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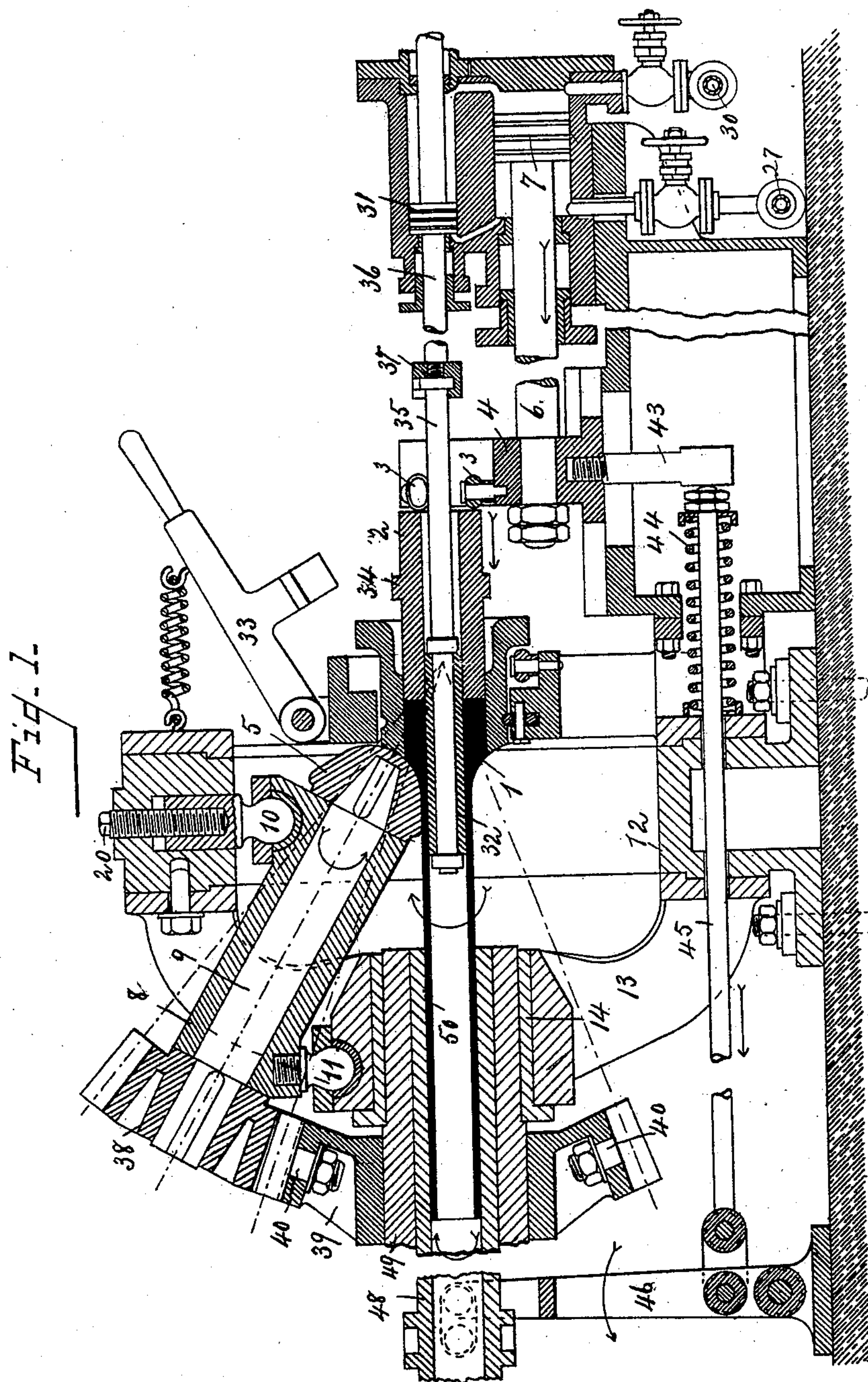
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P. HESSE.

MEANS FOR PRODUCING TUBES BY ROLLING.

No. 582,472.

Patented May 11, 1897.



