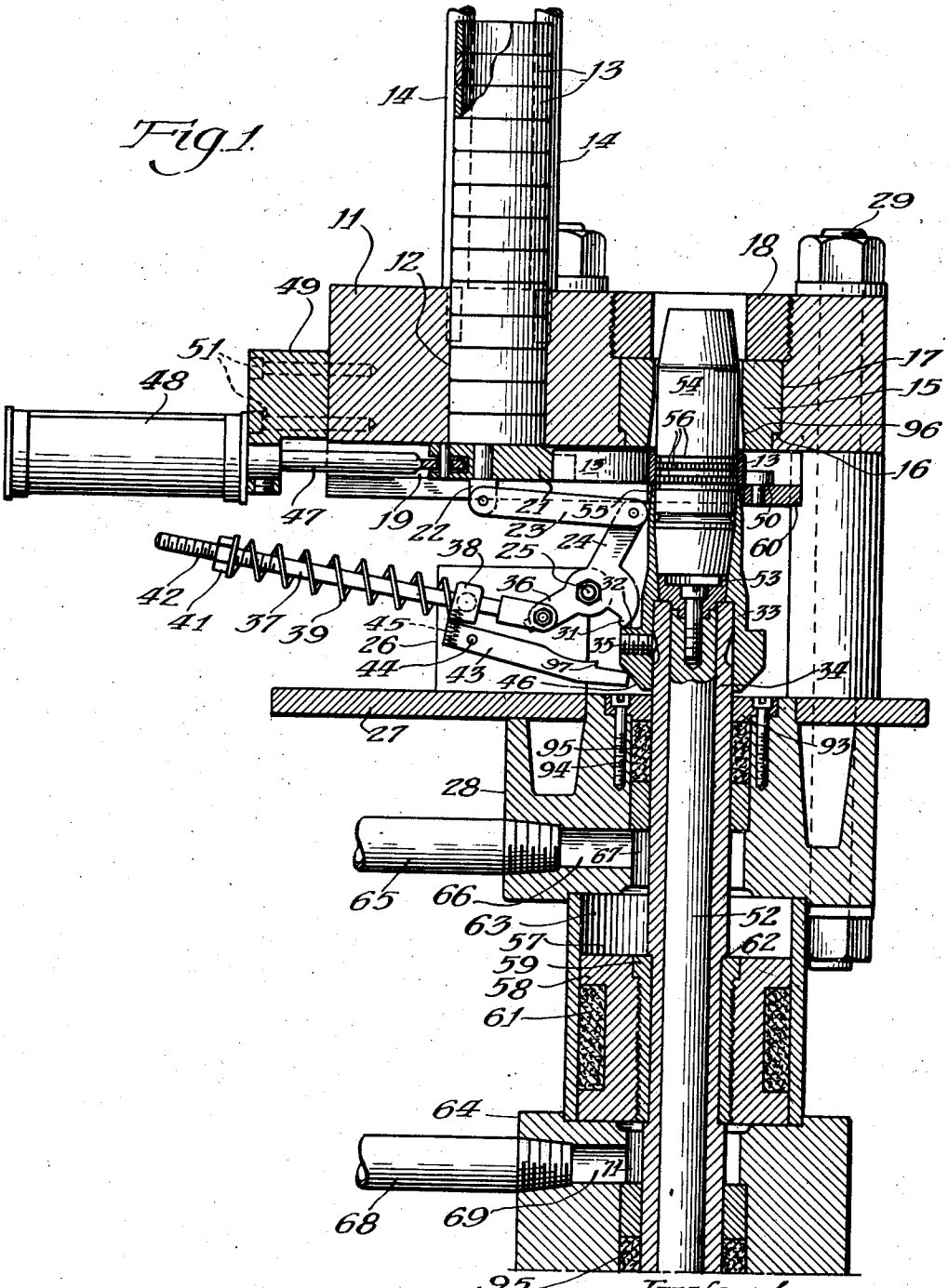
Aug. 27, 1946. A. MINARIK, JR., ET AL 2,406,392

APPARATUS FOR APPLYING ROTATING BANDS TO PROJECTILE SHELLS

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Fig. 1.



