No. 817,056. PATENTED APR. 3, 1906.

E. T. GREENFIELD.

MACHINE FOR FORMING METAL TUBES.

APPLICATION FILED AUG. 5, 1904.

9 SHEETS—SHEET 1.

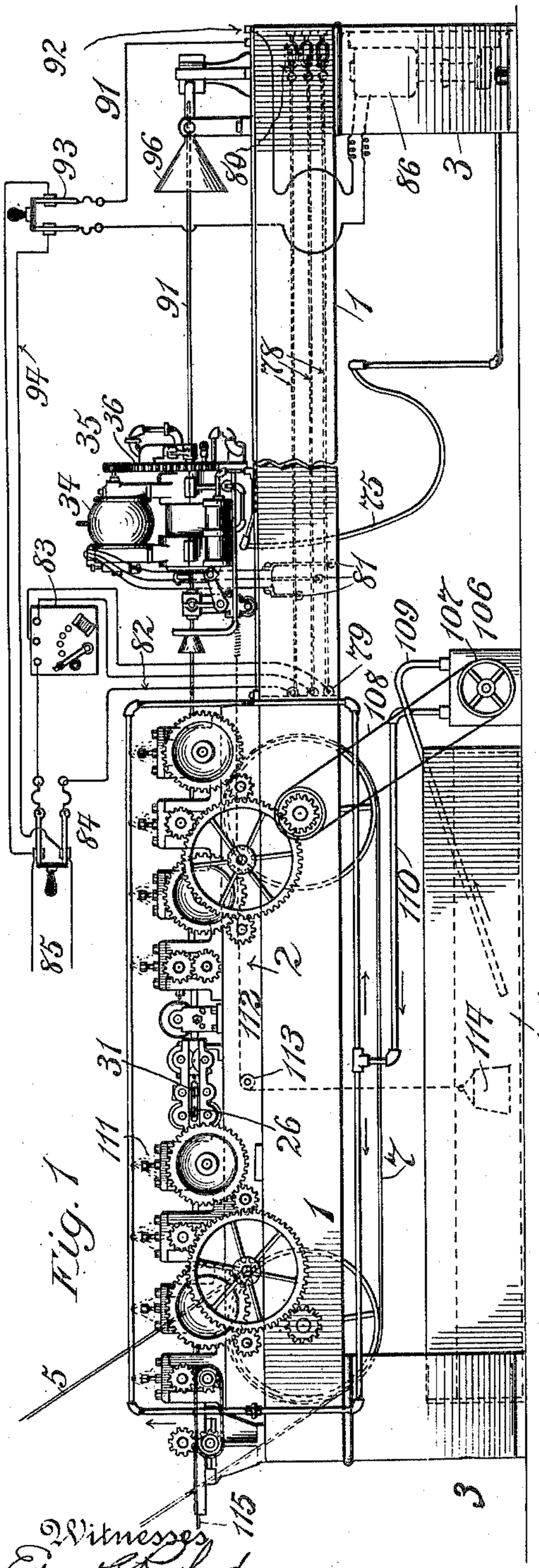

Fig. 1.

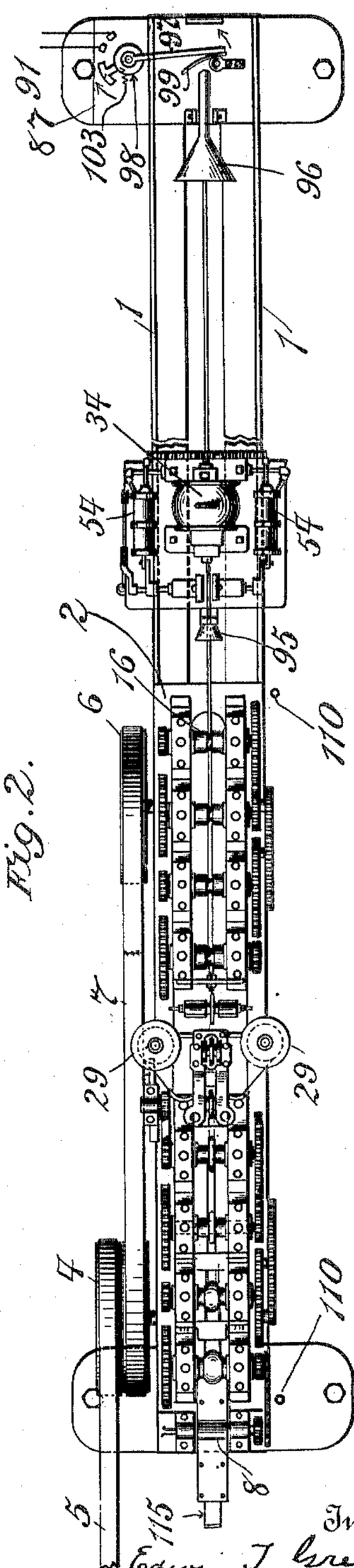

Fig. 2.

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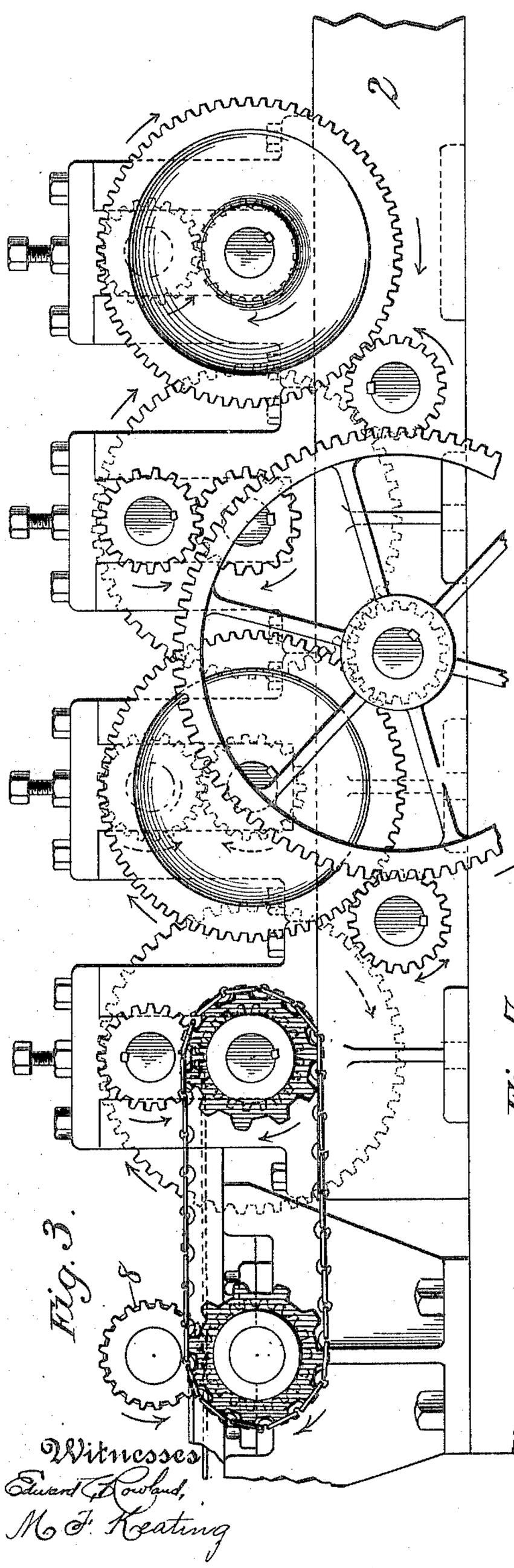

Fig. 3.

