No. 771,883. PATENTED OCT. 11, 1904.

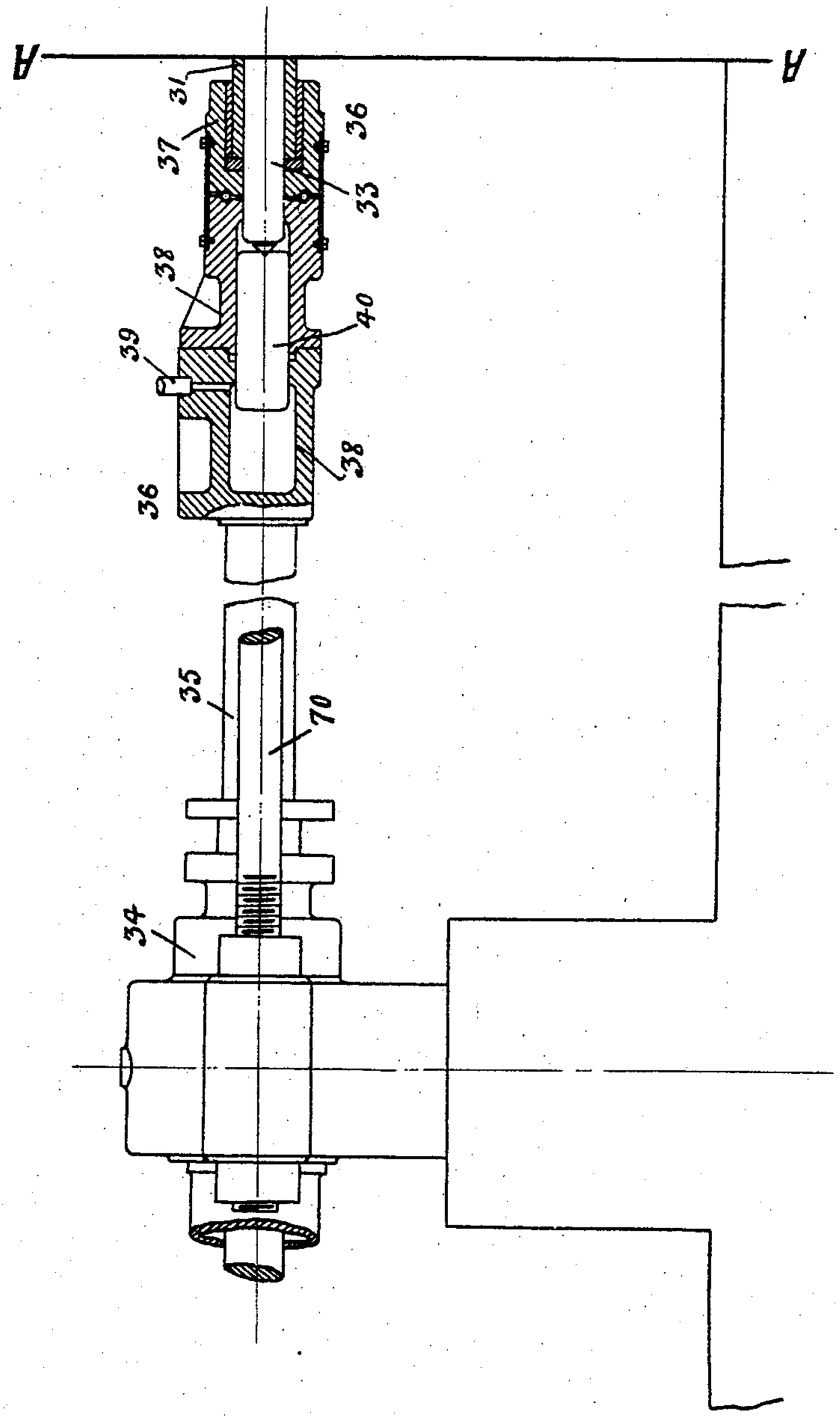
B. F. McTEAR.

MACHINERY FOR MAKING SEAMLESS METAL TUBES, &c.

APPLICATION FILED FEB. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 1.

FIG. 1.



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NO MODEL. 8 SHEETS—SHEET 2.

