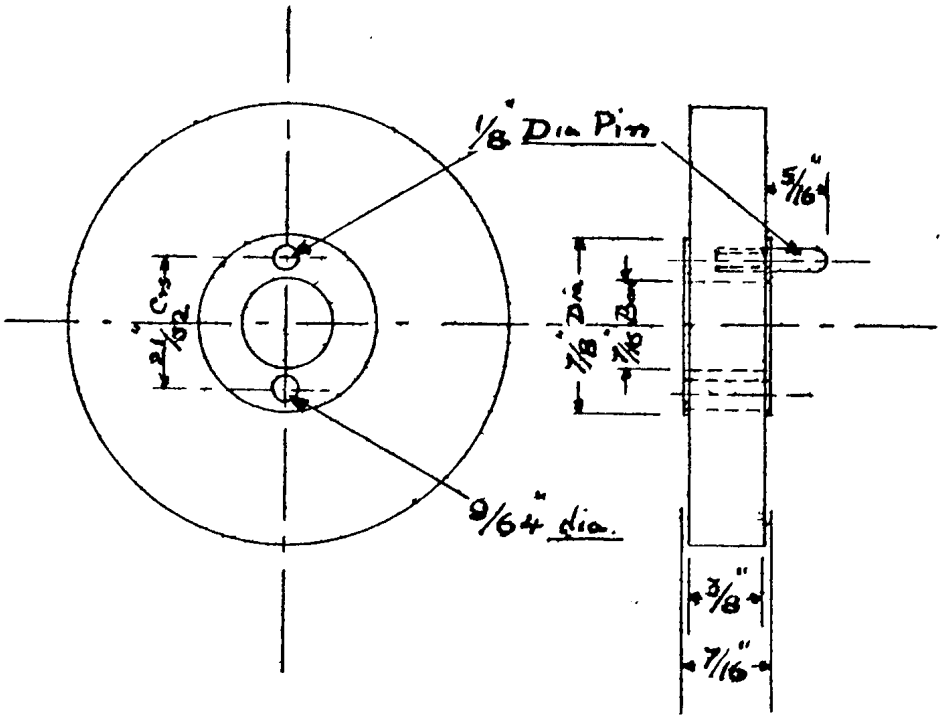
Material M.S



SPINDLE SLEEVE AND COLLAR

DETAIL 21

12.5.83



D.P.-18

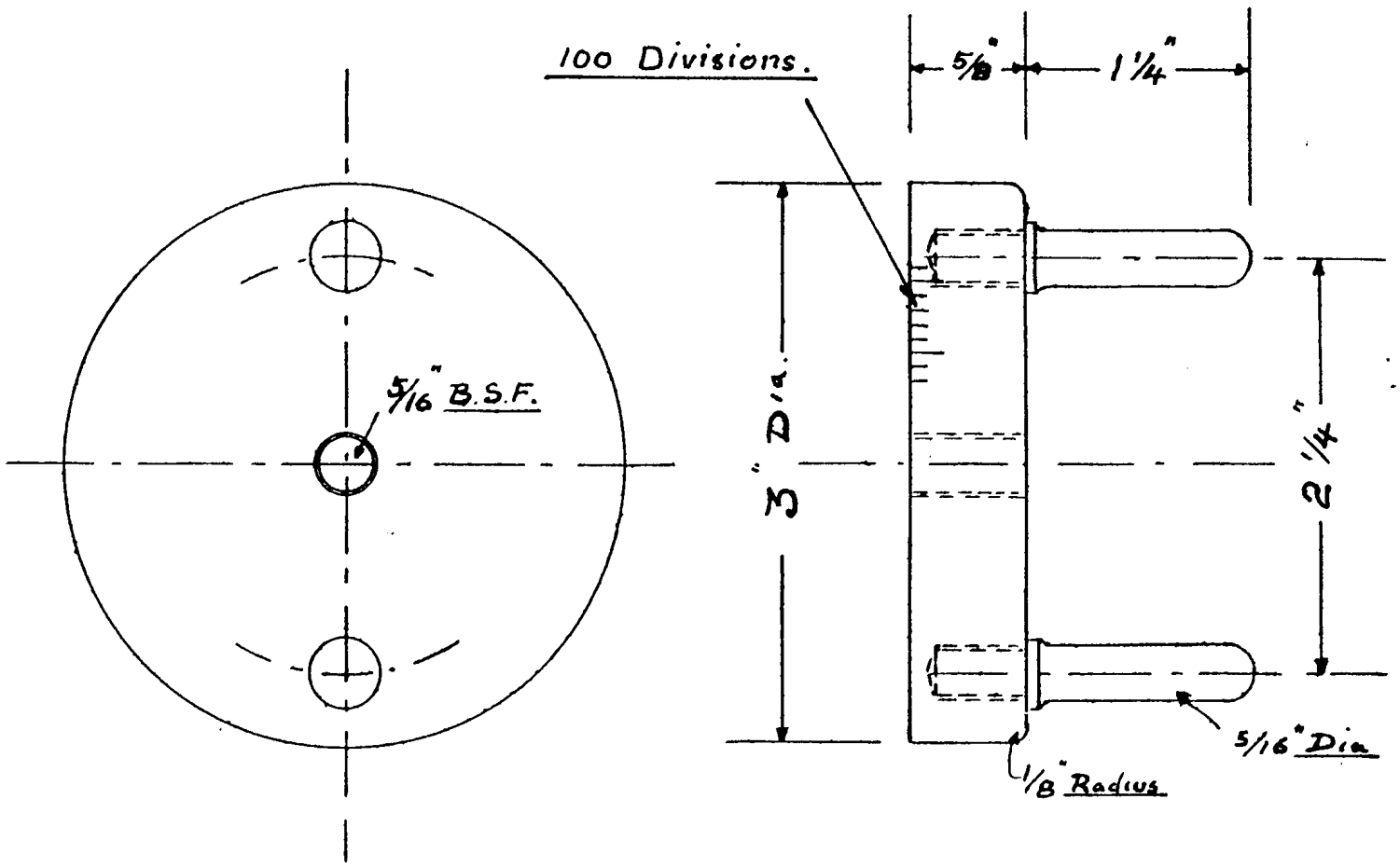
No. of Teeth	No. off.	Finished O.D. ins.
18	2	1·111
21	1	1·277
24	1	1·444
27	1	1·611
30	1	1·777
33	1	1·944
36	1	2·111
38	1	2·222
39	1	2·277
54	1	3·111
60	1	3·444
72	1	4·111

CHANGEWHEELS.

DETAIL 22

MATERIAL M.S.

W.D.H. 3.11.65

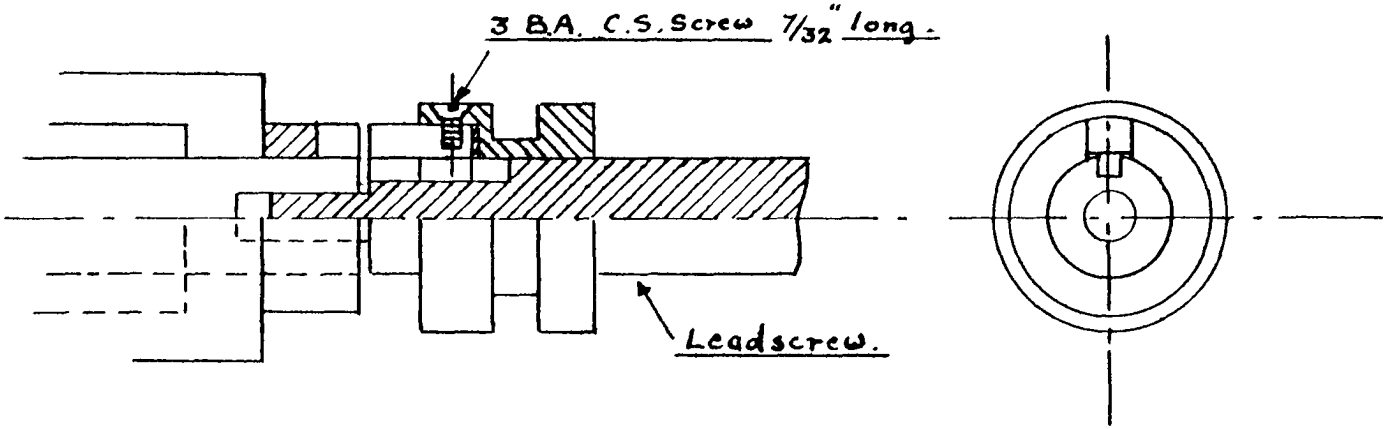


CROSSLIDE FEED HANDWHEEL

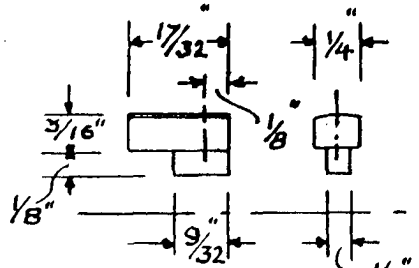
DETAIL 23

MATERIAL M.S

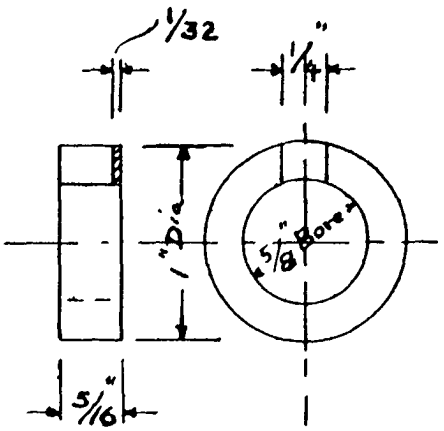
3.11.55



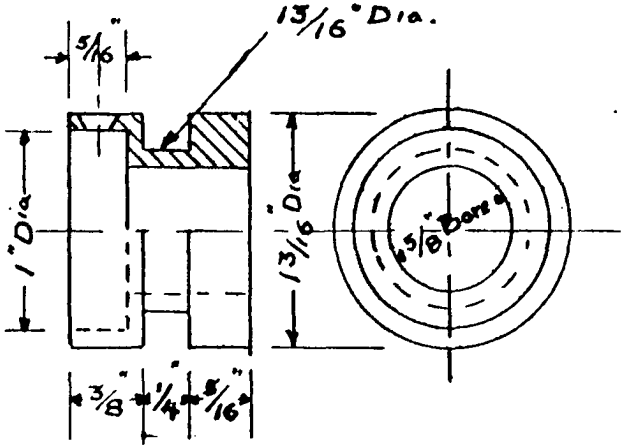
KEY



RING



COLLAR.

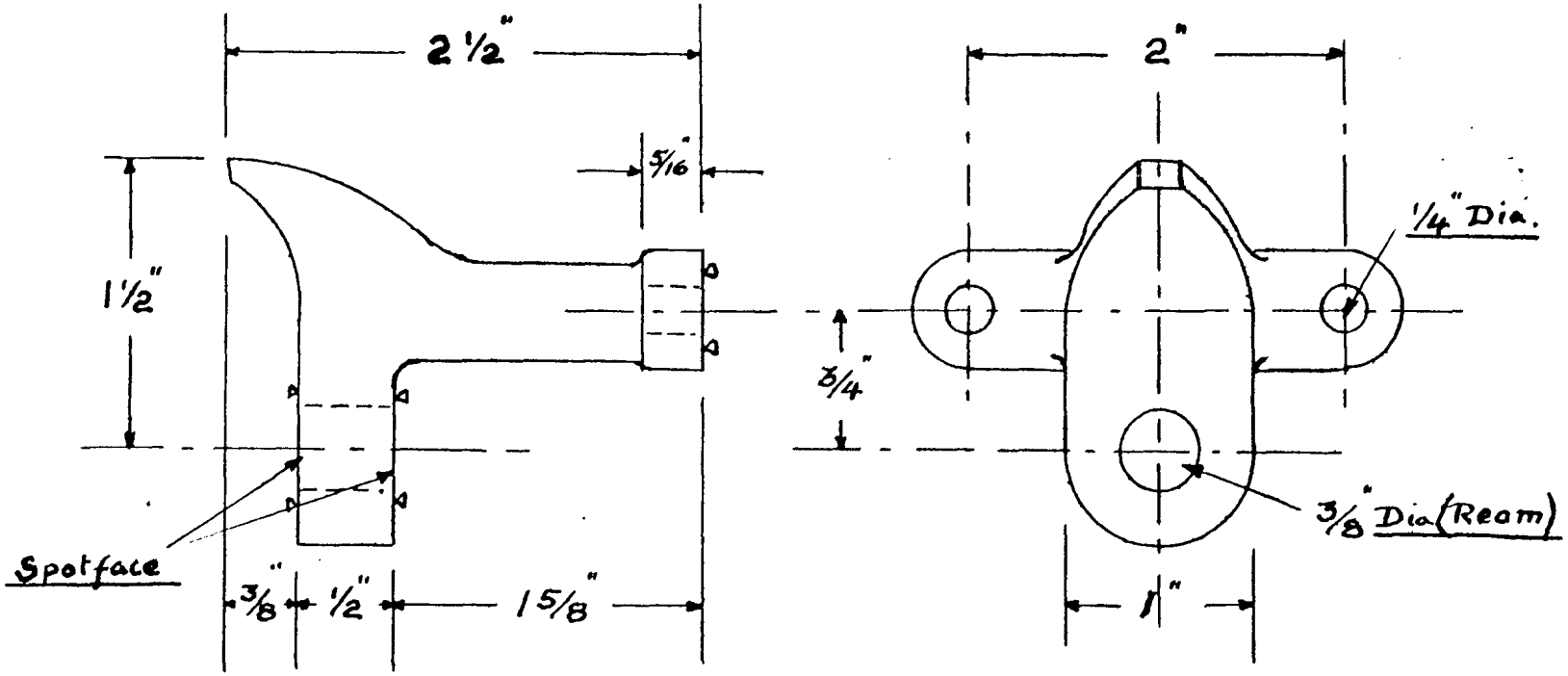


MATERIAL M.S.

ASSEMBLY AND DETAIL OF DOG CLUTCH

DETAIL 24

W & H.
27.11.55

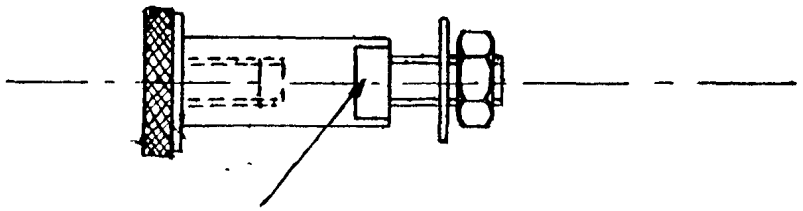


CROSSLIDE FEEDSCREW BRACKET

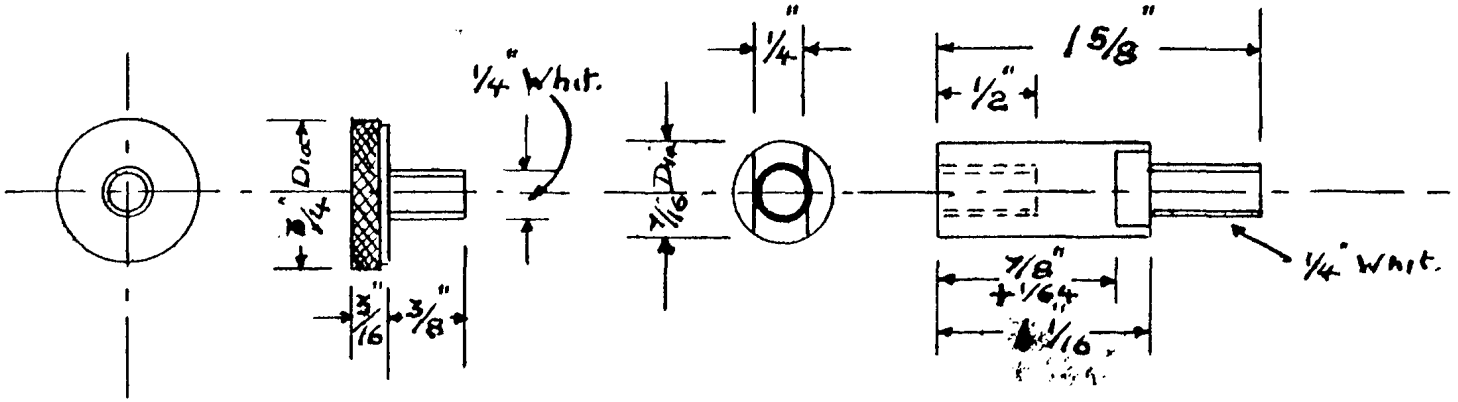
DETAIL 25

MATERIAL C.I.

WSH, 25.10.65



4 OFF

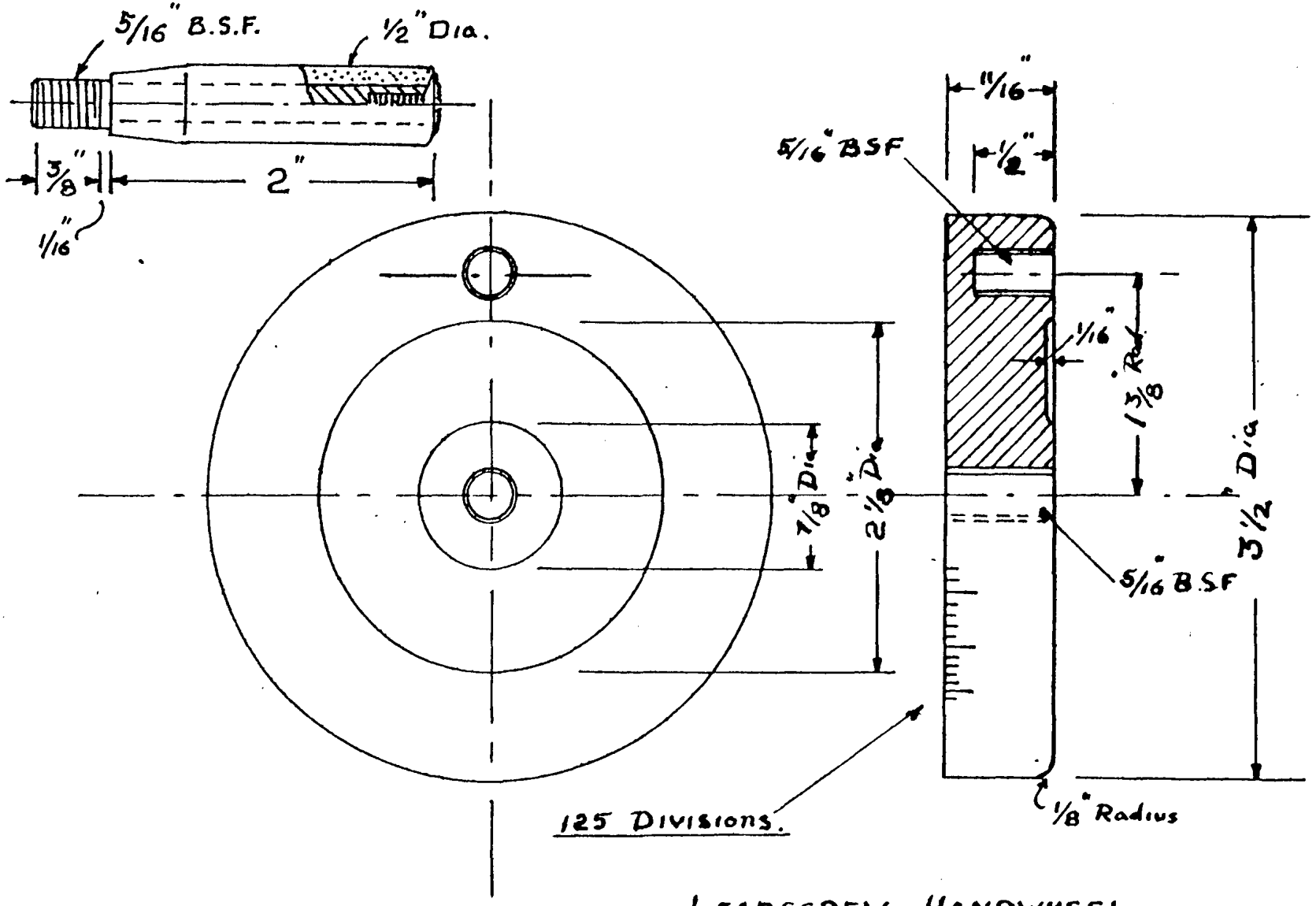


CHANGEWHEEL STUDS.