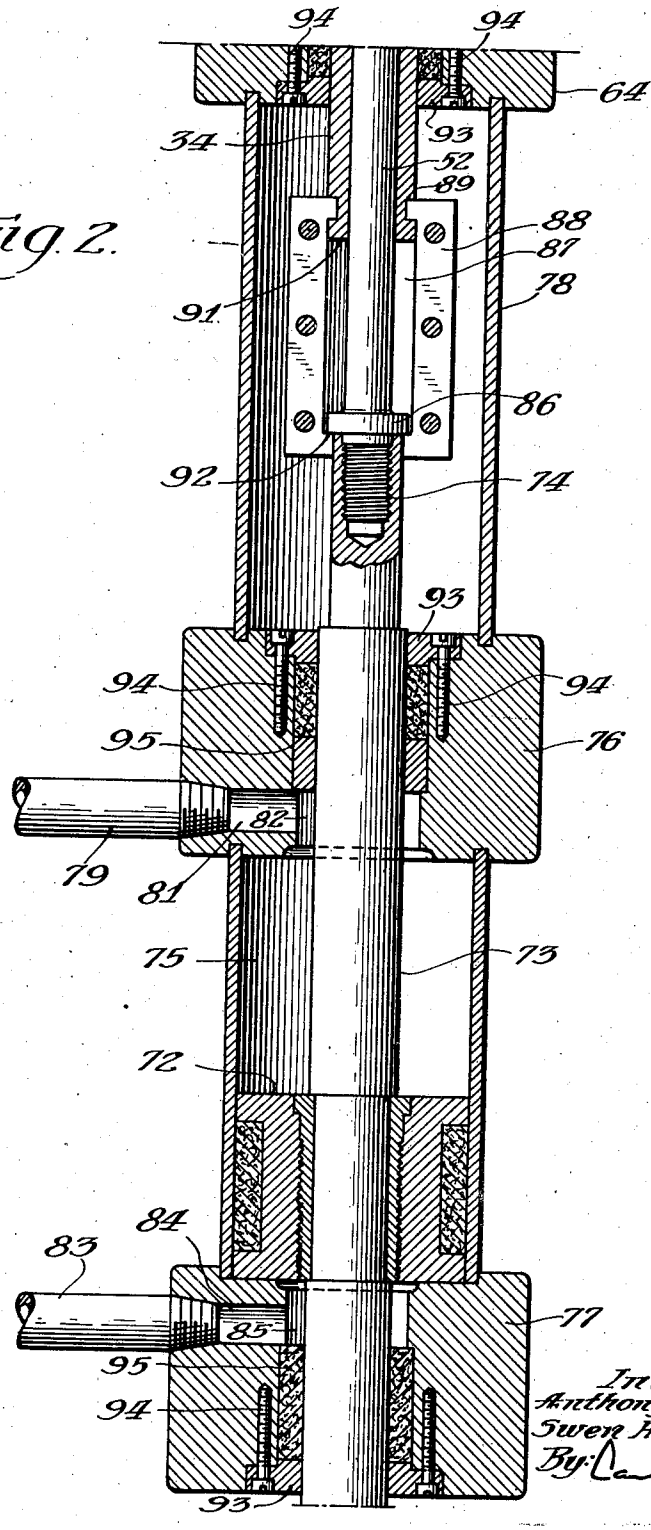
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APPARATUS FOR APPLYING ROTATING BANDS TO PROJECTILE SHELLS

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Fig. 2.



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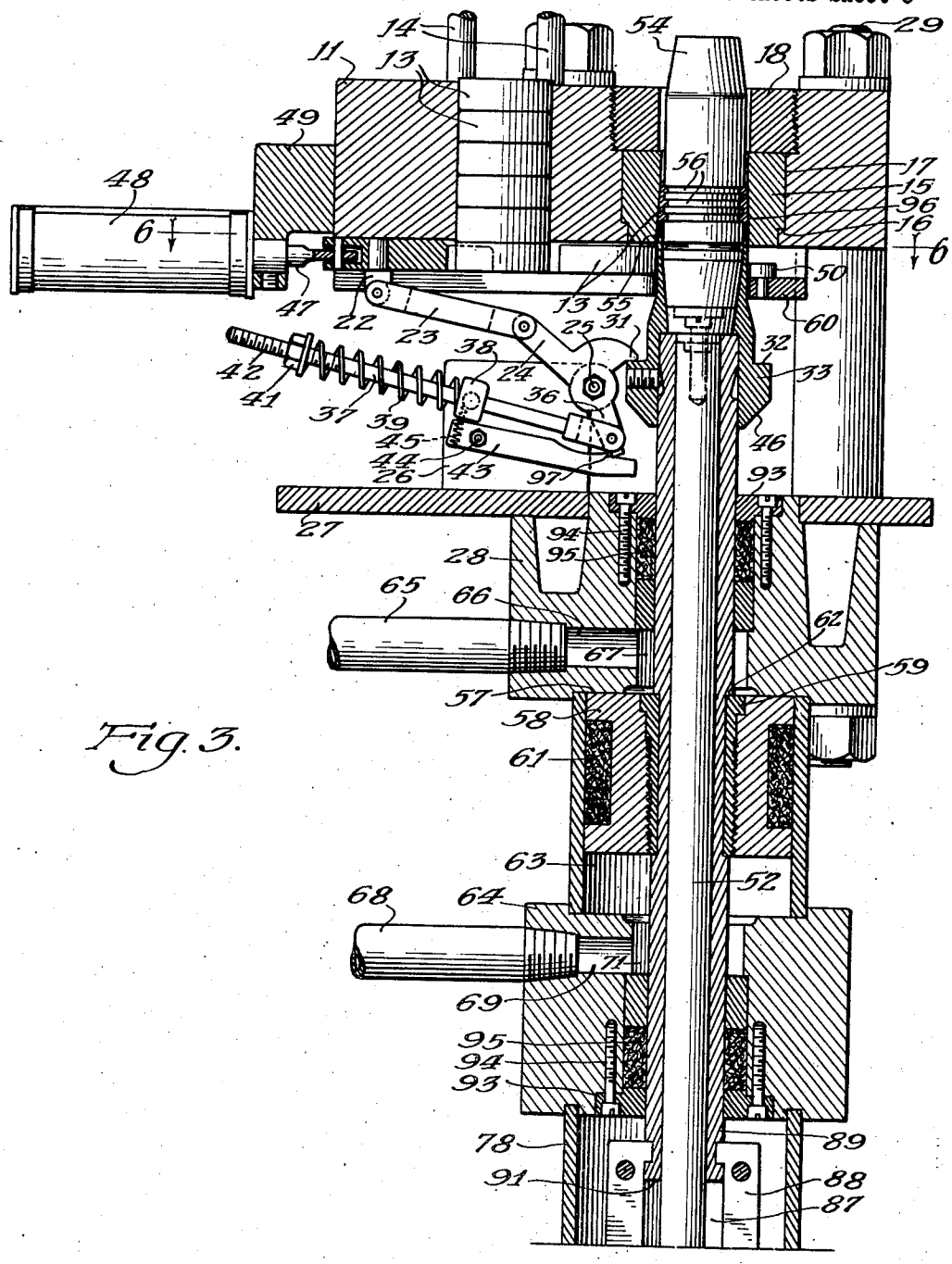