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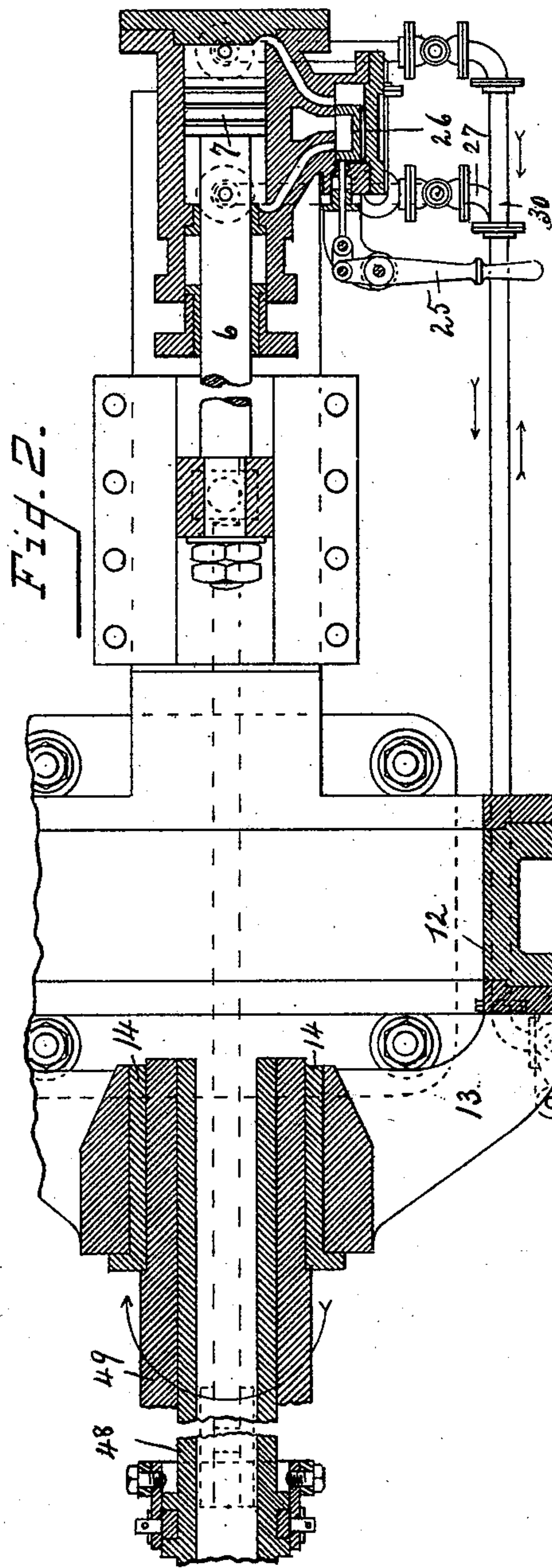
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