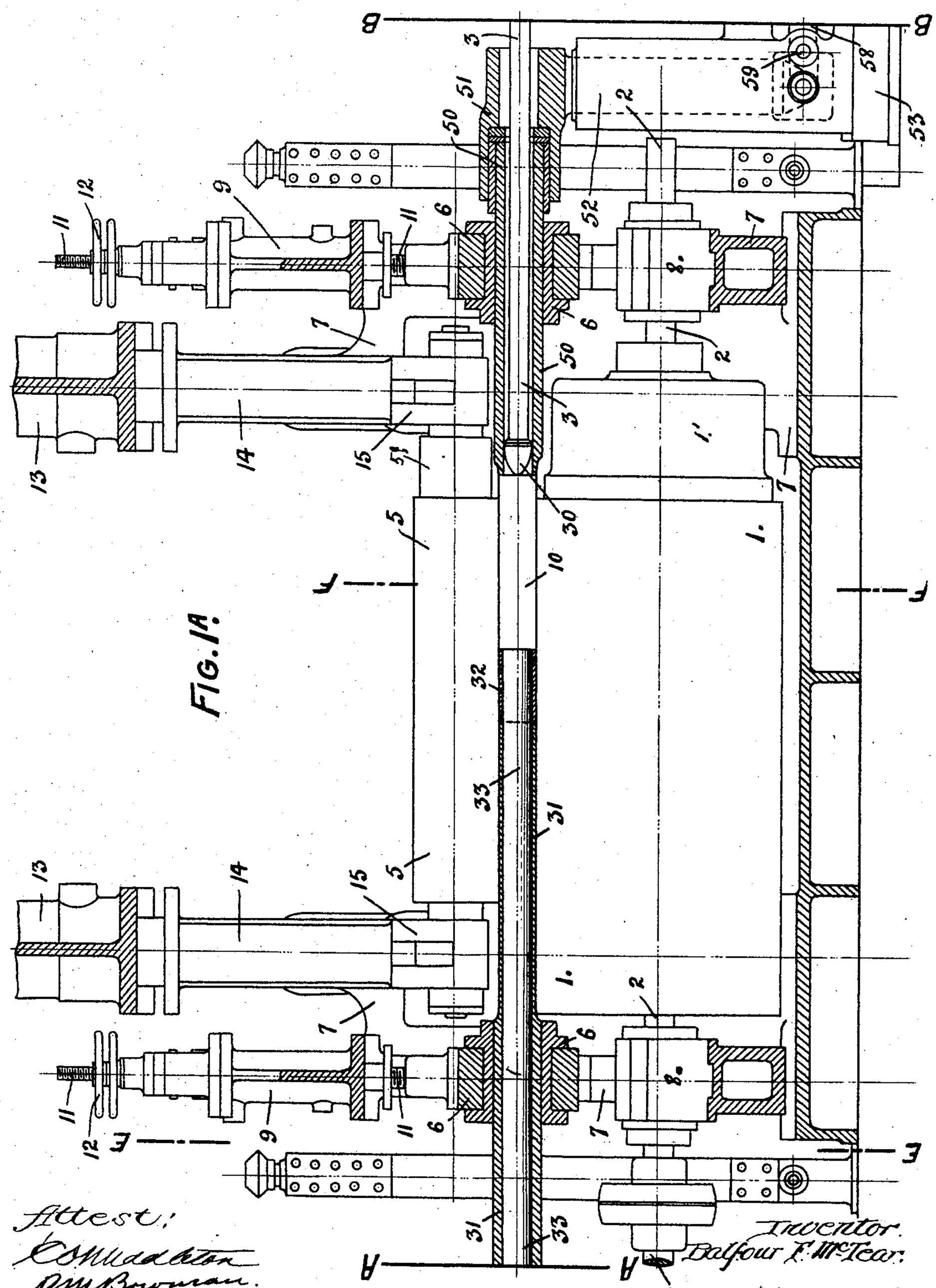

FIG. 1.

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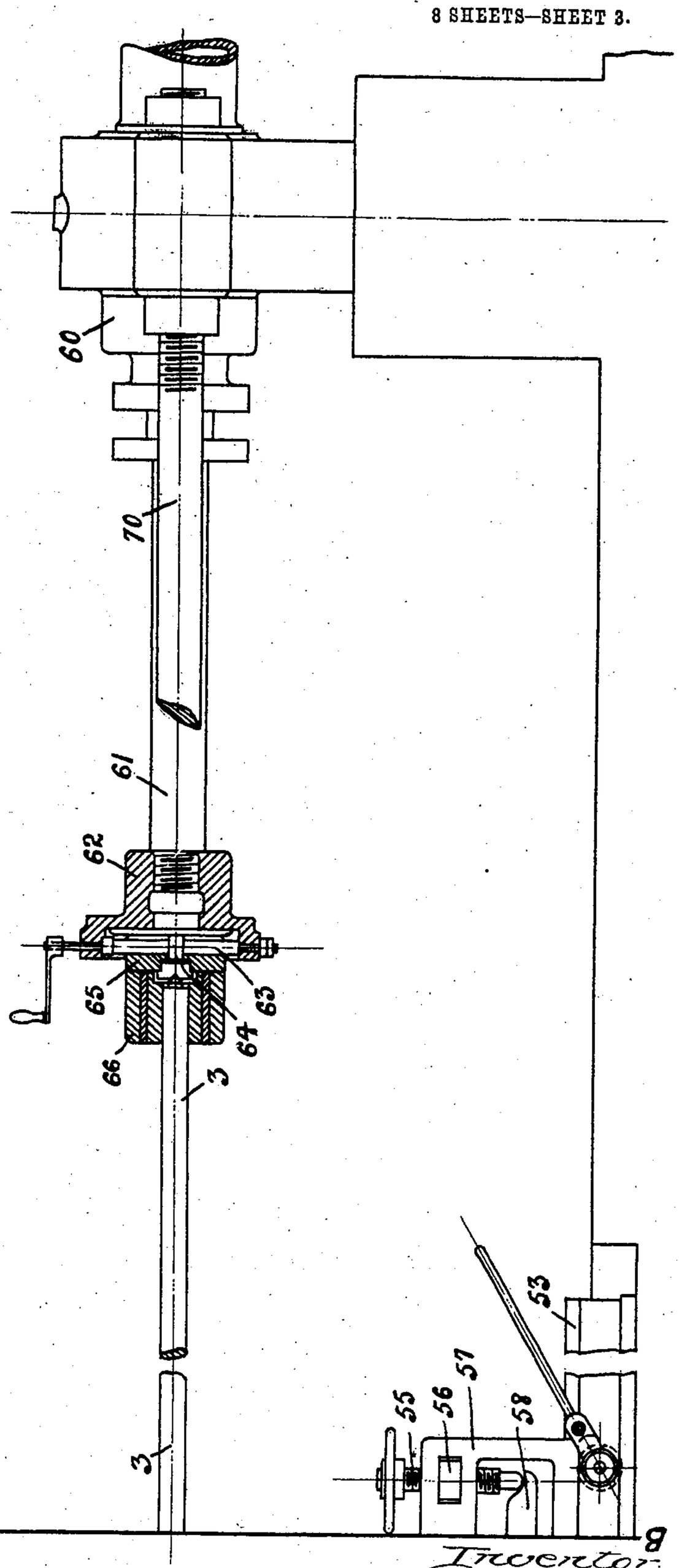
NO MODEL. 8 SHEETS—SHEET 3.

FIG. 1B.