Fig. 3.

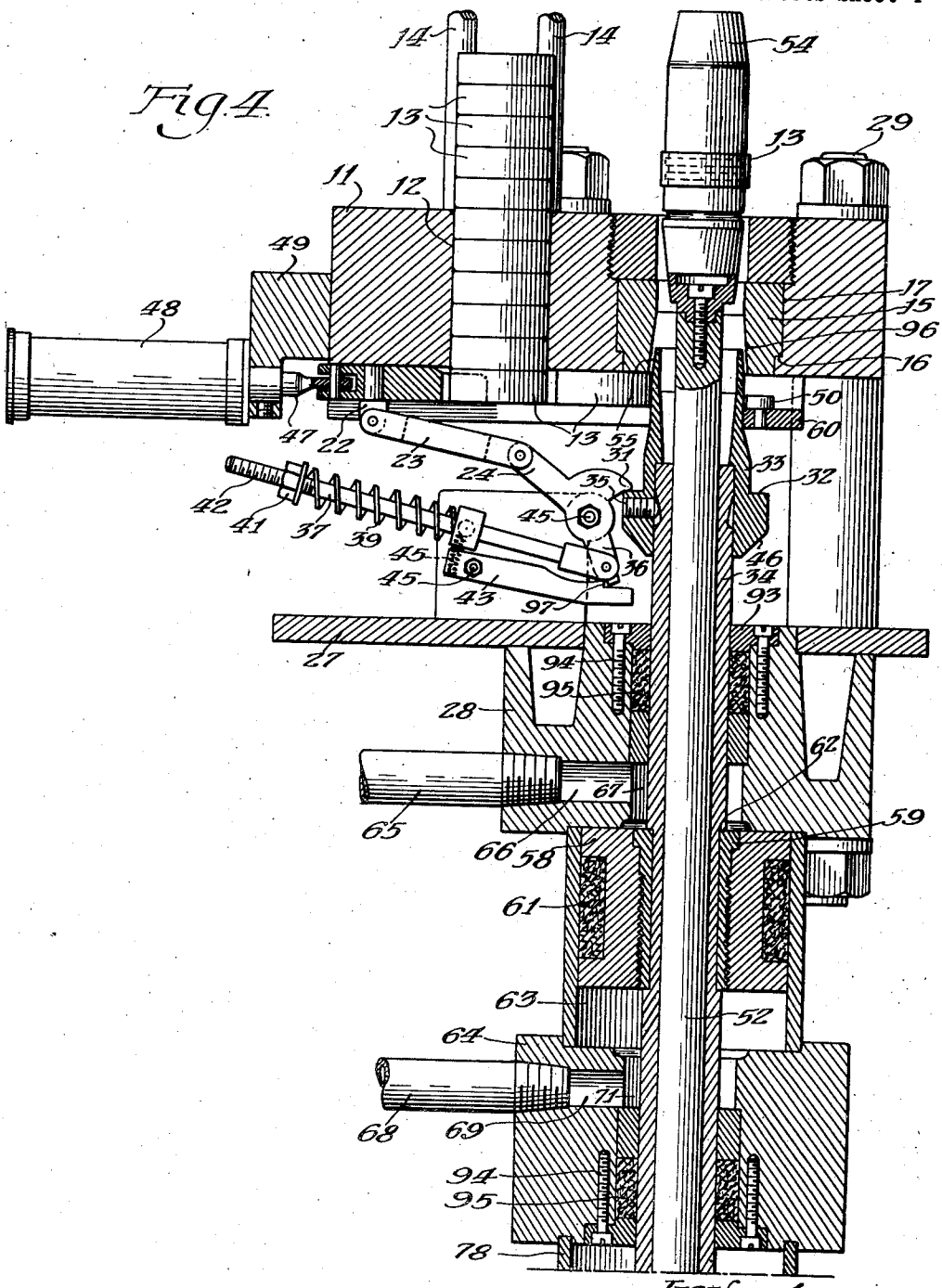
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APPARATUS FOR APPLYING ROTATING BANDS TO PROJECTILE SHELLS

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Fig. 4.