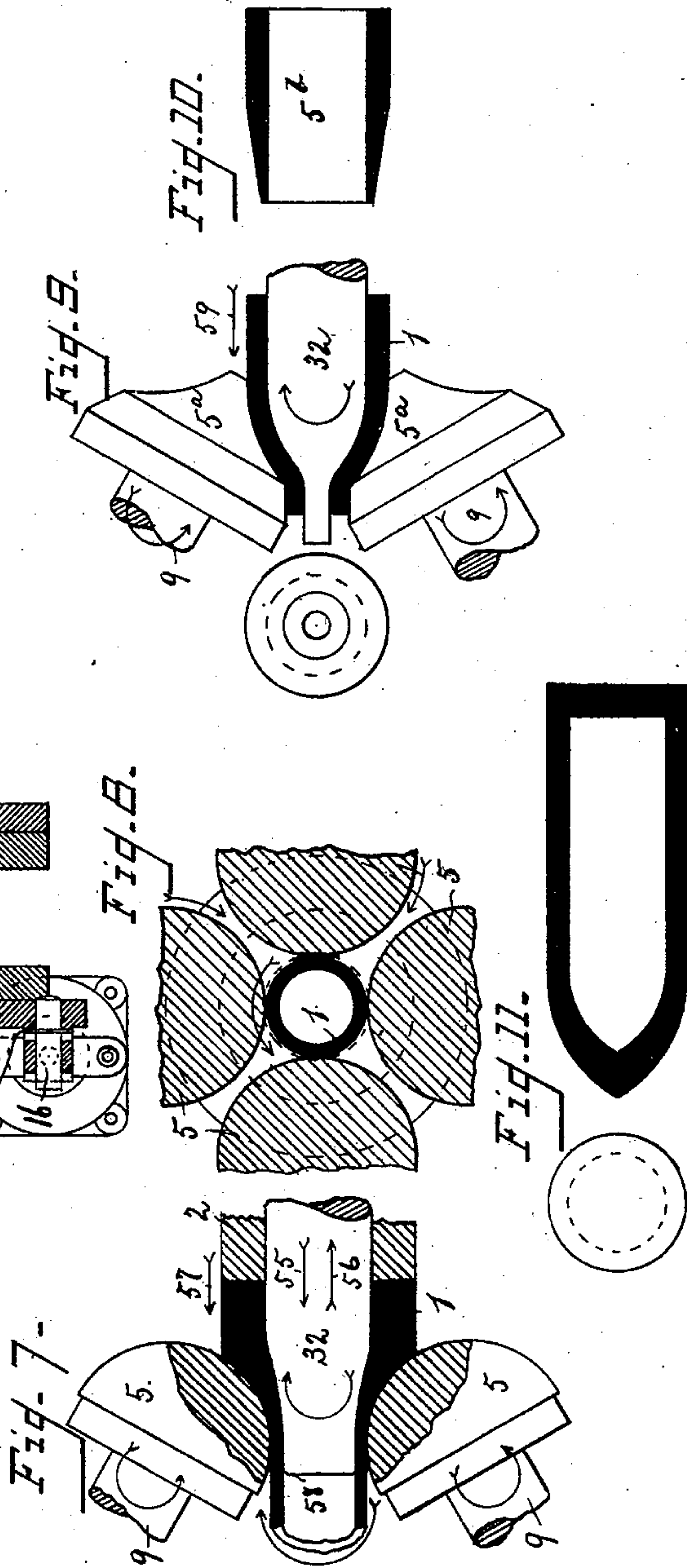
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