MATERIAL M.S.

DETAIL 26

27.11.55

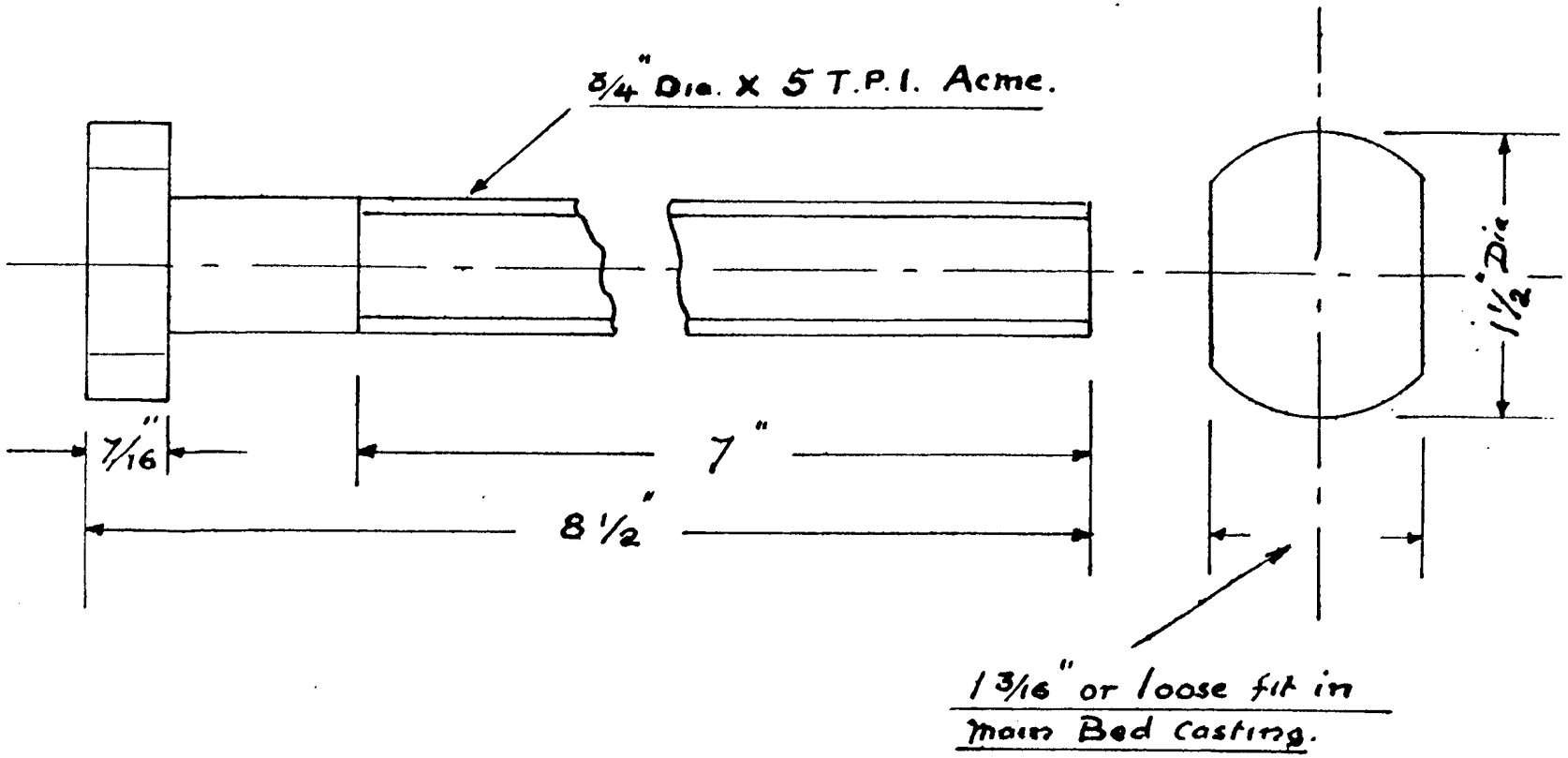


LEADSCREW HANDWHEEL

DETAIL 27

MATERIAL M.S

27.11.55

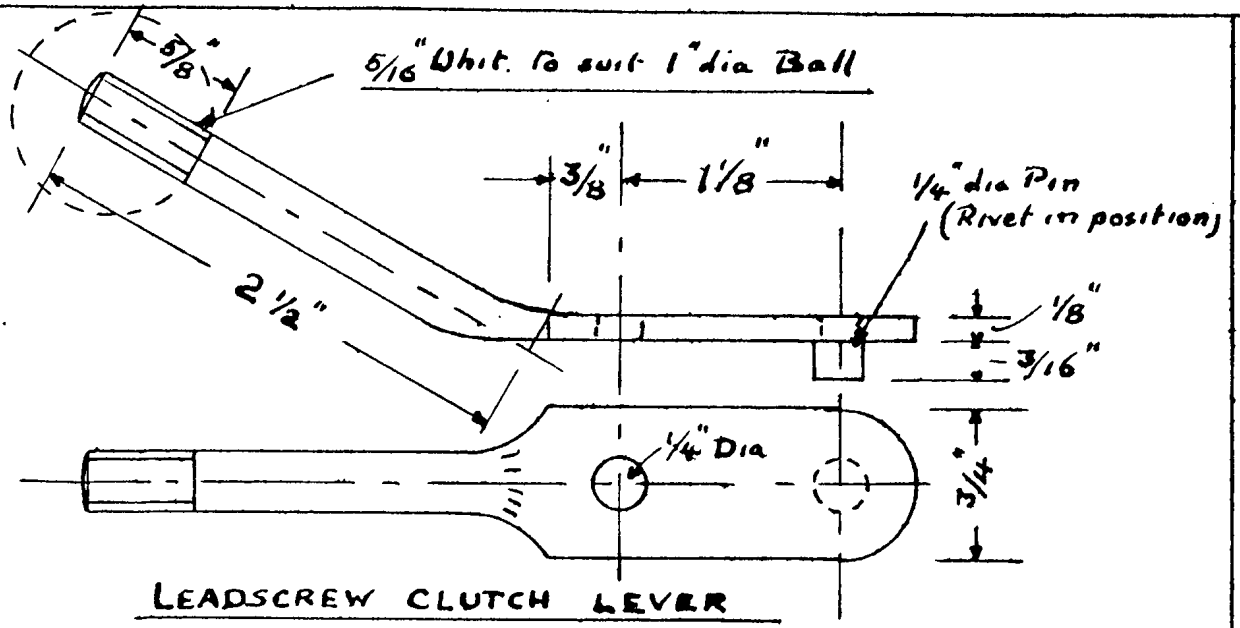


VERTICAL FEED SCREW

DETAIL 28

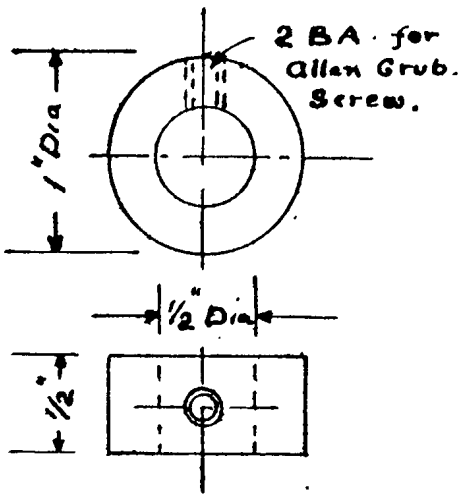
MATERIAL M.S.

25.2.56



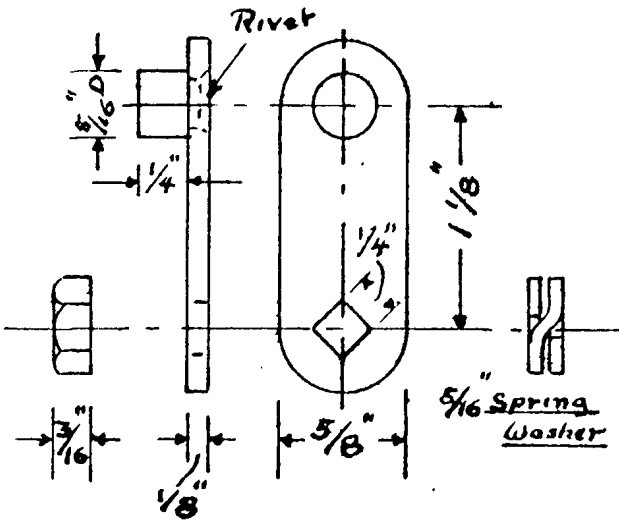
LEADSCREW CLUTCH LEVER

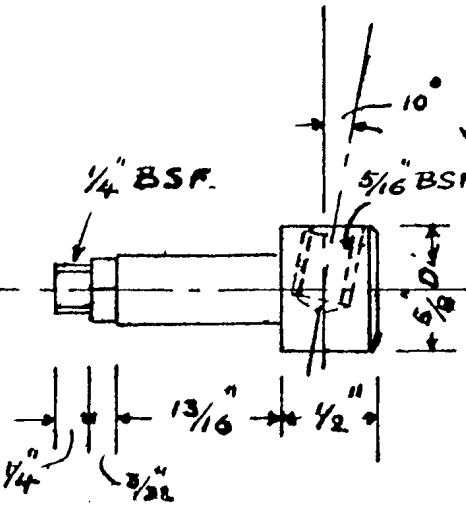
Material. M.S.

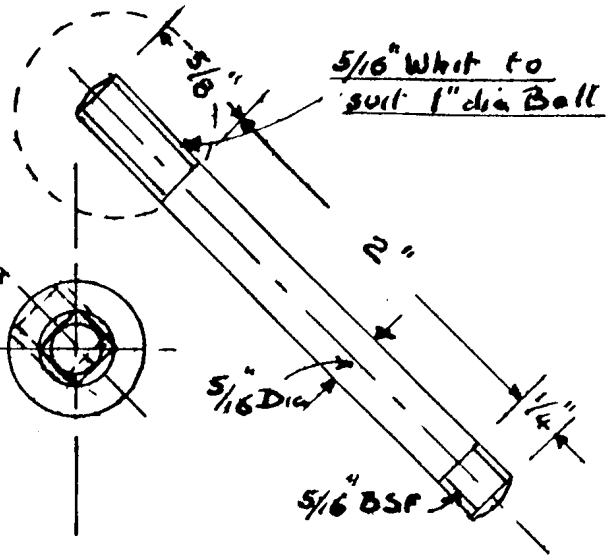


TAILSTOCK SPINDLE COLLAR

M.S.





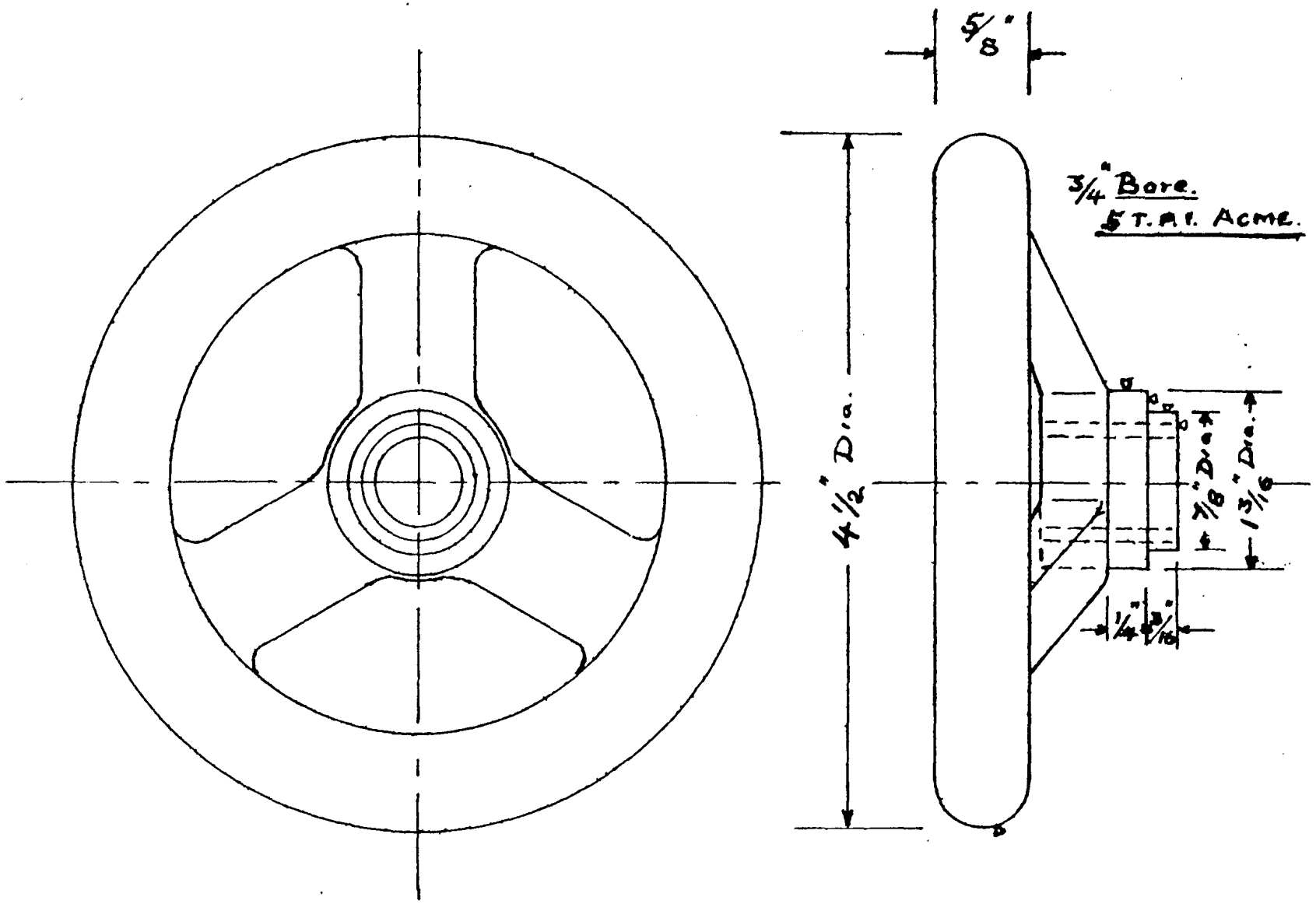


HEADSTOCK CLUTCH LEVER

Material M.S

DETAIL 29

25.2.56



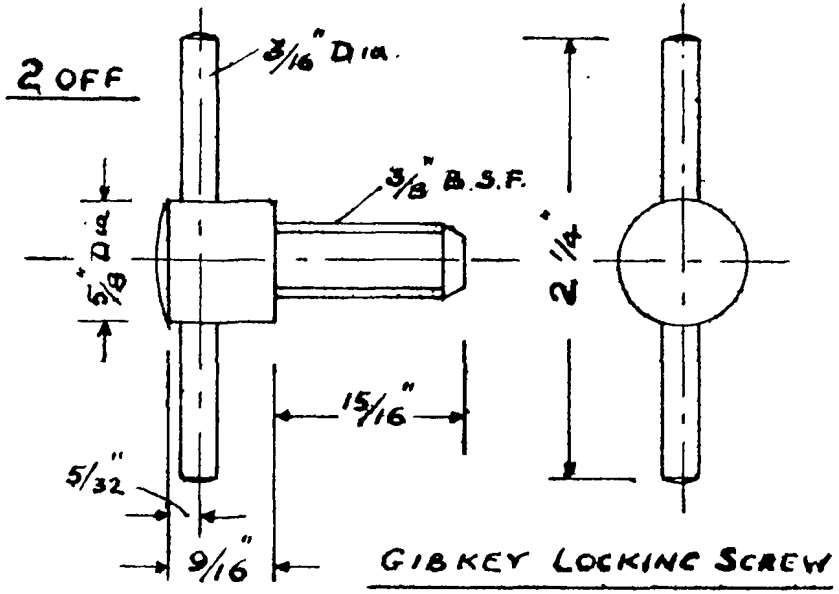
VERTICAL FEED HANDWHEEL

DETAIL 30

Material C.I.