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Fig. 5.

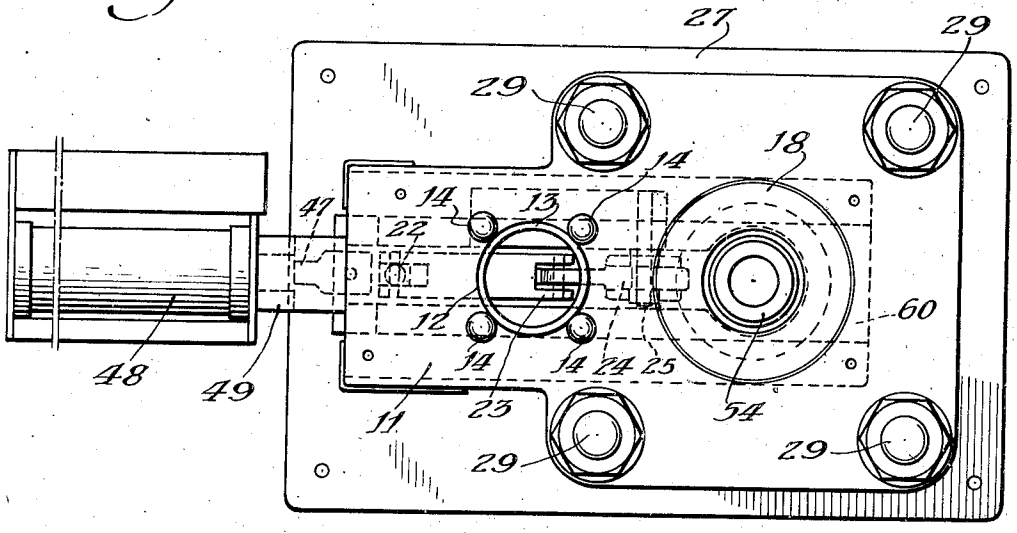
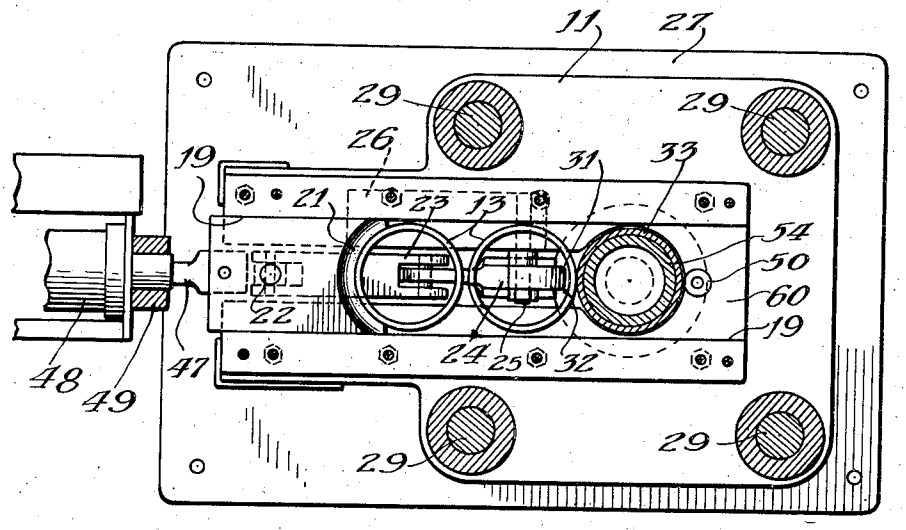


Fig. 6.



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Fig. 7.

