E. J. STEELE & T. H. C. HANSEN.

MACHINE FOR FORMING TUBES.

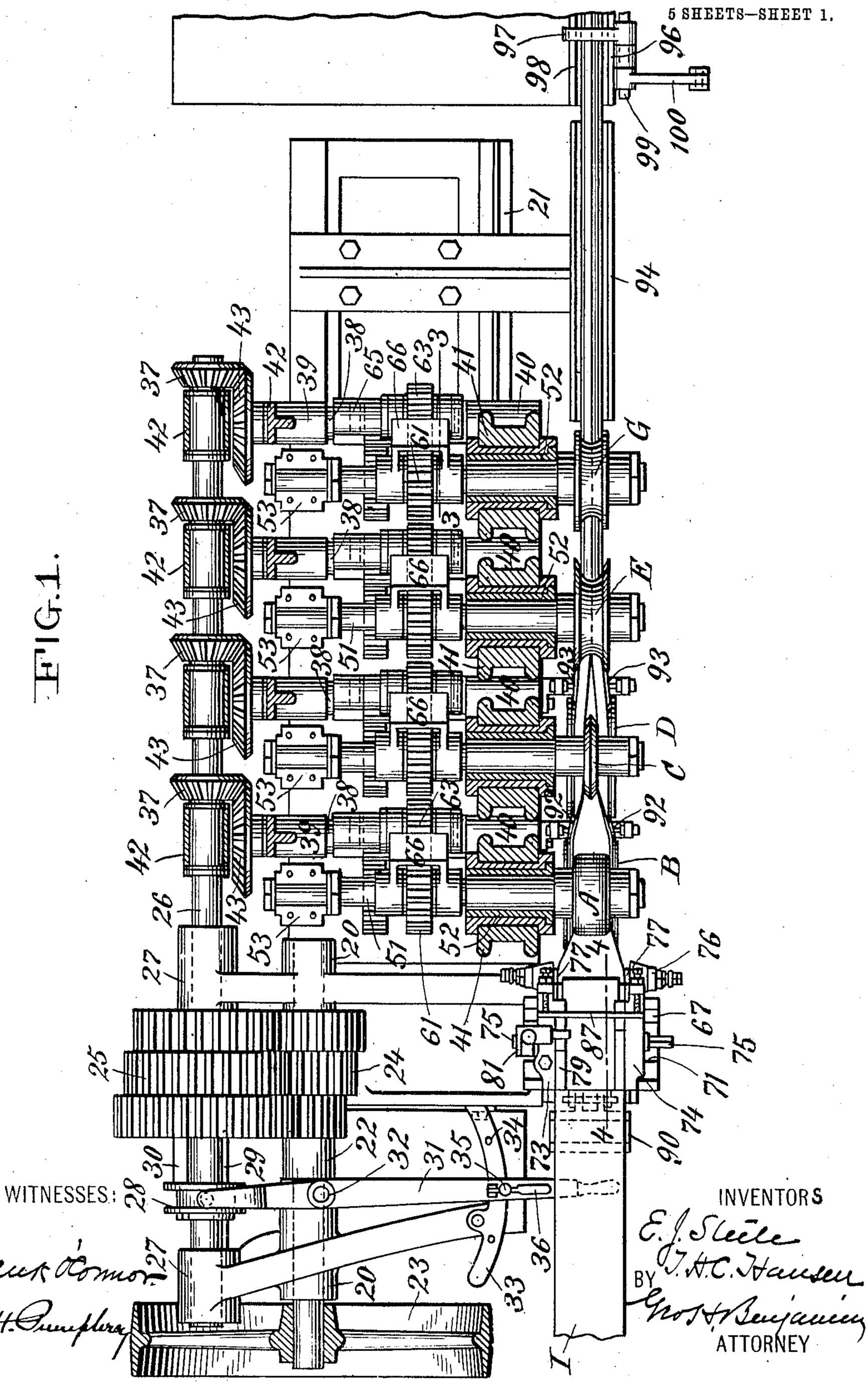
APPLICATION FILED JUNE 9, 1905.

943,902.

Patented Dec. 21, 1909.

5 SHEETS—SHEET 1.

FIG. 1.



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5 SHEETS—SHEET 2.

FIG. 3.