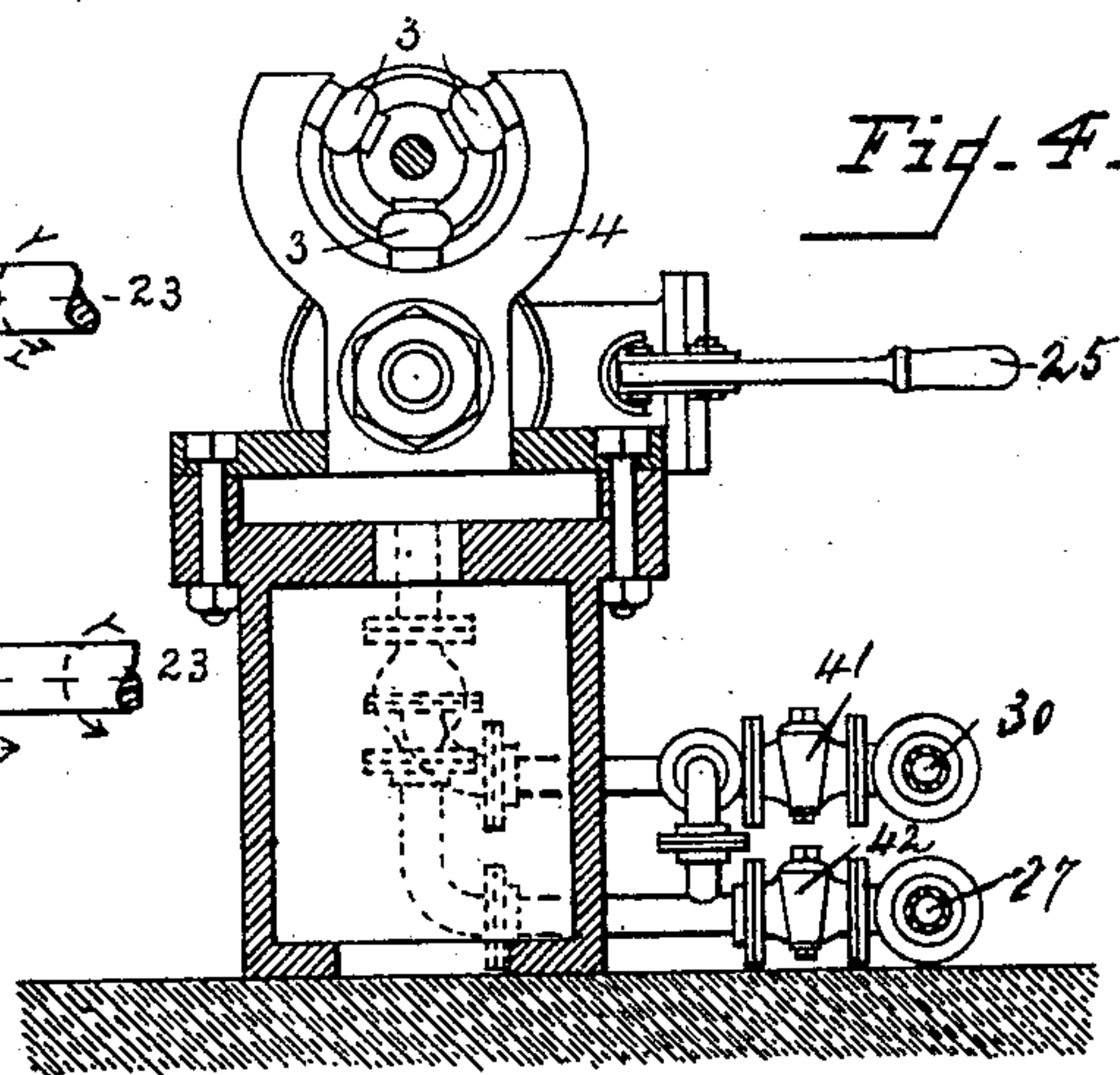
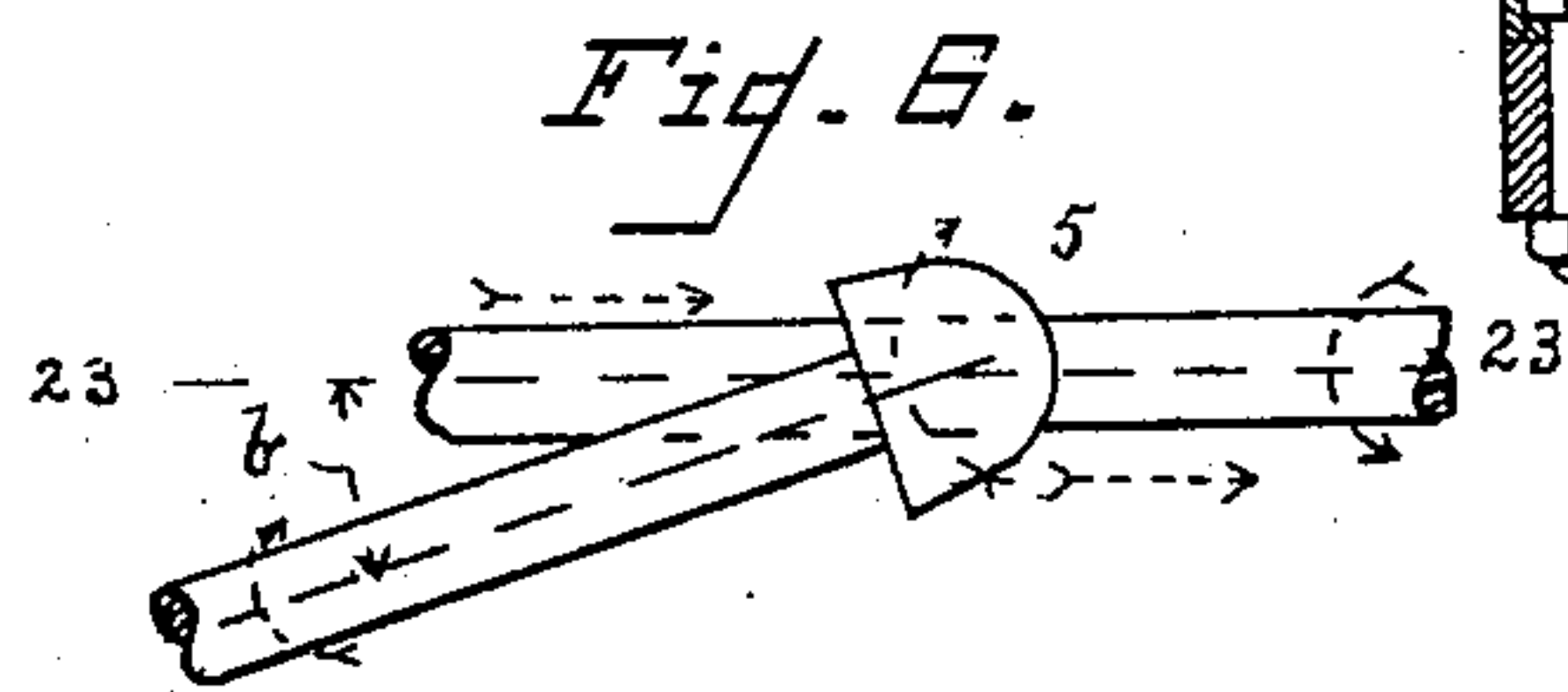
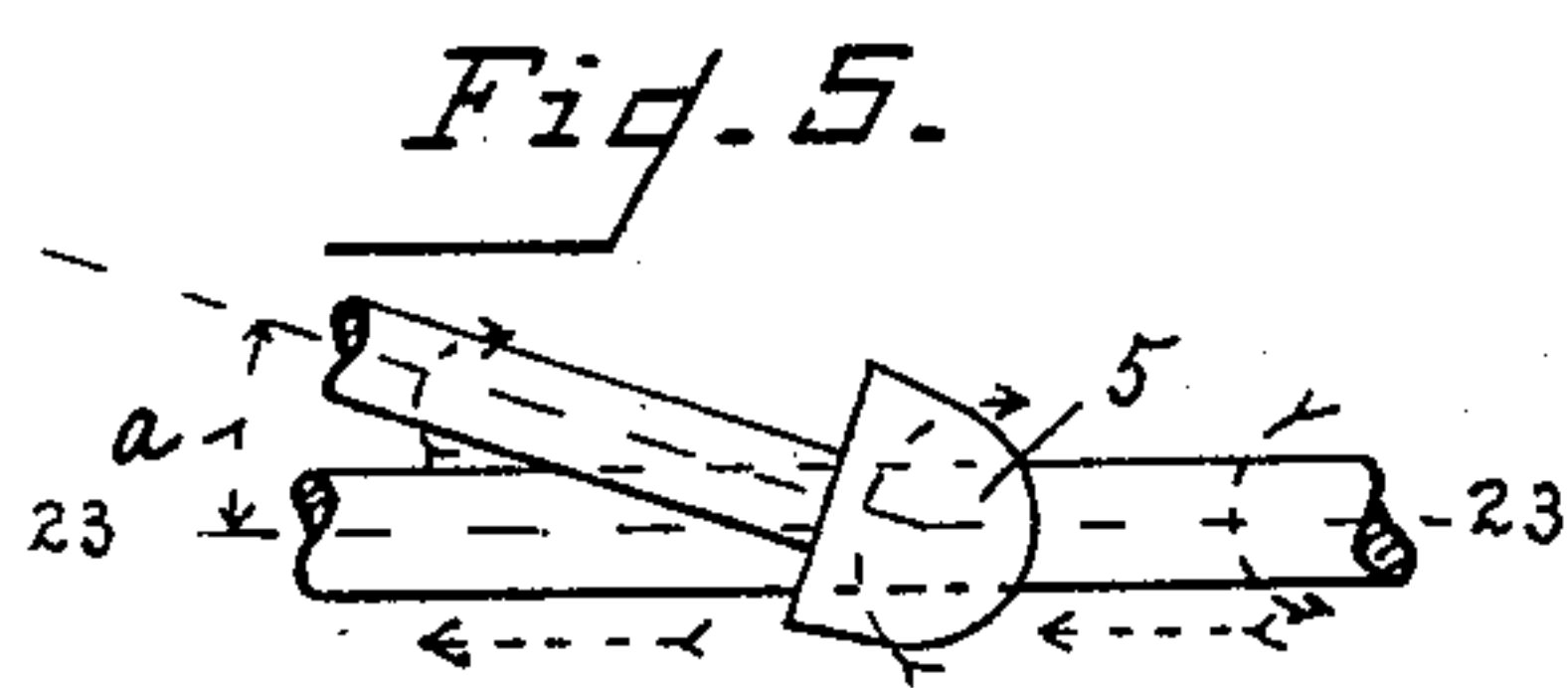