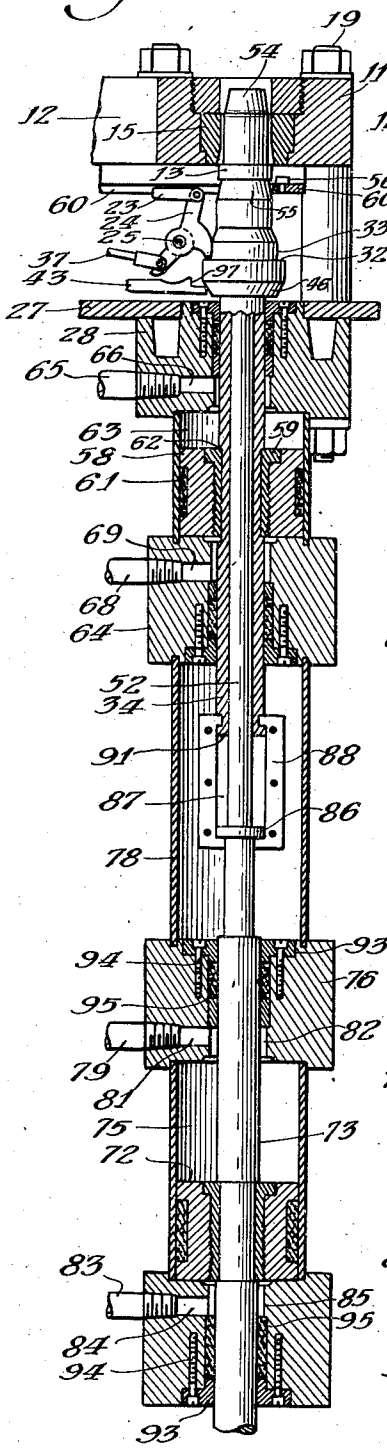


Fig. 8.

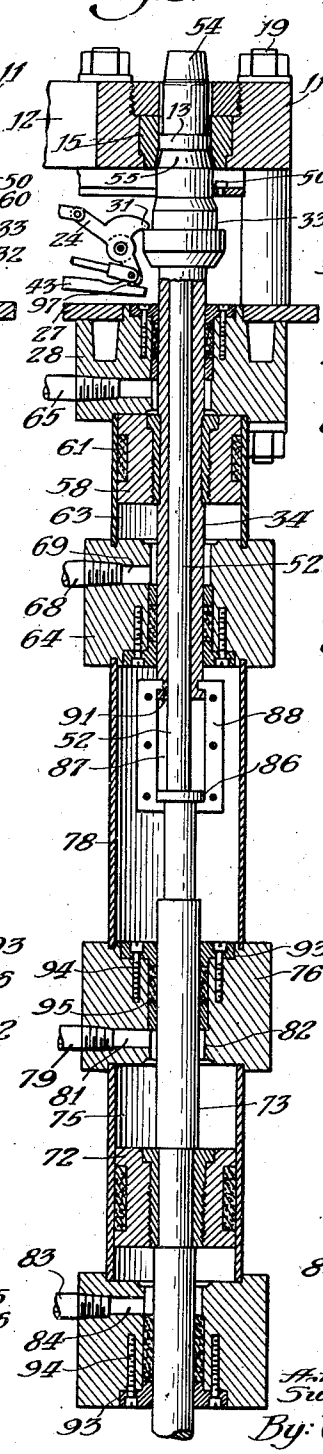
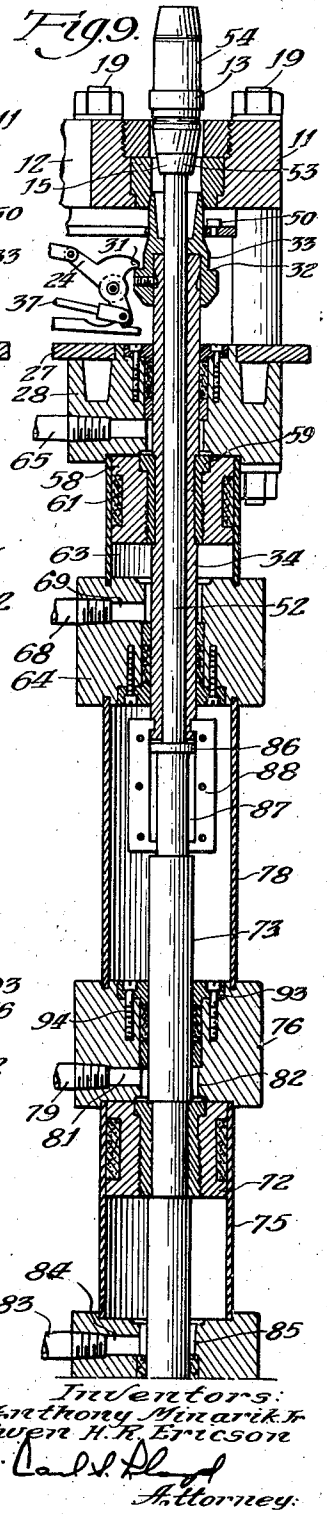


Fig. 9.



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APPARATUS FOR APPLYING ROTATING BANDS TO PROJECTILE SHELLS

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Application March 6, 1943, Serial No. 478,320

11 Claims. (Cl. 78—15)

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This invention relates to a method and apparatus for joining concentric cylindrical members and, more specifically, for applying rotating bands to shells for projectiles, such as are used in field guns and other artillery pieces. The shells are made of steel, and in order to cause the projectile to rotate in the barrel of the gun, it is customary to place a band of copper or other relatively soft material on the exterior of the shell so that it may be cut into by the spiral rifling in the gun barrel, to cause rotation of the shell as it travels through and leaves the barrel.

Heretofore such rotating bands have been applied by a swedging process or in other manner, which has not only been slow but has been inefficient in that the bands were not always securely or uniformly applied.