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NO MODEL. 8 SHEETS—SHEET 4.

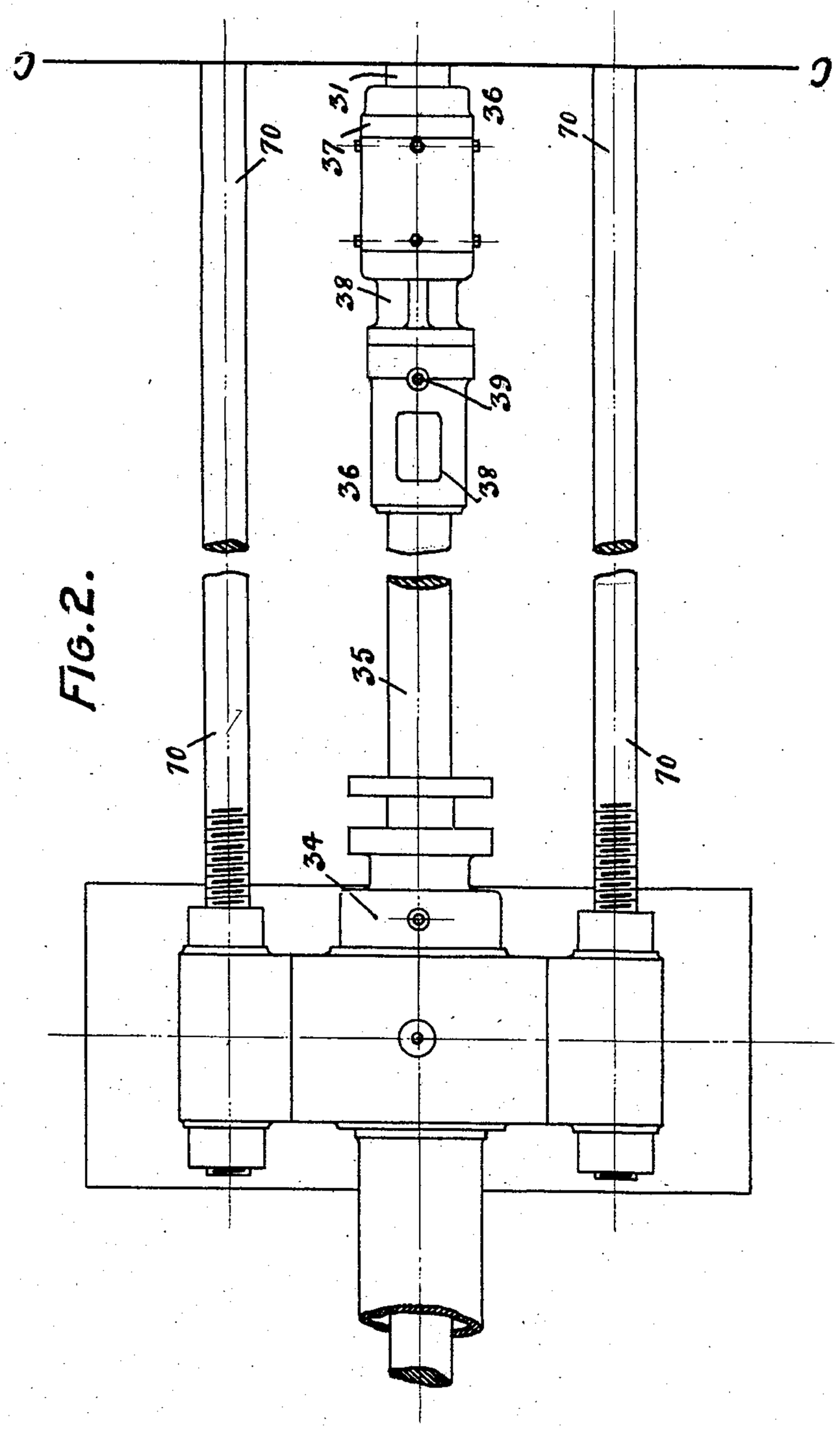

FIG. 2.

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NO MODEL. 8 SHEETS—SHEET 5.

