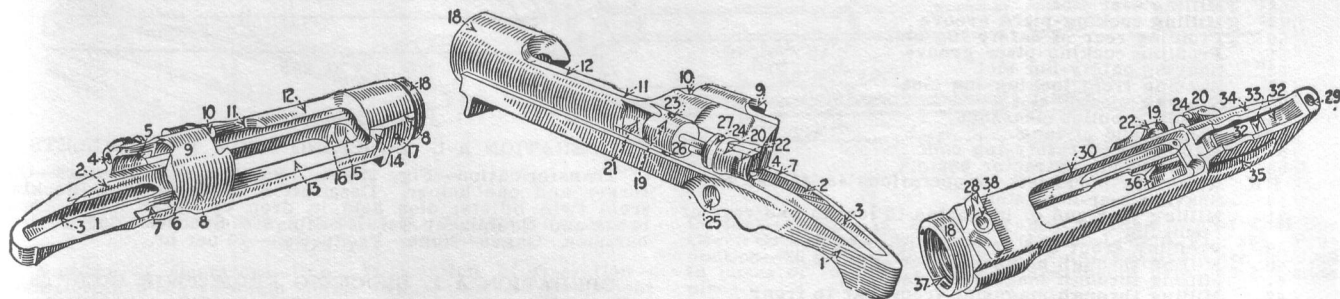
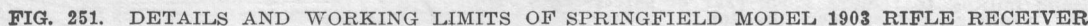


After completion the receiver is casehardened and when it is found necessary, owing to scale having formed, is sand blasted, afterwards being browned. There are four measuring points used in making the receiver: First comes the bore after operation 3, then the front end after operation 7¾. Following operation 11 the right side is used



1. Top of tang, operations 1, 25, 45, 45½	10. Cartridge-clip slot, operations 34, 38 and 39	20. Cutoff lug, back, operation 15	30. Magazine opening, operations 71, 60, 61, 62, 63, 64
2. Portion of well, or bolt hole, not cut away, operations 2, 3, 6	11. Thumb cut off, operation 37	21. Profiling over cutoff, front, operation 15	31. Bolt-stop pin hole, operations 77 and 81
3. Cocking - piece groove, operations 49 and 51	12. Top of left wall, operations 25 and 36	22. Profiling over cutoff, rear, operation 15	32. Sear slot, operation 48
4. Cutoff-spindle hole, operation 26	13. Right side, operations 29 and 35	23. Ejector - pin hole, operations FF and 23	33. Sear-nose hole, operations 23 and 59
5. Left locking-lug slot, operation 32	14. Front shoulder, operations 29 and 35	24. Groove for cutoff-spring spindle, operation 47	34. Profiling on side of tang, right, operation 21
6. Right locking - lug slot, operation 33	15. Upper ramp, operation 67	25. Sear-pin hole, operation 24	35. Profiling on side of tang, left, operation 22
7. Handle seat, operations 30 and 35	16. Lower ramp, operation 66	26. Ejector slot, operation 54	36. Safety-lug slot, operation 52
8. Right side, operations 9 and 11	17. Gas-escape hole, operation 24	27. Clearance for cutoff-spring spindle, operation 47	37. Thread to fit barrel, operation 18
9. Safety-lug slot, operations 14	18. Tenon, operations 7 and 7½	28. Front guard-screw hole, operation 23	38. Recoil lug, operations 8, 10, 71
	19. Cutoff lug, front, operation 14	29. Rear guard - screw hole, operation 23	

Operations on the Receiver

The receiver is an example of an extensive series of machine operations on one piece which would be hard to equal, weight for weight, in any other mechanical part manufactured in quantity. It presents many interesting milling and profiling operations which are handled in jigs and fixtures that represent exceptionally good practice.

Many of these fixtures and gages can be applied equally well, in many cases at least, to other lines of work. This applies to both the fixtures and to the methods of gaging which will be new to many shops, especially those which have not been previously engaged in munition work.

The receiver, which is probably the most complicated component of the rifle, judged from the number of operations performed on it, is a drop forging weighing 4.75

mandrel, which is a good push fit through the hole, is used in nearly all operations on the receiver. This mandrel locates the forging with relation to the bore, and the milled surfaces referred to are forced against stops by a clamping device. As will be seen in the various operations, much of the milling is done in pairs.

It will also be noticed that many formed cutters are used in this connection, some of them being built up of a large number of separate milling cutters. Interlocking cutters have been found much more satisfactory than large, solid formed cutters, both on account of the replacement costs being lower and because they are more easily ground. In this connection it is interesting to observe that the best results are being secured by grinding on the top of the cutting teeth instead of on their

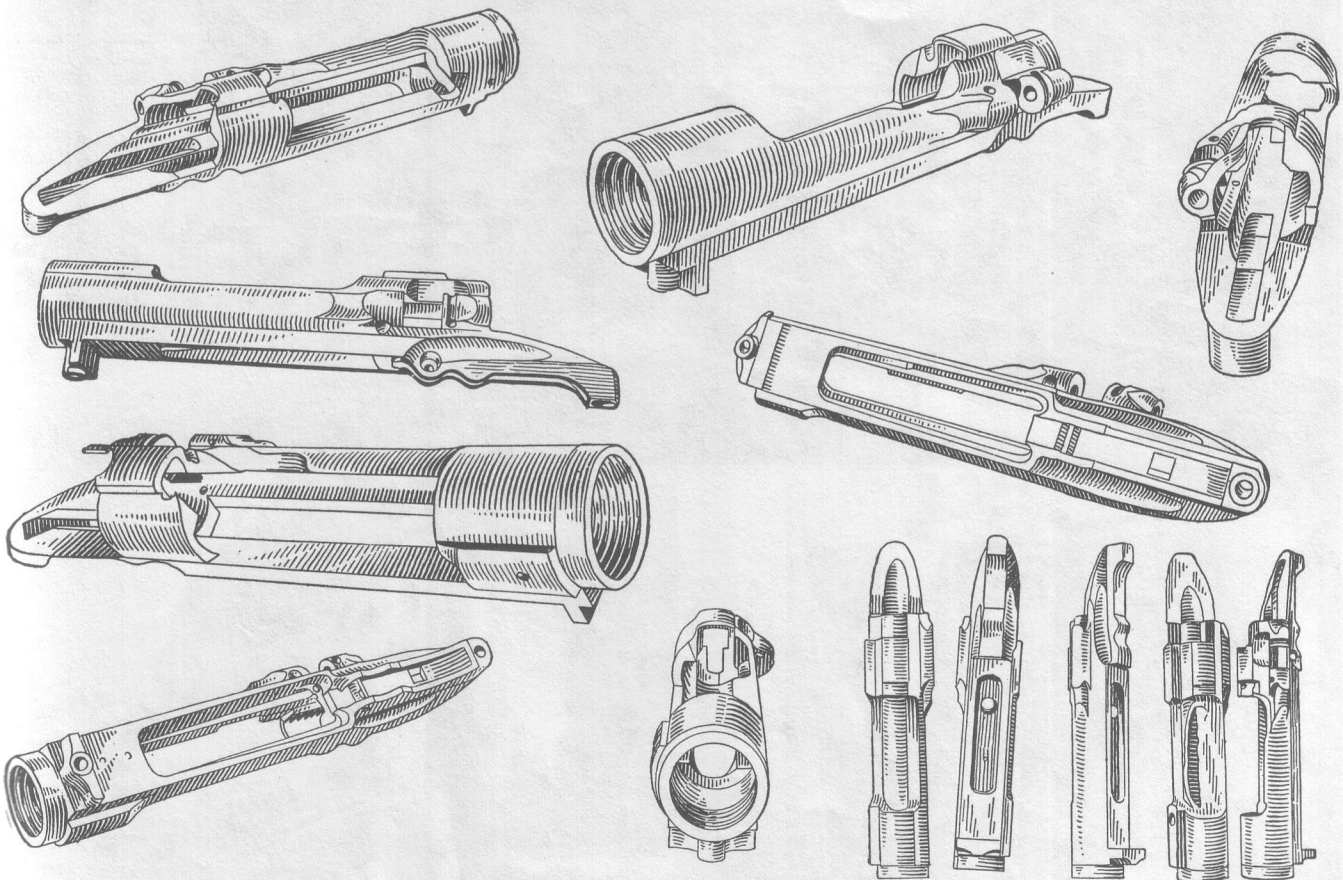


FIG. 245-A. VIEWS OF RECEIVER IN VARIOUS POSITIONS AND STAGES

lb. It is machined until only 0.98 lb. remains. It is Class C steel, $1\frac{3}{4} \times 1\frac{3}{8}$ rectangular, in multiples of 15 in. Some idea of this transformation can be had from Fig. 245. The first operation is to bore the bolt or well hole, and this forms the working point for future operations. After the bottom and left side are milled, they are also used as working points in connection with the bore. A

faces, as is usual with formed cutters. Special appliances for grinding, among them a sort of pendulum support for the cutter, make this less difficult than might be supposed. One of these devices is shown in Fig. 248, while Fig. 247 shows another special grinder for straight-faced cutters that are grooved on centers.