In accordance with our invention the bands are applied through a process involving the use of a die which is preferably actuated by hydraulic means and employs relatively movable elements, whereby the band is properly located and bonded onto the shell, after which the latter may be ejected from the machine. The process is a very rapid and efficient one and the apparatus employed is certain and effective in operation, the result being that the shells may be banded in much shorter time than heretofore and there is a much smaller percentage of rejects because of loose or improperly placed bands.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical, sectional and elevational view of a portion of an apparatus embodying the structure of the invention and by which the process may be practiced;

Fig. 2 is a similar view of another portion of the apparatus, being a continuation downwardly from the lower part of Fig. 1;

Figs. 3 and 4 are views similar to Fig. 1 showing the apparatus in two additional positions;

Fig. 5 is a top plan view of the apparatus;

Fig. 6 is a transverse sectional view of the upper part of the apparatus taken substantially on the section line 6—6 of Fig. 3;

Figs. 7, 8 and 9 are partial sectional views showing three successive steps in the process and the relative positions of the hydraulic plungers at the different stages of the operation.

Referring first to Fig. 1, the apparatus comprises a block 11 having therein an opening 12 through which the bands 13 may pass downwardly

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from a magazine formed by rods 14 extending upwardly from the top of said block.

The block also supports a female die element 15 which is supported upon a shoulder 16 in the lower part of an aperture 17 in the block and is held in place by a ring 18 having screw-threaded engagement with the block 11 in an enlarged upper part of the aperture 17.

The block 11 has a transfer passageway 19 therein, through which the lowermost band may be moved from a position beneath the magazine to a position beneath the female die element 15. The movement of the bands in this passageway is effected by means of a pusher 21 which is connected by depending ears 22 to a link 23 connected to a lever 24 which is pivoted at 25 to a block 26 on a supporting shelf 27 resting upon a support 28 which is connected to the block 11 by means of bolts 29.

The lever 24 has a nose portion 31 engaging a shoulder 32 on a male die element 33 which is connected to the upper end of a tubular plunger 34 by means of set screws 35.

Said lever 24 has a tail portion 36 extending beyond the pivot 25 and pivotally connected to a rod 37 slidably mounted in a guide member 38. A spring 39 is mounted on said rod between said guide member 38 and a nut 41 on an outer screw-threaded portion 42 of the rod.

A locking lever 43 is mounted on the block 26, to which it is pivoted at 44, and a spring 45 is positioned between a portion of said lever at the left of the pivot, as shown in Fig. 1, and the guide member 38, the ends of said spring extending into recesses in said members 38 and 43, or being otherwise suitably secured thereto. The opposite end of the lever 43 engages a lower beveled portion 46 on the die element 33 when the latter is in the position shown in Fig. 1.

The pusher 21 is connected by a link 47 with a dash-pot or other suitable cushioning element 48, which is supported by a block 49 secured by screws 51 to the block 11.

A plunger rod 52 is mounted within the tubular plunger 34 and has a head portion 53 adapted to engage the lower end of the shell, which is indicated in the drawings by the reference number 54. This inner plunger 52, as will later appear, is adapted to have relative movement with respect to the outer tubular plunger 34 and with respect to the die element 33 secured to the upper end of said tubular plunger.

When the plunger 34 and die element 33 are in the position shown in Fig. 1, the pusher 21 will have been advanced to its forward position, plac-

ing a band 13 into position on the upper end of the die element 33 which is of tubular form and has a tapered upper end, as indicated at 55. A stop member 50 is provided on a frame part 60 to stop the band at exactly the right position. After the ring is so positioned, the shell is dropped through the ring 18 and female die element 15 into the tubular die element 33, which is suitably shaped to receive the lower end of said shell with a close fit. In assuming this position, a series of grooves 56 on the exterior of the shell is disposed within the band 13.

The plungers 34 and 52 are actuated by hydraulic pressure in manner which will now be described.

A piston 57, composed of two shouldered elements 58 and 59 and a packing element 61, is permanently secured to the tube 34 by a shouldered engagement, as indicated at 62, and is adapted to move within a cylinder or sleeve 63 which is mounted between the block 28 and a block 64 spaced below said block 28. A pipe 65 communicates with a horizontal passage 66 in the block 28 and said passage communicates by means of a vertical passage 67 with the interior of the cylinder 63 above the piston 57.

A pipe 68 communicates with a horizontal passage 69 in the block 64, and said passage communicates through a vertical passage 71 with the interior of the cylinder 63 beneath the piston 59. Up-and-down movement of the tubular plunger 34 is thus effected by alternate admission of hydraulic pressure into the cylinder 63 below and above the piston 59.

The inner plunger 52 is similarly moved up and down by means of a piston 72 secured to a two-dimensional plunger rod 73 which is connected to the plunger rod 52 by a screw-threaded connection indicated at 74. Said piston 72 moves in a cylinder 75 extending between blocks 76 and 77, the former being connected with the block 64 by means of a tubular member 78.