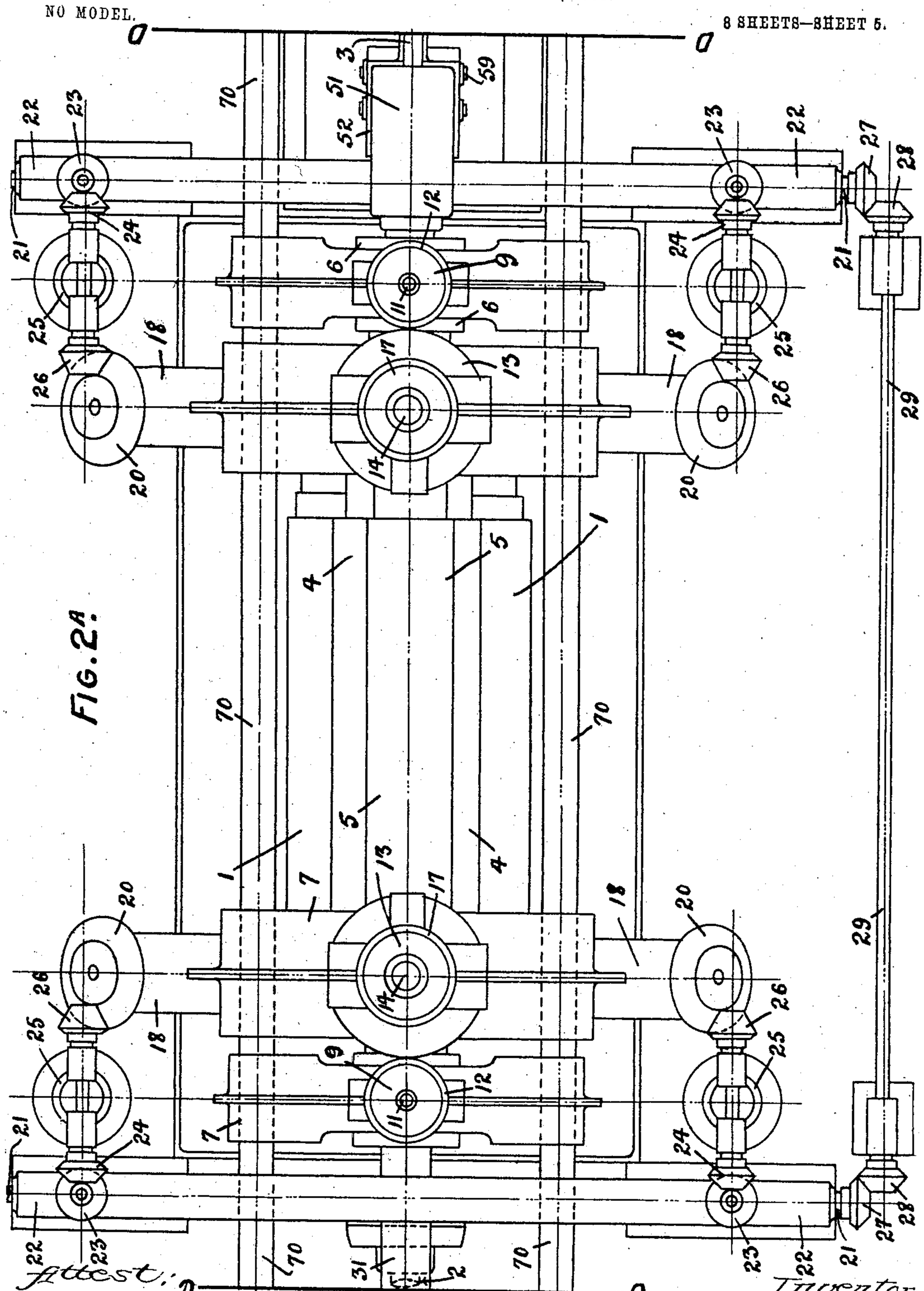

FIG. 2.

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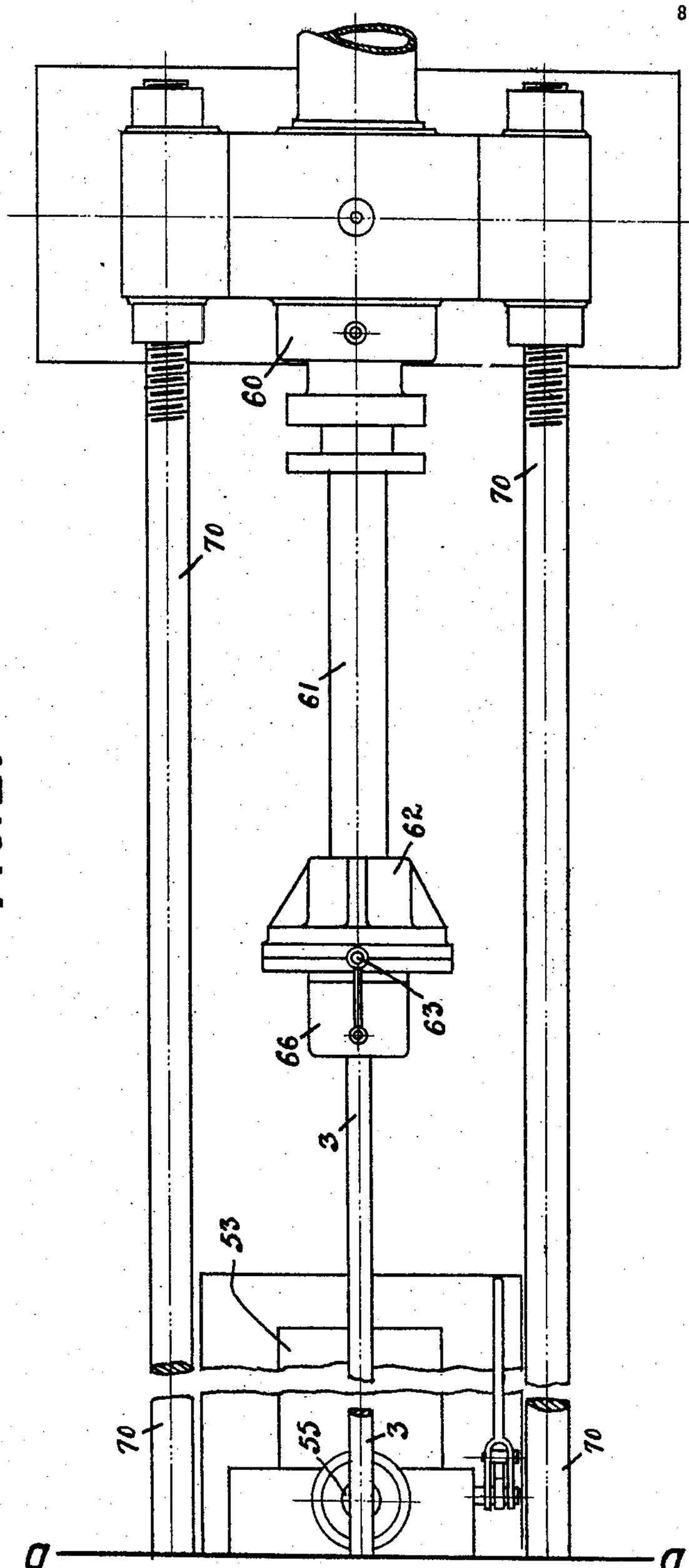
NO MODEL. 8 SHEETS—SHEET 6.

FIG. 2B.