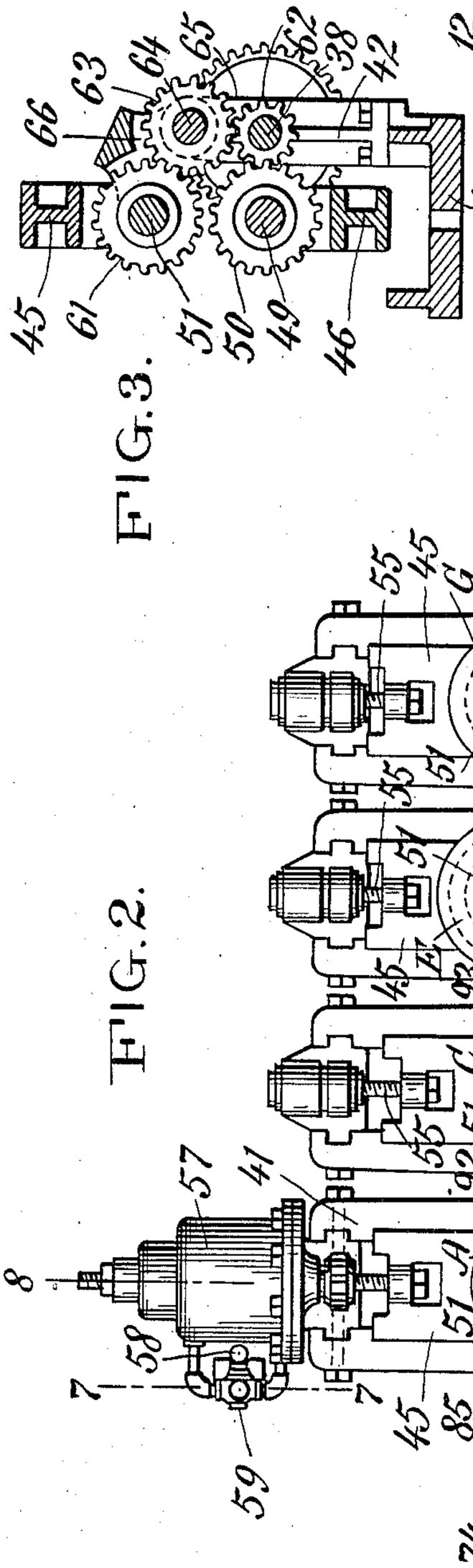
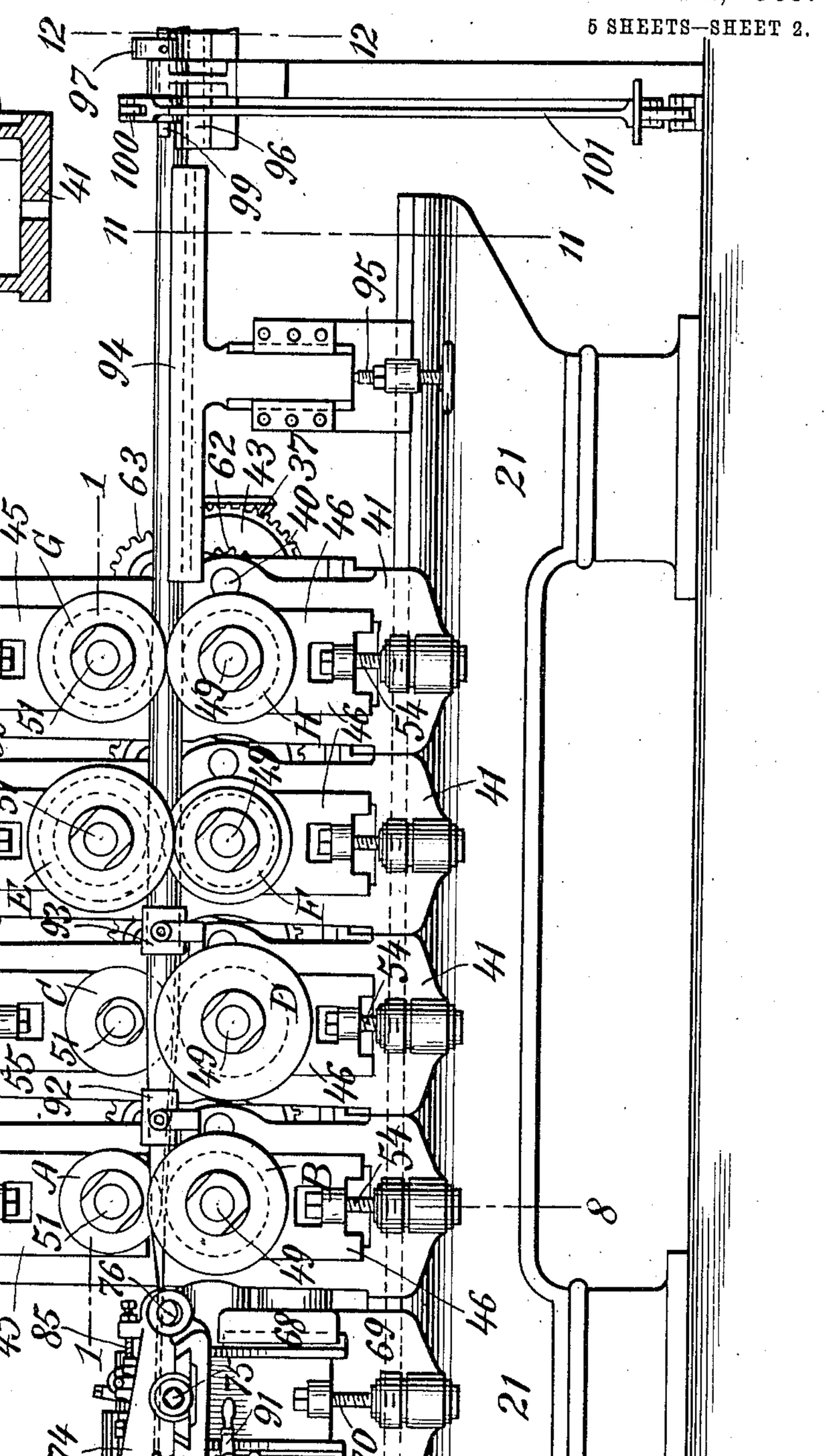


FIG. 2.