Hydraulic pressure is admitted to the cylinder 75 above the piston 72 through a pipe 79, communicating with a horizontal passage 81 in the block 76, which in turn communicates with the cylinder 75 by means of a vertical passage 82. The hydraulic medium is admitted to the cylinder 75 beneath the piston 72 through a pipe 83 communicating with a horizontal passage 84 in the block 77, said passage in turn communicating with the cylinder by means of a vertical passage 85. Thus admission of the pressure medium through the pipe 83 causes upward movement of the piston 72, and admission of such medium through the pipe 79 causes downward movement of said piston, the rods 73 and 52 moving with said piston.

The limits of the movement of said rods 52 and 73 are provided by means of an enlargement 86 on the lower end of the rod 52 which is movable vertically in a central opening 87 in a connecting coupling frame 88, the upper end of which is connected at 89 with the lower end of the tube 34. Said enlargement 86 at the upper end of its path of movement engages the lower end 91 of said tube 34, and at the lower end of such path of movement engages a shoulder 92 at the bottom of said coupling frame.

Bearings or guide members 93 are provided in the blocks 28, 64, 76 and 77 for the plunger elements which slide within said blocks, said members being secured in place by means of screws 94, and suitable packing 95 is provided in said blocks inwardly from said bearing members, as

shown in Figs. 1 and 2, as well as other figures of the drawings.

The three positions of the hydraulic plungers and of the movable die are shown in Figs. 1, 3 and 4, respectively, and also in Figs. 7, 8 and 9, respectively, the latter showing also in single figures the two plunger-operating pistons and associated hydraulic blocks or heads 28, 64, 76 and 77 above described.

Figs. 1 and 7 show the starting position with the movable die member 33 in its lowermost position and the inner plunger 52 and plunger-head 53 in depressed position. In this position it will be noted that the pusher 21 is held in its forward position by means of the spring 39 which draws the rod 37 to the left (viewing Fig. 1) when permitted to do so.

In Figs. 3 and 8 the parts are shown at the upper end of the stroke of the tubular plunger 34 and die member 33. It will be noted that in this position the die member 33 has been moved upwardly into the member 15, the lower part of the inner wall of the latter being tapered, as indicated at 96, to receive the tapered end of the member 33. The shell 54 has been moved upwardly, as has the band 13 thereon, certain of the material of the latter having been forced into the grooves 56 by pressure against the tapered female die 96. The band is still supported by the die member 33 and has been held in fixed relation to the shell thereby. The movement of the die 33 to its uppermost position has actuated the lever 24 against the tension of the spring 39 and moved the pusher 21 to its rearward position, said lever being locked in this position at this time by engagement of the end of the tail part 36 thereof with a shoulder 97 on the locking lever 43.

In the position shown in Figs. 4 and 9, the inner plunger 53 has continued to move upwardly after the outer plunger 34 and die 33 have reached their uppermost position, and has forced the shell and applied band all the way upwardly through the die member 15. The banding operation has then been completed and the shell may be removed by hand or by gravity, or in any suitable manner.

The parts are thereafter restored to the position of Fig. 1 by admission of hydraulic pressure above the actuating pistons 57 and 72, and in this movement another band 13 is moved into position to receive a shell, as shown in this figure, the locking lever 43 being disengaged from the part 36 of the lever 24 in this position by reason of contact of the end of said locking lever with a beveled surface 46 on the lower exterior portion of the die member 33.

The hydraulic pressure medium is alternately supplied through the pipes 68 and 83 to cause the upstrokes of the plungers 34 and 52 and through the pipes 65 and 79 to cause the downstrokes of said plungers respectively by any suitable hydraulic circulating system (not shown) subject to manual control by the operation of the machine.

The operation of the apparatus and the successive steps in the practice of the process need be only briefly described since they will be quite fully understood from the foregoing description.

Starting with the position of the parts shown in Figs. 1 and 7 in which one of the bands 13 is located against the stop 50 and a shell 54 has been dropped into place, manually or otherwise, passing through the band and assuming the relation thereto shown in these figures, the operation

may be started by actuation of the manual control (not shown). The plungers 34 and 52 will thereupon be moved upwardly together to the position shown in Figs. 3 and 8, forcing the shell, which rests on the head 53 of the plunger 52, and the band, which rests on the top of the die member 33, upwardly into the die member 15, causing the band to be secured to the shell by displacement of the metal of the band, a part of which enters the grooves 56 on the shell. The plunger 34 has then reached its uppermost point, but the plunger 52 continues to move upwardly, forcing the shell with the applied band the rest of the way through the die member 15 and freeing the shell from the dies for discharge. This additional movement of the plunger 52 carries it to the position shown in Figs. 4 and 9. After removal of the shell, reverse movement of the plungers 52 and 34 will bring the parts back to the position shown in Figs. 1 and 7, ready for another operation.

It will be noted that the band 13 is supported by the die member 33 in a definite relation to the shell 54 until it is firmly connected to the shell, thus assuring accuracy and uniformity in the results of the banding operation.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible in view of the prior art.