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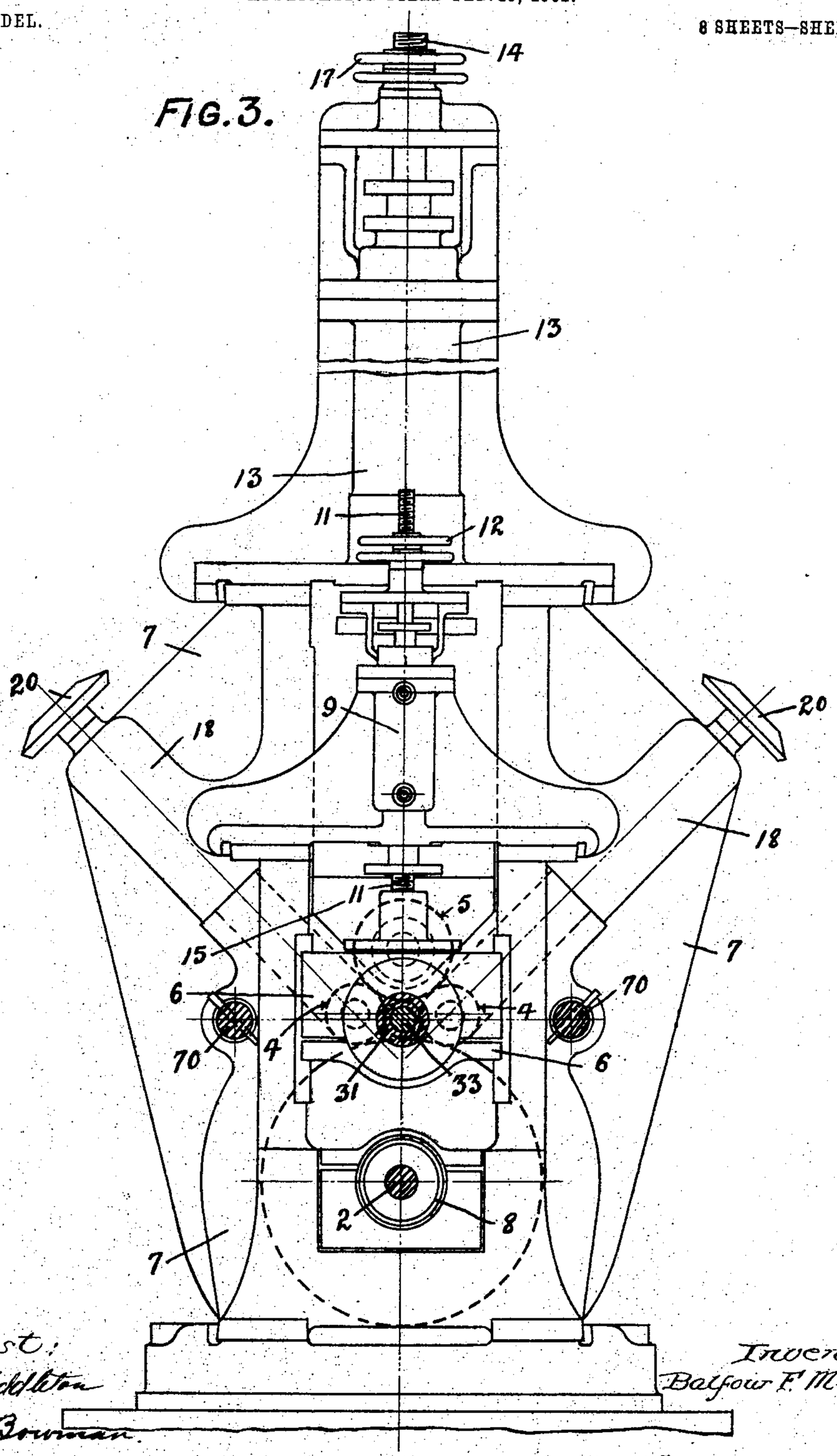
APPLICATION FILED FEB. 15, 1902.

NO MODEL. 8 SHEETS—SHEET 7.

FIG. 3.