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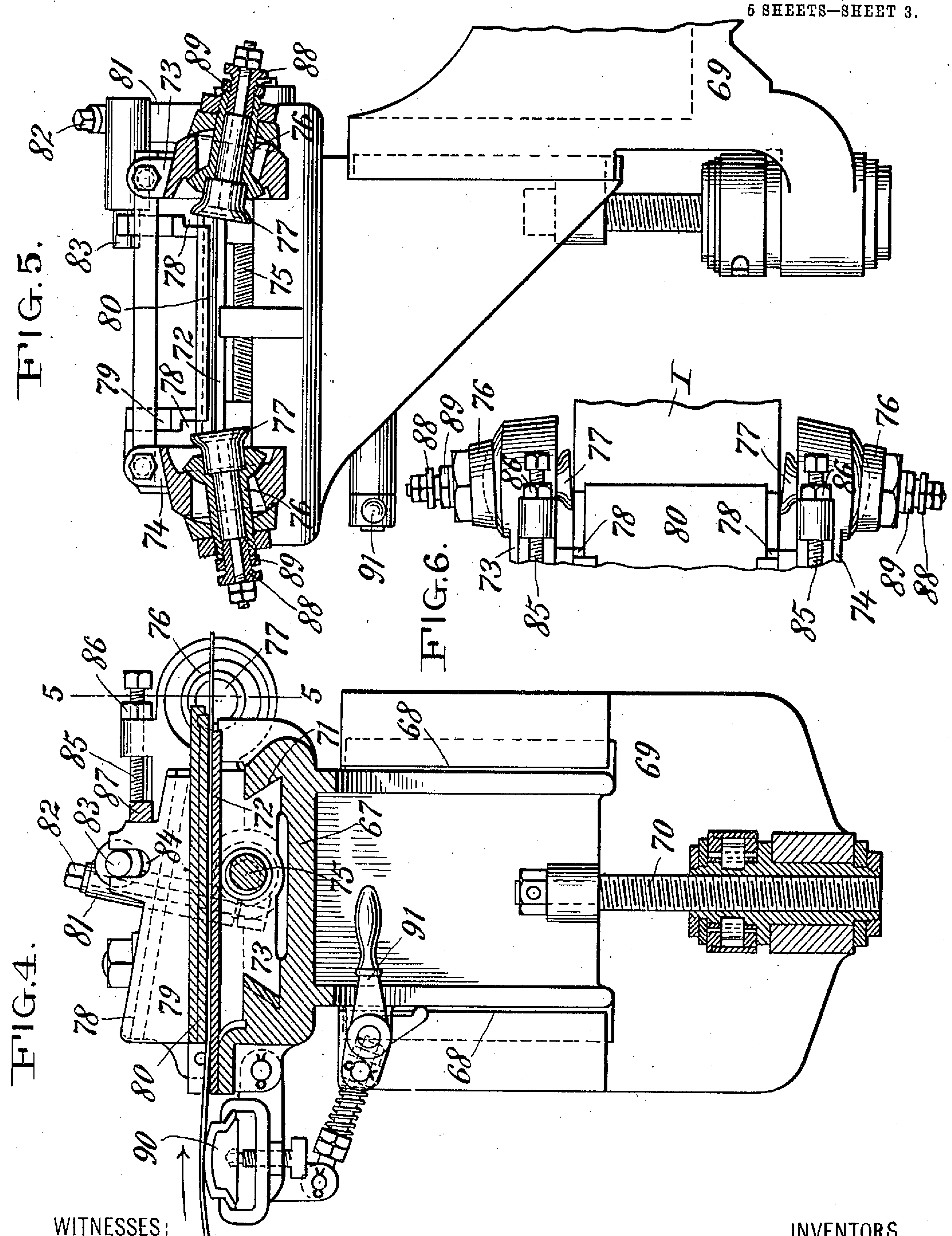

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5 SHEETS—SHEET 4.

FIG. 12.

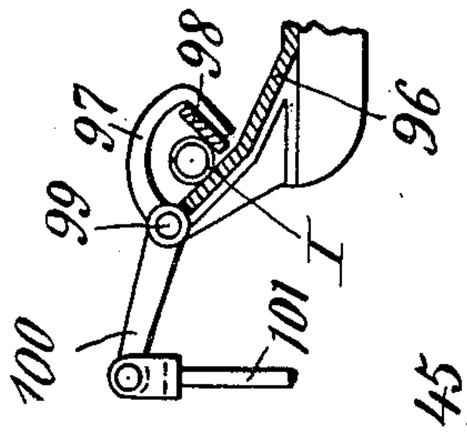


FIG. 11.