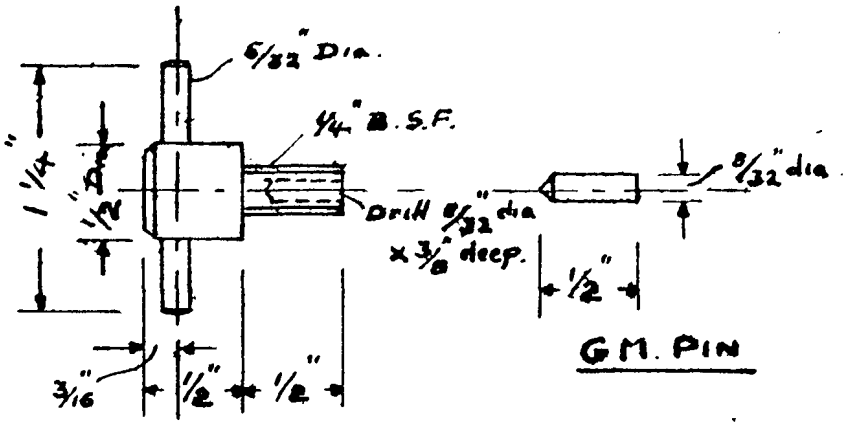
25.2.56

DETAIL 31



GIBKEY LOCKING SCREW

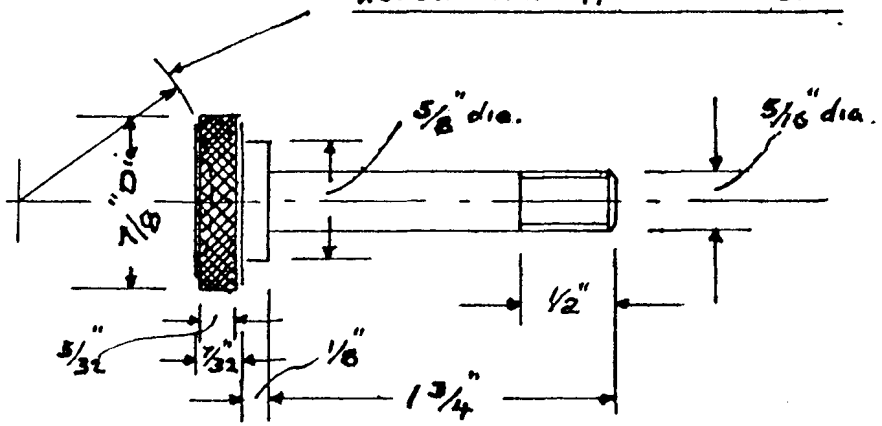
Material M.S.



GM. PIN

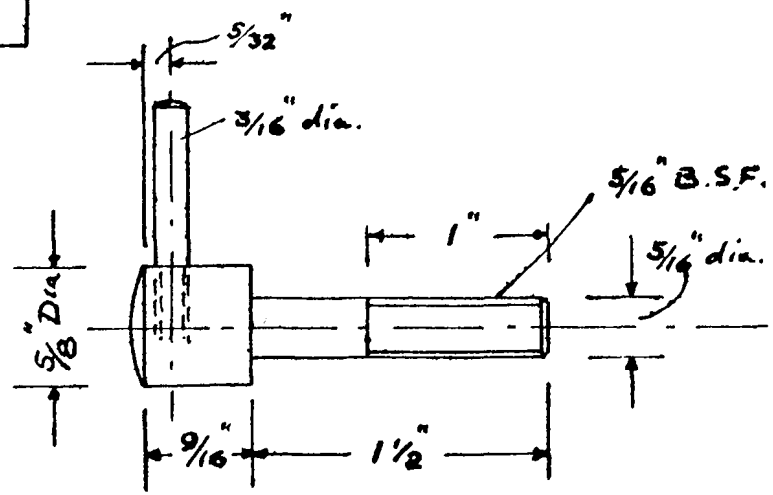
LOCKING SCREW FOR TAILSTOCK BARREL

Material. M.S.



HEADSTOCK COVER LOCKING SCREW

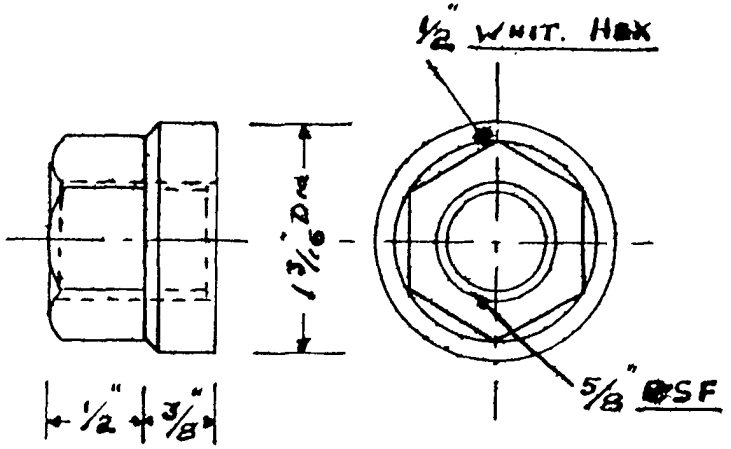
Material M.S.



CHANGEWHEEL CARRIER LOCKING SCREW

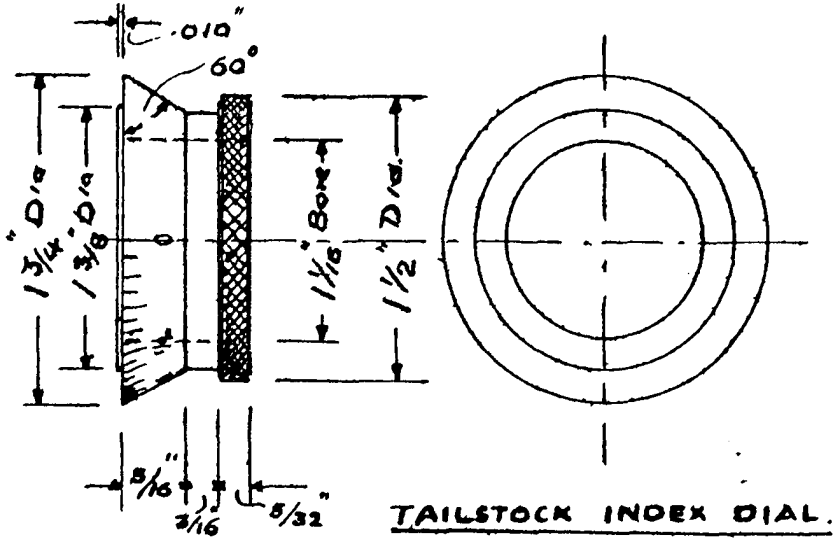
Material M.S.

25.2.56



HEADSTOCK HOLDING NUT

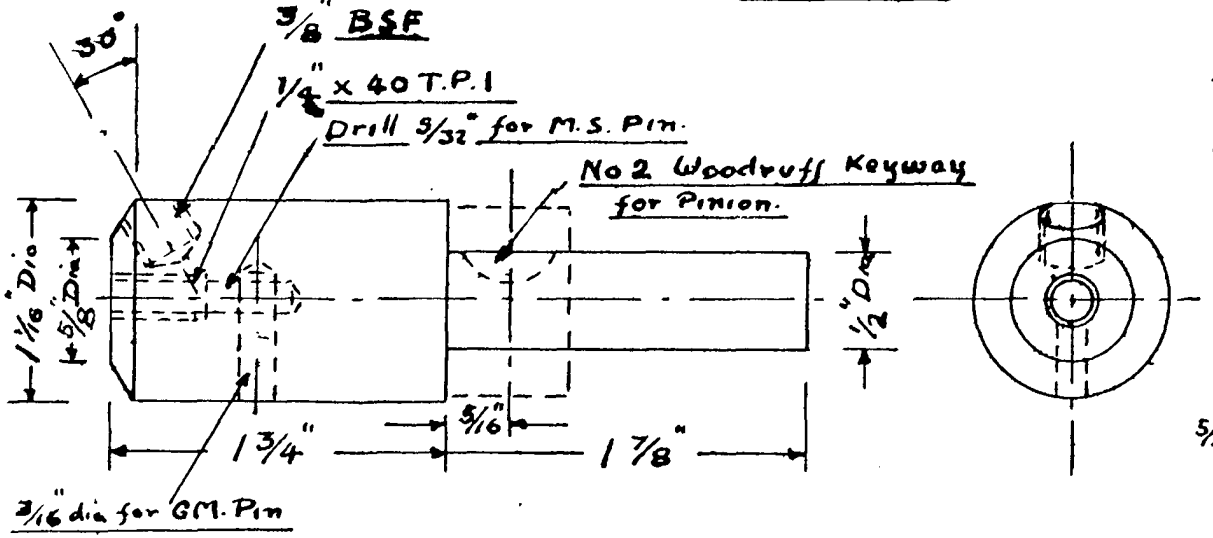
Material M.S.



TAILSTOCK INDEX DIAL.

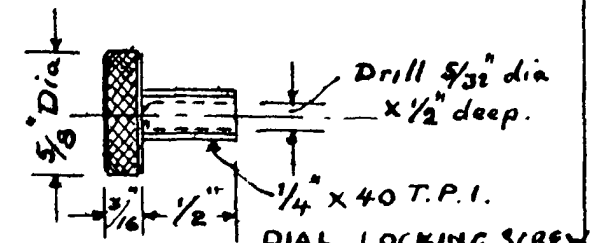
Material M.S

DETAIL 32

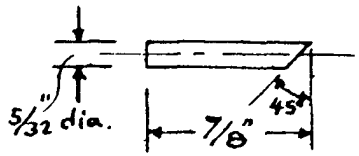


TAILSTOCK OPERATING SPINDLE.

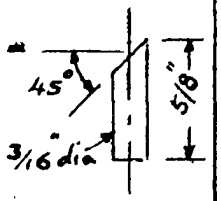
Material M.S.



DIAL LOCKING SCREW



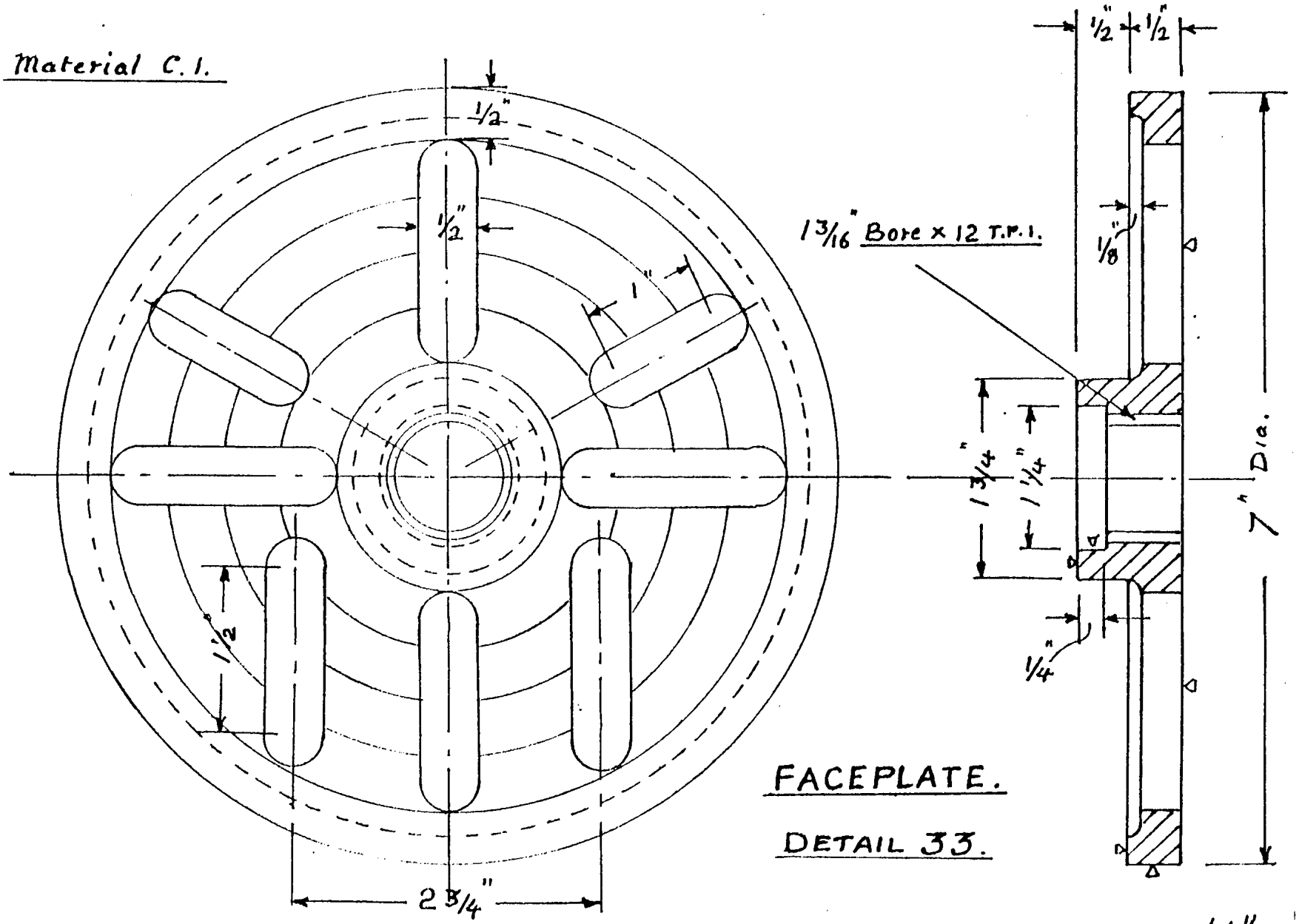
M.S. PIN



G.M. PIN

28.2.66

Material C.I.

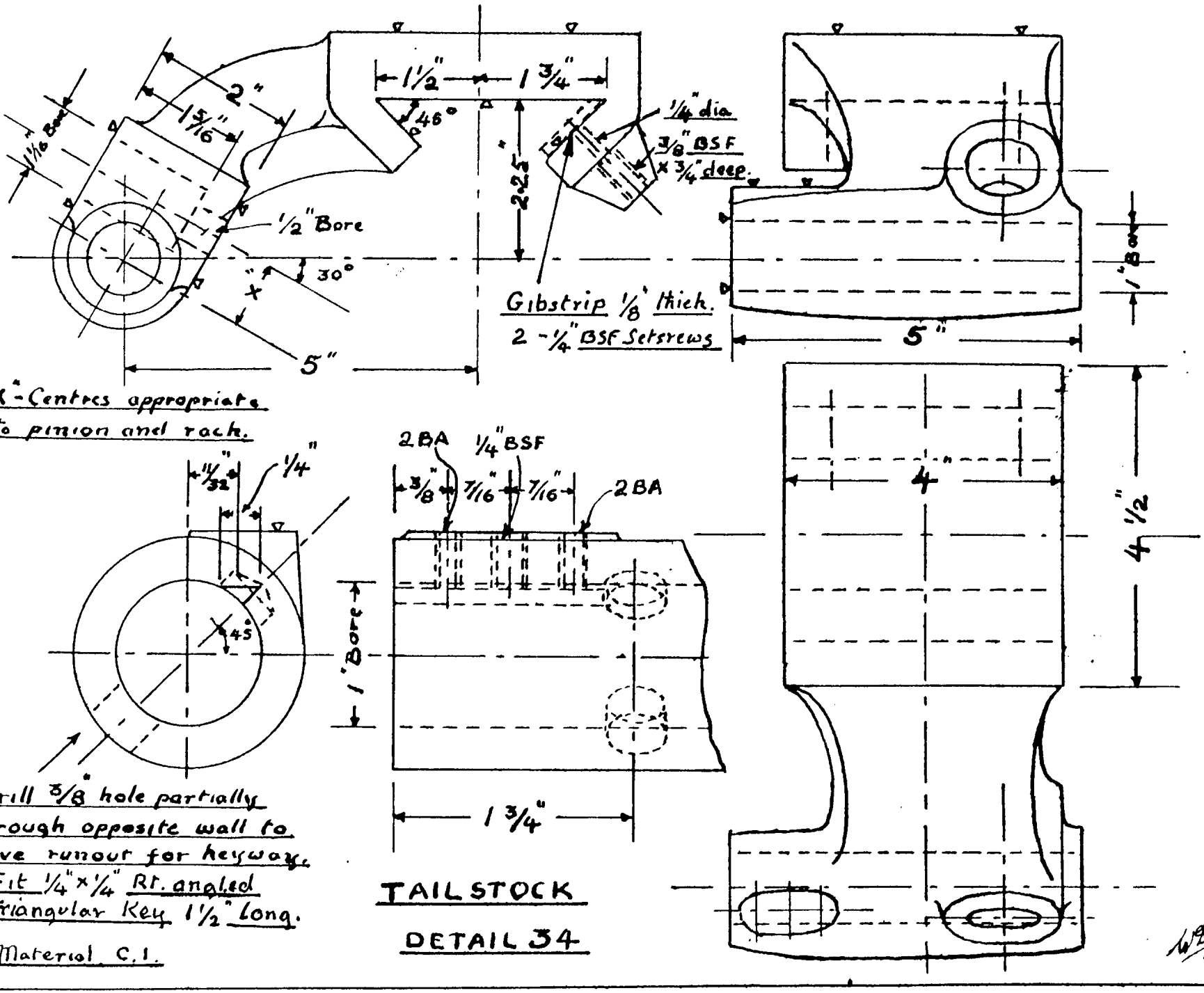


FACEPLATE.

DETAIL 33.

WDH

2.10.81



X - Centres appropriate to pinion and rack.