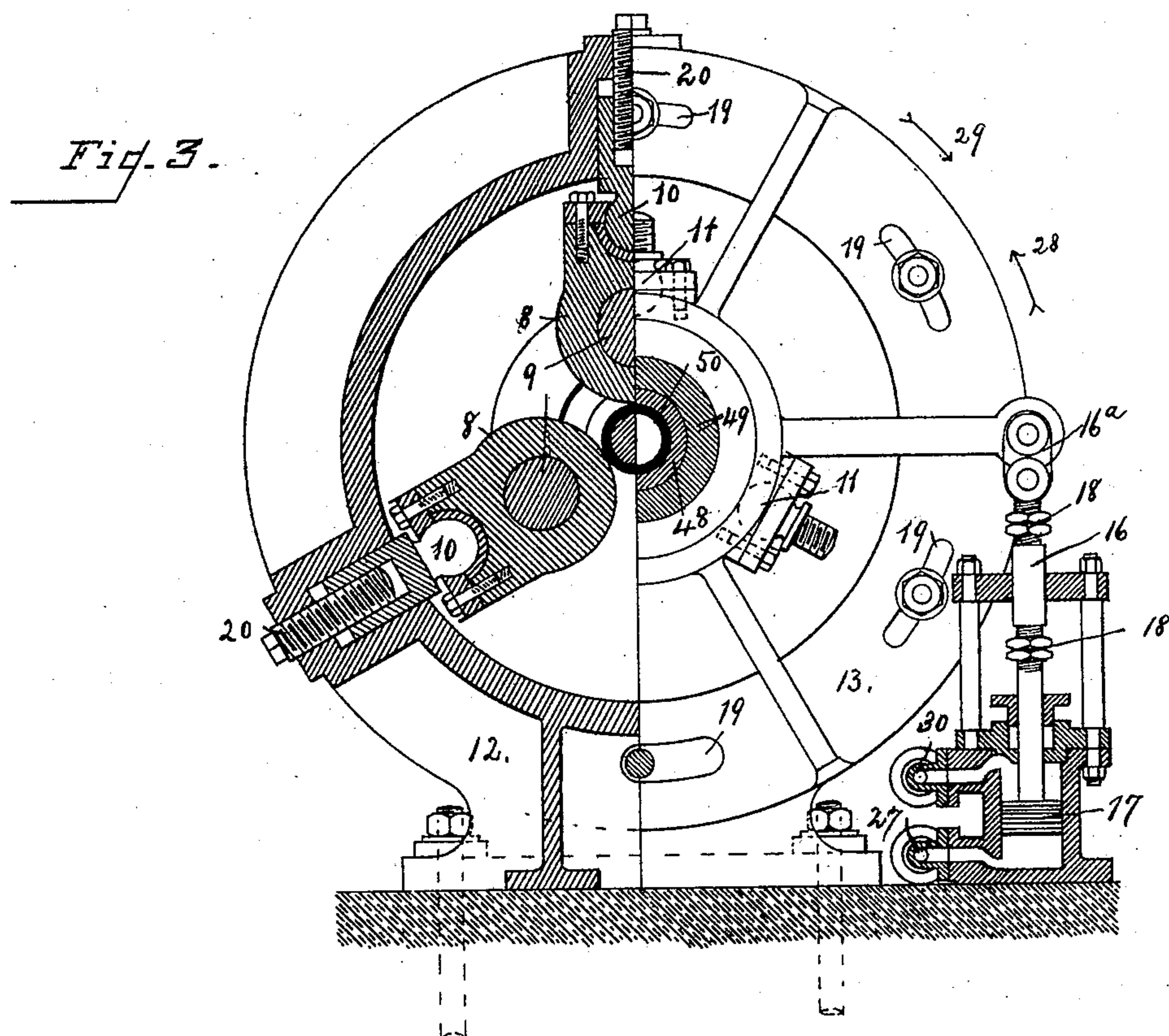
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# UNITED STATES PATENT OFFICE.