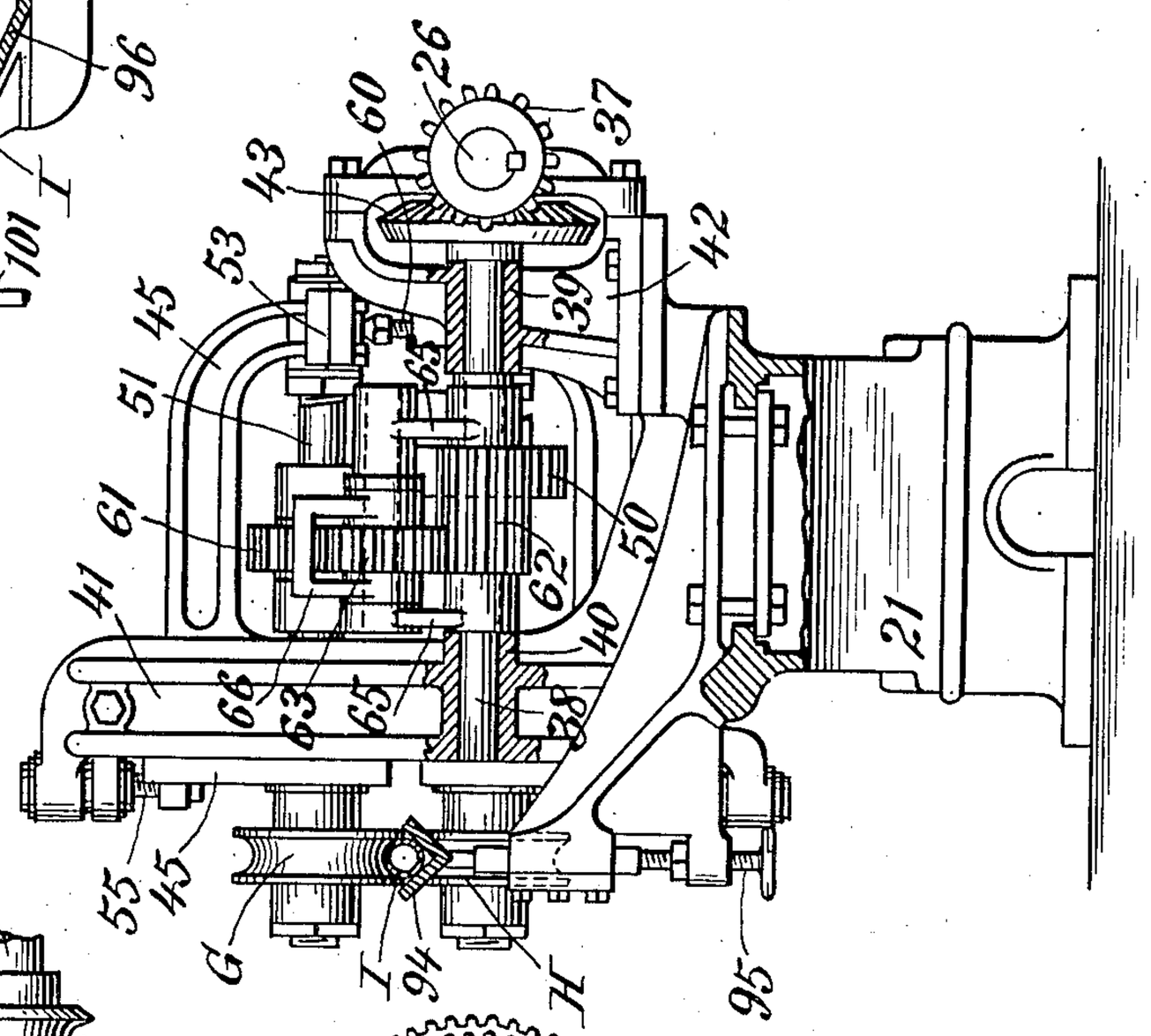


FIG. 10.

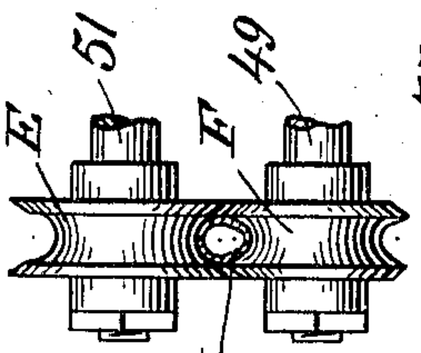


FIG. 9.

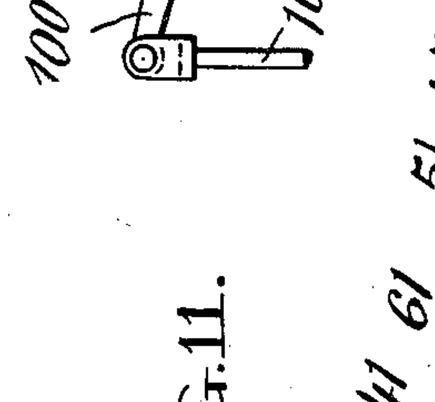
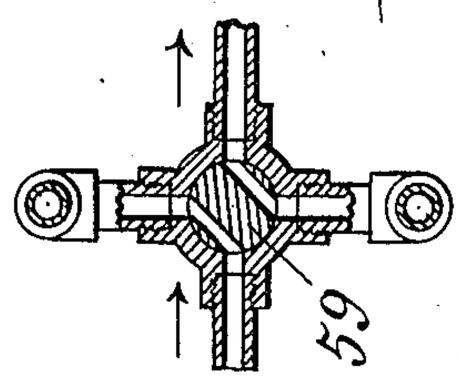


FIG. 8.

FIG. 7.



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5 SHEETS—SHEET 5.

FIG. 13.

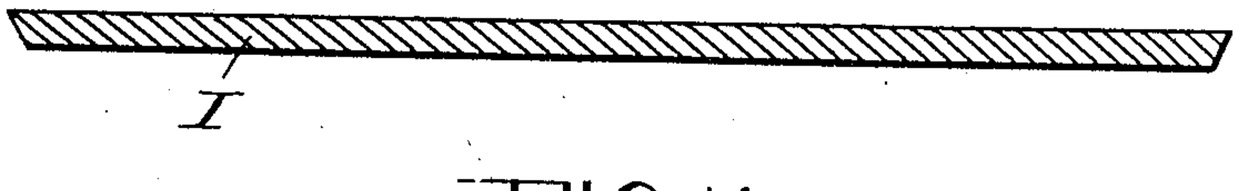


FIG. 14.

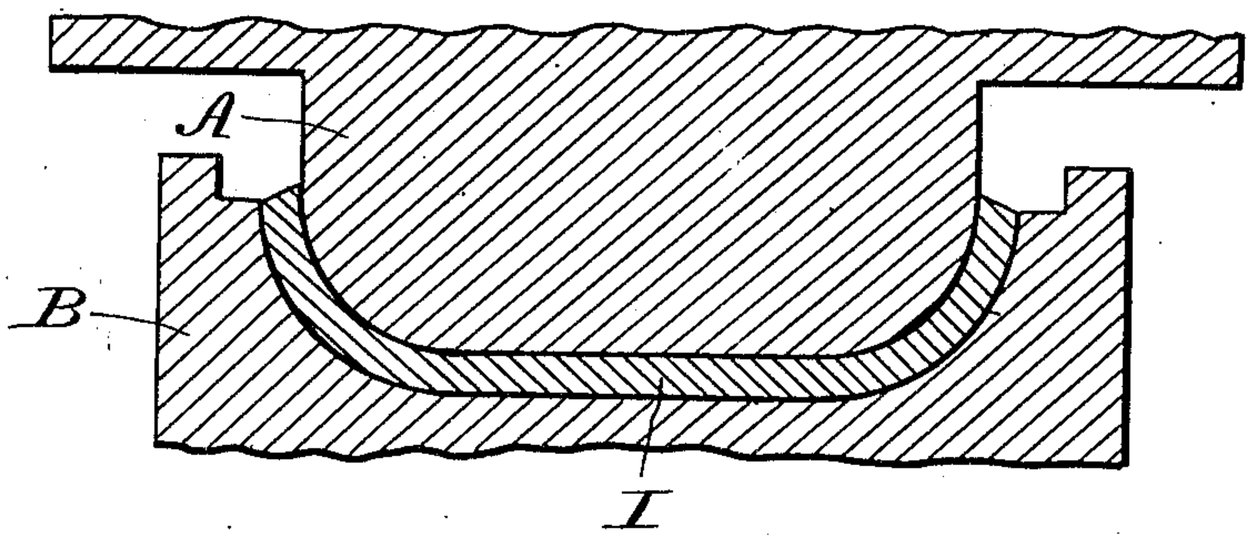


FIG. 15.