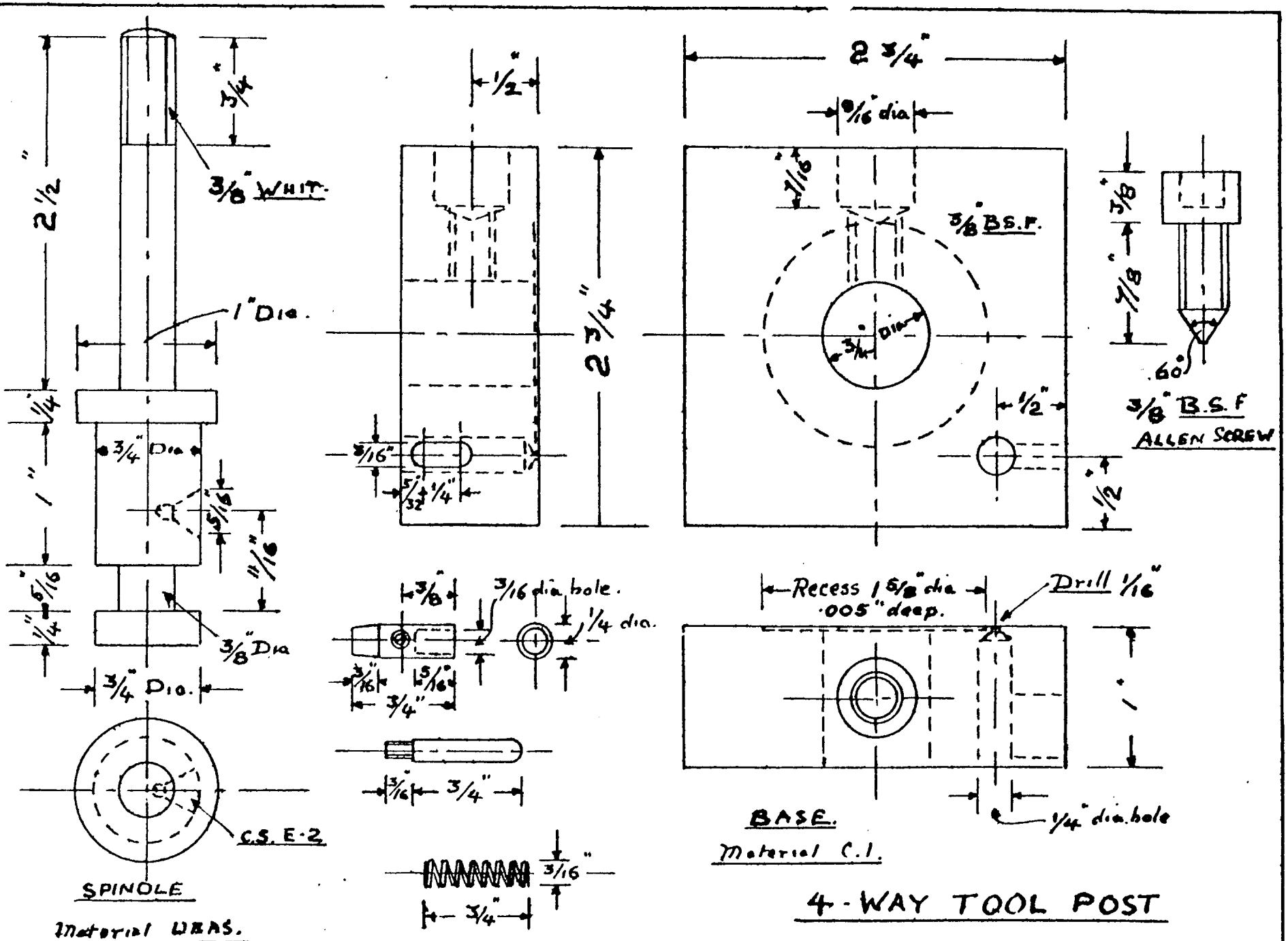
Drill ⅜" hole partially through opposite wall to give runout for keyway. Fit ¼" x ¼" Rt. angled triangular Key 1½" long.

Material C.1.

TAILSTOCK

DETAIL 34

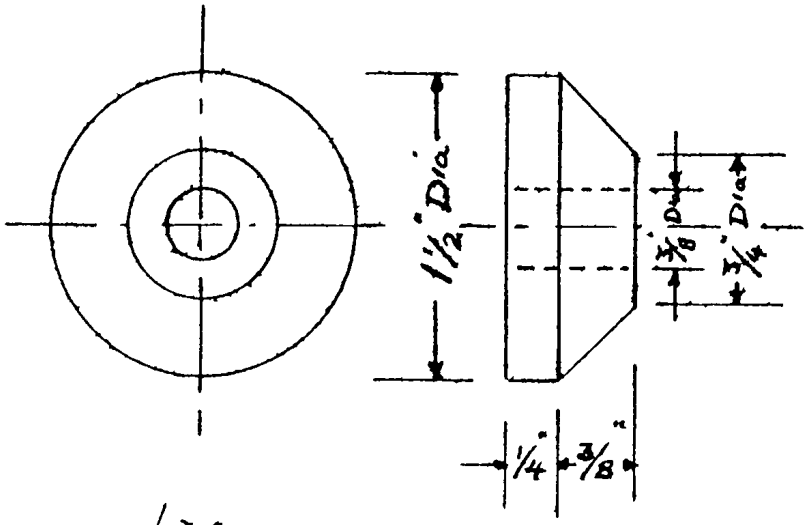
26.2.56



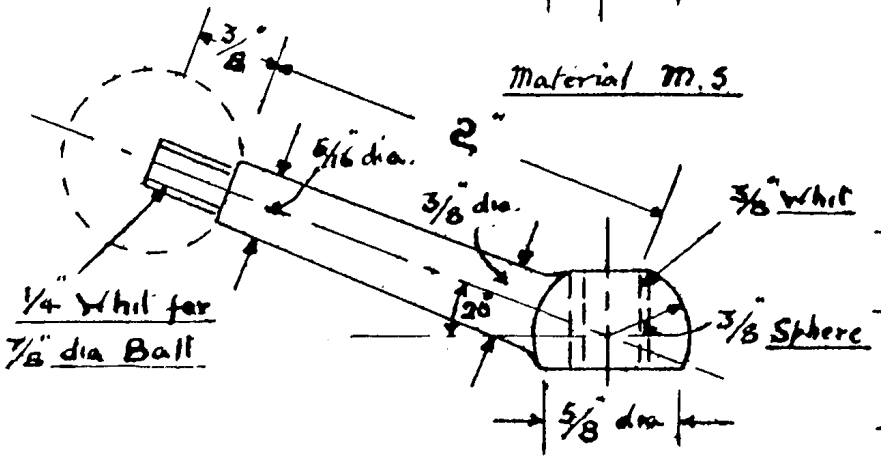
4-WAY TOOL POST

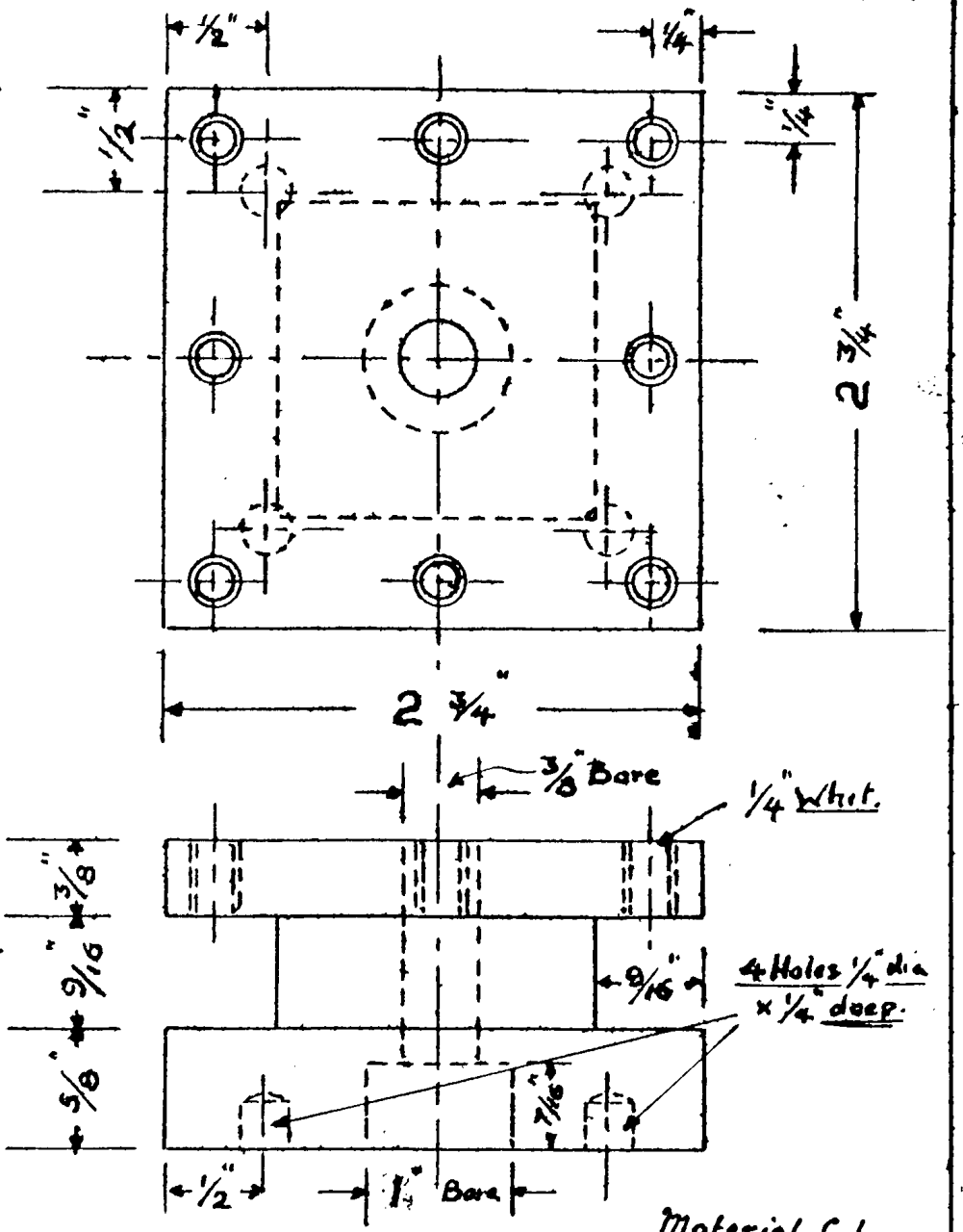
DETAIL 35

3.3.56



Material M.S



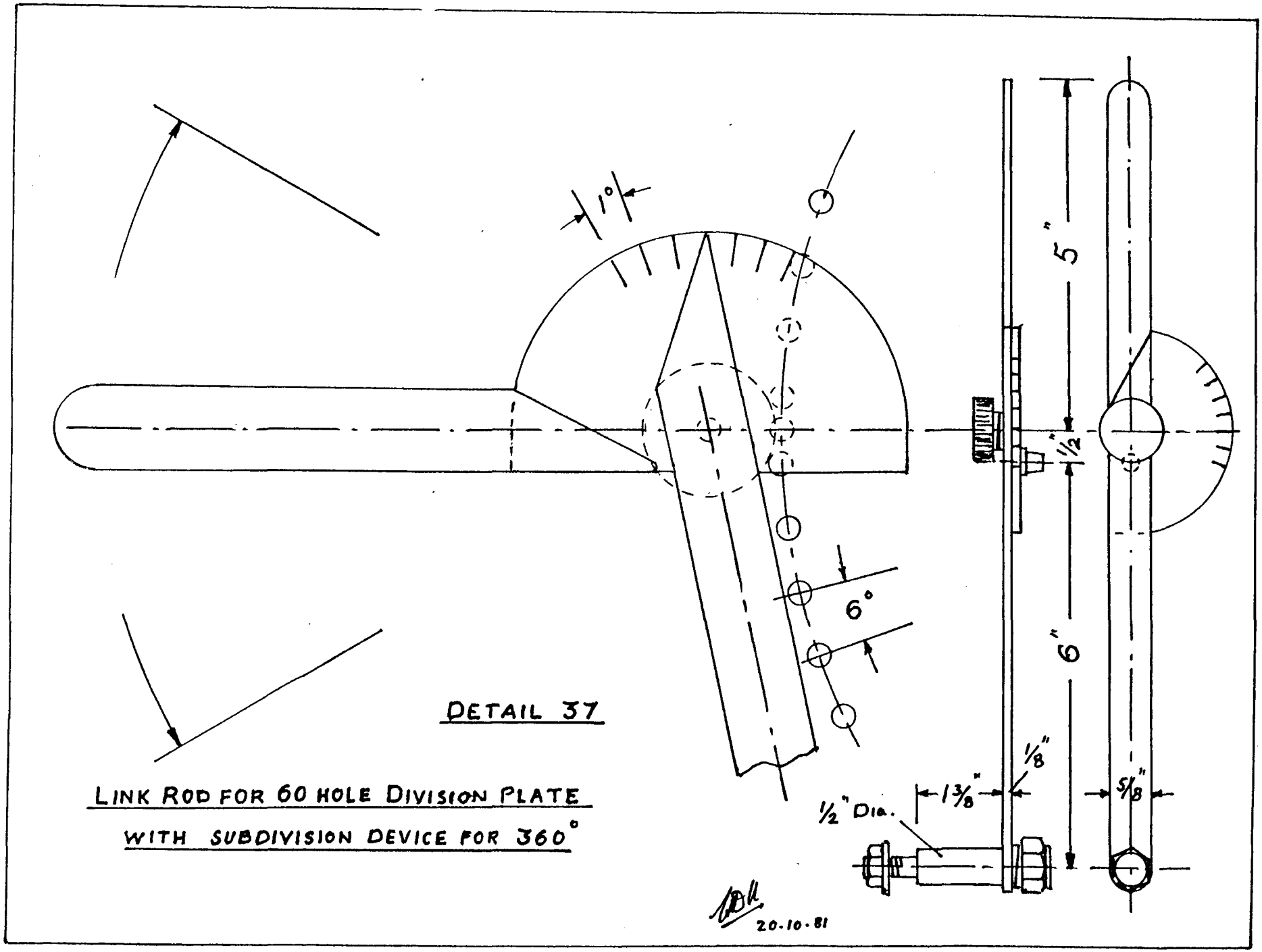


Material C.I.

4-WAY TOOL POST

DETAIL 36

4.3.56

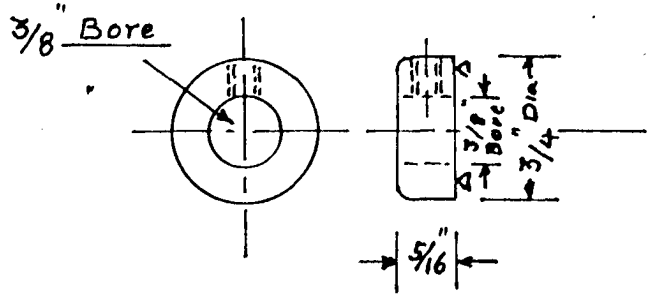


DETAIL 37

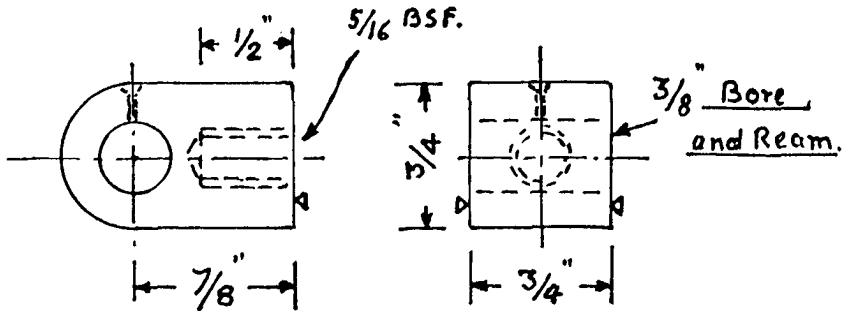
LINK ROD FOR 60 HOLE DIVISION PLATE
WITH SUBDIVISION DEVICE FOR 360°

20.10.81

Material M.S.



LEADSCREW THRUST COLLAR.

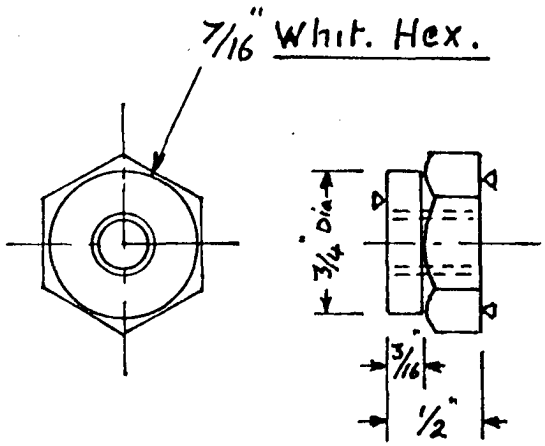


Material Phos. B.

LEADSCREW BEARING.

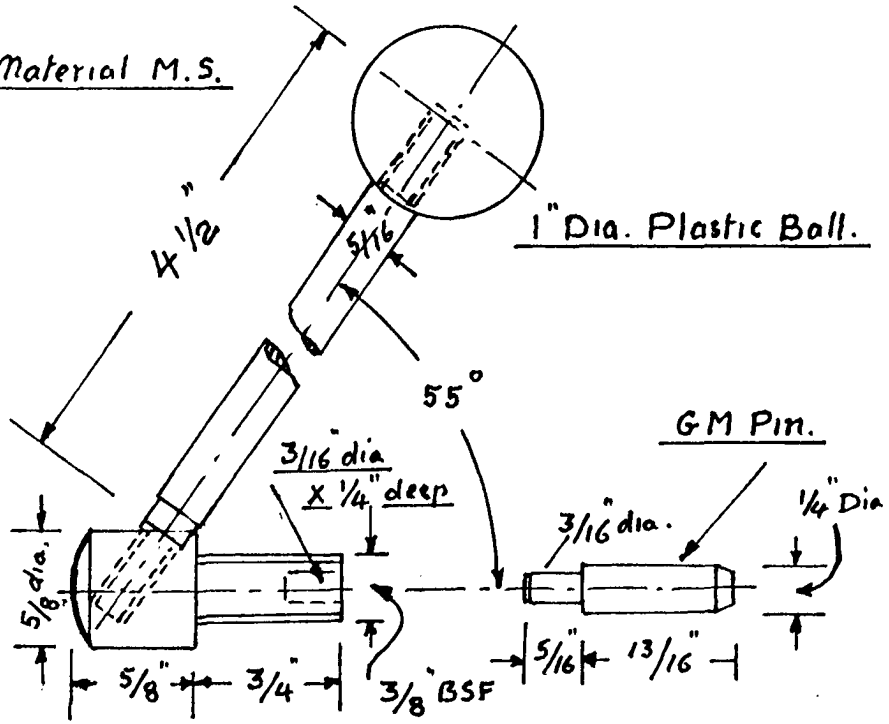
DETAIL 38

Material M.S.



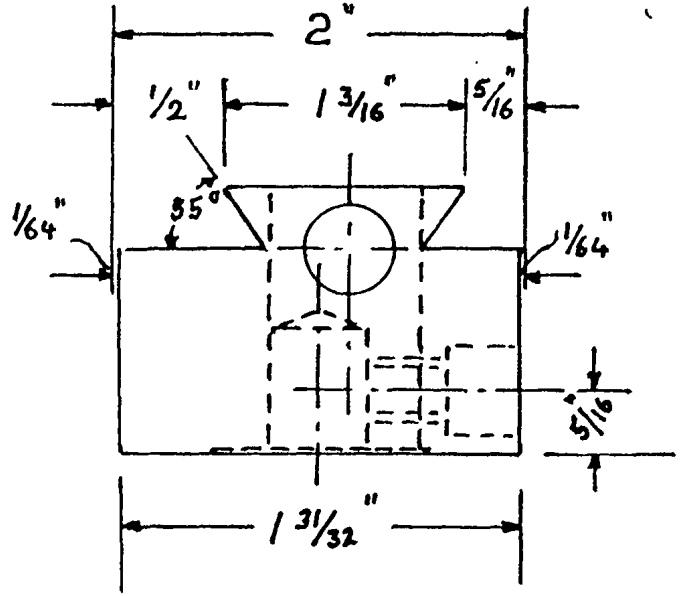
LEADSCREW HANDWHEEL NUT.