PAUL HESSE, OF ISERLOHN, GERMANY.

## MEANS FOR PRODUCING TUBES BY ROLLING.

SPECIFICATION forming part of Letters Patent No. 582,472, dated May 11, 1897.

Application filed July 10, 1896. Serial No. 598,729. (No model.) Patented in Germany January 30, 1894, No. 82,703.

*To all whom it may concern:*

Be it known that I, PAUL HESSE, a subject of the King of Prussia, German Emperor, residing at Iserlohn, in Westphalia, Kingdom of Prussia, Germany, have invented certain new and useful Improvements in Means for Producing Tubes by Rolling, (for which I have obtained a patent in Germany, No. 82,703, dated January 30, 1894;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to certain improvements in rolling-mills, and provides for the manufacture of gun-barrels and other metal tubes, as well as projectiles and hollow cylindrical bodies, either with open or closed ends, as may be required.

The nature of my improvements will be readily understood by referring to the accompanying drawings, whereon—

Figure 1 represents a vertical longitudinal section of my improved rolling-mill. Fig. 2 is a horizontal longitudinal section thereof. Fig. 3 is a vertical transverse section, partly in elevation. Fig. 4 is a vertical cross-section taken in front of the slide-block. Figs. 5 and 6 illustrate the rolls with respect to the axial line of the machine. Fig. 7 is an enlarged detail of the rollers, presser-piece and modified form of mandrel, with work-piece thereon. Fig. 8 is a cross-section of same with outer surfaces of rollers broken away. Fig. 9 shows a modified form of roller and mandrel with the work-piece between same. Fig. 10 represents in section a work-piece with tapered end for introduction between the rollers. Fig. 11 is an end view and longitudinal section of a projectile manufactured by my improved rolling-mill.

In this rolling-mill the hollow work-block 1 is pressed between the rolls 5, which are arranged in a circle around the center of the machine and so geared that all will turn in the same direction, the pressure on the work-piece being exerted by means of a piston or presser-piece 2, the rear end of which rests against rollers 3, mounted on pins connected with the sliding block 4. This sliding block 4 is secured to the piston-rod 6 of a hydraulic cylinder having a piston 7.

The shafts 9, to which the rolls 5 are secured, are adapted to operate in the sleeves 8, the lower ends of said sleeves being supported within the roll-frame 12 by ball-and-socket bearings 10, in which, by means of screws 20, they are adjustable in the radial direction. The outer ends of the guide-sleeves 8 are connected by ball-and-socket bearings 11 with a movable disk 13. This disk serves also as a support for a bearing 14, which receives one end of the main shaft 49. It is obvious that this shaft 49 might be secured in separate bearings independent from the disk 13.

The disk 13 is connected, as shown in Figs. 2 and 3, with the piston-rod 16 of the piston 17, which is worked by hydraulic pressure or by any other suitable means. The stroke of the piston of this machine can be regulated by nuts 18. The disk 13 is provided with slots 19, Fig. 3, through which pins project from the frame 12, so that the disk can move in either direction indicated by the arrows 28 and 29. This arrangement enables me to give to the shafts 9 of the rollers 5 a position more or less out of line with the central axis of the machine. Thus the rollers by their revolution will either draw in the work-piece or push it out, according to the angle under which they leave or plane which might be placed through the central shaft and one or the other of the shafts 9 when in central position. Therefore the direction of revolution as well as the direction of the transfer of motion and that of the work-piece under operation can always remain the same. This will be more clearly understood from Figs. 5 and 6, wherein the rolls 5 are supposed to have the same direction of revolution. In Fig. 5 the shafts of rolls 5 form an angle  $\alpha$  with the central line 23. Therefore the rolling will produce the motion of the work-piece in the direction of the dotted arrow. In Fig. 6 the shafts of the rollers form an angle  $\beta$  with a central line, and thus the work-piece will be expelled in the opposite direction, as shown by arrow in dotted lines; but I do not make use of this principle in rolling tubes in this machine, for, on the contrary, at the first part of the rolling I place the rollers so that they will have a tendency to expel the work-piece, and I use hydraulic pressure to act against this expelling motion. The presser-



piece 2 therefore pushes the work-piece 1 between the rollers 5 under a strong pressure, and the rollers working against this pressure produce the effect that all pores of the metal are closed and that the material is strongly condensed or densified, so that its quality is far superior to that of metal rolled under ordinary circumstances.