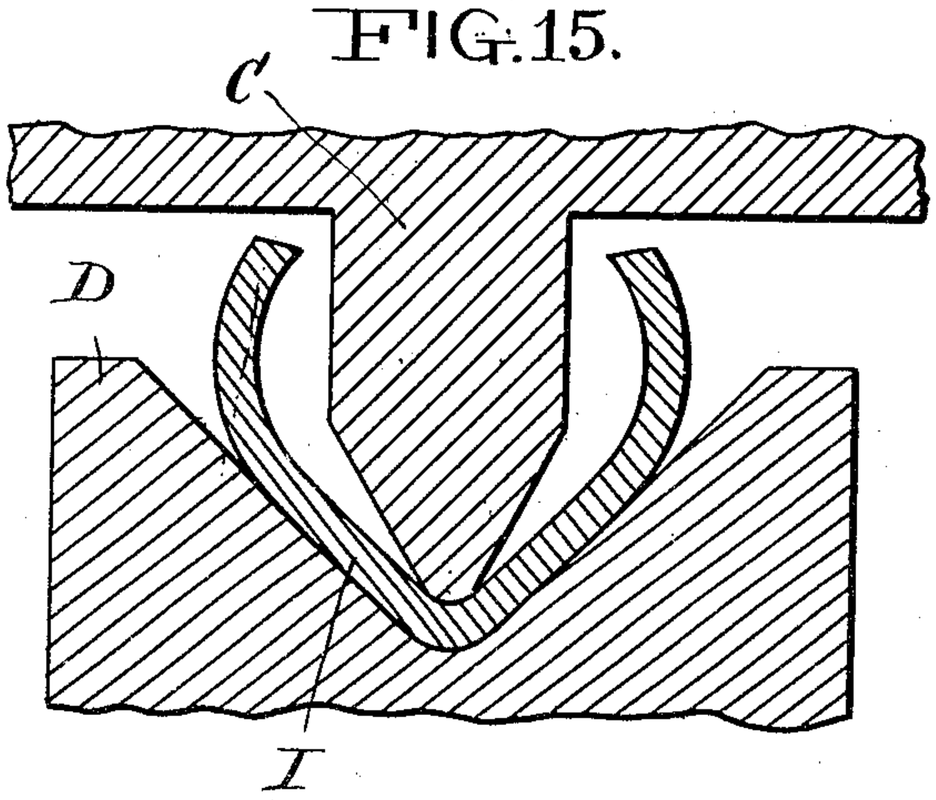


FIG. 16.

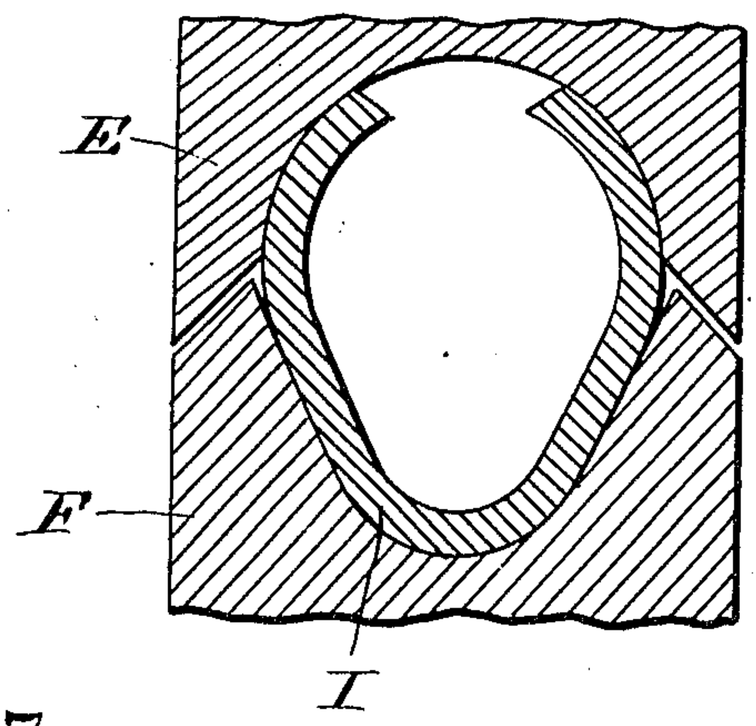
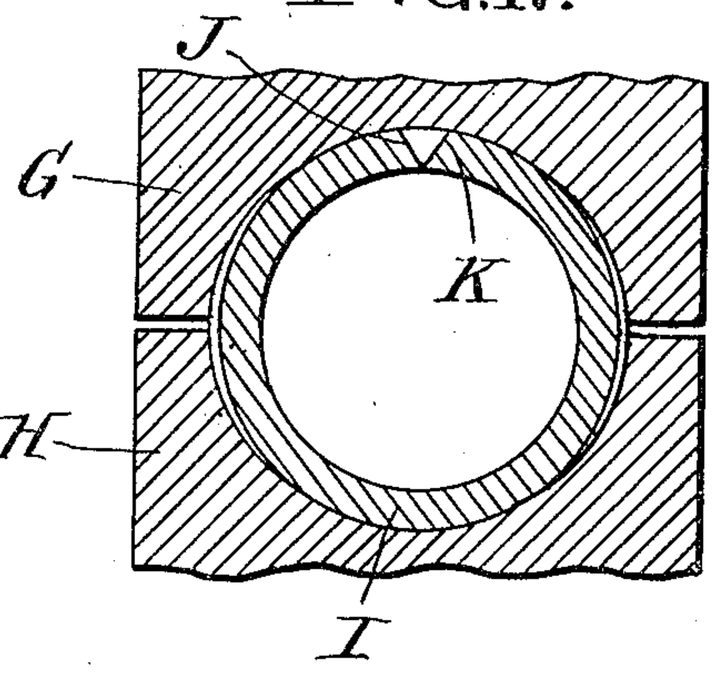


FIG. 17.