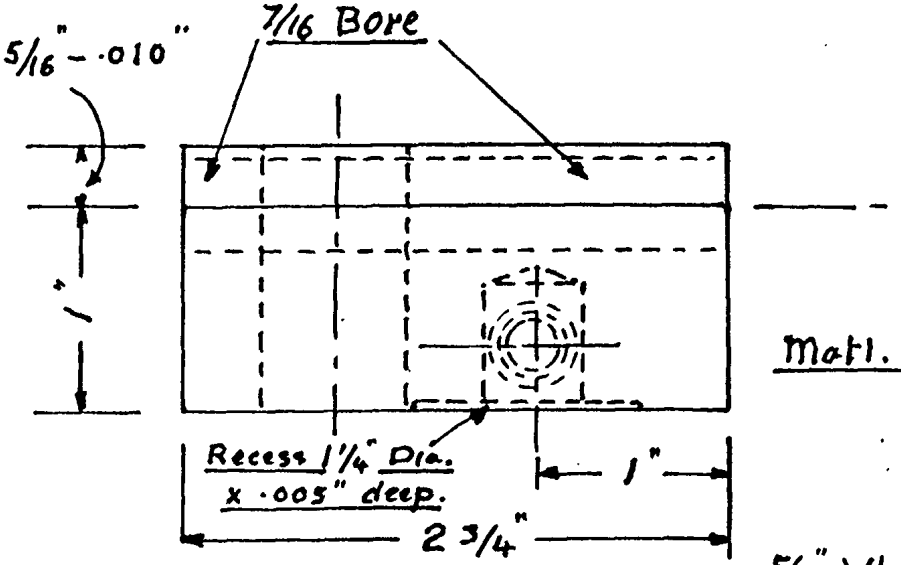
Material M.S.



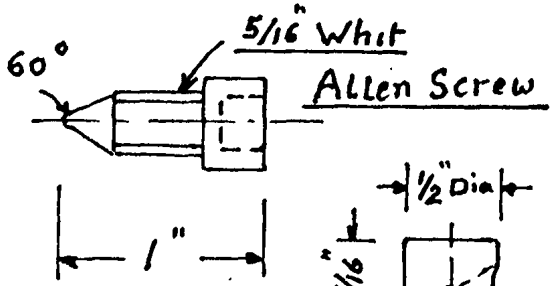
TAILSTOCK LOCKING SCREW.

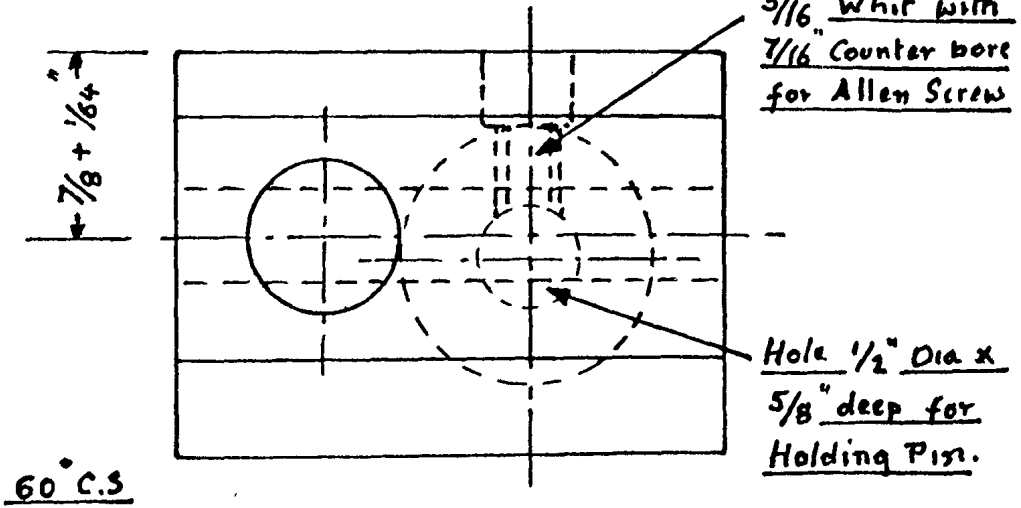
30.1.82

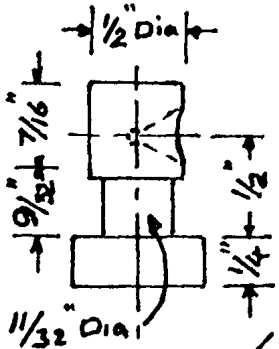


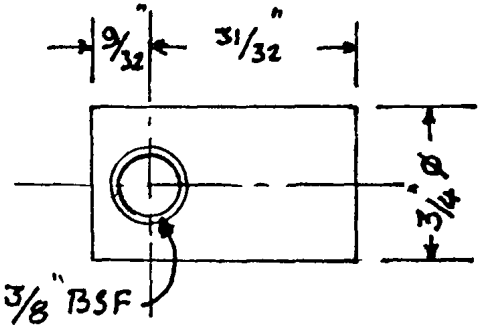


Matl. C.I.

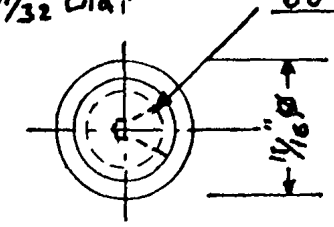








Phos. B. NUT.

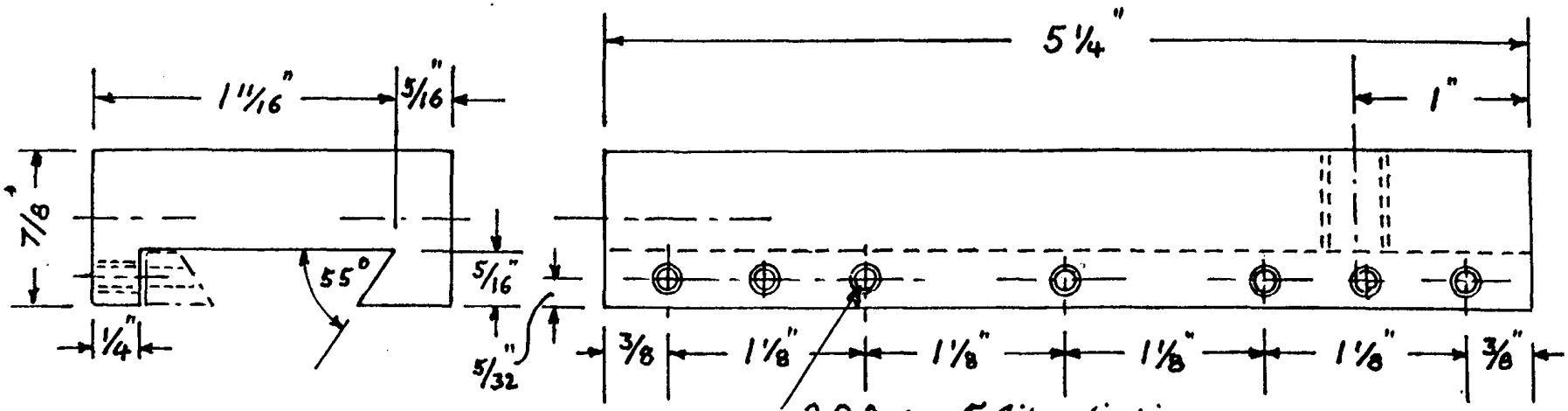


Holding Pin
Casehardened.

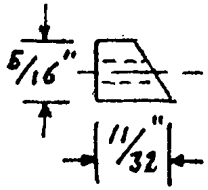
TOPSLIDE BASE.

DETAIL 39

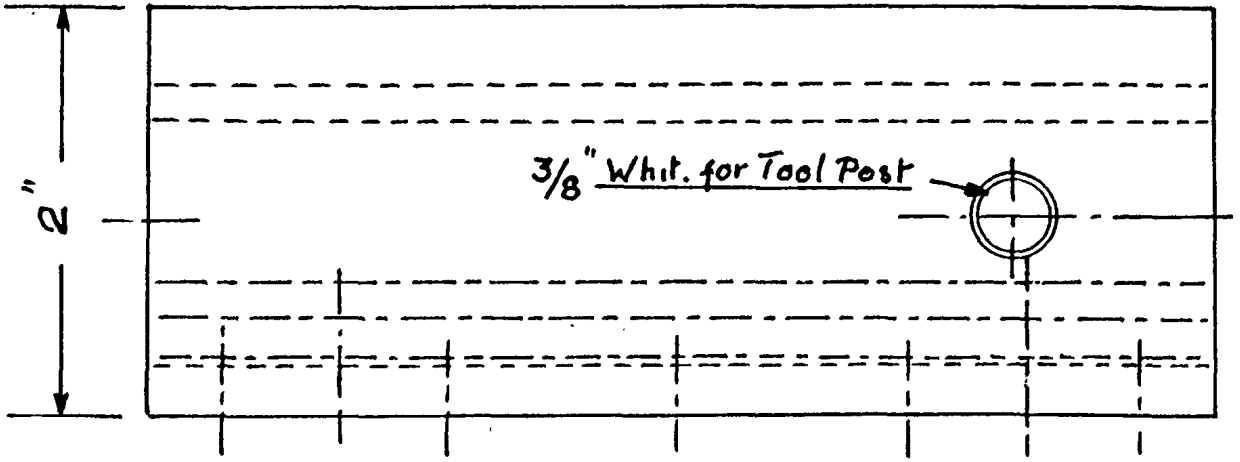
WBH
9.10.81



2 BA for 6" Gib adjusting screws and 2 locating pins.



M.S. Gib full length of Slide.

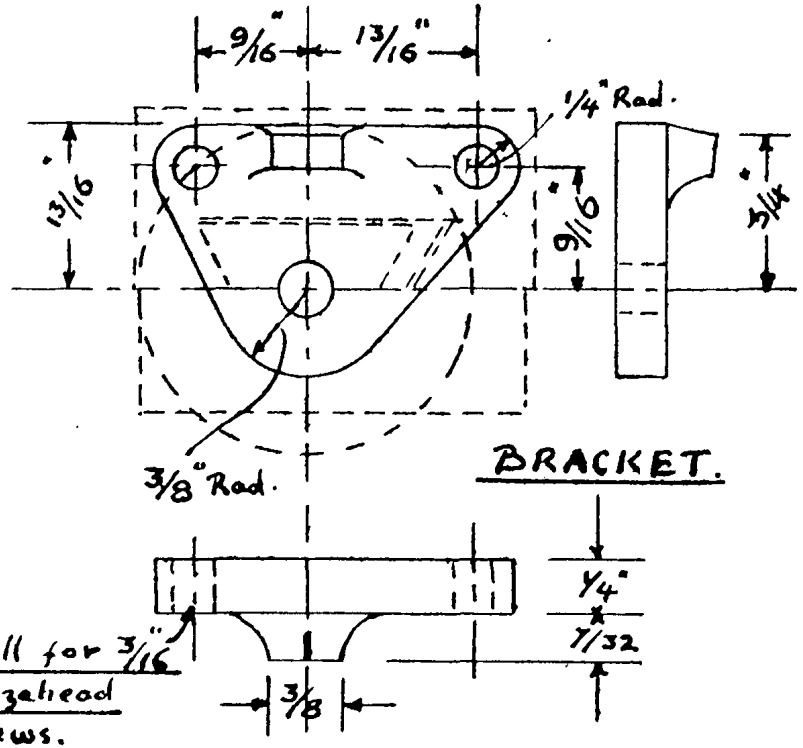


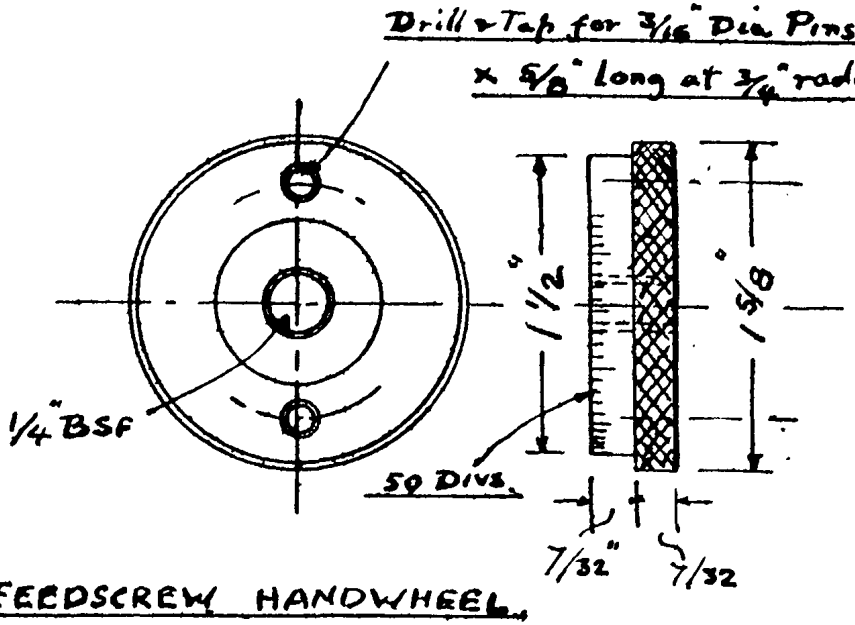
Material. C.I.

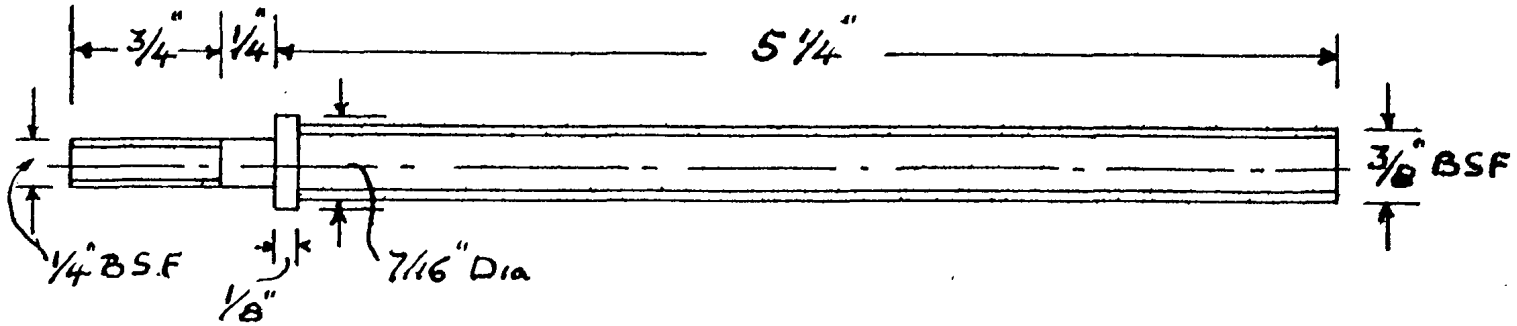
TOPSLIDE.

DETAIL 40

7.11.81





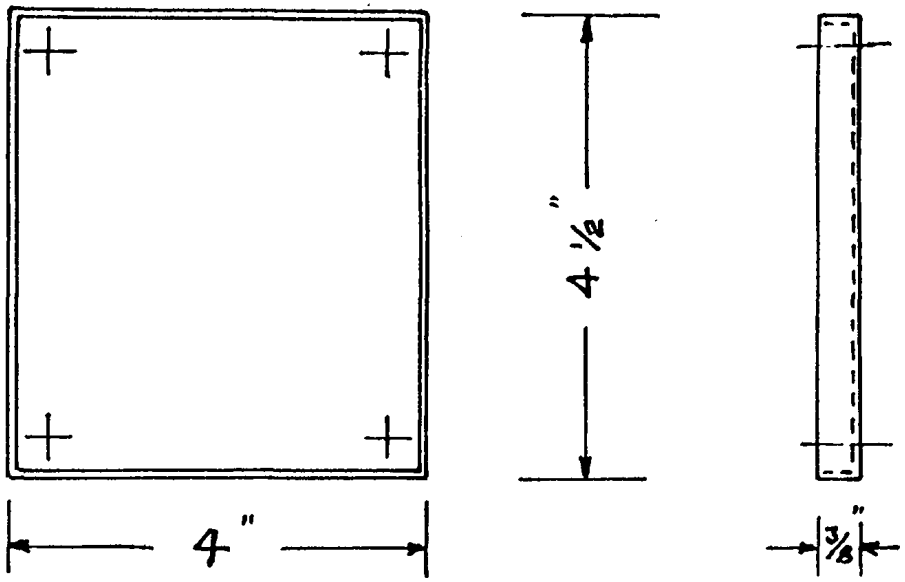


TOPSLIDE FEEDSCREW

DETAIL 4-1

Material M.S.

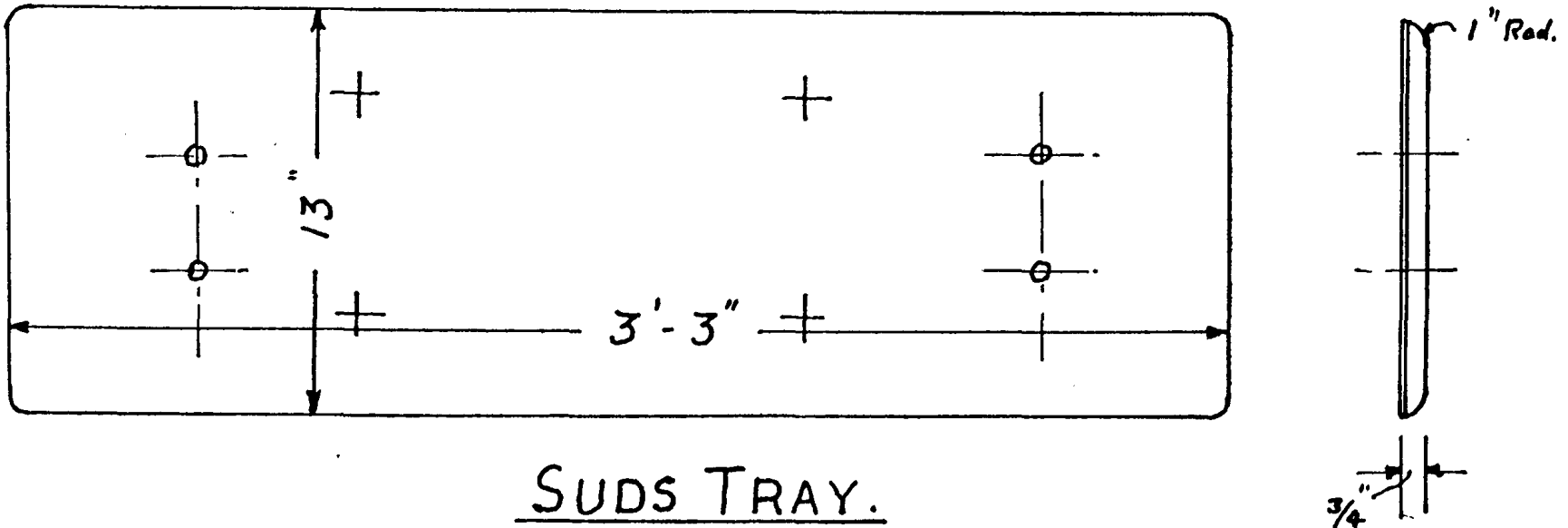
12.3.56



TOOL TRAY.