The molecules of the work-piece, being constantly under high pressure and being constantly shifted against each other under the action of this rolling process, produce the good result above mentioned. When the presser-piece 2 has arrived close to the rollers it cannot act any further, and were no other means provided the work-piece would have an offset. To obviate this objectionable feature, means are afforded, as hereinafter mentioned, whereby the rollers are adapted to be displaced in such manner that their action of expelling is changed into a drawing-in action, and thus the work-piece continues to move through the rollers, and is thus rolled to even diameter.

The displacement of the rollers or of the middle line of their shafts, as indicated by Figs. 5 and 6, is effected in the following manner: By means of lever 25 the slide 26 of the hydraulic motor is at first so placed that the water drives the piston 7 in the direction of the arrow, Fig. 1. The water also passes through the pipe 30 into the space on the vertical cylinder above the piston 17. The disk 13 will therefore turn in the direction indicated by arrow 29, and the rollers 5 will form with their shafts the angle  $b$ , Fig. 6, thereby acting against the motion of the work-piece while it is being pressed forward between the rollers.

When the press-piece 2 has arrived in front of the rollers, Fig. 1, the slide 26, by means of lever 25, is reversed either by hand or automatically, so that the water acts upon the front surface of the piston 7 and passing through pipe 27 fills the space under the piston 17, so that through its rod 16 and link connection 16<sup>a</sup> the disk 13 will revolve in the direction of the arrow 28. Thus the rollers take the position indicated in Fig. 5, and in this position they produce the forward motion of the work-piece by drawing the same in and by rolling the same out to its free end. Thus a tube or shaft of equal diameter throughout is obtained.

As the spaces in the cylinder of piston 7 are also in connection with the spaces in another cylinder having a piston 31, as shown in Fig. 1, the return stroke of piston 7 will also produce the return stroke of piston 31, and the mandrel in 32 being connected to said piston will be drawn out of the work-piece. At the same time the lever 33 will be thrown down, so that it catches against the collar 34 of the presser-piece 2, and the mandrel will therefore be drawn out completely, as the presser-piece is prevented from following the movement of same.

The mandrel 32 is secured upon the rod 35, which is connected to the piston-rod 36, by means of a coupling 37, so that it can freely revolve while it follows in longitudinal direction. Therefore when necessary the piston 31 may be employed to press the mandrel 32 into the work-piece 1, if so desired. It will therefore be understood from the above that one slide is used to guide simultaneously three press-pistons, which would not be possible in hydraulic pressure other than the one represented.

The pinions 38 of the shafts 9 of the rollers 5 are provided with ordinary stationary teeth, but the gear-wheel 39 of the main shaft has teeth which are connected to the rim thereof by swivel-joints, as shown at 40, so that these teeth can automatically adjust themselves according to the deflection or out-of-line position of the rollers.

By providing the pipes 27 and 30 with cocks, as shown at 41 and 42, or with three-way cocks, it is possible to lead the water through said pipes 27 and 30 in such a way that the piston 17 can be alternately moved in opposite direction, as above described. The rollers are so placed as to draw in the work-piece and thereby contribute to the action of the press-piston 7, or the rollers 5 may be centrally placed, so that they will neither expel nor draw in the work-piece, in which case the work-piece is moved forward between the rollers by the presser-piece only, and at the last moment the rollers are displaced in such manner as to insure a drawing-in action, or the rollers may be made in any desired successions to first act against the work-piece, and all these manipulations during the working process can be varied without changing the direction of their motion or that of the driving power. The work-piece may also be introduced between the rollers from an opposite direction—i. e., through the hollow shaft 49.

It is evident that the actions of the hydraulic pistons 7, 17, and 31 can be obtained by any other press or power and can be reversed automatically or otherwise.

The sliding block 4, Fig. 1, is provided with a depending arm 43, which operates against the spring-actuated push-bar 45, thereby moving the lever 46 and the sleeve 48, connected therewith, so that the said sleeve shall move in the hollow shaft 49 in such a way as to form a guide for the tube 50 as same is being rolled from the work-piece and thereby prevent its bending. The action of the spring 44 after the return of the piston 7 and slide-block 4 will bring the sleeve 48 back to its first position, and thus the end of the tube 50 will project sufficiently far through same as to permit of its being drawn out entirely.

The piston 17 may be dispensed with and a displacement of the ball-joints 11 be effected by the pistons 7 or 31 at the forward and backward stroke of either of these pistons by a suitable connection of levers, cog-wheels, or other known mechanical means in such a



manner as to produce a displacement of the disk 13.