In order to give some idea of the great many operations necessary on the receiver three views are given in

Operations on the Receiver—(Continued)

The use of the closely fitting mandrel for gaging as well as for working is brought out very clearly in operation 52 and shown in Fig. 450.

As examples of some minor operations, it is only necessary to refer to Figs. 465 and 466 to Figs. 467 and 470; to Figs. 511 and 512, to Figs. 519 and 520 and to Figs. 533 and 534, although there are by no means all that can be studied to advantage.

This may also be a good time to refer specifically to some of the gages and gaging operations such as Figs. 468, 472, 480, 495, 500, 504, 514; 518, 522, 526, 537, 555 and 563.

On an article which is as complicated as the Springfield rifle receiver, speaking relatively to the number and sequence of operations, there must always be a large number of minor cleaning up, burring, filing, and polishing

difficult machining operations which have preceded them. And it is a fact that while these minor operations appear in themselves to be unimportant in the average shop they are often the ones that are found to delay most everything else. It is a case of little difficulties becoming big obstacles.

The progressive shop manager, especially in such plants as are concentrating their energies on mass production of one article, has an opportunity to make extensive savings in cost by eliminating the delays which necessarily arise with a succession of these minor operations. One of the most potent ways to save money on a sequence of such operations is to as far as possible eliminate the handwork.

No matter how highly skilled hand labor becomes, it can never approach the efficiency of a mechanical device

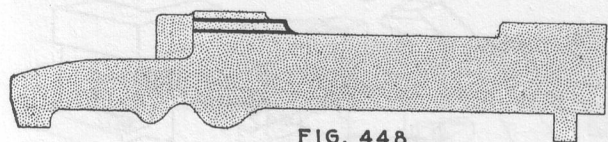


FIG. 448

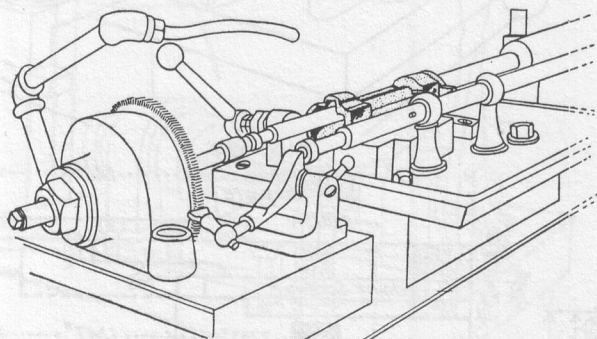
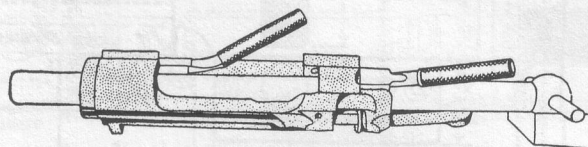


FIG. 449



Operation 52

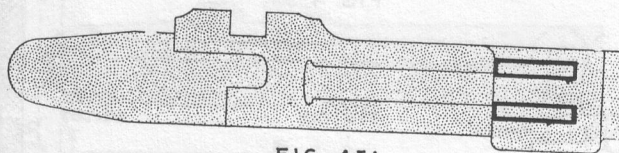


FIG. 451

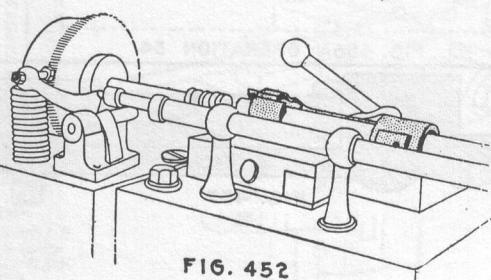


FIG. 452

Operation 53

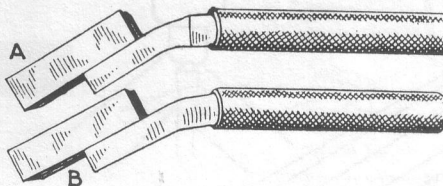


FIG. 450

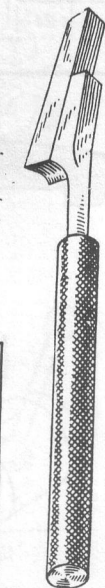


FIG. 453

OPERATION 52. SHAVING SAFETY-LUG SLOT

Transformation—Fig. 448. Machine Used—Machine made at Hill shops, Fig. 449. Number of Operators per Machine—One. Work-Holding Devices—Held in vise jaws. Tool-Holding Devices—In barrel. Cutting Tools—Radius cutters. Cut Data—30 strokes per min.; 0.005-in. feed. Coolant—Cutting oil, ½-in. stream. Average Life of Tool Between Grindings—150 pieces. Gages—Fig. 450; A, width; B, depth, curved to fit between plug and bridge over safety-lug slot. Production—50 pieces per hr. Note—Located by bottom and side.

OPERATION 53. SHAVING FRONT LOCKING-LUG SLOT

Transformation—Fig. 451. Machine Used—Machine made at Hill shops. Number of Operators per Machine—One. Work-Holding Devices—Held in vise jaws, Fig. 452. Tool-Holding Devices—Same as Fig. 371. Cutting Tools—Similar to Fig. 371. Cut Data—50 strokes per min.; hand feed. Coolant—Cutting oil, ¼-in. stream. Average Life of Tool Between Grindings—150 pieces. Gages—Fig. 453, depth of slot, goes between plug and wall. Production—50 pieces per hr. Note—Locating points, bottom and side.

operations which are really as essential to the correct finishing of the piece as are the more pretentious and

properly designed to perform the same work. This is almost a self-evident statement, and it is borne out by a multitude of cases common to the experience of any shop