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UNITED STATES PATENT OFFICE.

ELISHA JONES STEELE, OF TORRINGTON, CONNECTICUT, AND THORVALD HANS CHRISTIAN HANSEN, OF KENOSHA, WISCONSIN, ASSIGNORS TO THE COE BRASS MANUFACTURING COMPANY, A CORPORATION OF CONNECTICUT.

MACHINE FOR FORMING TUBES.

943,902. Specification of Letters Patent. Patented Dec. 21, 1909.

Application filed June 9, 1905. Serial No. 264,538.

To all whom it may concern:

Be it known that we, ELISHA JONES STEELE and THORVALD HANS CHRISTIAN HANSEN, residing, respectively, at Torrington, county of Litchfield, State of Connecticut, and Kenosha, county of Kenosha, State of Wisconsin, have invented certain new and useful Improvements in Machines for Forming Tubes, of which the following is a specification.

Our invention consists in a machine for forming tubes from strip metal.

Many attempts have heretofore been made to form a closed tube from strip metal, which attempts have failed owing to the fact that when the tube is removed from the machine the natural resiliency of the metal acts to separate the opposing edges of the tube.

The machine which forms the subject of our invention is designed to overcome this objection, and to form what is strictly a closed tube; that is, a tube with the opposing edges in apposition and pressed closely together by the resiliency of the metal; and further, a tube in which the opposing edges are so shaped as to form a V-shaped groove or cavity extending from without inward into which the brazing solder may be placed preparatory to brazing, or otherwise uniting the opposing edges of the tube.

The object of our invention is to make a perfectly closed tube, and further, to materially decrease the cost of making such tubes. With our machine the tubes are formed continuously and by purely mechanical means without hand labor, thus doing away with the eight necessary operations now used in forming tubes.

The accompanying drawings will serve to illustrate our invention.

Figure 1 is a plan view and horizontal section, taken on the line 1—1 of Fig. 2. Fig. 2 is a side elevation. Fig. 3 is a vertical section and elevation, taken on the line 3—3 of Fig. 1. Fig. 4 is a vertical section and elevation on the line 4—4 of Fig. 1. Fig. 5 is a transverse section and elevation on the line 5—5 of Fig. 4. Fig. 6 is a partial plan view of Fig. 4. Fig. 7 is a transverse section on the line 7—7 of Fig. 2, showing the controlling valve. Fig. 8 is a transverse section on the line 8—8 of Fig. 2. Fig. 9 is an end view showing the relation to each other of the rolls of the second pair. Fig. 10 is an end view showing the relation of the third pair of rolls. Fig. 11 is an end view and partial section, looking from the right, taken on the line 11—11 of Fig. 2. Fig. 12 is a section and elevation taken on the line 12—12 of Fig. 2. Fig. 13 is a transverse section taken through a strip to be formed into a tube, and showing the shape of the sides of the strip after passing the scarfing knives. Fig. 14 is a section through the first pair of rolls and strip, and showing the shape given to the strip by the action of these rolls. Fig. 15 is a corresponding view, showing the section given the strip by the second pair of rolls. Fig. 16 is a similar view, showing the section given the strip by the third pair of rolls. Fig. 17 is a similar view, showing the section given the strip by the fourth pair of rolls.

Before entering into a detailed description of the mechanism of the machine, we will generally describe its operation:— A strip of metal having the required thickness and width to produce a tube of given diameter is fed into the left hand side of the machine and between a pair of inclined circular scarfing knives, which are best shown in Fig. 5. These knives scarf the edges of the strip to give it the shape shown in Fig. 13. After being scarfed, the strip is fed between the first pair of rolls and shaped primarily by the depression of the upper roll and secondarily by rolling, as shown in Fig. 14. It then passes between the second pair of rolls and is shaped as shown in Fig. 15; then between the third pair of rolls and shaped as shown in Fig. 16, then between the fourth pair of rolls, which it will be observed, together form an elliptical opening, and is shaped as shown in Fig. 17; that is, the tube is made circular in section with the edges of the tube in apposition, with the V-shaped groove or recess extending from the co-acting edges upward and outwardly. The tube is then fed out of the machine and into a carrier, indicated at the extreme right of the machine, from which carrier the tube rolls by gravity, when the retaining device shown in Fig. 12 is lifted. The tube is then taken to the brazing room and the V-shaped groove or recess filled with solder and the tube introduced into the usual brazing furnace. Or, if desired, the introduction of the

brazing solder and brazing or its equivalent may be effected while the tube is passing through the machine.

We have not in this application described the apparatus for brazing, or otherwise securing the edges of the tube together, by solder when in the machine, as it is our intention to make this feature the subject of a separate application and merely wish to have it understood that it is possible to perform this act in connection with the machine shown.

Referring now to the construction of the machine:

Mounted in suitable bearings 20, projecting upwardly from a base 21, is a shaft 22, and secured to the end of this shaft is the main driving pulley 23. Located upon the shaft 22 is the cone of gears 24, any one of which may be arranged to drive any one of the cone of gears 25, mounted loosely on the shaft 26. This shaft is located in bearings 27, projecting upward from the base.