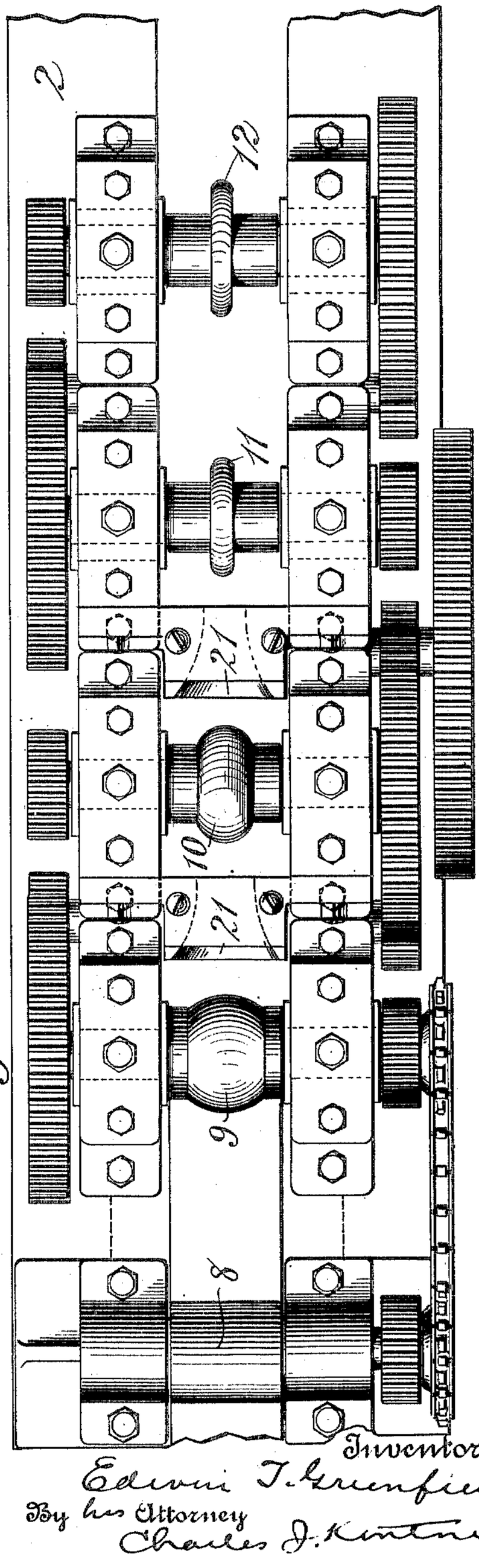

Fig. 4.

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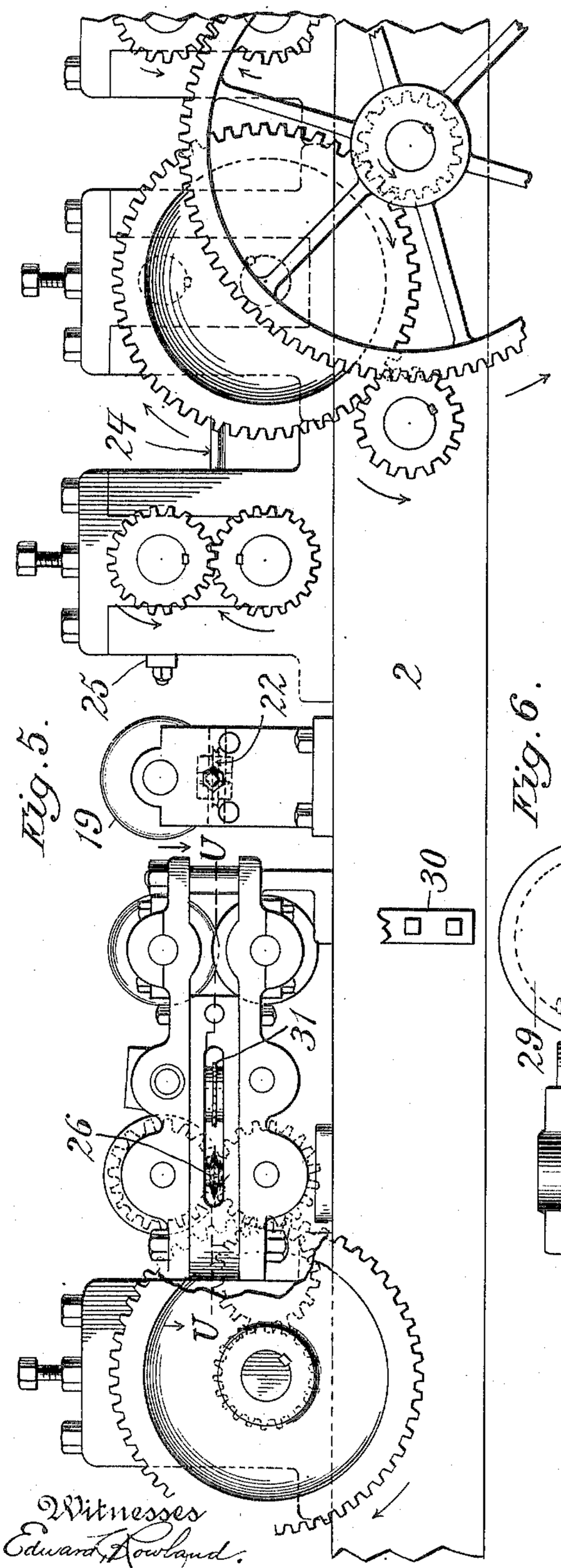

Fig. 5.

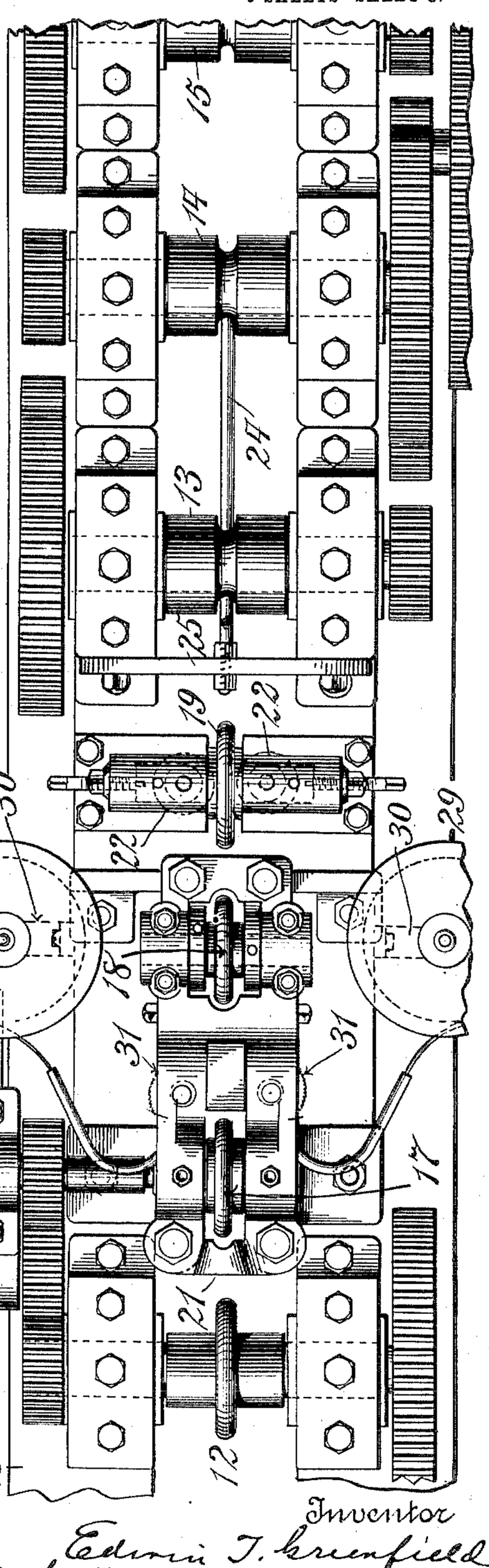

Fig. 6.