DETAIL 42

Material 20 g. m.s.

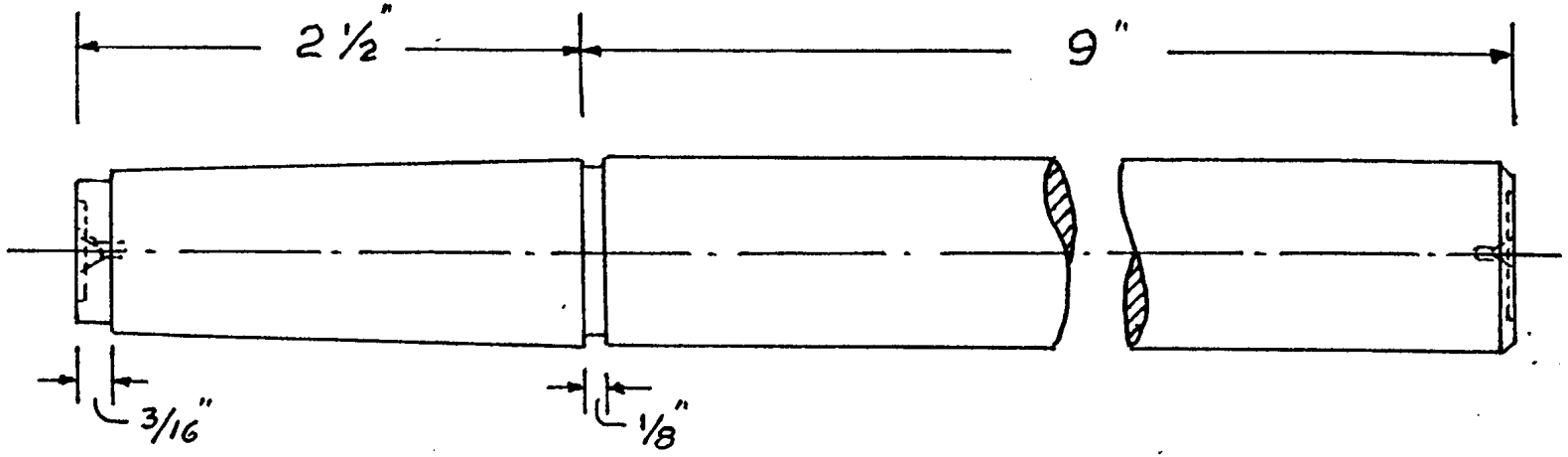


SUDS TRAY.

DETAIL 43

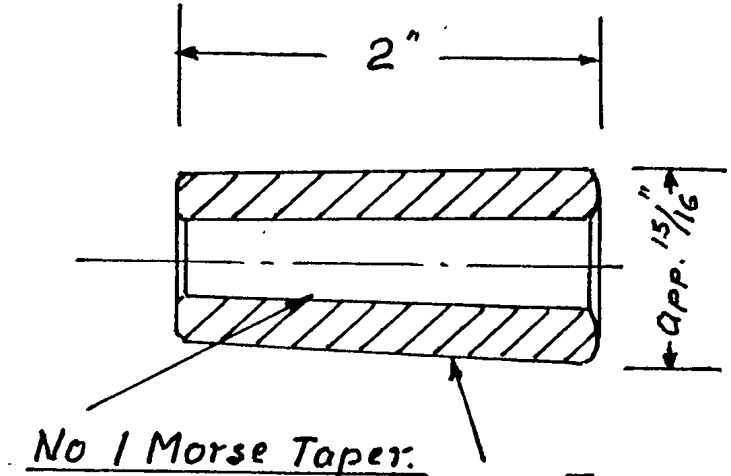
Material 16 g. m.s.

19.7.82



GROUND TEST BAR

No 3 Morse Taper to suit mandrel nose.

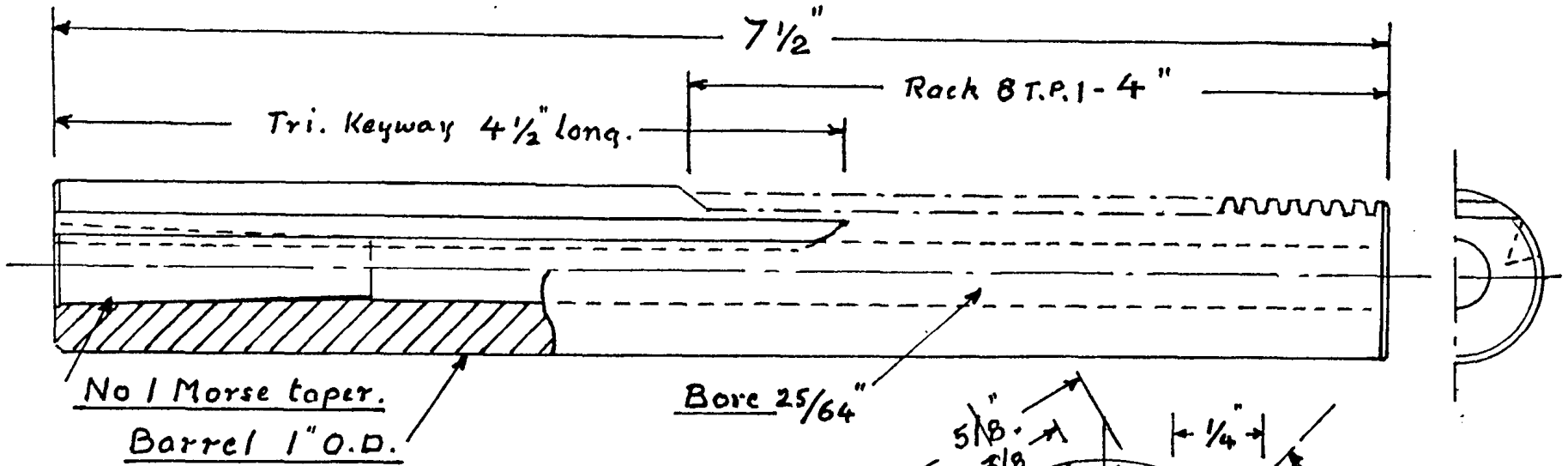


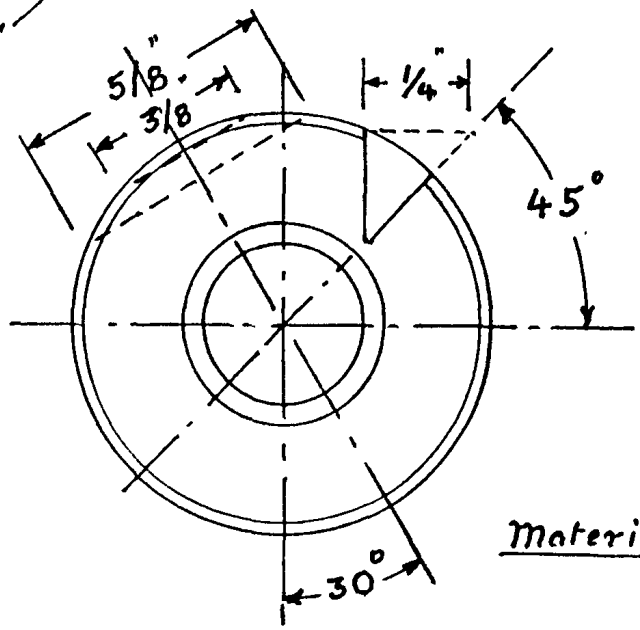
Material. Stainless Steel.

REDUCING SLEEVE.

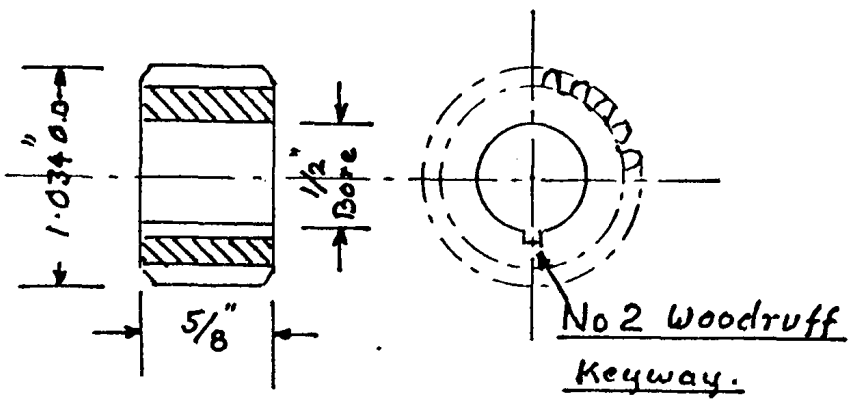
DETAIL 44

4.11.81





Material. M.S.

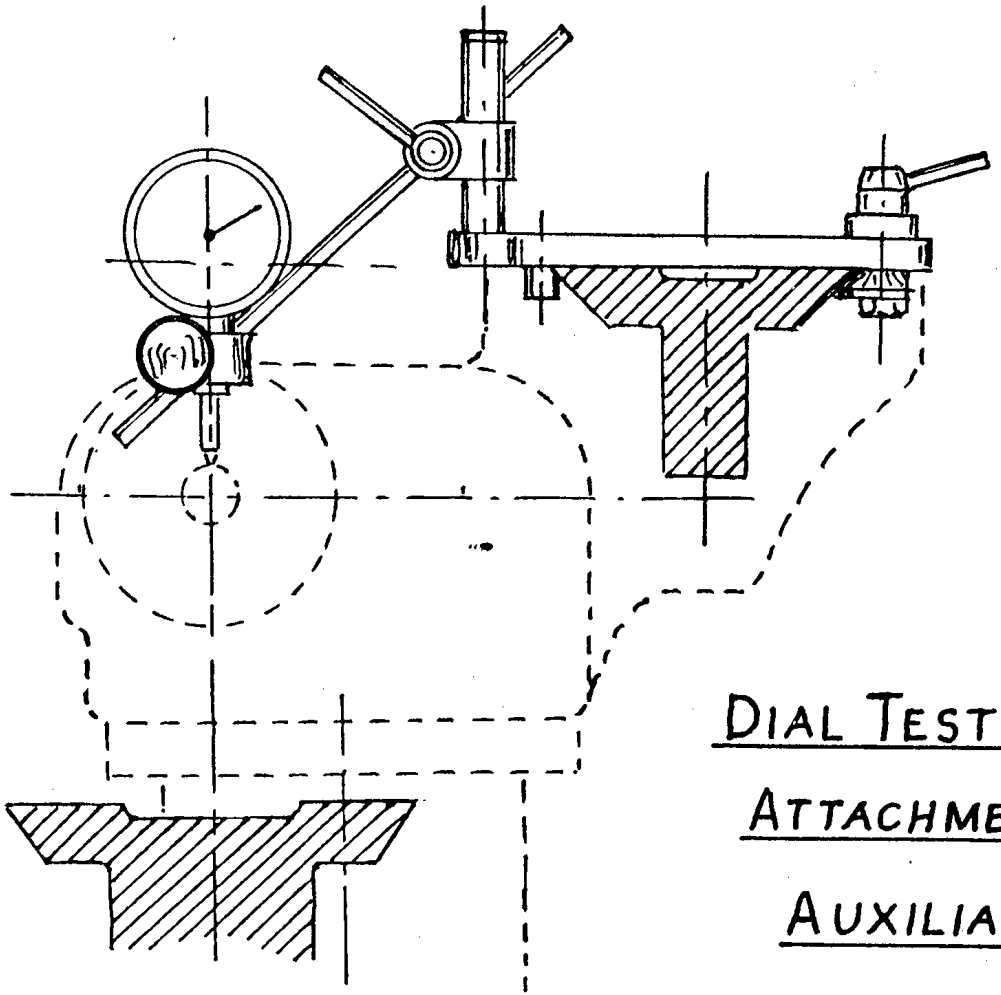


PINION - 24 TEETH

TAILSTOCK BARREL.

DETAIL 45

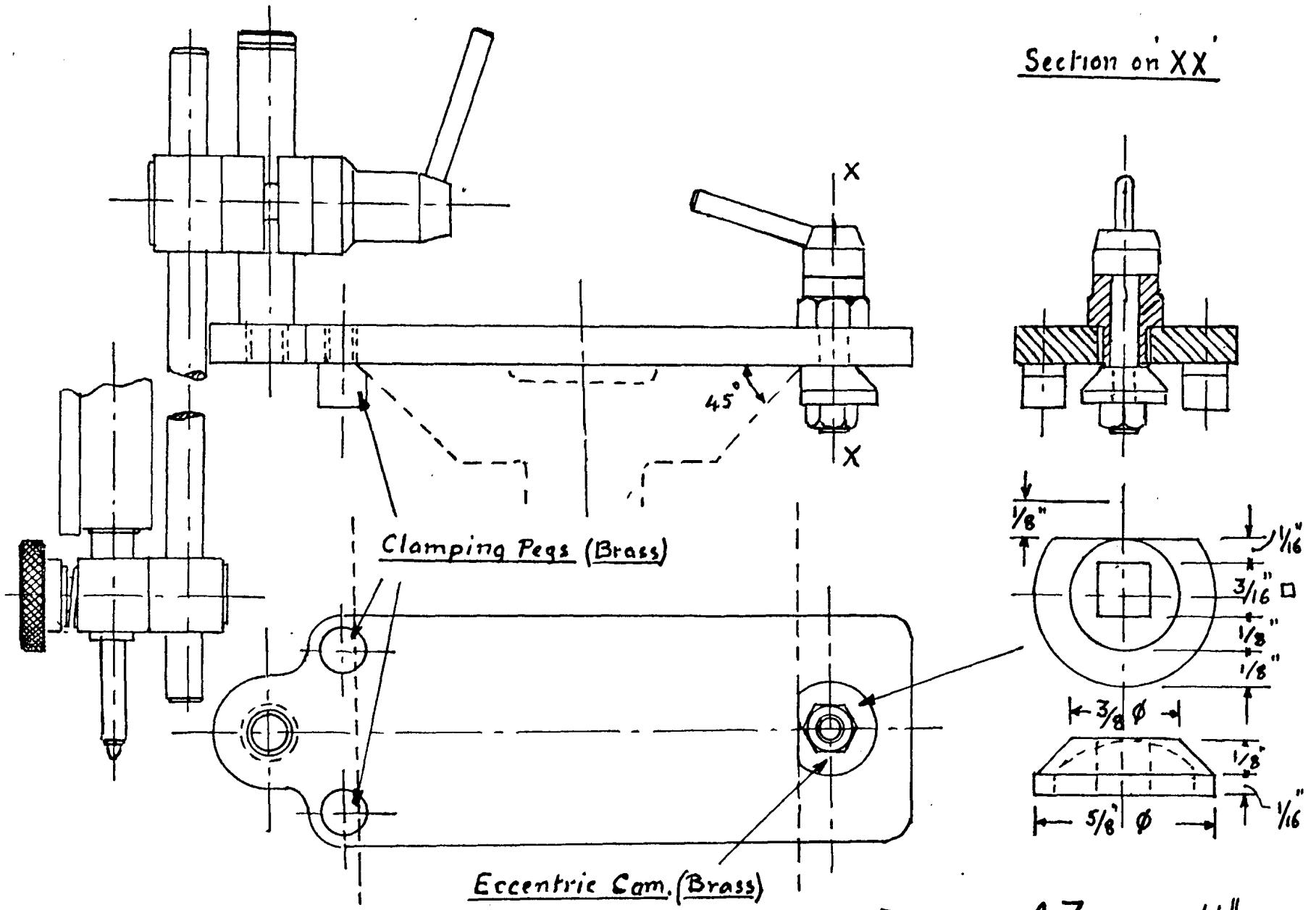
10.11.81



DIAL TEST INDICATOR ATTACHMENT FOR AUXILIARY BED.

DETAIL 46

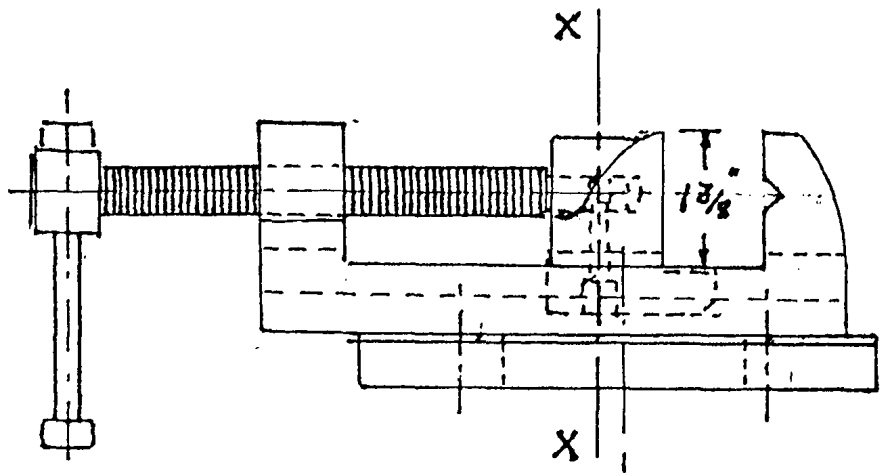
13.10.81

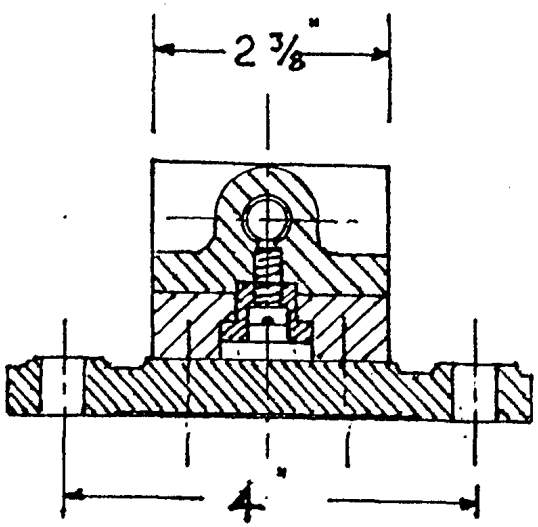


CLAMP BASE FOR D.T.I.