We claim:

1. Apparatus for joining cylindrical members at least one of which is made of pressure-displaceable material, comprising a die, separate movable supports for each of said members, means for moving said supports in unison to force one of said members into pressure contact with said die to cause said members to be bonded together, and means for thereafter causing further movement of one only of the supports to discharge the joined members from said die.

2. Hydraulically operable apparatus for joining cylindrical members at least one of which is made of pressure-displaceable material, comprising a die, separate movable supports for each of said members, means for moving said supports in unison to force one of said members into pressure contact with said die to cause said members to be bonded together, and means for thereafter causing further movement of one only of the supports to discharge the joined members from said die, said supports being equipped with means for hydraulic operation thereof.

3. Apparatus for joining cylindrical members at least one of which is made of pressure-displaceable material, comprising a die, separate movable supports for each of said members, means for moving said supports in unison to force one of said members into pressure contact with said die to cause said members to be bonded together, means for thereafter causing further movement of one only of the supports to discharge the joined members from said die, and means controlled by one of said supports for feeding one of said members to assembling position upon each complete operation of said support.

4. Apparatus for joining cylindrical members at least one of which is made of pressure-displaceable material, comprising a die, separate movable supports for each of said members, means for moving said supports in unison to force one of said members into pressure contact with said die to cause said members to be bonded together,

means for thereafter causing further movement of one only of the supports to discharge the joined members from said die, means controlled by one of said supports for feeding one of said members to assembling position upon each complete operation of said support, and means also controlled by said support for locking said feeding means out of action in all but one position of said support.

5. Apparatus for applying rotating bands to shells, comprising a die member, two relatively movable plungers mounted adjacent said die, one being arranged to support the shell and the other to support the band in predetermined relationship to the shell, said plungers being movable a predetermined distance in unison to move a band and a shell into operative relation to the die to cause the latter to exert pressure on the band to press the same into bonding relation to the shell, and one of said plungers being further movable to discharge the shell with the band bonded thereto from said die.

6. Apparatus for applying rotating bands to shells, comprising a die member, two relatively movable plungers mounted adjacent said die, one being arranged to support the shell and the other to support the band in predetermined relationship to the shell, said plungers being movable a predetermined distance in unison to move a band and a shell into operative relation to the die to cause the latter to exert pressure on the band to press the same into bonding relation to the shell, and one of said plungers being further movable to discharge the shell with the band bonded thereto from said die, said plungers being equipped with means for hydraulic operation thereof.

7. Apparatus for applying rotating bands to shells, comprising a die member, two relatively movable plungers mounted adjacent said die, one being arranged to support the shell and the other to support the band in predetermined relationship to the shell, said plungers being movable a predetermined distance in unison to move a band and a shell into operative relation to the die to cause the latter to exert pressure on the band to press the same into bonding relation to the shell, one of said plungers being further movable to discharge the shell with the band bonded thereto from said die, and means controlled by one of said plungers for feeding a band to assembling position adjacent said die upon each complete operation of the plunger.

8. Apparatus for applying rotating bands to shells, comprising a die member, two relatively movable plungers mounted adjacent said die, one being arranged to support the shell and the other to support the band in predetermined relationship to the shell, said plungers being movable a predetermined distance in unison to move a band and a shell into operative relation to the die to cause the latter to exert pressure on the band to press the same into bonding relation to the shell, and one of said plungers being further movable to discharge the shell with the band bonded thereto from said die, said plungers being mounted one within the other and the inner plunger having said additional movement after the outer one comes to rest.

9. Apparatus for applying rotating bands to shells comprising a female die element, a magazine for the bands, a transfer device for moving the bands successively to an assembling station adjacent said die at which station the shell may be placed within said band, a plunger engaging

the band, a second plunger engaging the shell, means for moving said plungers a predetermined distance in unison to move the shell and encircling band part way through said die to cause the band to be pressed into bonding engagement with the shell, and means for thereafter moving the plunger which engages the shell a further distance to move the shell and applied band the rest of the way through said die.

10. Apparatus for applying rotating bands to shells comprising a female die element, a magazine for the bands, a transfer device for moving the bands successively to an assembling station adjacent said die at which station the shell may be placed within said band, a plunger engaging the band, a second plunger engaging the shell, means for moving said plungers a predetermined distance in unison to move the shell and encircling band part way through said die to cause the band to be pressed into bonding engagement with the shell, means for thereafter moving the plunger which engages the shell a further distance to move the shell and applied band the rest of the way through said die, and means for causing reverse movement of said plungers.

11. Apparatus for applying rotating bands to shells comprising a female die element, a magazaine for the bands, a transfer device for moving the bands successively to an assembling station adjacent said die at which station the shell may be placed within said band, a plunger engaging the band, a second plunger engaging the shell, means for moving said plungers a predetermined distance in unison to move the shell and encircling band part way through said die to cause the band to be pressed into bonding engagement with the shell, means for thereafter moving the plunger which engages the shell a further distance to move the shell and applied band the rest of the way through said die, and means for causing reverse movement of said plungers, said plunger-operating means being hydraulically operable.

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