In Figs. 7 and 8 the mandrel 32 is shown as having the part between the rolls 5 of a smaller diameter than the balance thereof. This mandrel 32 being coupled by a joint 37 to the piston 31, as above explained, and shown in Fig. 1, will conform to the movement of the rollers 5, as shown by the arrows, Fig. 8, and it will be moved longitudinally, as shown by arrows 55 and 56. By this arrangement the following advantages are obtained:

First. The rear of the mandrel 32 or rod 35 can be made larger in diameter to better resist the strain to which it is exposed in case the rollers 5 act upon the piece of work in an ejecting manner, as well as to better resist the strain in case the work-piece is drawn in by the rollers, as indicated by the arrow 57 in Fig. 7.

Second. Pipes of the diameter 58, Fig. 7, may be rolled out to the smallest thickness without danger of being torn off or otherwise injured by the mandrel.

Third. The work-piece 1 is gradually worked down from one end thereof to the final dimensions of the tube to be rolled. Thus the heat in the compact body is retained longer and the rolling process may be effected much slower at any desirable rate of low speed.

Fourth. The amount of power is considerably decreased, so that the parts of the machine can be reduced to the smallest possible dimensions.

Fifth. That the mandrel 32, by turning it gradually down to the small diameter 58, can be fully used up from front to rear end whenever the wearing out of the working part makes it necessary to turn it down on a lathe.

Sixth. The free opening between the mandrel and the rolls 5, by moving the mandrel 32 in the direction of arrows 55 or 56, can be varied in size, so that with the same mandrel tubes of any degree of thickness and of any diameter may be rolled out; also, hollow bodies may be produced, having in their lengths any variety of parts projecting out or sunk in, as will be easily understood.

In Fig. 9 I have shown how by a suitable shape of rollers 5<sup>a</sup> hollow bodies may be produced having a point or bottom of any required shape. To this end a cylindrical body 5<sup>b</sup> must first be gradually tapered in its thickness at the end which is intended to be contracted, as shown in Fig. 10. This being heated to welding heat, is introduced between the rolls 5<sup>a</sup> and is pressed in the direction of arrow 59 between these rolls, whereby the metal is pressed together, as indicated in Fig. 9.

If a hollow body is taken having already a bottom at one end, the open end of same can in this manner be closed without using a mandrel and thus form a projectile, as shown in Fig. 11. In the construction the wall is not weakened by the cutting of threads, and thus the resistance against the inner charge is highly increased, and the action of the explo-

sion is consequently considerably better. The thickness of the wall can be made less, and in consequence thereof the weight of the projectile for the same amount of charge can be greatly decreased. Furthermore, the diameter of the projectile can be lessened and the length increased as may be required.

It is well known in ordnance that the results obtained by a smaller caliber are very important, inasmuch as they occupy less space in the field and in places of storage, and besides having less weight, increased accuracy is also insured. By using a reversible roller-carrying disk the hollow bodies may also be manufactured in such a way that the rollers for the work-piece can be manipulated substantially as above described and thus serve to automatically eject the same.

It is of course understood that driving power is applied to the shaft 49 either from a band-pulley, gearing, or other well-known manner.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In rolling-mills the combination of a frame having an internal bearing, a hollow shaft fitted in said bearing and a work-receiving sleeve adapted to operate in the hollow shaft, a series of rollers having shafts provided with sleeves and ball-and-socket joints connecting same with the frame, and means for adjusting the ball-and-socket joints, substantially as set forth.

2. In rolling-mills the combination of a frame having an inner bearing, a hollow main shaft adapted to operate in said bearing, a work-receiving sleeve arranged within said shaft, a series of rollers having adjustable sleeve-bearings as described, the main shaft provided with a gear-wheel having teeth connected therewith by swivel-joints, as described, and the roller-shafts provided with pinions adapted to be driven by the gear-wheel of the main shaft as set forth.

3. In a rolling-mill the combination of a frame provided with a central bearing, a hollow shaft fitted in said bearing and a sleeve adapted to operate in the hollow shaft, a lever connected with the sleeve and a spring-actuated push-bar with means substantially as described, for operating the push-bar in opposition to its spring and a series of rollers adapted to operate around the central bearing, substantially as set forth.

4. In combination with the rolling-mill frame and the movable disk, provided respectively, with pins and slots, as described, the rollers 5, having sleeves, the ball-and-socket joints connecting the said sleeves with the frame and disk, as set forth, so that the relative positions of the rollers, may be changed with respect to the axis of the machine, substantially as and for the purpose specified.

5. In a rolling-mill having a frame provided with an adjustable disk, and rollers connected with said frame and disk, as described, a



mandrel for holding the work-piece and a  
presser-piece having a collar, with a lever  
adapted to engage said collar and thus pre-  
vent same being withdrawn with the mandrel,  
5 substantially as set forth.

6. In a rolling-mill, the combination of a  
series of rolls with the work-holding mandrel,  
a presser-piece adapted to operate thereon, a  
sleeve for receiving the finished work-piece,

and means substantially as described, where- 10  
by the said parts are operated, independent  
of each other as set forth.

In testimony whereof I affix my signature  
in presence of two witnesses.

PAUL HESSE.

Witnesses:

SOPHIE NAGEL,  
W. H. MADDEN.