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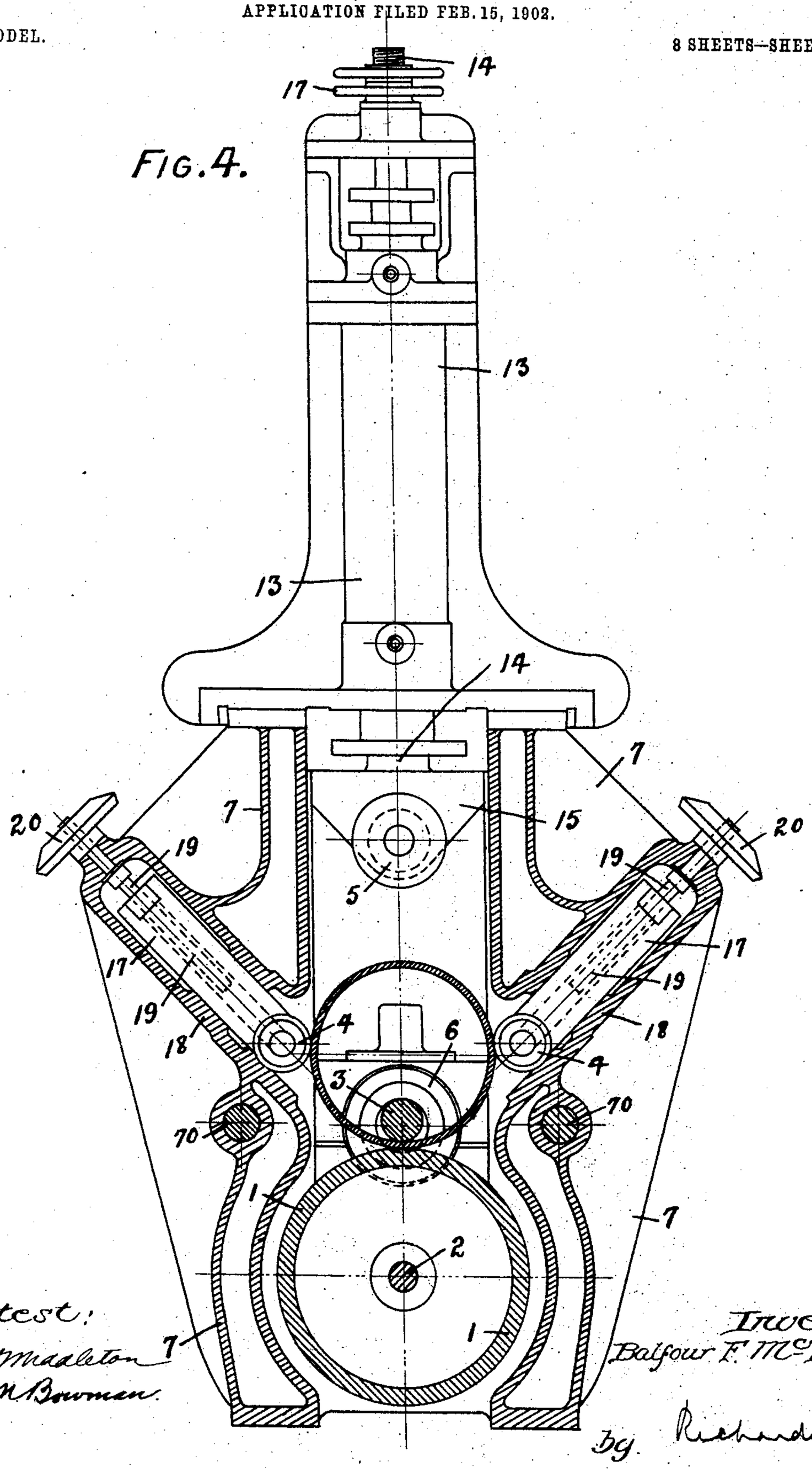
NO MODEL. 8 SHEETS—SHEET 8.

FIG. 4.



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No. 771,883. Patented October 11, 1904.

UNITED STATES PATENT OFFICE.

BALFOUR FRASER McTEAR, OF RAINHILL, ENGLAND.

MACHINERY FOR MAKING SEAMLESS METAL TUBES, &c.

SPECIFICATION forming part of Letters Patent No. 771,883, dated October 11, 1904.

Application filed February 15, 1902. Serial No. 94,235. (No model.)

To all whom it may concern:

Be it known that I, BALFOUR FRASER McTEAR, engineer, a subject of the King of England, and a resident of Brook Cottage, Rainhill, in the county of Lancaster, England, have invented certain new and useful Improvements in Machinery for Making Seamless Metal Tubes, Cylinders, or Hollow Bodies, of which the following is a specification.

This invention has reference mainly to the manufacture of seamless and weldless tubes or hollow cylinders and cylindrical bodies of steel and other hard metals or alloys; and it has more particularly for its objects and effects to provide new or improved machinery or means for making such articles or bodies and of operating upon or manipulating tubular or hollow bodies in the process of manufacture of machinery. The effects of the improvements, which are hereinafter described, are that a hollow billet is first pierced in the machine and then while in this machine the reduction of the thickness of the walls and the increase of the diameter are effected. These operations and effects are carried on and produced in the one machine and in one heat and rapidly, and these, with their several objects and results, are hereinafter described, together with the description of the various improvements connected with the machinery especially directed and adapted to the accomplishment of the objects referred to.

The machine in its general characteristics will have horizontal rollers which will be revolved, and according to this method of manufacture the solid billet or cylinder will be placed in the machine and held in position externally and circumferentially by the rollers, and it will be pierced axially by a piercing mandrel or tool, and while the piercing action is proceeding it is revolved and preferably at a high speed by and within the rollers. This piercing tool or mandrel will be introduced longitudinally through the housing and suitable bearings and supported and guided at the forward end, while at the other it will be held up by hydraulically or equivalently pressed longitudinal support which is adapted to offer less resistance than the opposing longitudinal pressure acting against it due to the pressure and piercing action and will give way. Then, further, according to this invention the mandrel which is used as a piercing-mandrel is adapted to serve as the internal roller for circumferentially rolling the hollow billet after it has been pierced, it being released from the means employed for pressing it forward and brought under the action of supporting-bearings in the housings or frames of the machine, by which it is positively actuated and controlled.

The invention will be further described by the aid of the accompanying drawings. In these, in Figures 1, 1[a], and 1[b], a side sectional elevation of the machinery is shown in three parts or sections and on three separate sheets, the lines A A and B B representing the planes at which the machinery is cut. In Figs. 2, 2[a], and 2[b] a plan of the machinery is shown in three similar parts or sections on three separate sheets, as are shown in Figs. 1, 1[a], and 1[b], the planes of section being at the lines C C and D D. Fig. 3 is an end elevation in section of the machinery, taken at the line E E, Fig. 1[a]; and Fig. 4 is an end elevation in section of the machinery, taken at the line F F, Fig. 1[a].

Referring now to the drawings, and more particularly to that portion of the machine in which the billet is held and pierced and the tube or hollow body is subsequently rolled circumferentially and its diameter increased, 1 is a lower or anvil roller, being the driven roller of the machine, and 2 its shaft, which is revolved by any suitable machinery or power. This roller is reduced in diameter at one end, as shown at 1′.

3 represents the mandrel, which subsequently to the piercing becomes the internal roller employed in the circumferential rolling operation.

4 represents adjustable side rollers, which assist in holding the billet in position in the machine while being pierced at the sides and which subsequently in the diametrical enlarging peripheral rolling action support the hollow body at or near the plane of the horizontal diametrical axis—that is, at the widest part and follow this widest part as the cylinder increases in diameter.