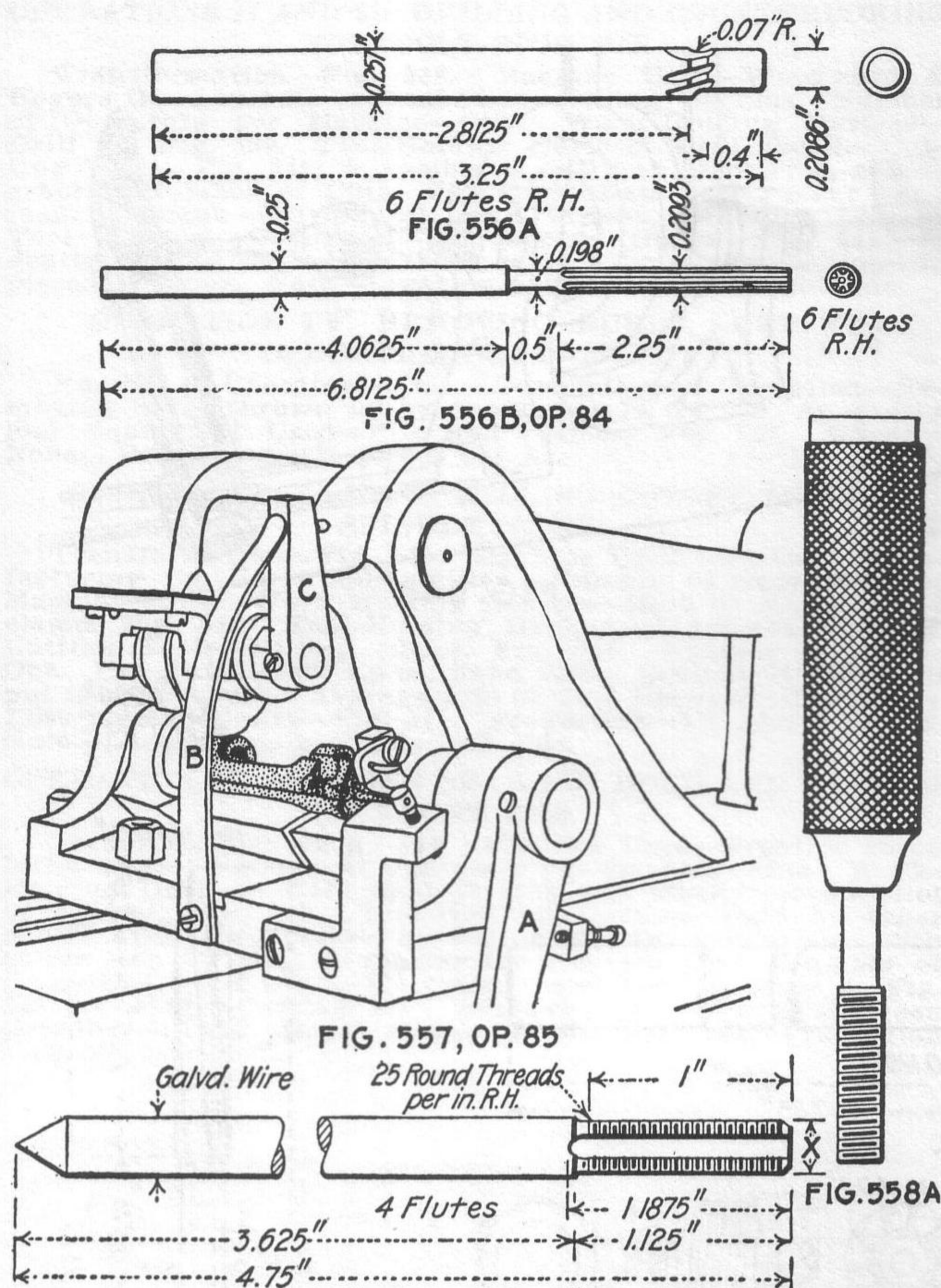


FIG. 558. OP. 96.

OPERATIONS 95 AND 95½. SHAVING FOR EXT. CAM

Transformation—Figs. 551 and 552. Machine Used—Double-ended machine made at Hill shops, Fig. 553; bar rocked by connecting-rod A; moved back and forth by cam cut in B working on stud C. Number of Operators per Machine—One. Work-Holding Devices—Held on stud at front and by vise. Tool-Holding Devices—Oscillating bar. Cutting Tools—Shaving cutter, Fig. 554; A, for extractor cam; B, for front locking cams. Cut Data—Speed, 75 strokes per minute; feed, 0.005 per min.; ratchet feed mechanism shown at D, Fig. 553. Coolant—Cutting oil put on with brush. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 555-A; plug goes in hole, arm A rests against right side and B fits against cam, while a straight-edge measures across front end; Figs. 555-B and 555-C, front-cam gages used in same way. Production—45 pieces per hr. Note—Locating points, hole and bottom.

OPERATION 95¾. REMOVING BURRS

Number of Operators—One. Description of Operation—Removing burrs thrown up by operations 95 and 95½. Apparatus and Equipment Used—Scraper. Production—250 per hr.

OPERATION 83. POLISHING CIRCLE, FRONT END

Number of Operators—One. **Description of Operation**—Polishing front end for stamping. **Apparatus and Equipment Used**—Polishing jack and wheel. **Production**—80 pieces per hr.

OPERATION 84. REAMING AND COUNTERSINKING CUT-OFF SPINDLE, JOINT-PIN, EJECTOR-PIN AND GAS HOLES

Machine Used—Prentice speed lathe, 14 in. Number of Operators per Machine—One. Work-Holding Devices—Held in hands. Tool-Holding Devices—Drill chuck. Cutting Tools—Countersink and reamer, Figs. 556-A and 556-B. Number of Cuts—One. Cut Data—Speed, 900 r.p.m.; hand feed. Coolant—Cutting oil put on with brush. Average Life of Tool Between Grindings—2,000 pieces. Gages—None. Production—80 pieces per hr. Note—Practically a burring job.

OPERATION 85. STAMPING

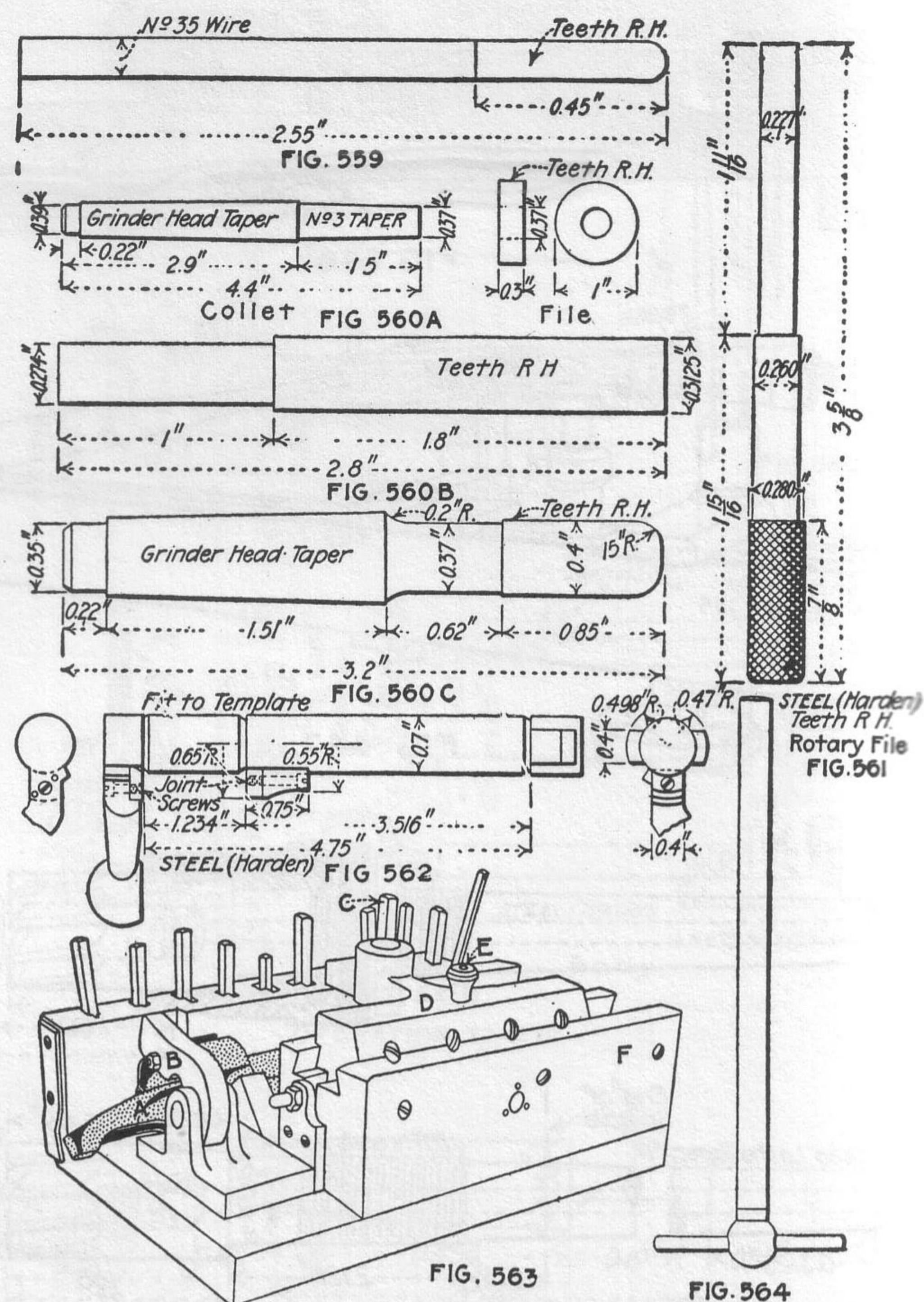
Number of Operators—One. Description of Operation—Stamping "U. S. Springfield Armory, Model 1903"; work rotated by handle A, Fig. 557. Apparatus and Equipment Used—Roll stamping machine, made at Hill shop, Fig. 557; supporting fixtures as shown; stamping roll controlled by spring B against arm C. Production—120 per hr.