28 indicates a slotted collar longitudinally movable upon the shaft 26. This collar moves over a spline 29 on shaft 26 and carries a spline 30, which is adapted to engage with recesses cut in the interior of the hubs of the cone of gears 25.

31 indicates a lever pivoted at 32 on one of the bearings 20. By means of this lever the slotted collar 28 and spline 30 may be reciprocated on the shaft 26, so as to throw any of the cone of gears 25 into connection with the shaft 26, the object of which arrangement is to provide for a change of speed of the machine. The lever 31 moves over a sector 33 having holes 34 therein, adapted to coöperate with a pin 35 on the end of a latch 36, pivoted upon the lever 31. The speed changing device shown is that which we find desirable for use; we may, however, substitute for it any other speed changing device, or we may drive the machine at a single speed.

Located upon the shaft 26, and secured thereto, are the beveled gears 37. Mounted on the ends of the shafts 38, carried in bearings 39, 40, situated in the vertical standards 41, 42, projecting upward from the main frame 21, are the beveled gears 43, in mesh with gears 37. The vertical standards or uprights, 41, Figs. 2, 8 and 11, are slotted; or in other words, cut away at their center to form the guides 44. Situated in these guides are the frames or housings 45, 46. Located in the bearings 47, 48, in the lower frame or housing, Fig. 8, is a shaft 49, and on this shaft a gear 50, and a roll B. A similar shaft, 51, is carried in the bearings 52, 53, in the frame or housing 45. The frame or housing 46 is made vertically adjustable by means of the screws 54, and the frame or housing 45, so far as relates to the three housings to the right of Fig. 2, by means of the screws 55. The housing 45 to the left is shown as connected to the piston 56, of an air cylinder 57. The reciprocations of the piston 56 is controlled by the handle 58. By moving the handle the position of the valve 59 is altered to admit air above or below the piston 56. The piston 56 therefore acts to reciprocate the frame or housing 45 of the first pair of rolls. For the purposes of description, we will call the rolls in order, from left to right, A,B, C,D, E,F, G,H.

60 indicates a limiting screw, by reason of which the distance between the shafts 49, 51, may be determined. Situated on the shaft 51, is a gear 61, and on the forward end of the shaft a roll A. In order to communicate the motion of the shaft 26 to the shafts 49, 51, there is located on the shaft 38, best shown in Fig. 3, a wide gear 62, which is in mesh with gear 50 on shaft 49, and also in mesh with a gear 63, mounted on shaft 64, carried in the upper end of a link 65, which is pivoted on shaft 38, as shown in Figs. 3 and 11. The gear 63 is in mesh with the gear 61 on shaft 51. Shafts 51, 64, are connected through the link 66. It will thus be seen that the frames 45, 46, may be moved vertically relative to each other without the shafts 49, 51, being thrown out of gear with the driving shaft 26.

The pairs of rolls A,B, C,D, E,F, G,H, are given any desired shape, but preferably the roll A has a flattened convex surface, and the roll B a flattened concave surface, Figs. 8, 14; the roll C has a projecting flange with a V-shaped edge, while the roll D has a V-shaped cavity cut in its periphery, Figs. 9, 15; the roll E has a concave cavity cut in its periphery, while the roll F has a substantially U-shaped cavity cut in its periphery, Figs. 10, 16; the roll G has a concave cavity, which forms one-half of an ellipse, cut in its periphery, and the same is true of the roll H, Figs. 11, 17. The object of giving the different shapes to the rolls is to bend and roll the metal progressively to the shapes shown in Figs. 6 to 17 inclusive.

In order to scarf the opposing edges of the strip I, or in other words, in order to give the opposing edges surfaces which will be inclined downwardly and inwardly toward each other, as shown at J, K, Fig. 17, we provide the scarfing attachment at the left of the machine. The scarfing attachment, Figs. 4, 5, 6, consists of a base 67, vertically adjustable in guides 68, formed in a standard 69 secured to the base 21. This vertical adjustment is effected by means of a screw 70. The top of the base portion 67 is dovetailed transversely to form a slot 71 and extending across the center of the slot is a plate 72 secured at the ends to the base portion 67.

Situated at each end of the slot 71 are two side frames 73 and 74 which are adjustable toward or from each other along the slot by means of a screw 75 having a right and left hand thread.

Arranged in adjustable universal bearings 76 on each of the side frames 73 and 74 are the rotary scarfing knives 77. The vertical faces of these knives are arranged at an angle to the plane of the plate 72. The side frames 73 and 74 are each provided with an inclined guide 78 on which a frame 79 having corresponding guides at each end can slide. The frame 79 has a base plate 80 which extends across above and parallel to plate 72. Between the plates 72 and 80 the strip I is free to pass. The friction of the strip will cause the frame 79 to be drawn along the inclined guides 78 causing the plate 80 to press upon the strip.

An arm 81 is secured to screw 75 by means of a screw 82, a pin 83 extending from arm 81 rides in a slot 84 on the frame 79. By this means any movement of frame 79 will be imparted to screw 75 to force the side frames 73 and 74 together with the cutters 77 toward or away from the edges of the strip.

The distance between the plates may be adjusted by means of the screws 85 and lock nuts 86, which by means of the cross bar 87, limits the movement of frame 79. The depth of cut of cutters 77 is regulated by means of screw 88 and lock nut 89. The cutters are made to revolve by placing the center of the cutter below the path of the strip I.

90 indicates an elastically supported device for oiling the lower side of the strip. 91 the handle for throwing this device into and out of engagement with the strip I. Any other suitable device may be substituted for that shown.