5 is an upper roller, which bears on the up-

per part of the billet while being pierced and subsequently to the piercing is moved out of the way in an upward direction. This roller is reduced in diameter at one end, as shown at 5'.

6 represents bearings in the main housings or frames 7 of the machine, which support the mandrel 3 after the piercing operation is done and also support portions of the mechanism connected with the piercing machinery herein described. The bearings 6 are moved up and down in the main housings or frames 7 of the machine by hydraulics—namely, by a piston working in a cylinder 9, the lower end of the piston-rod 11 being connected with the bearings 6 and supporting these bearings, while the upper end passes through the top of the cylinder 9 and is threaded, and this threaded part is provided with wheels 12, which screw onto it and by means of which the limit of downward movement or adjustment of the piston and bearings 6 can be fixed and the degree of same regulated at will.

10 represents the metal operated upon in the machine, first in the form of a billet and then in the form of a hollow body.

The bearings which support the shaft 2 of the lower roller 1 are designated 8 and are fixed in the bottom of the main frame 7.

Within the bearings 6 and cylinders 9 there is mounted on a portion of the main frames 7 hydraulic cylinders 13, similar to the cylinders 9, with pistons within them and piston-rods 14 extending through the lower and upper ends of said cylinders, the lower ends of these rods supporting bearings 15, carrying the ends of the roller 5. These bearings are guided by inside guide-faces 16 in the frames 7. The upper ends of the pistons 14 are provided with wheels 17, screwed onto the ends of these rods, similarly to the wheels 12, in connection with the cylinders 9 and rods 11. These hydraulic cylinders move the roller up and down, as required.

The side supporting-rollers 4 are carried on the lower ends of sliding bearings 17, working in hollow guides 18, formed on the main frames 7, and they are moved in and out of the guides 18 by threaded shafts 19, which mesh with threads in a hole in the slides 17, the shafts 19 being supported and guided at their upper ends in the metal at the ends of the guides 18 and provided at their outer ends with bevel-wheels 20. The rotation of the bevel-wheels 20 is effected by shafts 21, mounted in the frames 22, and by the revolution of which the bevel-wheels 23, supported in the side frames, are revolved, and these revolve bevel-wheels 24, fixed on the shafts 25, on the opposite ends of which there are other bevel-wheels 26, meshing with the wheels 20. A similar mechanism is disposed at each end of the rolling machinery, and these mechanisms are geared together by bevel-wheels 27 on the ends of the shafts 21 and bevel-wheels 28, meshing with 27 and supported on the opposite ends of the shaft 29. By revolving either of the shafts 21 the wheels 20 will be revolved and will move the slides 19 in or out and with them the side rollers 4.

Now with regard to the portion of the machinery for piercing the billet 10, at the back of the billet there is employed a tube 31 and a short length of tube 32 between it and the billet 10. The bore of these tubes is at least as large as the piercing conical bulb or head 30 on the end of the mandrel 3. This tube 31 passes through and is supported by the bearings 6 during the piercing action, and within it there is employed a bar 33, the inner end of which bears up against the end of the billet 10 and is normally pressed and held up against it by hydraulic pressure, while the tube 31 is also pressed up by hydraulic pressure. The hydraulic pressure for holding the tube up is obtained by employing a hydraulic cylinder 34, operating a ram 35, on the end of which there is a head 36, the outer end 37 of which carries or supports the tube 31, while the inner end 38 is in the form of a cylinder, to which the hydraulic or pressure water is admitted through the pipe 39 and with which there is a ram 40, which presses on the end of the inner holding-up bar 33. The portion 37 of this head holding the tube 31 is free to revolve up against the end of the part 38, while the inner end of the bar 33 is free to revolve upon the end of the ram 40, and these parts 31 and 33 would be revolved when the rollers 1 and 5 are revolved during the piercing action—that is, the billet 10 and these parts 31 and 33 would be revolved together—while the thrust backward, due to the longitudinal pressure exerted by the mandrel 3 in the piercing action, would be borne by the ends of the part or cylinder 38 and its ram 40, respectively.

Regarding the portion of the forcing apparatus for piercing the billet 10 at the opposite end of the billet supporting the rolling-machine, the mandrel 3 is supported at its head by a tube 50, carried by the socket piece or support 51, mounted in and adapted to be adjusted up and down in the column 52, which is free to be moved or adjusted longitudinally along the bed 53. The tube 50 is further supported by the bearings 6, through which it passes. In the position for piercing, which is shown in Fig. 1ª, the outer end of the tube 50 will be moved onto the end of the billet 10, so that the piercing-bulb 30 will be supported centrally at the commencement of the piercing action by the tube 50. After or during the piercing action the column 52 will be moved back in the usual way along the bed 53, on which it is adapted to slide. The adjustment of the slide or socket 51 vertically is effected by a screwed spindle 55, working through a nut 56 on the bracket or frame 57 and pressing on one end of a lever 58, fulcrumed at 59, and the opposite end of which

is connected with the lower end or stem of the support 51, which slides up and down in the column 52.

The piercing-mandrel 3 is pressed forward by a hydraulic cylinder 60 and its ram 61, and the mandrel 3 is adjustable vertically in relation to the ram 61 by the employment on the head of the ram 61 of a head-piece 62, which has in it a vertically-threaded shaft 63, which passes through and meshes with a nut 64, carried in the block or head-piece 65, in which the back end of the mandrel 3 fits. By turning this shaft 63 in either direction the block 65 will be raised up and down on the head 62, which forms the abutment to the block 65. The mandrel 3 will revolve with the billet 10 in the piercing operation, and to permit of this revolving action its back end is coned, and this coned part rests in a socket piece or bearing 66 in the bottom of the block 65.