OPERATION 93. TAPPING GUARD-SCREW HOLES

Number of Operators—One. Description of Operation—Tapping screw holes for guard. Apparatus and Equipment Used—Vise; holding fixture and hand brace; taps, Fig. 558, three in set. Gages—558-A. Production—40 receivers per hr.

OPERATION 86. ROTARY FILING CUTOFF-SPRING GROOVE

Transformation—Same as Fig. 428. **Number of Operators**—One. **Description of Operation**—Filing out groove. **Apparatus and Equipment Used**—Prentice speed lathe, 12 in.; rotary file to round shape of groove, Fig. 559. **Production**—85 per hr.



OPERATION 87. ROTARY FILING UNDER SIDE OF TANG

Number of Operators—One. Description of Operation—Rotary filing; blending side cuts together and filing under side of tang and filing groove on under side of tang. Apparatus and Equipment Used—Rotary file with taper shank; files are hand cut, made at Hill shops, Fig. 560; A, under side of tang; B, thumb cut; C, rear of front circle. Production—20 per hr.

OPERATION 96. FILING TOP OF RIGHT WALL, ETC.

Number of Operators—One. Description of Operation—Filing and blending cuts together and filing corners. Apparatus and Equipment Used—Rotary and flat files; rotary in Fig. 561. Gages—Fig. 562; this is practically a finished bolt with hardened lugs and distance pieces. Production—7 per hr.

OPERATION 88. STAMPING SERIAL NUMBER

Number of Operators—One. Description of Operation—Stamping serial number. Apparatus and Equipment Used—Hand stamp and hammer with work-holding fixture, Fig. 563; receiver A is held by finger clamp B; stamp C fits in guide in slide D; this is moved by handle E; there is a ratchet beneath slide, and there are guide lines at F. Production—120 per hr.

OPERATION 89. POLISHING ALL OUTER SURFACES

Number of Operators—One. Description of Operation—Polishing all top surfaces that show. Apparatus and Equipment Used—Polishing jack and wheel. Production—10 pieces per hr.

OPERATION 90. FILING AND GENERAL CORNERING

Number of Operators—One. Description of Operation—General filing and cornering. Apparatus and Equipment Used—Hand file. Production—6 pieces per hr.

OPERATION 91. CASEHARDENING

Description of Operation—Packed in new, whole bone, heated to 750 deg. C. (1,382 deg. F.) and heated for 2½ to 3 hr. **Apparatus and Equipment Used**—Brown & Sharpe furnaces for crude oil, 10 to 14 lb. air pressure; firebox 30x48 in.; cast-steel boxes hold 42 receivers; quenched in oil.

OPERATION 91-A. SAND BLASTING

Description of Operation—Only used when scale forms in casehardening or when work comes in for repair. **Apparatus and Equipment Used**—Sand-blast house.

OPERATION 94½. POLISHING WELL

Description of Operation—Hold receiver in hand and push well over a special lap. Apparatus and Equipment Used—Bench lathe or polishing head. Gages—Fig. 564. Production—80 per hr.

OPERATION 92. ASSEMBLING WITH BOLT STOP

Number of Operators—One. Description of Operation—Assembling bolt stop to receiver. Apparatus and Equipment Used—Handwork. Production—400 per hr.