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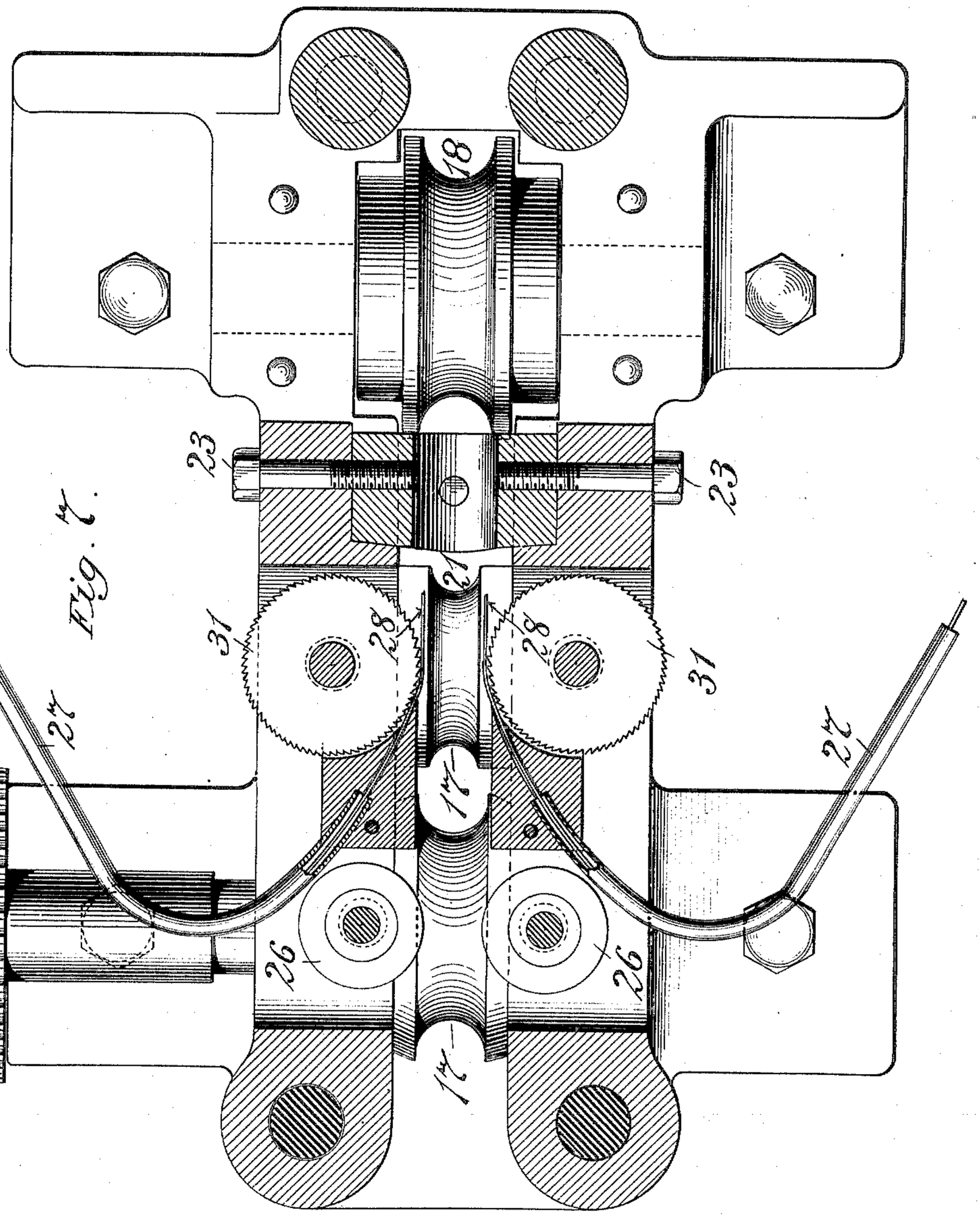

Fig. 6.

Witnesses
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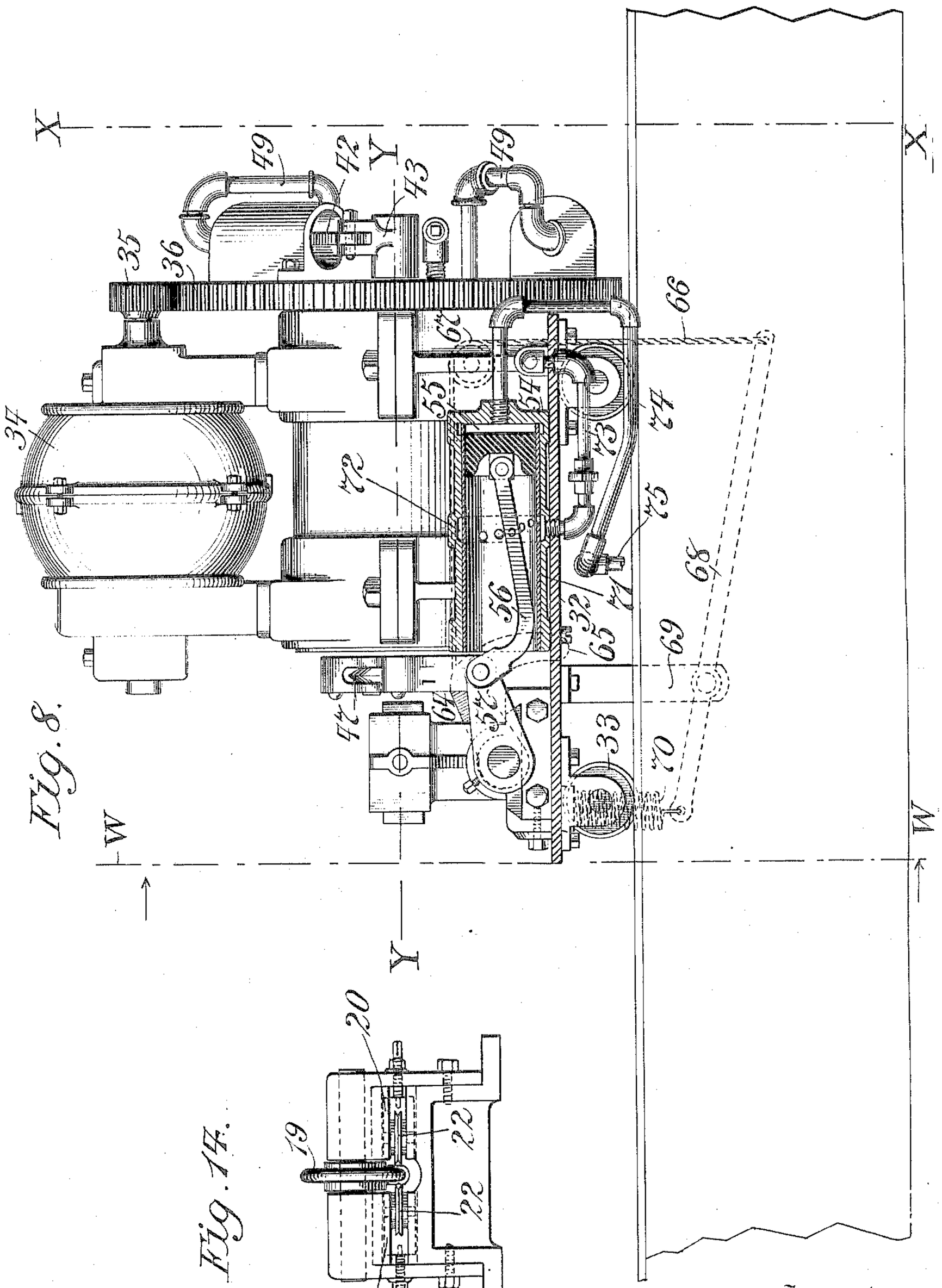

Fig. 8.

Fig. 14.