All the main portions of the machinery are connected together—namely, the cylinder 34, the frames 7, and the cylinder 60 are all coupled together by the two side bars 70, the opposite ends of which are coupled or fastened to the heads of the rams 34 and 60, while these rods pass through the frame 7 and are suitably fastened in them.

The mode of use and operation of the machinery is as follows: At the commencement of operations the roller 5 is raised up and out of the way, and the side rollers 4 are brought together so as to just receive the billet. Then the hot billet 10 is placed between the rollers 4 and rests on the anvil-roller 1, and the upper roller 5 is brought down onto the top of the billet. Also the bar 33, together with the tubes 31 and 32, is passed or moved longitudinally into position, and the tube 50 and mandrel 3 are also moved into position, as shown, and the roller 1 is set in action. The rotation of this roller 1 will revolve the billet 10, and as it revolves the mandrel 3 is forced forward by the hydraulic cylinder 60 and ram 61. As the bulb 30 on the mandrel 3 enters the billet 10 it expands it, and at this end the rollers 1 and 5 are reduced in diameter, as before stated, and the metal of the billet forced out by the bulb will be pressed out into this annular recess of the rollers and will form a head or shoulder on the billet which assists in holding it longitudinally in the rollers. This head or shoulder remains as such during the whole rolling operation. Then as the bulb 30 passes into the body of the billet the flow of metal tends to pass or be forced longitudinally in the direction of movement of the bulb 30, and while the back end of the billet is supported by the tubes 31 and 32 and bar 33 yet the pressure in the ram-cylinder 34 on the ram 35 is so regulated that the total pressure acting on the back end of the billet 10 will be considerably less than that forcing the unpierced portion upward against this pressure, so that as the metal of the billet flows longitudinally between the rollers 1, 4, and 5 the hydraulically-pressed supporting parts 31, 32, and 33 recede before it. When the bulb 30 reaches the end of the billet and commences to perforate it and pass out of its end, it will act directly on the end of the bar 33, and at this moment the pressure-water acting on this bar in the cylinder 38 will be withdrawn—say by hand or automatically—so that the bulb 30 can press the bar 33 back through the tube 31 and also the ram 40 to the back end of the cylinder 38. During this time the outer edge of the pierced billet will be held or supported by the annular forward edge of the tube 32. In this manner the billet 10 may be pierced completely. After this the roller 5 may be moved up out of the way and the tubes and bars 31, 32, and 33 withdrawn longitudinally from their bearing 6, while the tube 50 will have been already withdrawn from the other bearing 6 during the piercing action. The mandrel 3 then passes through the bearing 6 at the back end of the rollers, and then these bearings 6 can be moved down by their operating-gear above described, so as to press the mandrel down onto the interior surface of the billet or hollow body 10, whereupon it becomes an internal roller revolving with the billet, and as this mandrel is pressed down by moving the bearings 6 downward it reduces the thickness of the tubular body 10 and concomitantly enlarges its diameter, as indicated in Fig. 4. As this diameter increases the side supporting-rollers 4 are drawn or moved outward in the upward inclined direction by their operating-gearing above described. This rolling operation should be effected at a high rate of speed. When the hollow body 10 has been sufficiently operated upon or expanded, the machine—that is, the roller 1—is stopped and the mandrel 3 withdrawn and the body 10 removed. The action is thus a combined longitudinal piercing and circumferential internal and external rolling one, and it is beneficial to the metal, having no or little destructive action on the metal, while the liability of eccentric or untrue piercing is small.

In making cylinders of considerable diameter the machinery may be adapted to make them plain or corrugated cylinders or of irregular formation by making the rollers which operate upon the corrugated or irregular form corresponding with the form required.

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

1. Machinery for manufacturing seamless tubes or hollow bodies, comprising driven parallel cylindrical rollers adapted to hold the billet to be pierced and revolve same; a piercing-mandrel at one end of the rollers axially in line with the axis of the billet to be pierced;

bearings at each end of the machine adjustable up to and away from the billet-supporting roller, under which said mandrel lies after the piercing action; and a longitudinally-movable stem at the back end of the billet also axially in line with same for supporting back end of same, substantially as described.

2. Machinery for manufacturing seamless tube or hollow bodies comprising driven parallel cylindrical rollers adapted to hold the billet to be pierced and revolve same; a piercing-mandrel axially in line with the axis of the billet to be pierced; and bearings at each end of the machine adapted to press upon the opposite ends of the mandrel when it has pierced the billet, and adapted to press on the inner surface of the billet thus pierced and a longitudinally-movable means at the back end of the billet substantially as described.

3. Machinery for manufacturing seamless tubes or hollow bodies, comprising driven parallel cylindrical rollers adapted to hold the billet to be pierced, and revolve same; a piercing-mandrel axially in line with the axis of the billet; bearings at each end of the machine adjustable up to and away from the billet-supporting roller under which said mandrel lies after the piercing action; and longitudinally-movable means at the back end of the billet, also axially in line with same, for supporting the back end of same, substantially as described.

4. In machinery for manufacturing seamless tubes comprising driven parallel cylindrical rollers adapted to hold the billet to be pierced and revolve same, side rollers 4 for preventing lateral movement of the billet, a piercing-mandrel at one end of the parallel rollers and axially in line with the axis of the billet, a holding-up stem 31 for the billet at the other end of the parallel rollers, vertically-adjustable bearings 6 for the mandrel so as to give the same vertical movement and means for forcing the mandrel longitudinally through the billet.

5. In machinery for making seamless tubes or hollow bodies, the combination of a lower driven roller 1; an upper roller 5, side rollers 4; a piercing-mandrel 3 at one end of said rollers; a holding-up stem 31 at the other end of said rollers, vertical adjustable bearings 6 for pressing down the mandrel 3; and means for forcing said mandrel 3 longitudinally through the billet; substantially as set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

BALFOUR FRASER McTEAR.

Witnesses:

JOHN H. WALKER,

GEO. E. GODDING.