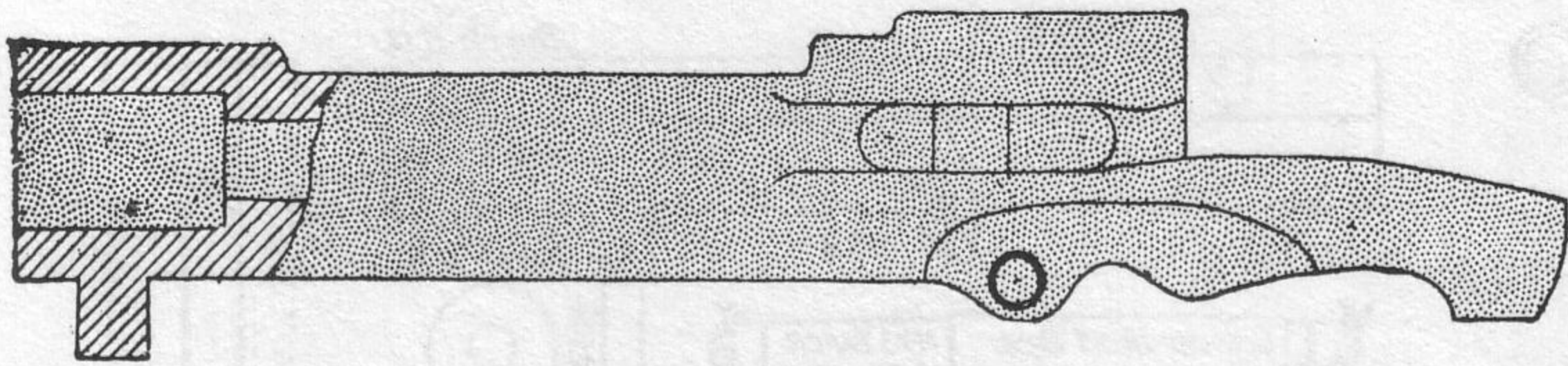


FIG. 546

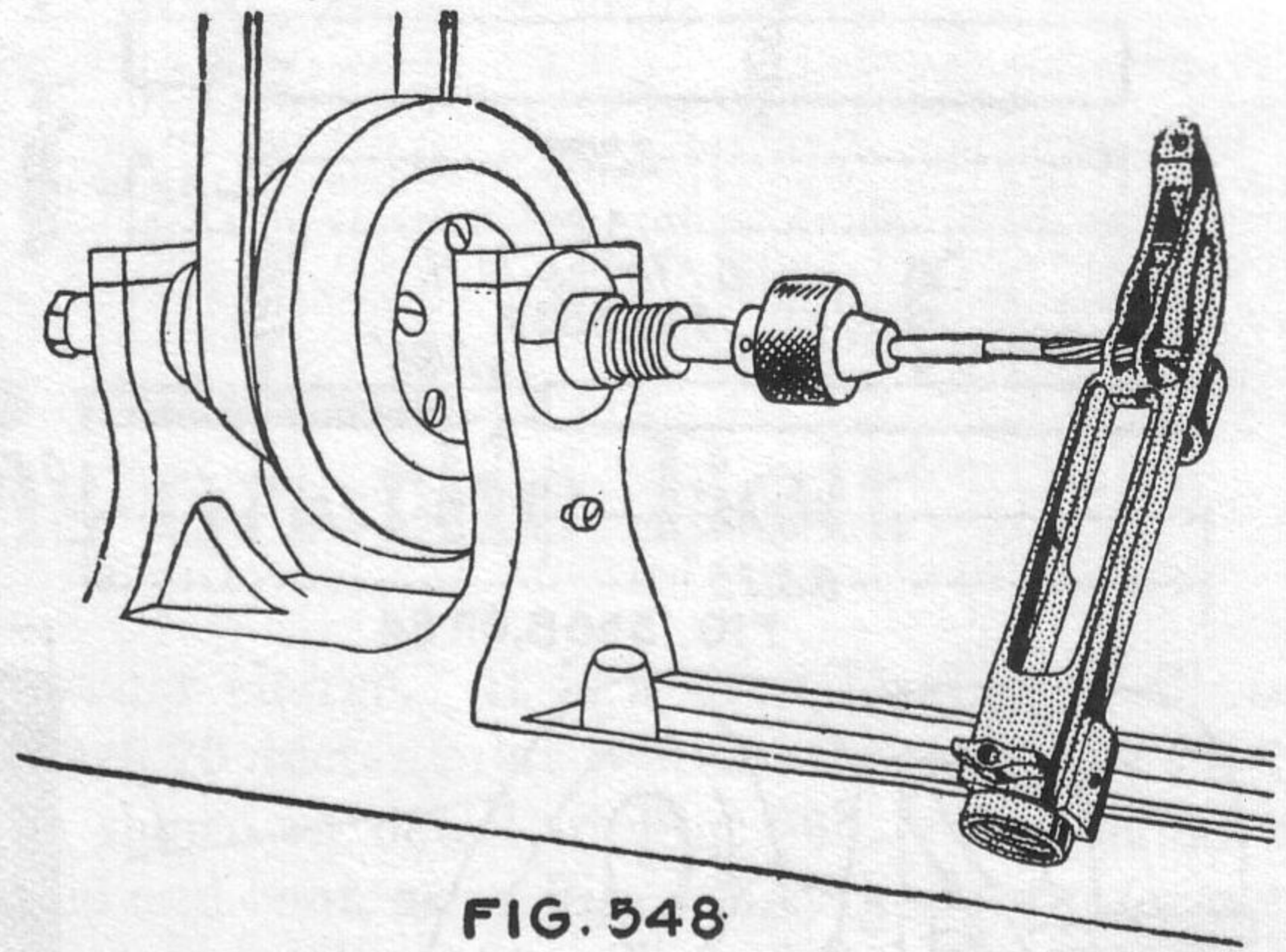


FIG. 548

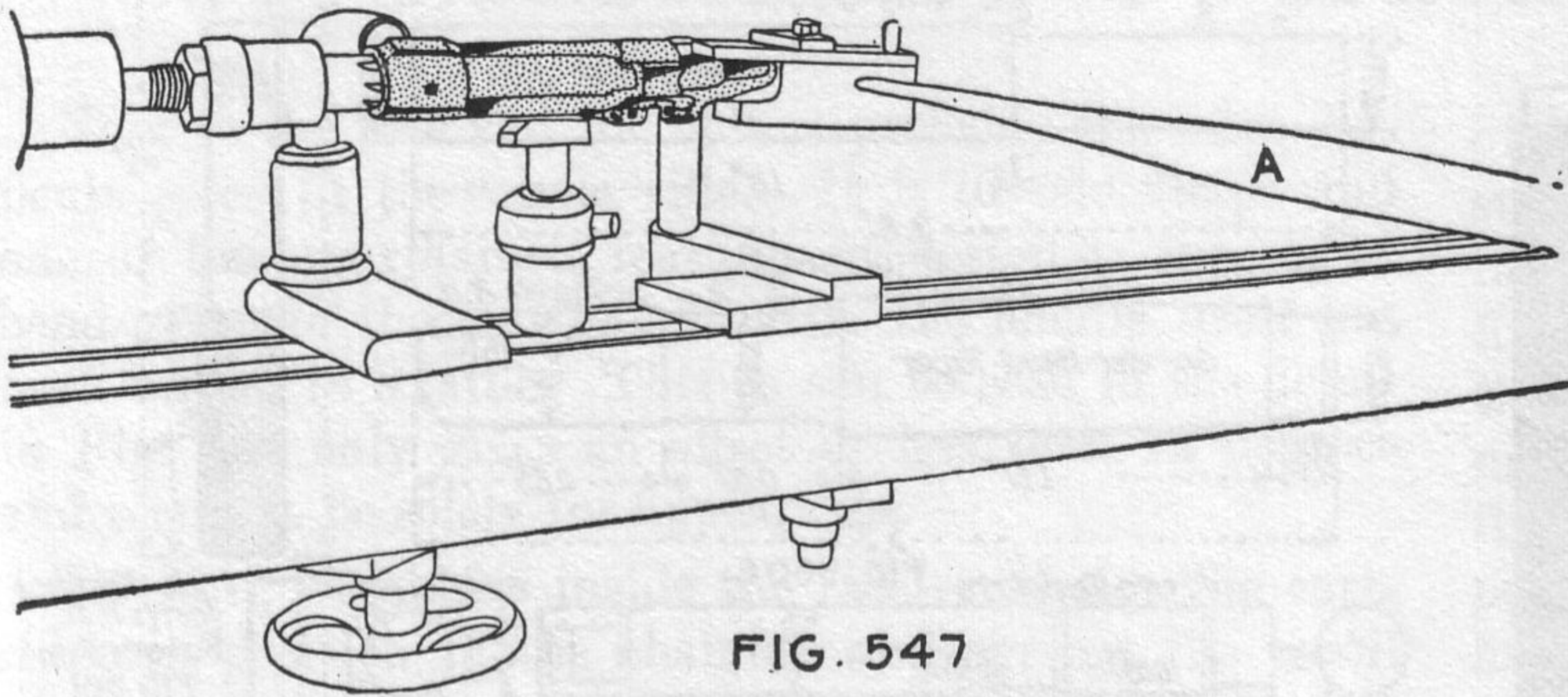


FIG. 547

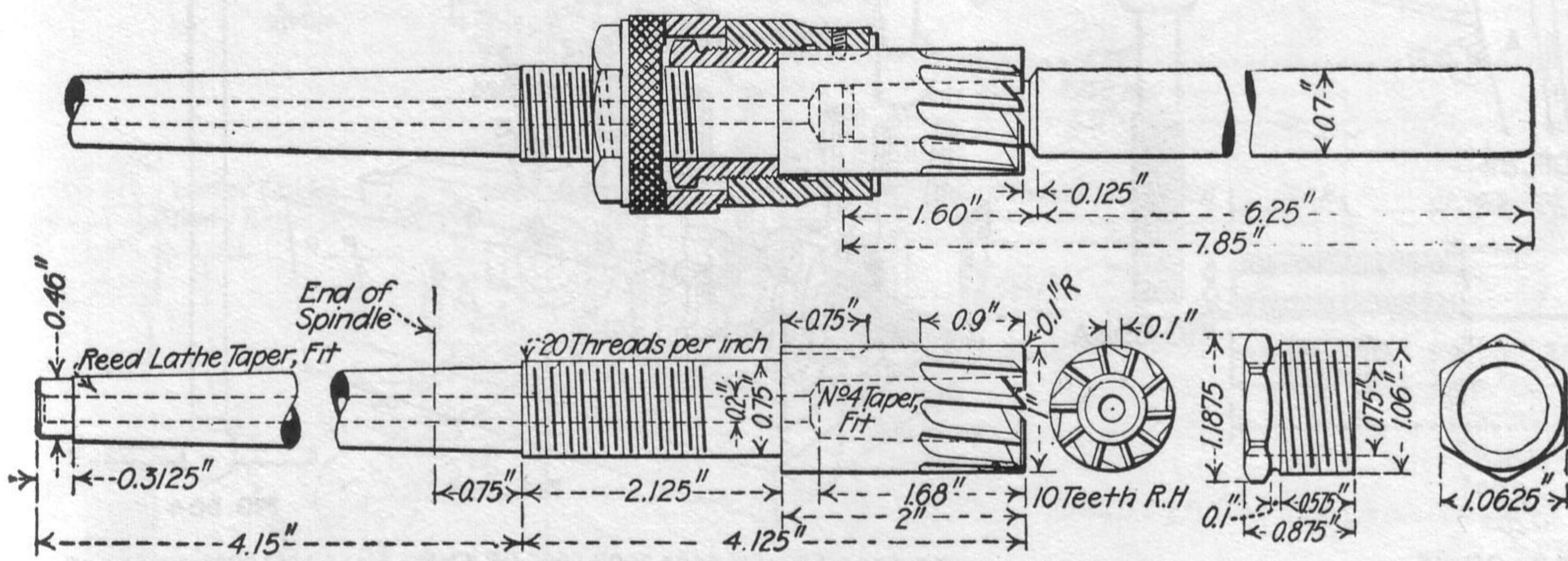


FIG. 549 A OPERATION 82

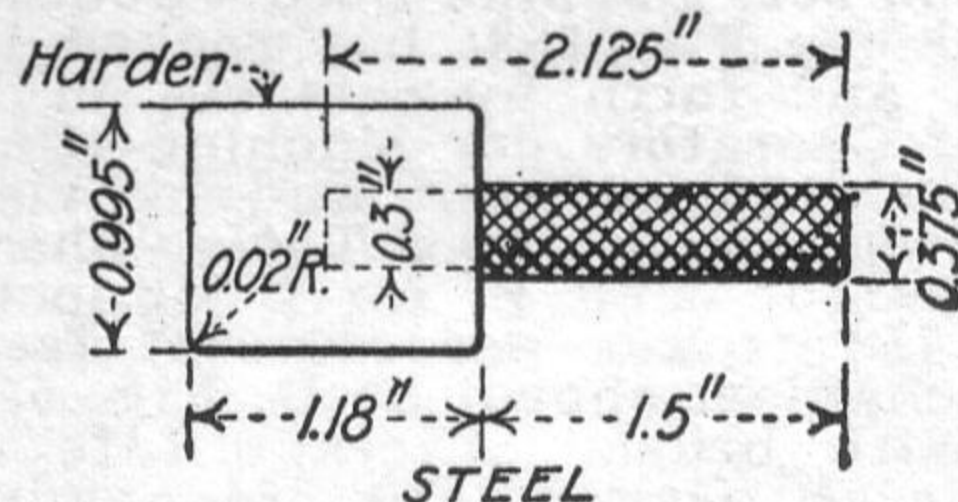


FIG. 550

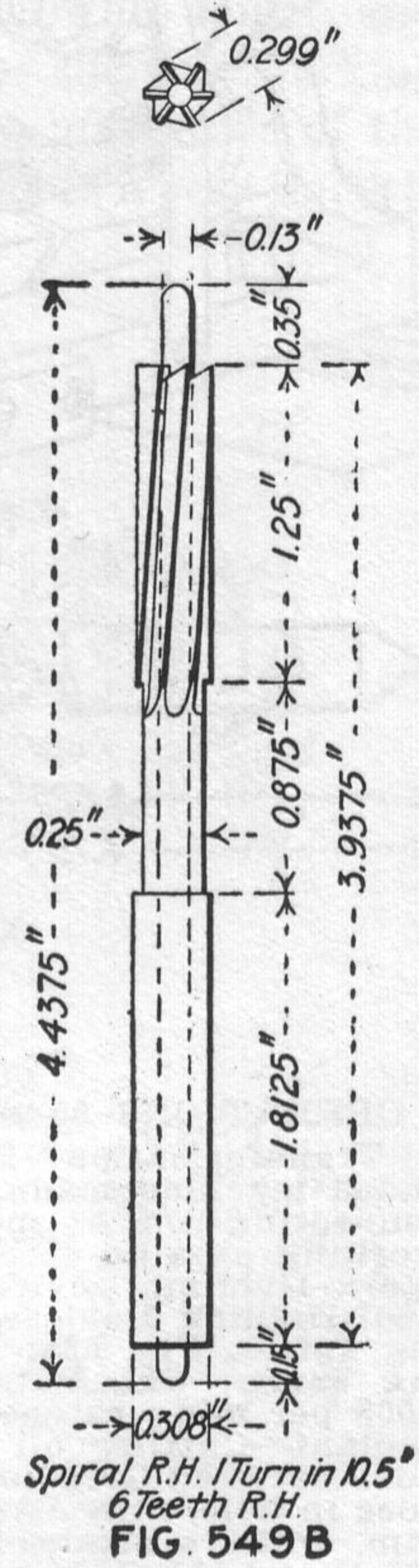


FIG. 549 B

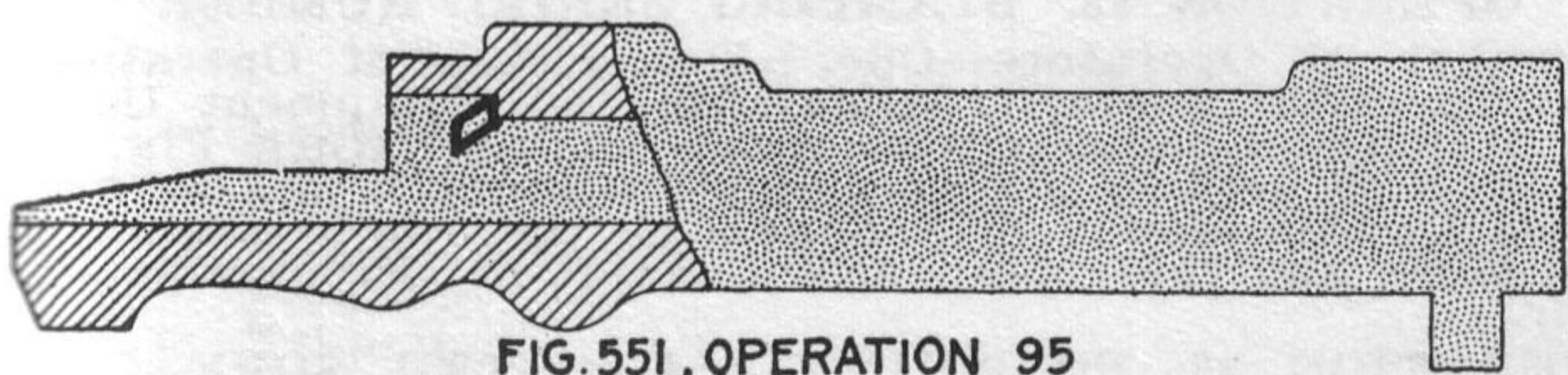


FIG. 551, OPERATION 95

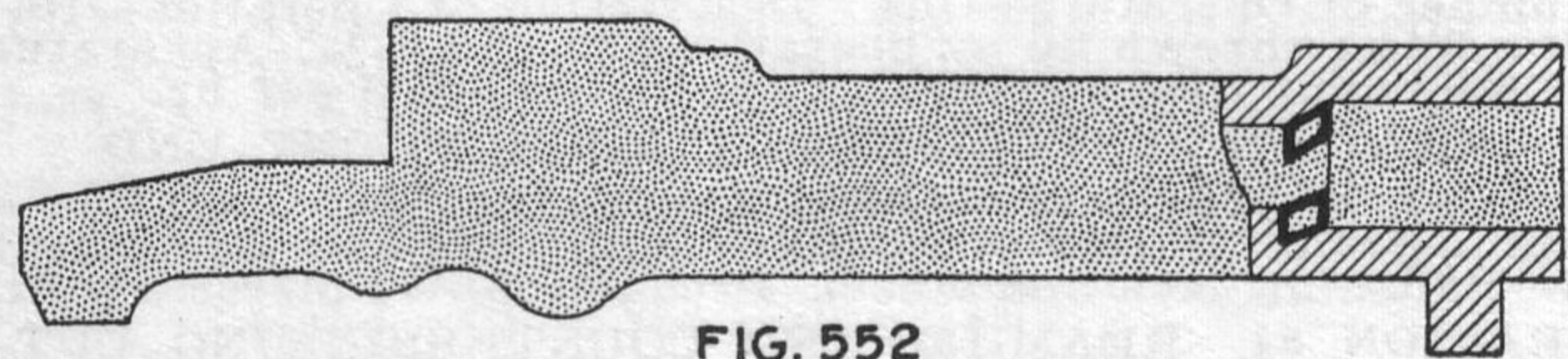


FIG. 552

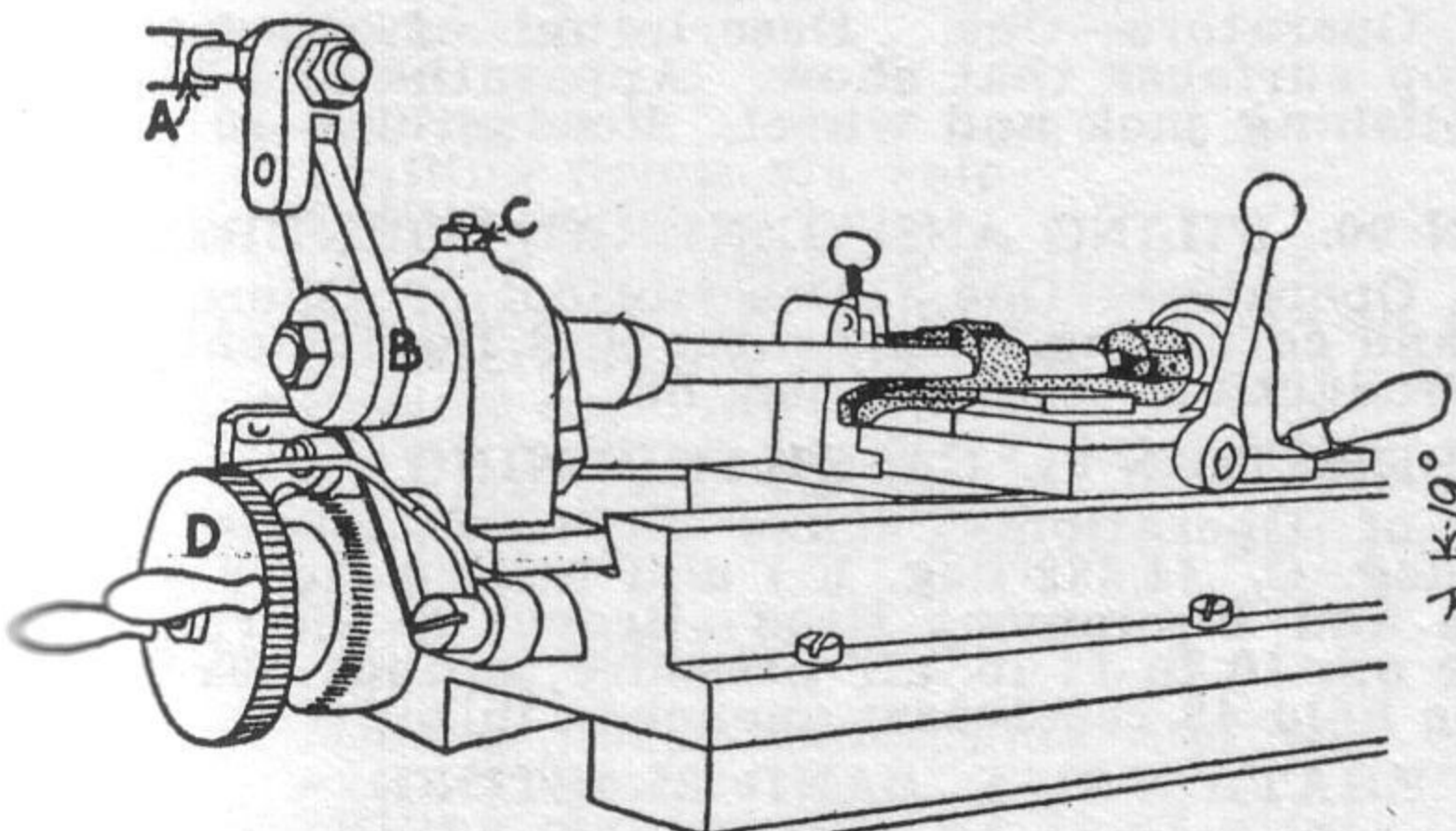


FIG. 553

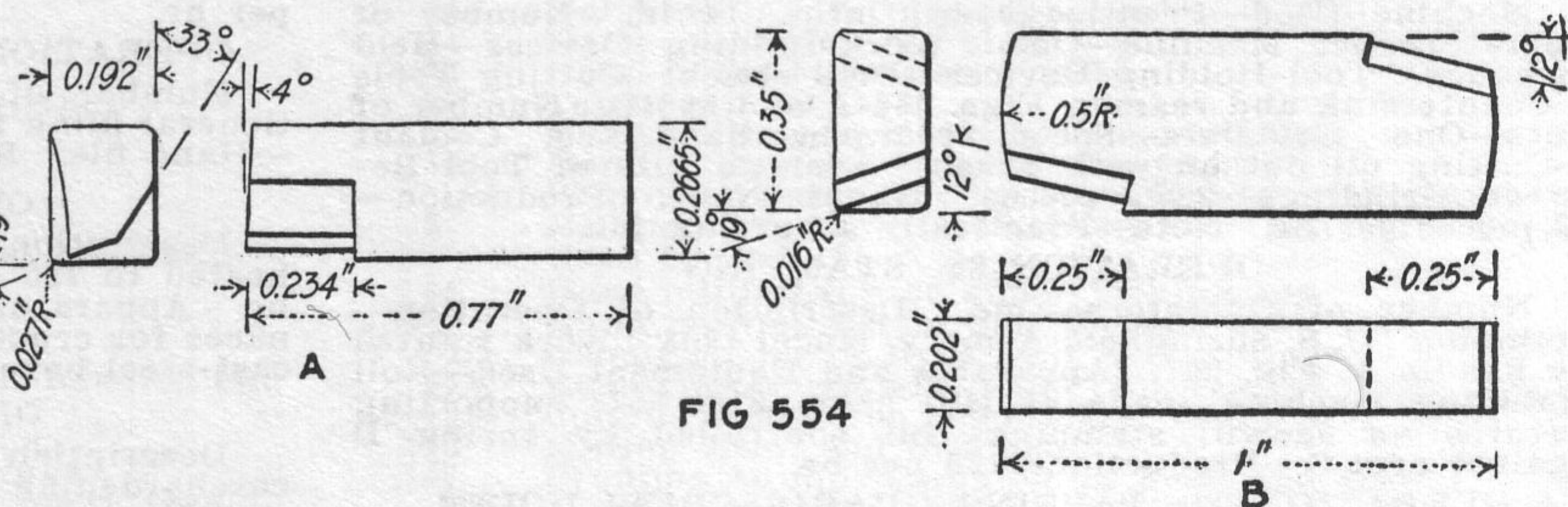


FIG. 554

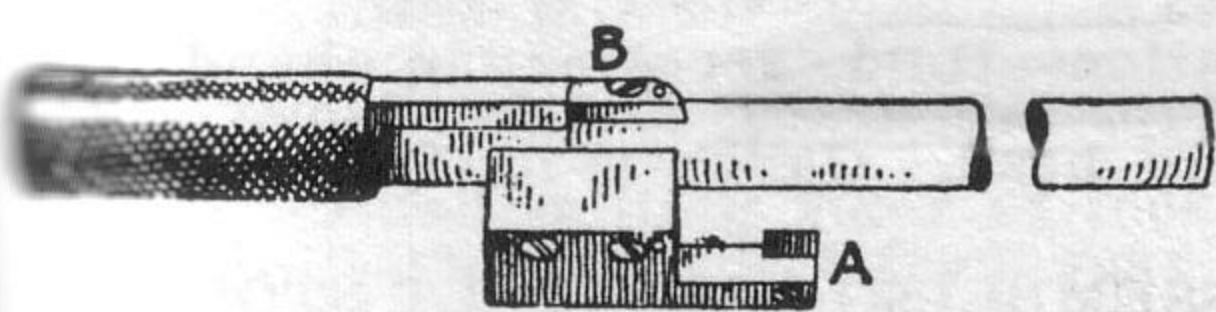


FIG. 555 A

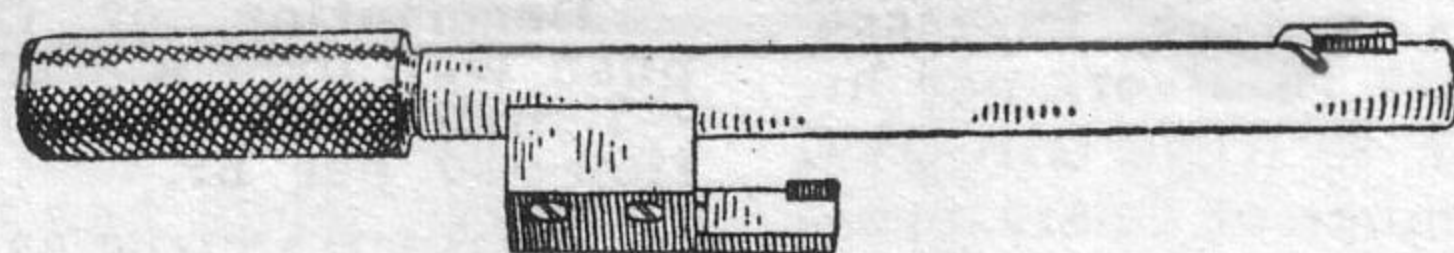


FIG. 555 B

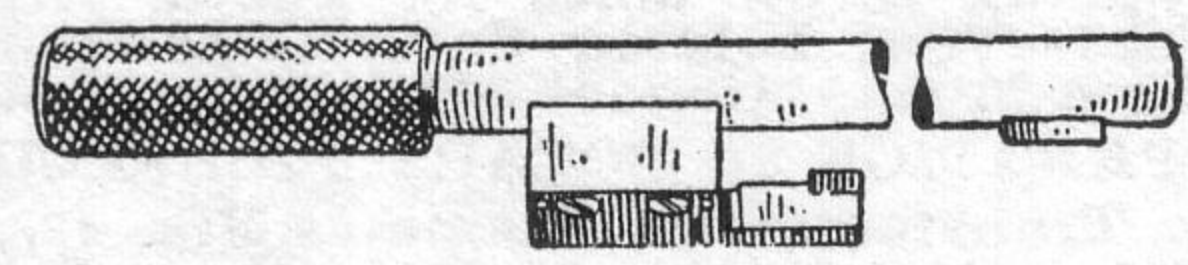


FIG. 555 C.

OPERATION 95 & 95 1/2

Operations on the Receiver—(Continued)

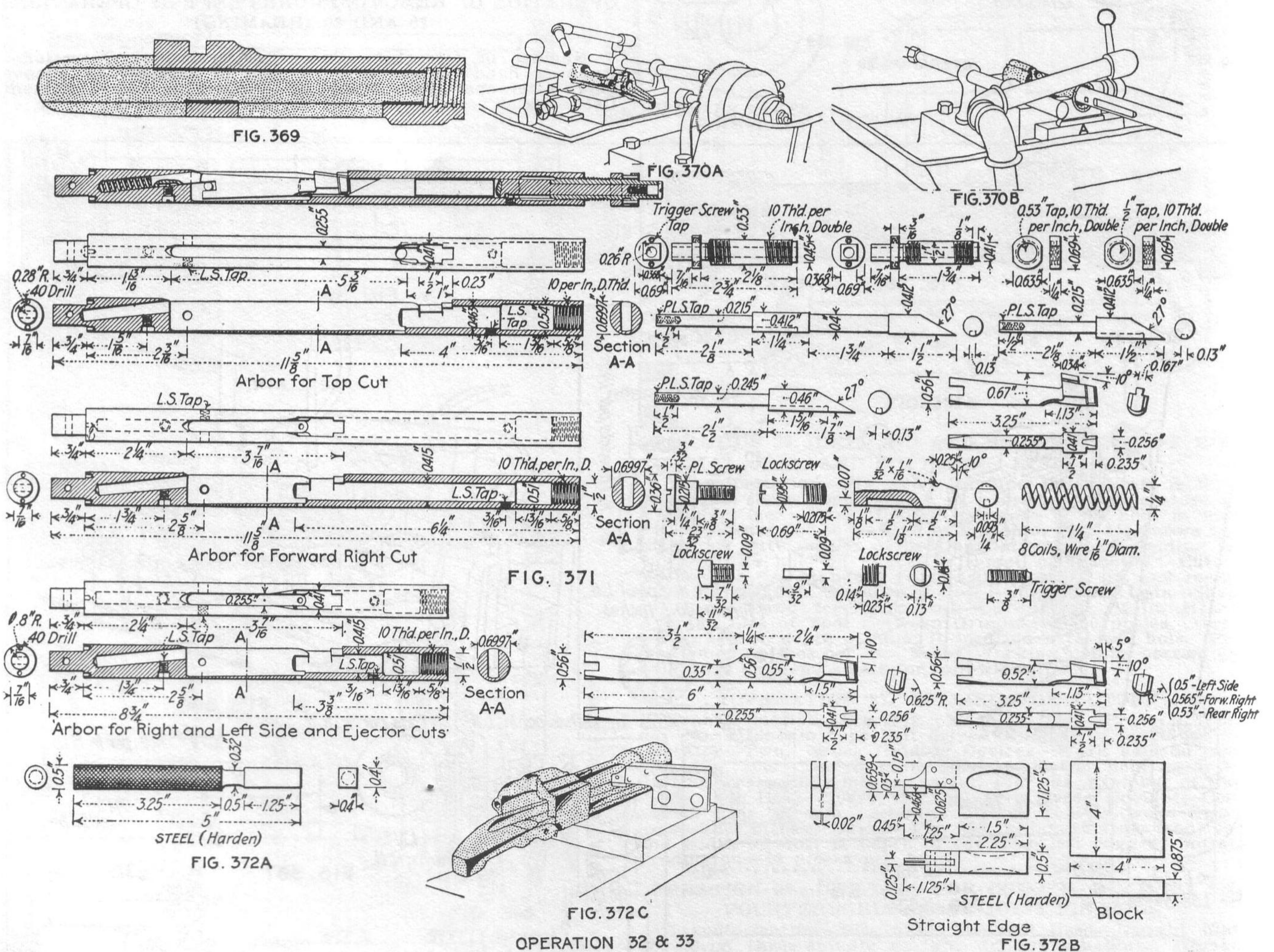