Situated between the pairs of rolls, A,B, C,D, and C,D, E,F, are the guides 92, 93. These guides serve to keep the general direction of the strip, when shaped under the action of the two first pairs of rolls. Situated beyond the pair of rolls G,H, is a guide 94, vertically adjustable by means of the screw 95. Located at the extreme right of the machine, is a carrier having an inclined surface 96. Pivoted to the upper portion of this surface is one of a number of arms 97, to the lower end of which is attached a strip 98, which is connected to the several arms. The arms are connected to a shaft 99, and secured to this shaft is a lever 100, and a foot treadle 101. The finished tube is fed between the inclined surface 96 and the strip 98. When the tube has passed fully out of the machine, the operator depresses the treadle 101, lifts the strip 98 and allows the tube to roll down the incline 36 and on to a table placed to receive it.

In this specification we have given a very general description of the mechanism of the machine, leaving out all details. We have taken this course as we wish it understood by those skilled in the art to which this invention belongs that we may change the details of the machine in many particulars. That is, we may change the form and shape of the scarfing attachment, and means employed to adjust the rolls of a pair relative to each other, the mechanism for driving the rolls and at the same time permitting their adjustment, the shape and arrangement of the guides, etc., etc. And further, because it is our intention to file separate applications to cover the constructive details of the various parts.

Having thus described our invention, we claim:—

1. A tube forming machine comprising a guide, means for scarfing the edges of the strip passed through the guide, a pair of rolls one of which has a plano-convex and the other a plano-concave surface, with means for giving one roll a quick vertical movement relative to the other roll, a series of pairs of shaping rolls, the last pair of rolls having concave surfaces.

2. A tube forming machine comprising a guide, means for scarfing the sides of the strip fed through the guide, a pair of rolls one of which has a plano-convex surface and the other a plano-concave surface, means for reciprocating one of said rolls relative to the other, a second pair of rolls, one of which is disk-shaped and the other has a V-shaped concavity upon its surface, a third pair of rolls one of which is concave on its surface and the other provided with a U-shaped concavity on its surface, a fourth pair of rolls, each provided with a concavity on its surface and said concavities conjointly forming an ellipse.

3. A tube forming machine comprising an adjustable guide, a pair of oppositely placed, angularly disposed rotary scarfing knives, a pair of rolls, one of which is vertically movable relative to the other, together with successive pairs of shaping rolls, the last pair of which have concavities on their surfaces and of such shape that pressure will be exerted upon the top and bottom of the shaped tube fed between them.

4. A tube forming machine comprising a guide, means for scarfing the sides of the strip fed through the guide, a series of pairs of rolls, with the rolls of each pair relatively adjustable, means for imparting a quick vertical movement to one of the rolls of the first pair and for exerting pressure by said roll upon the strip, together with adjustable power transmission means interposed between the rolls and the source of power.

5. A tube forming machine comprising a guide, means for scarfing the edges of a

metal strip fed through the guide, a series of pairs of rolls, means for reciprocating one roll of the first pair relative to the opposite roll and making pressure thereby, and said successive pairs of rolls shaped to give the strip fed between them the forms indicated and to finally produce a closed tube.

6. A tube forming machine comprising a guide, means for scarfing the sides of the strip fed through the guide, a series of pairs of rolls, means for reciprocating one roll of the first pair relative to the opposite roll of such pair, said rolls having the surface shape described, a main driving shaft, a second shaft, speed changing mechanism introduced between the shafts, and power transmission mechanism introduced between the second shaft and the pairs of rolls.

7. In a tube forming machine, a pair of rolls, one of which is vertically movable relative to the opposite roll and arranged to exert a preliminary shaping pressure upon the material introduced between the rolls before subjecting said material to the rolling, shaping action of said rolls.

8. In a tube forming machine, the combination of four pairs of rolls, the first pair having one roll arranged to be given a quick vertical movement relative to the opposite roll and to exert a preliminary pressure before rolling upon the material inserted between such pair of rolls, the co-acting surfaces of said first pair of rolls shaped, one plano-convex and the other plano-concave, the second, third and fourth pairs of rolls having a normally fixed operating relation with their co-acting surfaces shaped as shown and described.

9. A tube forming machine, comprising a series of adjustable rolls with one roll of the first pair adapted to be given a quick vertical movement relative to the opposite roll of the pair, and a guiding and scarfing attachment vertically and laterally adjustable relative to the rolls.

10. In a tube forming machine, the combination of a supporting base, a standard, a pair of frames situated in said standard, a shaft journaled in each frame and carrying a roll, a cylinder mounted on the top of the standard, a piston in said cylinder connected to the upper frame, and a hand lever for directing the flow of a motive fluid above or below the piston.

11. In a tube forming machine, the combination of a supporting base, power transmission means mounted upon said base, a series of standards, two vertically adjustable frames carried in each standard, a shaft in each frame, each having a roll and a gear, and power transmission means mounted upon a movable support, and interposed between the power transmission means on the base, and the gears on the shafts in the frames.

12. A tube forming machine provided with a series of pairs of co-acting rolls, said rolls shaped to progressively bend a flat strip into a circular form, and during the passage of said partially formed strip through the last pair of rolls exert a shaping pressure on the top and bottom of the partially formed strip but not upon the sides.

13. In a tube forming machine, a pair of finishing rolls shaped to exert pressure upon the top and bottom of the partially formed tube and to permit lateral movement without pressure at the sides of said tube.

14. In a tube forming machine, the combination of means for scarfing the edges of the strip, means for giving a preliminary shape and set to the end of the strip, and means for progressively rolling the strip to form a closed tube, the opposing edges of which will be spring-pressed by the resiliency of the metal toward each other.

15. A tube forming machine comprising a guide, scarfing knives set at an angle to the guide, a pair of rolls, one of which is capable of quick vertical movement relative to the other, successive pairs of shaping rolls, the last pair of the series shaped to have when in apposition, an elliptical opening between their faces.

16. In a tube forming machine, a pair of rolls, said rolls having concavities upon their faces which conjointly, when the rolls are in apposition, form an elliptical opening with its greatest axis horizontally disposed.

In testimony whereof, we affix our signatures, in the presence of witnesses.

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