DETAIL 47

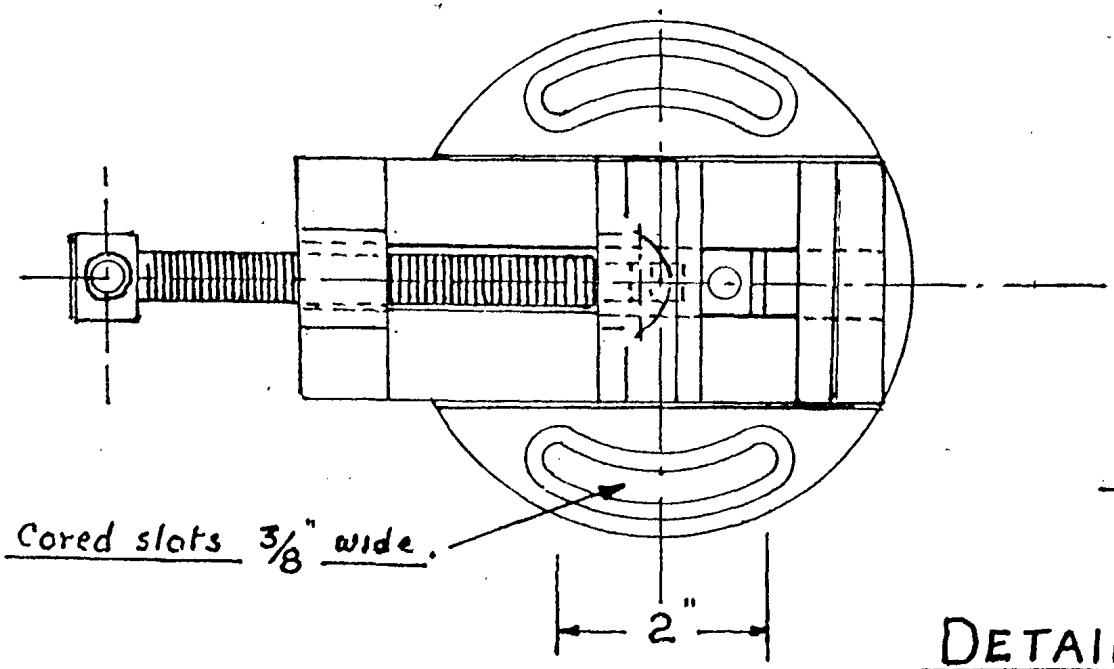
12.10.81





Section on XX

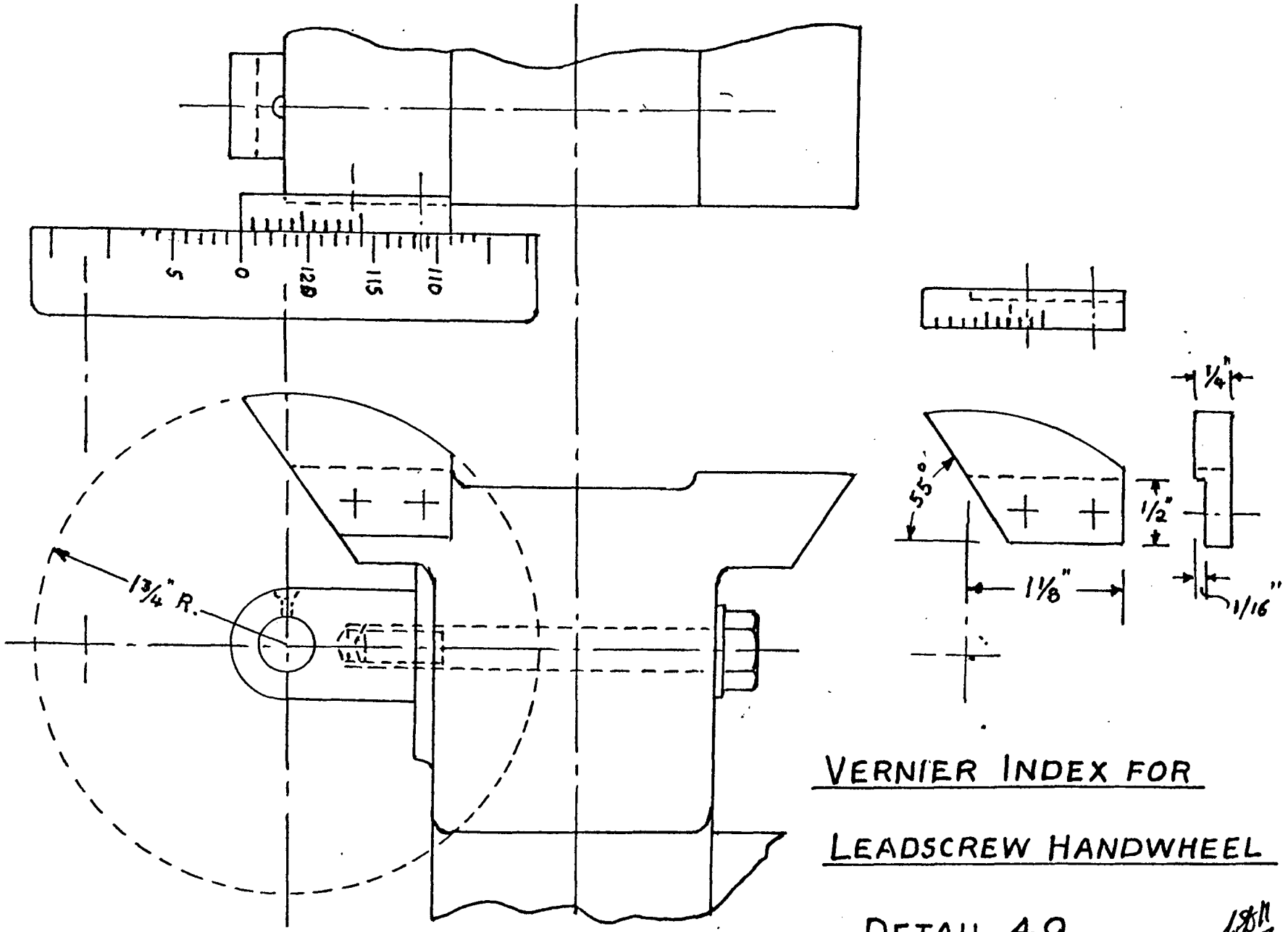
Scale 1/2 Full size.



MACHINE VICE.