Witnesses
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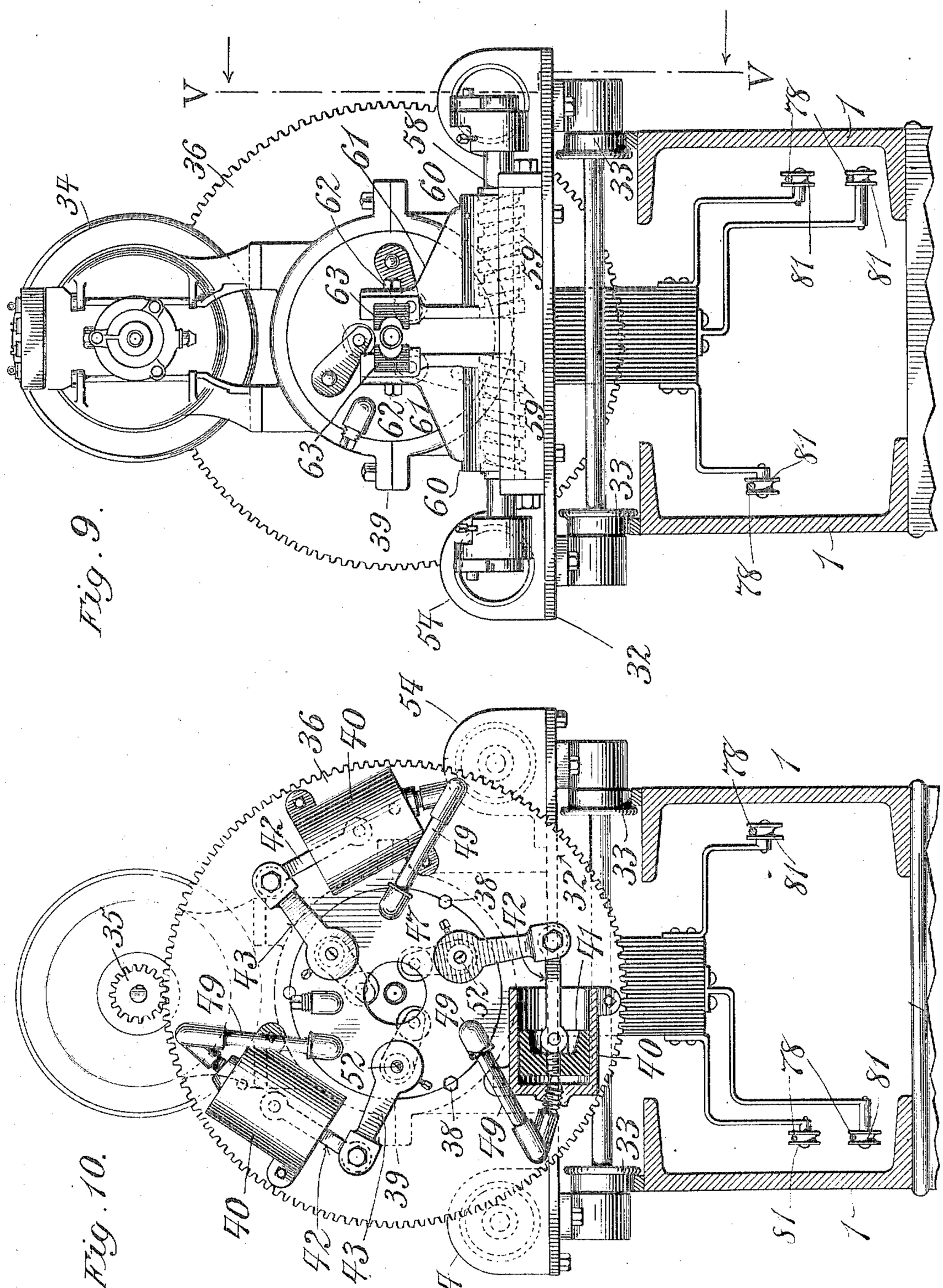

Fig. 9.

Fig. 10.

Witnesses
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9 SHEETS—SHEET 7.

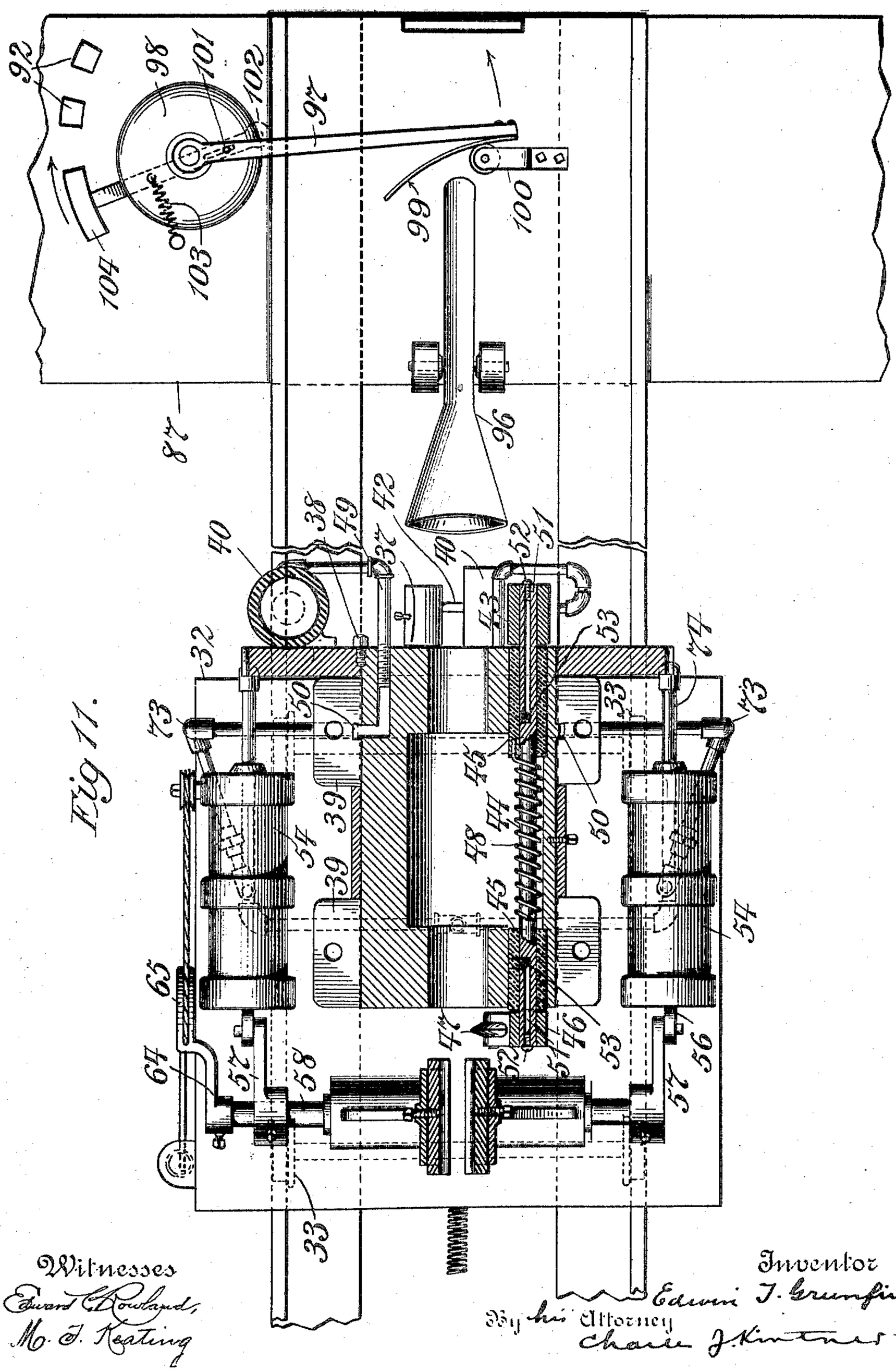

Fig 11.

Witnesses
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Fig. 12.