As the operations progress the receiver requires more and more careful handling in order to avoid mistakes, which would render all the previous work useless. These machinery operations are all accompanied by numerous corresponding gaging operations which should also be helpful in suggesting methods for other classes of work.

The details of the tools used for the shaving operation are clearly shown in Figs. 371, while Fig. 372 shows some of the methods of gaging.

Devices—Work held in vise jaws, Fig. 370-A. Tool-Holding Devices—Cutter held in bar; see A, Fig. 370-B. Cutting Tools—Cutter; special radius cutter; see Figs. 370-B and 371. Number of Cuts—One. Cut Data—Strokes of machine, 30 per min.; feed, about 0.003 in. per stroke; hand feed. Coolant—Cutting oil, 1/8-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Fig. 372; A, width of slots; B, height from bottom; C, use of gage. Production—20 per hr., two machines.

OPERATION 34. MILLING RECEIVER CLIP SLOT, ROUGHING

Transformation—Fig. 373. Machine Used—Pratt & Whitney No. 2 Lincoln type, belt drive. Number of Machines per Operator—One. Work-Holding Devices—Work held in vise



OPERATION 32. SHAVING LEFT LOCKING-LUG SLOT

Transformation—Fig. 369. Machine Used—Horizontal shaving machine, made at the shops. Number of Operators per Machine—One; two barrels at one setting. Work is held on angle plate; held by nose and sides, located against bottom, Fig. 374. Tool-Holding Devices—Threaded arbor. Cutting Tools—Side-milling cutters, Fig. 375. Number of Cuts—One. Cut Data—Speed, 60 r.p.m.; 1/8-in. feed. Coolant—Compound. Average Life of Tool Between Grindings—1,000 pieces. Gages—Fig. 376; A, depth from front end; B, width of slot and location from right side. Production—20 pieces per hr.

OPERATION 33. SHAVING RIGHT LOCKING-LUG SLOT

Transformation—Fig. 369. Machine Used—Horizontal shaving machine made in the shops. Number of Machines per

Operator—Two. Work-Holding Devices—Same as Fig. 370-A. Tool-Holding Devices—Same as operation 32. Cutting Tools—Same as Figs. 370-B and 371. Number of Cuts—One. Cut Data—Same as operation 32. Coolant—Cutting oil, 1/8-in. stream. Average Life of Tool Between Grindings—250 pieces. Gages—Same as Fig. 372. Production—20 pieces per hr., two machines.

OPERATION 35. PROFILING TOP OF RIGHT WALL, FRONT AND REAR SHOULDERS AND HANDLE SEAT TO FINISH

Transformation—Fig. 377. Machine Used—Pratt & Whitney profiler No. 2. Number of Operators per Machine—One. Work-Holding Devices—Work held in stud clamped by vise jaws, clamped on sides, located by nose and bottom, Fig. 378. Tool-Holding Devices—Taper shank. Cutting Tools—End-milling cutters, Fig. 380. Number of Cuts—Two. Cut Data—Speed