DETAIL 48

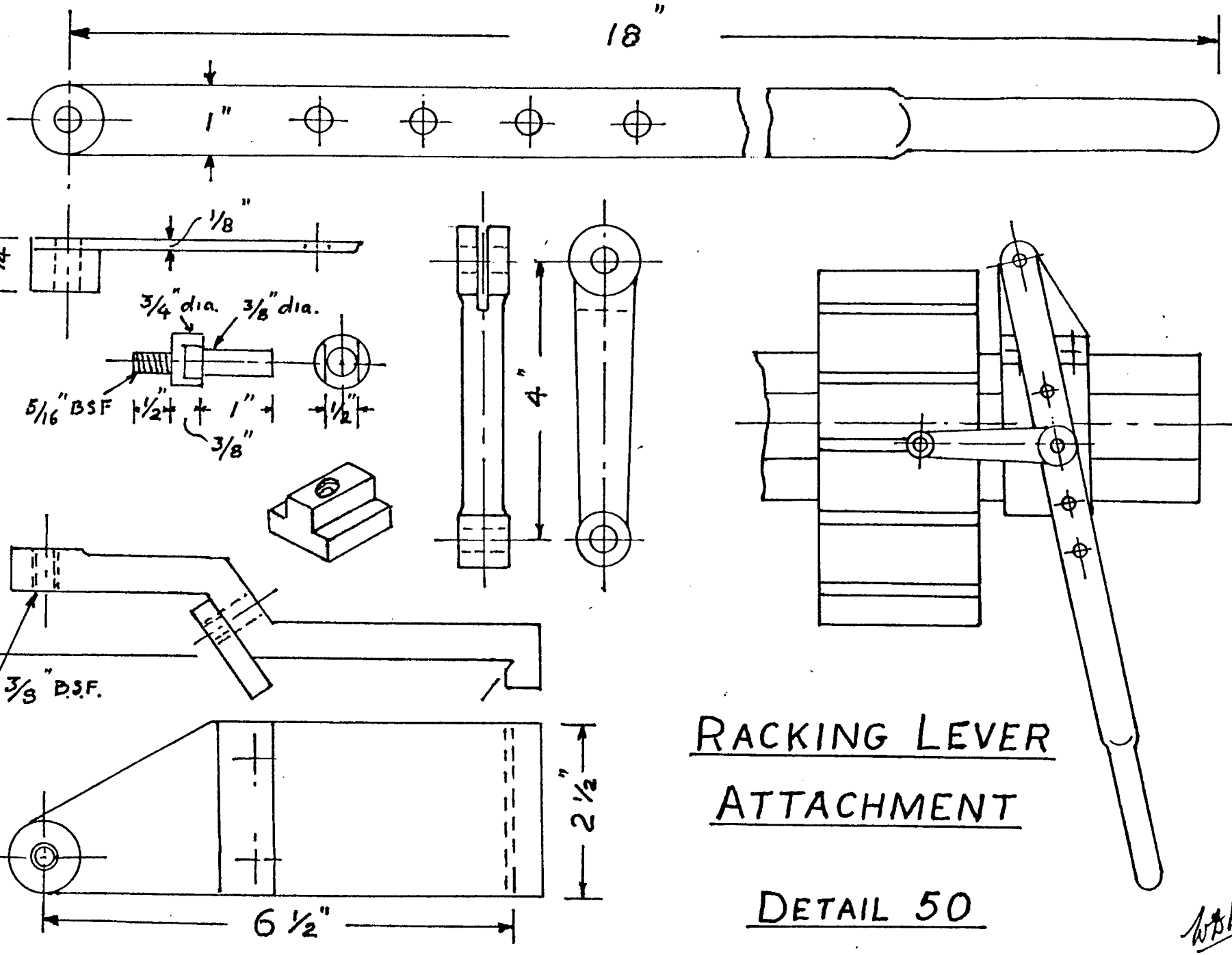
19.1.82



VERNIER INDEX FOR LEADSCREW HANDWHEEL

DETAIL 49

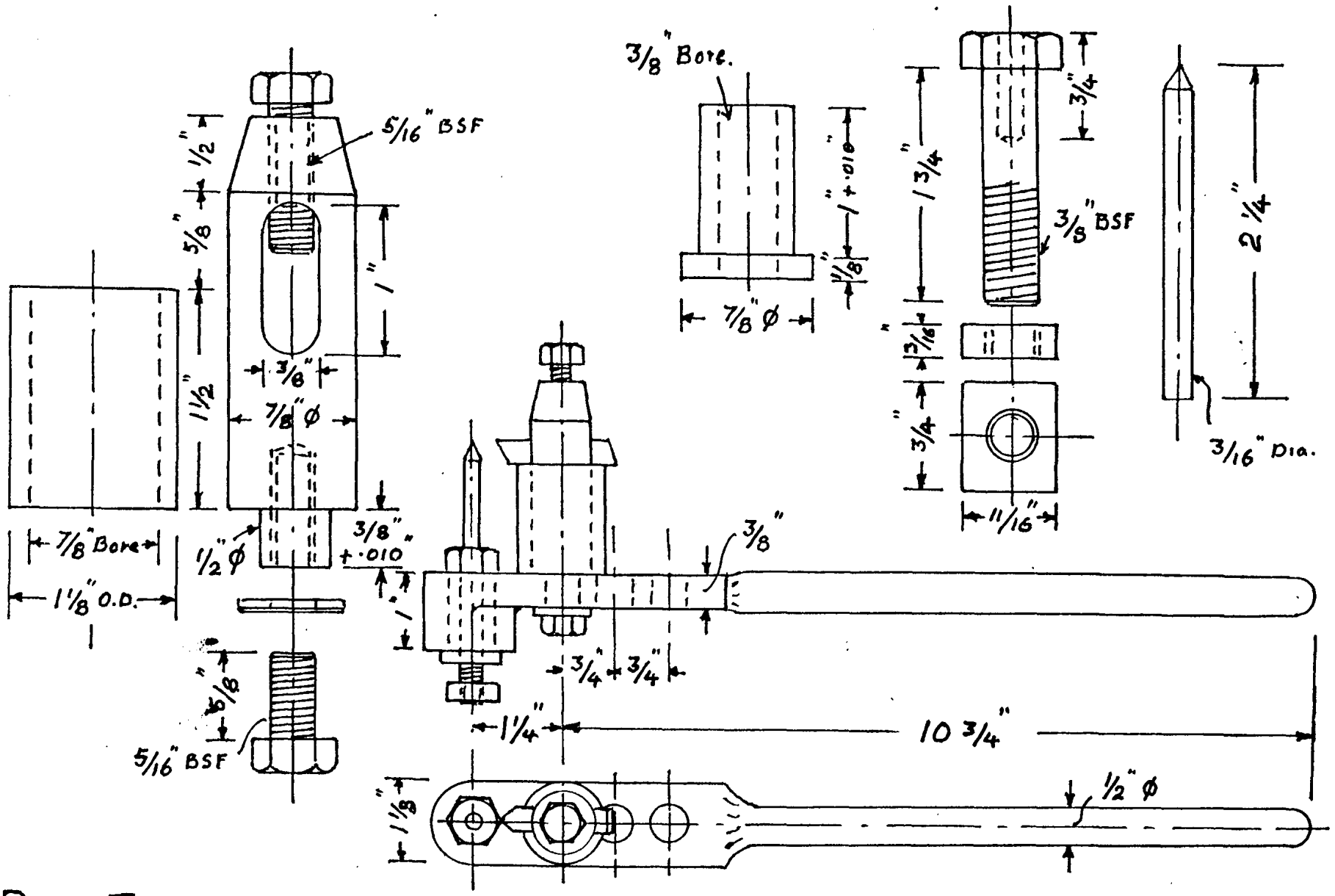
11.6.82



RACKING LEVER ATTACHMENT

DETAIL 50

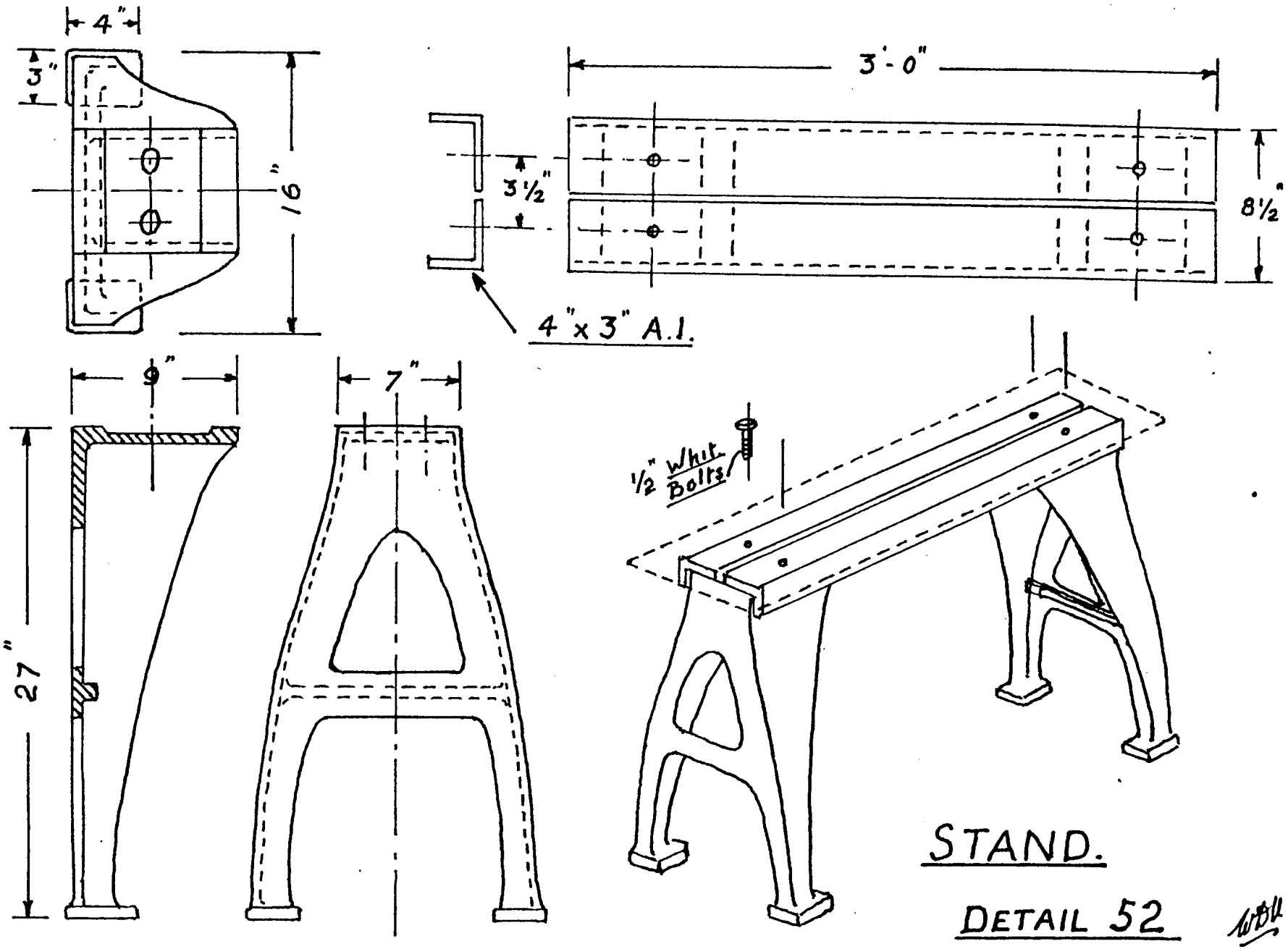
15.6.82



BALL TURNING TOOL

DETAIL 51

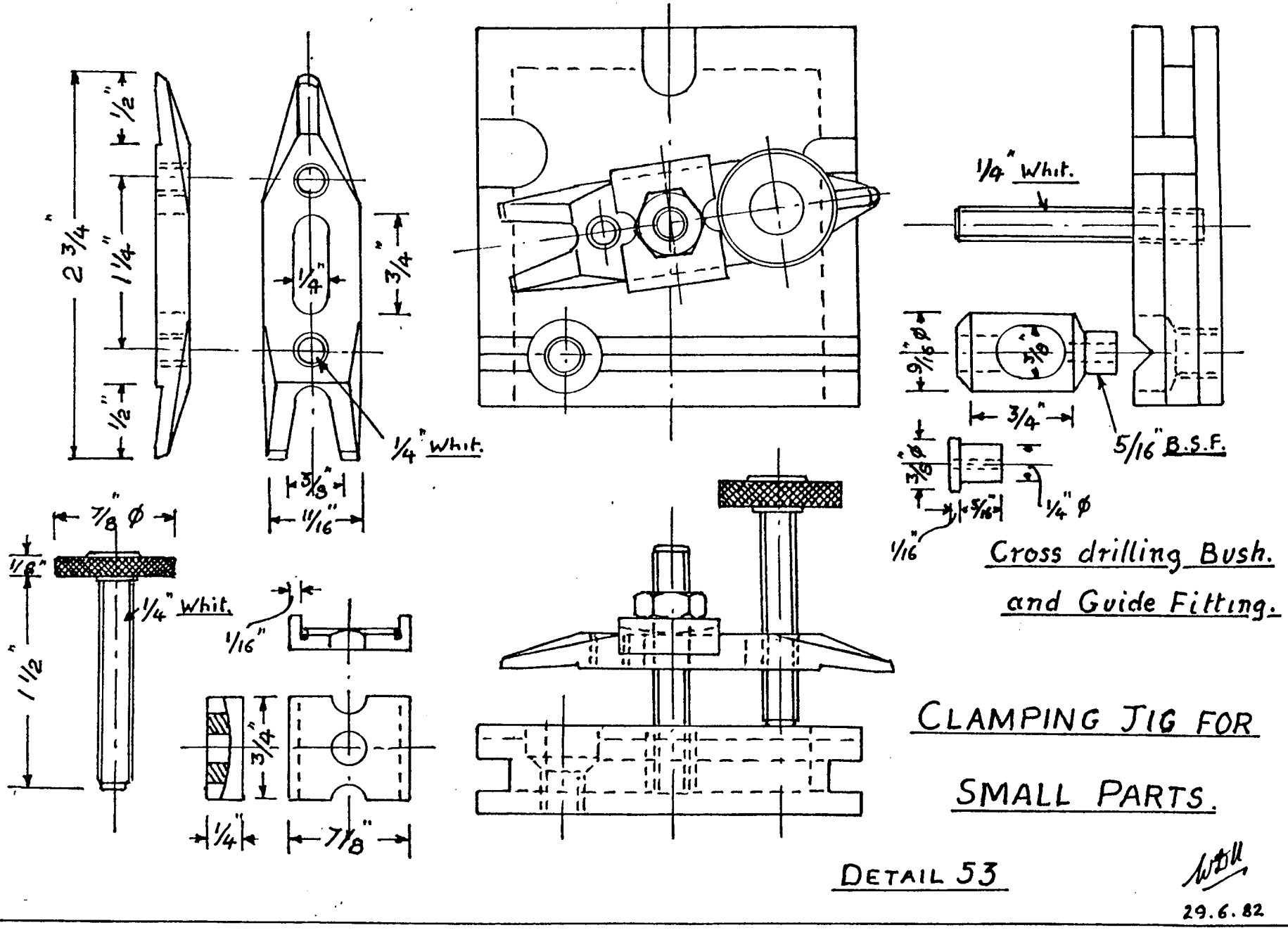
19.6.82



STAND.

DETAIL 52

18.7.82

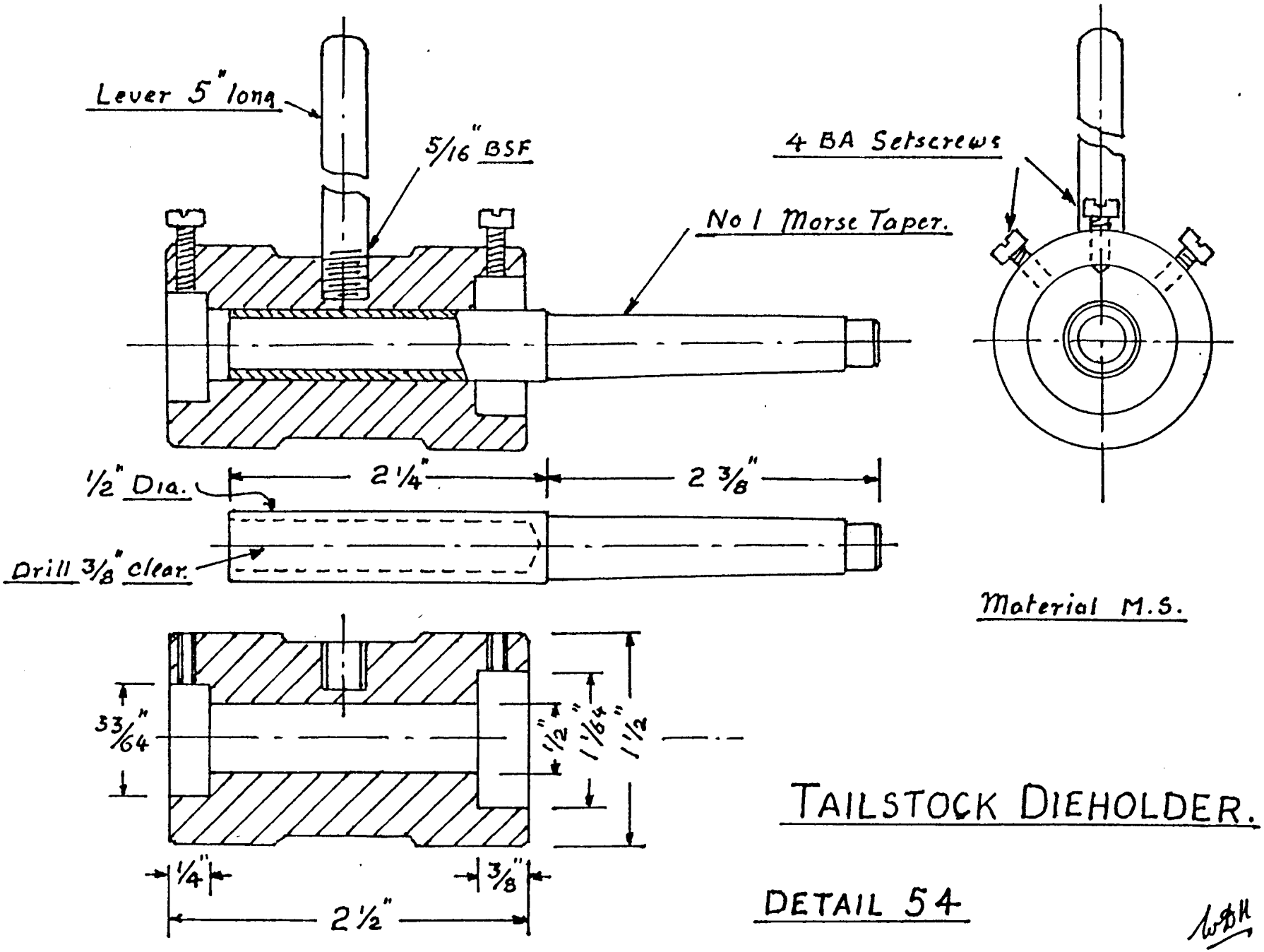


Cross drilling Bush. and Guide Fitting.

CLAMPING JIG FOR SMALL PARTS.

DETAIL 53

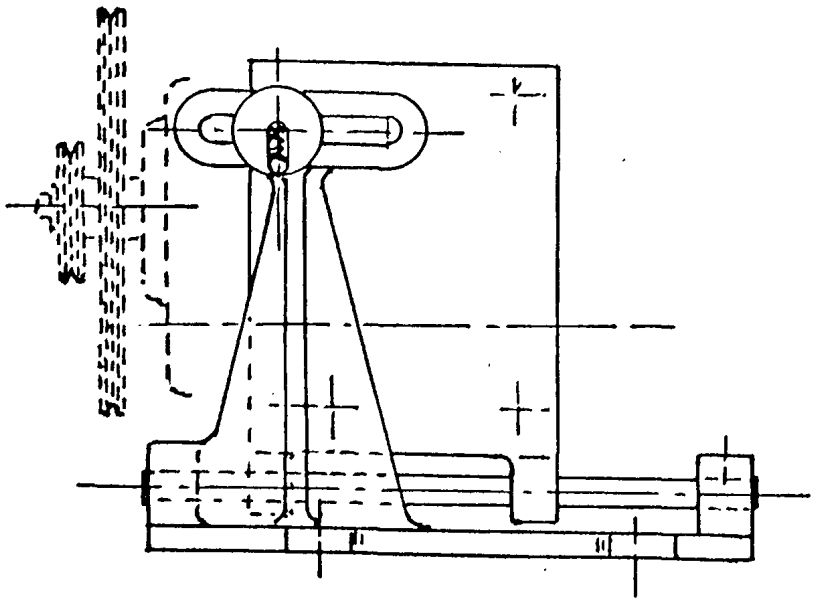
29.6.82

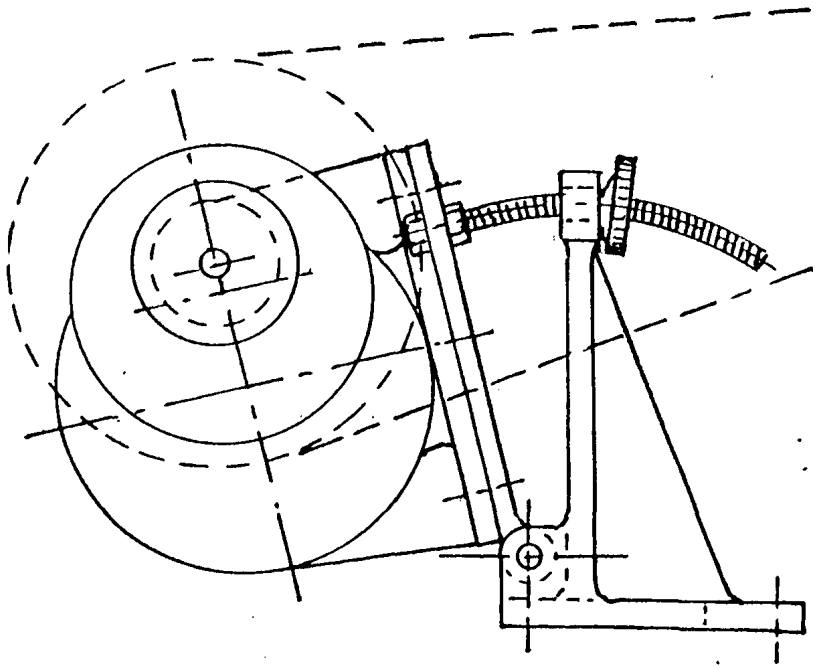


TAILSTOCK DIEHOLDER.

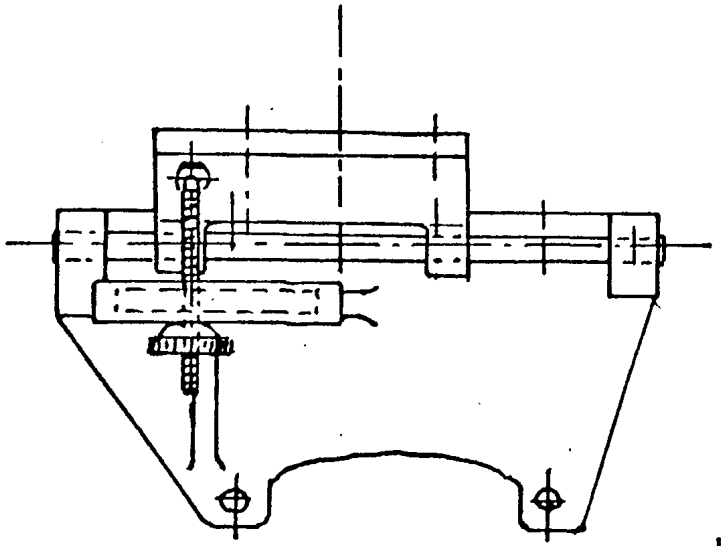
DETAIL 54

15.5.83





Scale - 1/4 Full Size.



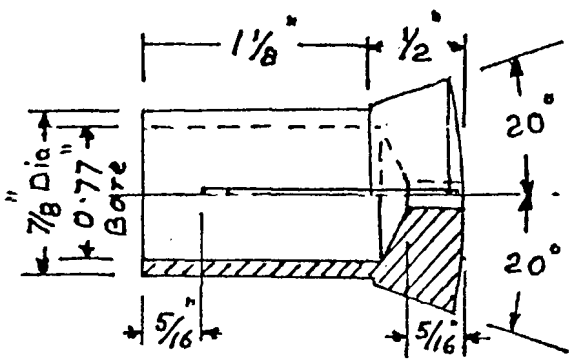
BRACKET AND HINGED CARRIER PLATE FOR DRIVE MOTOR.

Material C.I.

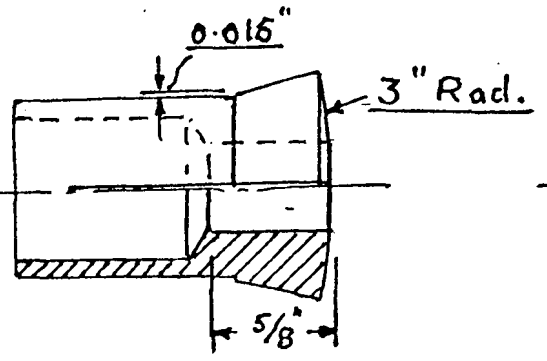
DETAIL 55

WDH

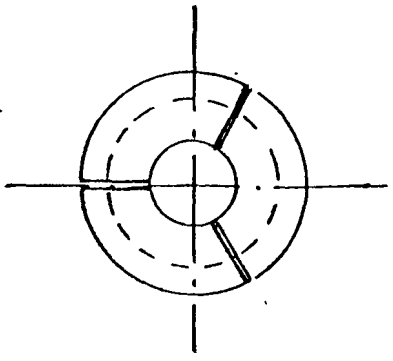
10.10.82

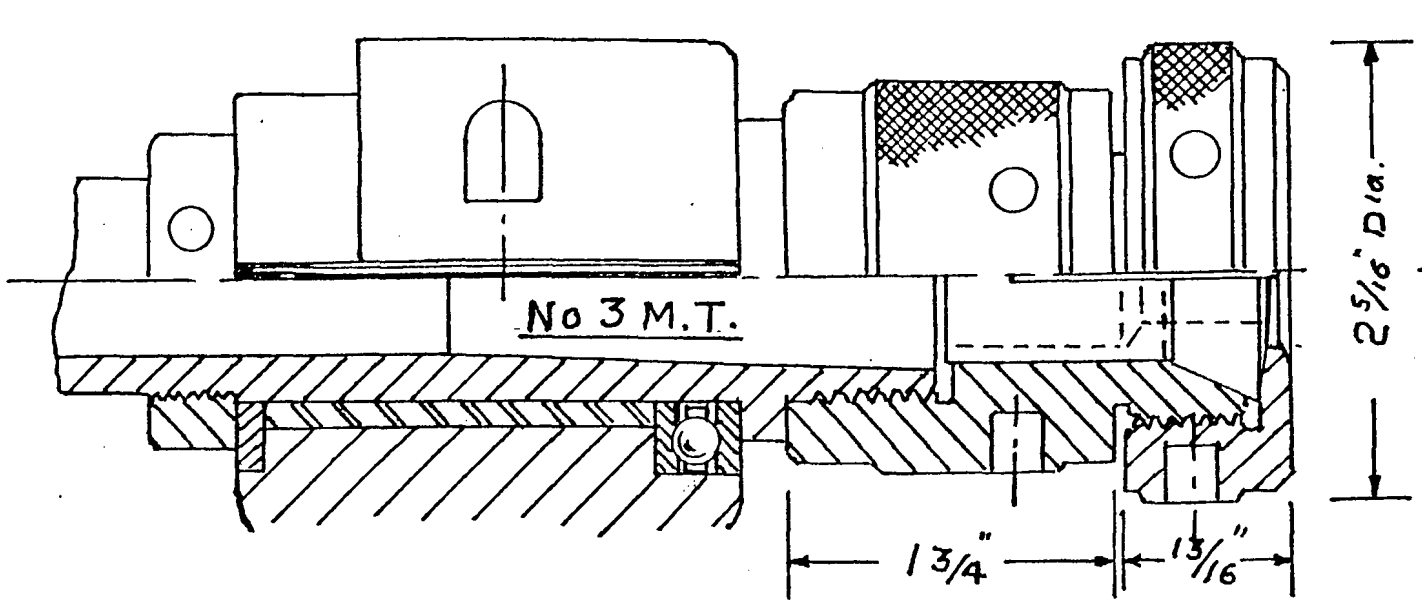


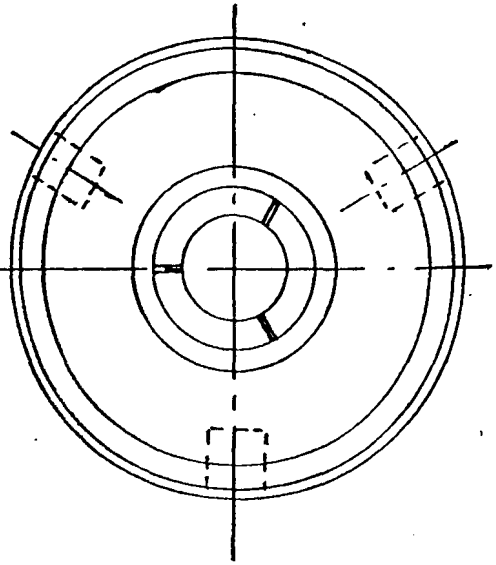
COLLETS 3/32" AND UNDER.



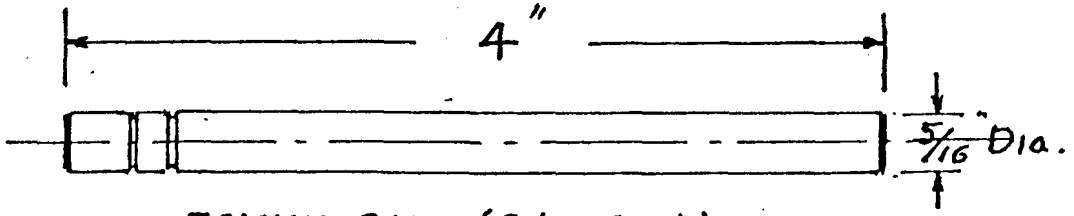
COLLETS OVER 3/32"







TO HOLD ROUND STOCK RODS UP TO 3/4" DIA.



TOMMY BAR. (Silver Steel.)

COLLET SET.

DETAIL 56

20.8.83