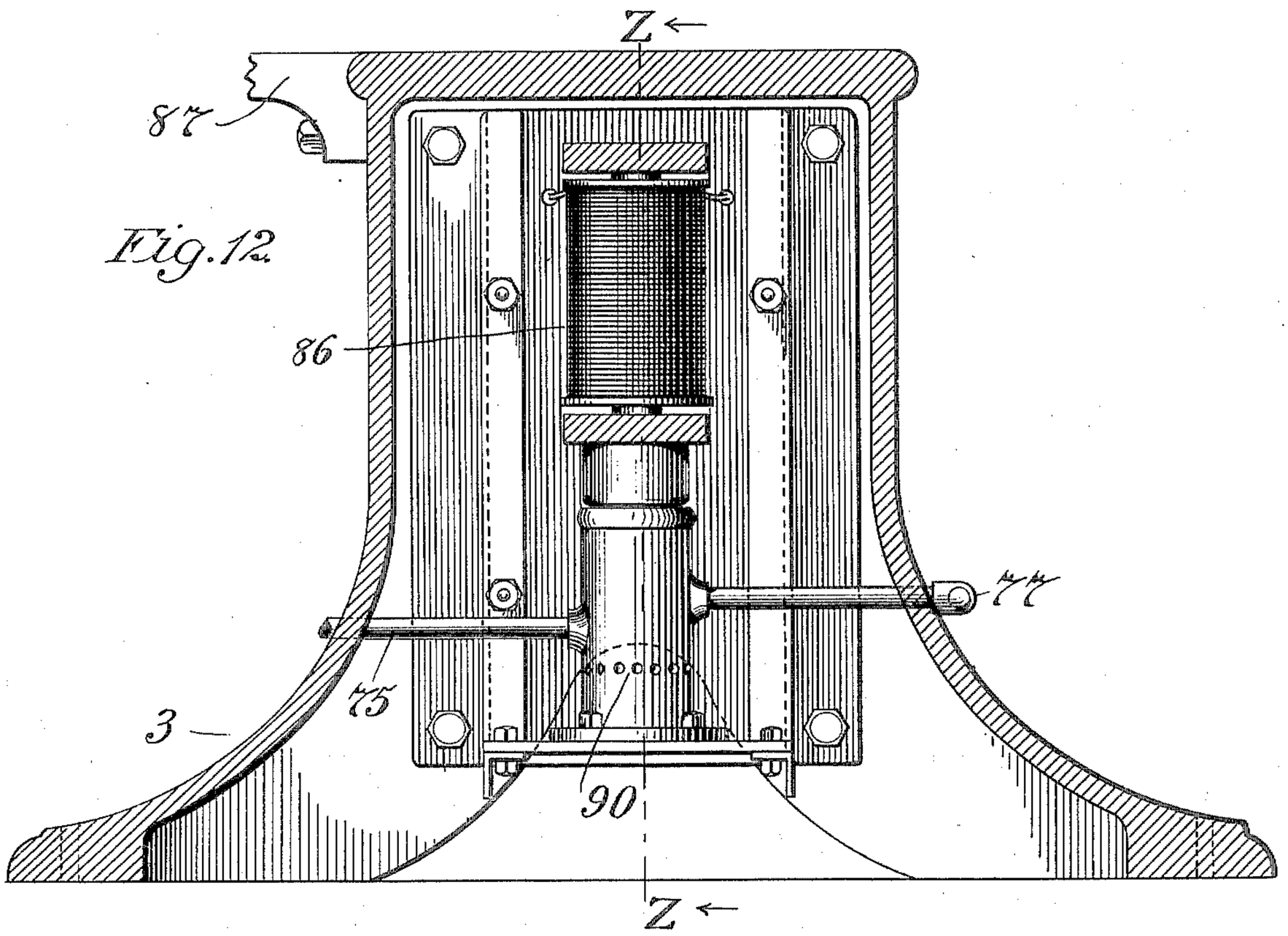
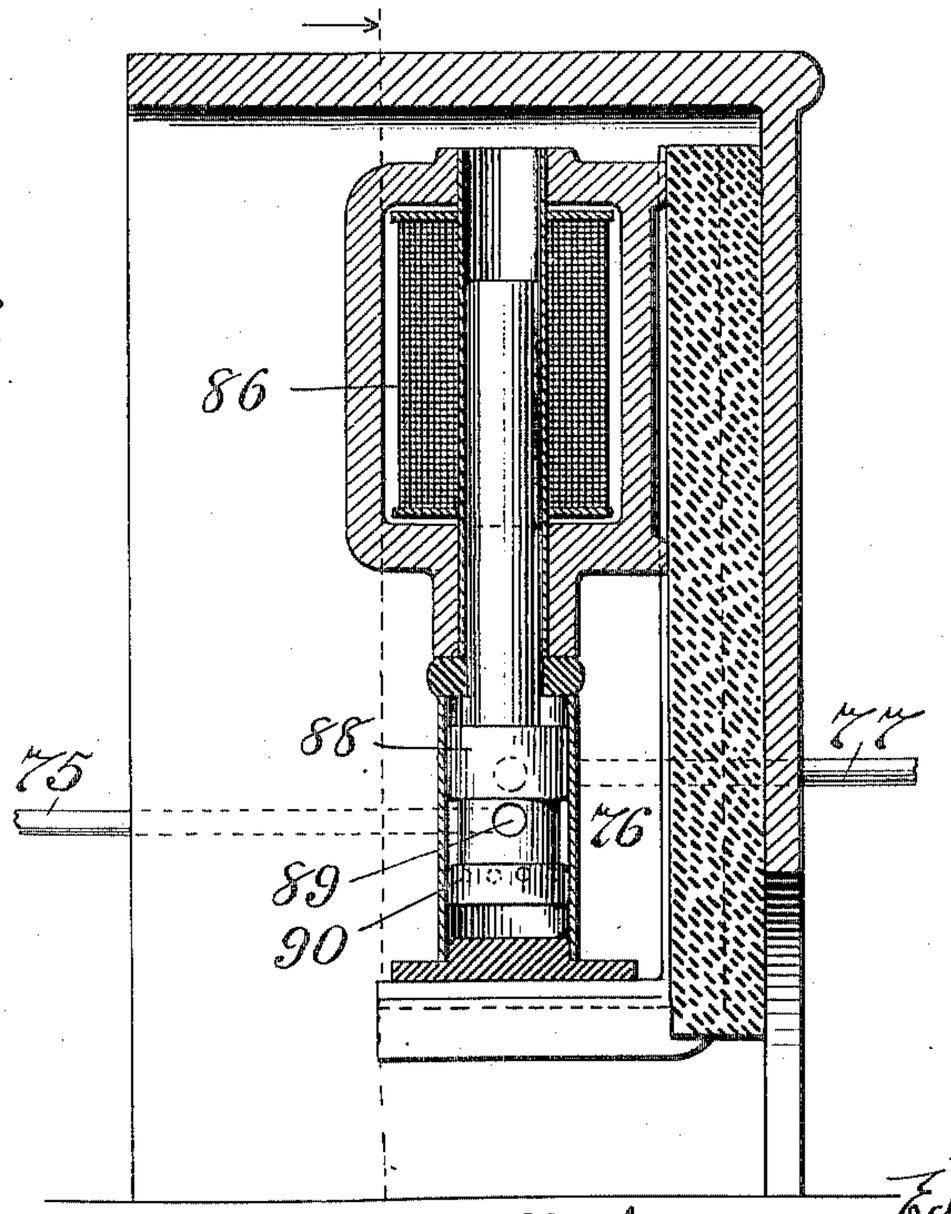


Fig. 13.



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9 SHEETS—SHEET 9.

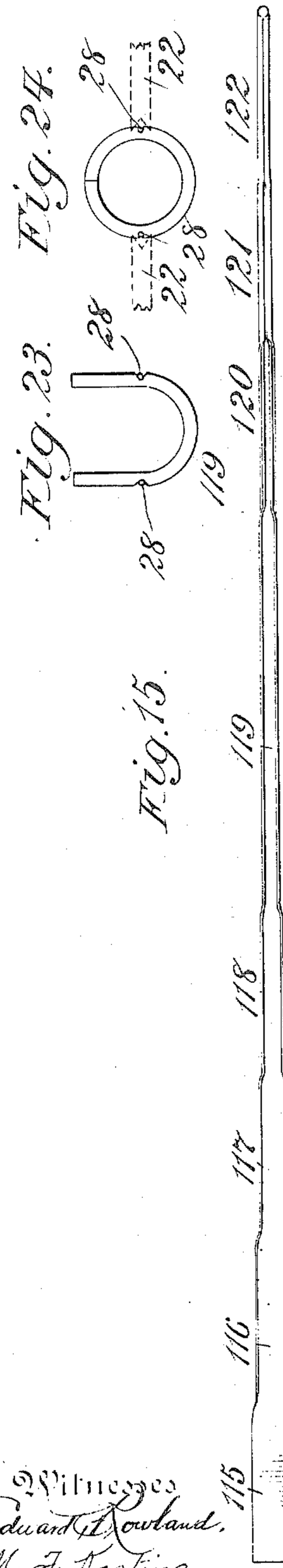

Fig. 15.

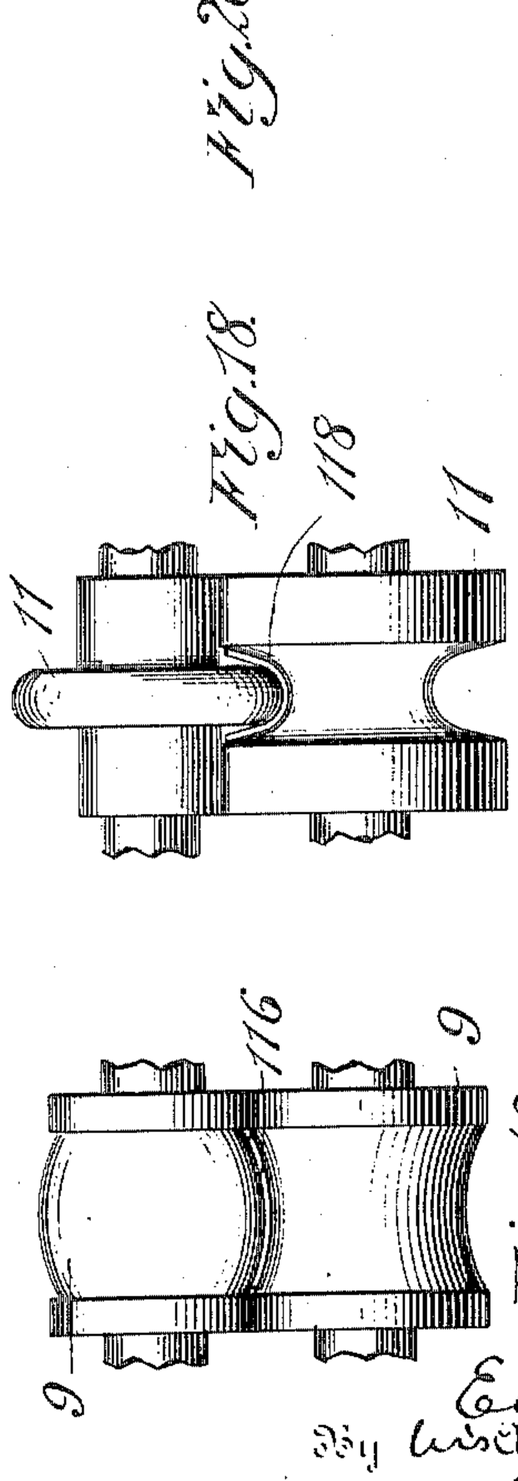

Fig. 18.

Fig. 16.

Fig. 20.

Fig. 22.

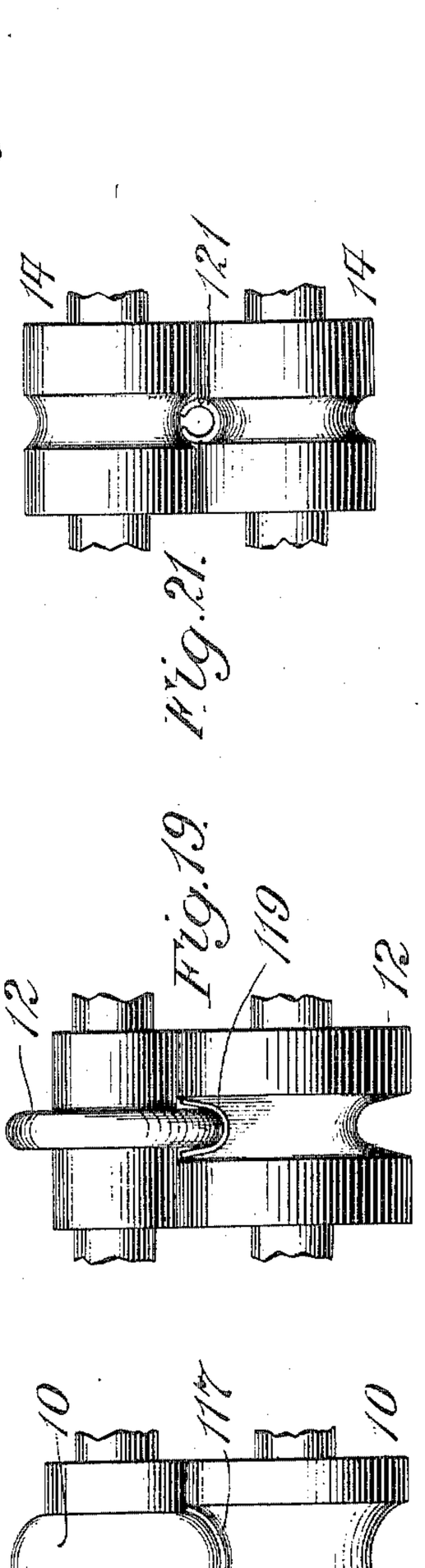

Fig. 21.

Fig. 19.

Fig. 17.

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UNITED STATES PATENT OFFICE.

EDWIN T. GREENFIELD, OF MONTICELLO, NEW YORK.

MACHINE FOR FORMING METAL TUBES.

No. 817,056. Specification of Letters Patent. Patented April 3, 1906.

Application filed August 5, 1904. Serial No. 219,606.

To all whom it may concern:

Be it known that I, EDWIN T. GREENFIELD, a citizen of the United States, residing at Monticello, county of Sullivan, and State of New York, have made a new and useful Invention in Machines for Forming Metal Tubes, of which the following is a specification.

My invention is directed particularly to a novel machine for forming metal tubes by rolling the same from a flat strip of metal, such as iron; and it has for its objects, first, to accomplish the formation of a tube from such a strip by continuously feeding the same forward and subjecting it to the action of forming-rolls in such manner that when the last set of rolls has acted upon it a perfectly cylindrical tube is formed, the action being continuous as successive strips are fed to the machine; second, to accomplish the formation of a tube by thus continuously feeding forward a strip of metal and to simultaneously successively automatically sever the completed tube into relatively short sectional lengths without discontinuing the continuous forward movement of the strip and the completed tube as they are fed forward and the latter emerges from the machine; third, to simultaneously accomplish the formation of a tube from a strip of metal by continuously advancing it between successive sets of forming-rolls and to secure to the face of the tube or embed therein a supply of brazing material sufficient to effect the brazing of a thread wire therearound in the manner disclosed in United States Patent No. 776,737, granted to me on the 6th day of December, 1904; fourth, to provide a machine for effecting the result thus sought which shall be wholly automatic in its operation and shall deliver the completed tubes in relatively short sectional lengths, the operation of the machine being continuous and the feeding of the material and the delivery of the completed product such that tubing may thus be made at a maximum rate of speed.

My invention contemplates the formation of tubes by a machine embracing two series of tube-forming rolls, one set of the first series being provided with grooves and the other corresponding set with concentric male parts, the second series having corresponding grooves in both faces and all so arranged that the strip of metal as it advances between the rolls is successively subjected to the rolling action of the same and in such manner as to give successive curvilinear effects, so that the tube finally emerges from the last pair of rolls in completed form with the edges abutting, so as to constitute a seam on one side thereof.

It contemplates also the provision of means whereby one or more grooves is or are cut in the outer surface of the tube and one or more brazing-wires securely embedded therein in order that the tube as thus completed may be utilized as a core for securing thereto a wire thread by a brazing process in the manner disclosed in prior applications and patents heretofore granted to me, particularly as disclosed in my patent hereinbefore referred to and United States Patent No. 727,128, granted May 5, 1903.

It contemplates also the combining of such tube-forming machinery with an automatic cutting mechanism so arranged as to travel with and be driven forward by the completed tube during the time that successive relatively short sectional lengths thereof are being cut off.

For a full and clear understanding of my invention, such as will enable others skilled in the art to construct and use the machine hereinafter described, reference is had to the accompanying drawings, the essential points of novelty of my invention being particularly pointed out in the claims at the end of this specification.

Figure 1 is a side elevational view of a complete machine embodying all of the essential parts of my invention, the electrical circuits and switches and starting-box for the electric motor and other electric controlling parts of the apparatus being shown in diagrammatic view, the source of electrical energy for supplying current in said circuits not being shown. Fig. 2 is a plan view of Fig. 1 as seen looking thereat from the top toward the bottom of the drawings, the apparatus for cooling the rolls and the electrical circuits being omitted in this view for the purpose of avoiding unnecessary complication of the drawings. Fig. 3 is an enlarged side elevational view of the feeding-rolls and the first series of tube-forming rolls, together with the interconnected gearing for effecting the operation of said parts; and Fig. 4 is a plan view as seen looking at Fig. 3 from the top toward the bottom of the drawings. Fig. 5 is a similar enlarged side elevational view of the second series of tube-forming rolls and the interconnected gearing for driving the same, the means for forming grooves in the outer surface of the tube and for feeding the brazing-

wire thereto and securing the same therein being also shown in this view. Fig. 6 is a plan view as seen looking at Fig. 5 from the top toward the bottom of the drawings, the reels, however, which support the brazing-wire being added in this view. Fig. 7 is an enlarged horizontal sectional view taken through Fig. 5 on the line U U and as seen looking thereat from the top toward the bottom of the drawings. Fig. 8 is an enlarged side elevational view of the mechanism which effects the severing of the completed tube into relatively short sectional lengths, together with the electric motor which drives said means and the car which carries the motor and all of said parts, the means for releasing the gripping device which connects the car to the tube as it is moved forward being shown in dotted lines, one of the cylinders and piston which actuates the gripping device and the floor of the car being shown in sectional view taken on the broken line V V, Fig. 9, and as seen looking thereat from right to left in the direction of the arrows. Fig. 9 is a transverse sectional view taken through the beams which support the entire machine on the line W W, Fig. 8, and as seen looking thereat from left to right in the direction of the arrows. Fig. 10 is a similar transverse sectional view taken through Fig. 8 on the line X X and as seen looking thereat from right to left, one of the cylinders and the piston which place the rotary cutters in contact with the tube for severing the same into short sectional lengths being shown in sectional view. Fig. 11 is a horizontal sectional view taken through Fig. 8 on the line Y Y and as seen looking thereat from the top toward the bottom of the drawings, a part also of the mechanism which effects the automatic operation of the electrically-controlled apparatus and the delivery-tube which delivers the completed tubes being shown in plan view in this figure. Fig. 12 is an enlarged sectional view taken through the base of the machine at the extreme right-hand thereof and illustrating in elevational view the valve mechanism which controls the admission of the air to the cylinders and the pistons which effect the automatic operation of the severing of the tubes and the release of the air therefrom, and Fig. 13 is a sectional view taken on the line Z Z through Fig. 12 and as seen looking thereat from right to left in the direction of the arrows. Fig. 14 is a detail elevational view of that portion of the machine which effects the embedding of the two brazing-wires in the outer surface of the tube. Fig. 15 is a plan view illustrating the method of successive operation by which a tube is completed by the mechanism from a flat strip of metal. Figs. 16 to 22, inclusive, are side elevational views of the rolls by which the successive steps illustrated in Fig. 1 are accomplished, the metal strip being illustrated in position between each pair of rolls. Fig. 23 is an enlarged sectional view of the strip at that portion of its movement through the machine where the brazing-wires are brought into position in the grooves in the lateral faces thereof; and Fig. 24 is a similar view of the completed tube with the brazing-wire secured in place, the horizontally-disposed groove-cutting disks which embed the wires being shown in dotted lines in this view for the purpose of illustrating more clearly their operation.

Referring now to the drawings in detail, in all of which like numerals of reference represent like or equivalent parts wherever used, and first to Figs. 1 to 6, inclusive, 1 1 represent iron beams which support the machine, and 2 a bed-plate secured to the upper surface thereof, 3 being the legs supporting the iron beams 1 1 at their opposite ends, said legs being secured directly to the floor by bolts, as shown.

4 is the main driving-pulley, and 5 a belt connecting the same with any source of power. (Not shown.) 6 is a second driving-pulley, connected by a belt 7 and an additional pulley to the shaft which carries the pulley 4.

8 8 are intergeared feed-rolls connected by a sprocket-chain and sprocket-wheels to a train of intermeshing gearing which drives the first series of tube-forming rolls 9 9, 10 10, 11 11, and 12 12, the shaft of the pulley 6 being connected by similar intermeshing gearing with a second set of tube-forming rolls 13 13, 14 14, 15 15, 16 16. All of said rolls are illustrated in enlarged view in Figs. 16 to 22, inclusive, except the pair 16 16, which differ from the pair 15 15 only in that the grooves in their faces are of smaller diameter.

17 17 17 17 and 18 18 are supporting-rolls for supporting the strip after it has assumed the conformation shown in Fig. 23 in order that the grooves may be cut in the lateral faces thereof and the brazing-wire fed into said grooves.

19 is a hard-metal cylindrical disk secured to a standard which in turn supports a pair of horizontally-disposed groove-cutting disks 22 22, sustained by sliding frames 20 20 and having adjustment-screws for varying their pressure against the lateral faces of the advancing curved strip, as clearly shown in Fig. 14.

21 21 21 are guideways located between the successive pairs of rolls for guiding the strip in the successive steps of its formation, the first two thereof being of semifunnel shape and secured to the opposite sides of the bed-plate by screws and provided with movable cap-plates, the last guideway 21 being of cylindrical form and secured to the machine by laterally-disposed bolts 23 23 at a point slightly in advance of the rolls 18. (See Fig. 7.)

24 is a forming-mandrel of cylindrical cross-section, of slightly less diameter than the grooves in the pairs of rolls 13 13 14 14, and adapted to be located in said groove, said mandrel being secured in position by a cross-head 25 and bolts and nuts, as shown in Figs. 5 and 6.

26 26 are V-shaped cutter-wheels located between the supporting-rolls 17 17, their function being to cut grooves in the outer surface of the strip, as shown in enlarged view in Fig. 23.

27 27 are curvilinear guideways for the brazing-wire 28, carried by wire-supporting reels 29 29, supported on opposite sides of the machine by standards 30 30.

31 31 are toothed feeding and indenting rolls (shown in enlarged view Fig. 7) for forcing the brazing-wire into the grooves as the strip advances and for securing it therein by indentation to the lateral edges of the grooves.

32 represents the bottom of a car supported by four wheels 33 33 33 33 upon rails secured to the top of the beams 1 1, said rails extending from the bed-plate 2 on the left to the extreme right-hand end of the machine.

34 is an electric motor carried by standards secured to the floor of the car, and 35 is a pinion upon the shaft of the armature thereof geared to a driving gear-wheel 36, which in turn is secured to a short hollow shaft 37 by set-screws 38 38 38, said shaft being journaled in journal-bearings 39 39, supported by standards secured to the floor of the car.

40 40 40 are three cylinders secured by bolts directly to the face of the gear-wheel 36 and provided each with a piston 41 and a pitman 42, connected at its free end to a lever 43, secured directly to one end of a rotary shaft 44, journaled at its opposite ends in Babbitt-metal bearings 45 45, secured in drilled openings in the hollow shaft 37.

46 46 46 are arms secured to the opposite ends of the shaft 44 and carrying at their free ends V-shaped steel cutter-wheels 47 47 47.

48 is a strong spiral spring having one end secured to one of the Babbitt-metal bearings 45 and the other to its corresponding shaft 44, its function being in each case to return its corresponding cutter to normal position.

49 49 49 are pipes each connected at one end to its corresponding cylinder 40, their other ends being connected through drilled holes in the hollow shaft 37 running to a groove 50 in one of the journal-bearings 39, said groove extending entirely around the shaft. (See Fig. 11.)

51 51 are oil-holes in the shafts 44, and 52 represents screws for plugging up said holes, 53 53 being cotton-waste for gradually admitting the oil to the journal-bearings 45 45.

54 54 are air-cylinders, and 55 55 pistons located therein and operatively connected by piston-rods 56 56 with cranks 57 57 on the opposite end of a horizontally-disposed shaft 58, supported in journal-bearings secured to the floor of the car.

59 59 are right and left hand screws on the shaft 58, and 60 60 are right and left hand half-nuts having the same pitch as the corresponding right and left hand screws 59.

61 61 61 are upwardly-extending standards integral with the half-nuts 60 and supporting at their upper ends and on their inner faces by bolts 62 62 semicylindrical clutches 63 63, adapted to grip or clutch the completed tube as it moves forward.

64 is an arm secured to one end of the shaft 58 and provided at its outer end with a curvilinear groove-sector 65, to which is attached a rope or cord 66, running over a pulley 67 and having its other end attached to a lever 68, journaled upon a standard 69, carried beneath the car-floor, the short arm of the lever 68 being attached at its outer end to a strong spiral spring 70, which in turn is secured to the bottom of the car-floor, the function of said parts being to restore the clutches 63 63 to their normal or non-gripping position.

71 represents cylindrical shells located within the cylinders 54 and provided each with a series of perforations extending around its center, said perforations being adapted to admit air into grooves 72 in the inner faces of the surrounding cylinders.

73 73 are pipes connecting the grooves 72 in the cylinders 54 with the groove 50 in the hollow shaft 37.

74 is a pipe running to the bottom of the car, where it is connected to a flexible pipe 75, which in turn is connected to a control-valve 76, operatively connected with a pipe 77, running to a source of air-supply. (Not shown.)

78 78 78 are three trolley-wires secured by eyes 79 at one end to a cross-bar between the iron beams 1 1 and by turnbuckles 80 to a similar cross-bar at the end of the machine.

81 represents trolley-wheels supported by trolley-arms, connected in turn to wires, as shown, running to the field and armature of the electric motor 34, carried by the car 32.

82 represents three wires running from the trolley-wires to a controller or starting-box 83 and switch 84, connected in turn when closed by conductors 85 to a source of electrical energy. (Not shown.)

86 is a solenoid for effecting the operation of the control-valve 76, 88 being the valve provided with an inlet-port 89, 90 being a series of exhaust-ports.

91 91 are conductors running from the solenoid 86 to a switch 93, connected by conductors 94 to the switch 84.

92 is a pair of contact-points supported upon an insulating-board 87.

95 and 96 are guiding-funnels for guiding

the completed tube as it advances, the former carried by the car 32 for guiding it through the clutches 63 63, and the latter pivotally supported upon the board 87.

97 is a switch-opreating arm pivoted upon a standard 98, and 99 is a spring carried at the free end of the switch-operating arm 97, 100 being a back-stop for the switch-operating arm, said back-stop carrying also a guide-roll for the completed tube.

101 is a pin carried by the switch-operating arm 97 and adapted to move in a slot in a second pivoted arm 102, supported by the standard 98, 103 being a strong spiral spring and 104 a contact-plate carried at the free end of the arm 102 and adapted to contact when moved in the direction of the arrow, Fig. 11, with the two contact-points 92.

Referring again to Fig. 1, 105 is a water-tank located beneath the machine, and 106 is a force-pump operatively connected by a pulley 107 and belt 108 with the power-driven mechanism. 109 is a suction-pipe extending from the tank 105 to the pump, and 110 an additional pipe running from the force-pump to points above the machine, where it is provided at intervals with nozzles 111 111, adapted to supply cold water to the several sets of rolls 9 9 to 16 16, inclusive. 112 is a cord one end of which is attached to the car 32 and the other to a weight 114, 113 being a pulley over which said cord passes, the function of the cord and weight being to restore the car to its normal position when the clutch is released.

Referring now to Figs. 15 to 22, inclusive, the numerals 115 to 122 indicate upon the strip, as seen in Fig. 15, and between the rolls, as seen in the other figures, the relative successive steps by which the strip of metal is successively curved as it passes between the several pairs of rolls until it emerges therefrom as a completed tube at the point 122.

The operation is as follows, referring first to Figs. 1 to 7, inclusive, and Figs. 15 to 24, inclusive, in connection therewith. A flat metal strip of the proper width and thickness is inserted by an attendant between the pair of feed-rolls 8, and the source of power connecting the belt 5 with the driving-pulley 4 is set in motion in the proper direction to rotate the aforesaid feed-rolls and all of the sets of tube-forming rolls in such manner as to continuously advance the strip and the switches 84 and 93 closed, so as to connect the motor 34 with the source of electrical energy and the solenoid 86 therewith when the contact 104 shall close the circuit at the contacts 92. As the strip is advanced successively through the first series of tube-forming rolls 9 9 to 12 12, inclusive, it assumes the successive conformations shown in Figs. 15 to 19, inclusive. In the successive steps indicated by 116 to 119 it (the strip) is bent consecutively until it has the U form (indicated in Fig. 19) between the rolls 9 9 to 12 12, inclusive, and passes at the same time through the semifunnel-shaped guideways 21 21. After leaving the rolls 12 12 it passes through another guideway 21 and between a pair of supporting-rolls 17 17, where it is subjected to the action of the two V-shaped cutter-wheels 26 26, which cut grooves in the lateral faces of the U-shaped strip in the manner shown in Fig. 23. As it advances between a second pair of supporting-rolls 17 17 the two toothed wheels 31 31 are brought into contact therewith and caused by reason of their saw-tooth nature to continuously draw the two brazing-wires 28 28 through the curvilinear guideways 27 27 from the reels 29 and force the same into the grooves, at the same time indenting the lateral edges of the grooves in such manner as to securely hold the wires within the same. The U-shaped strip and wires are now advancing through another guideway 21 and pass between the supporting-rolls 18 to a pair of horizontally-disposed groove-cutting disks 22 22 (see Fig. 14) and in such manner that the hard-metal cylindrical disk 19 acts as a support for the inner edges of the strip during the time that the disks 22 are cutting grooves on either side of the two inclosed wires 28, thereby additionally assuring the union of the wires with the outer surface of the strip. The strip is now advancing to the second series of tube-forming rolls, driven by the belt 7, pulley 6, and interconnected gear-wheels, where it passes between the first pair of rolls 13 13 and around the forming-mandrel 24, all of these pairs of rolls in the second series being provided with forming-grooves in their surfaces, so that as the strip is advanced the upper edges thereof are turned over the mandrel as it passes between the rolls 13 13 and 14 14, (see Figs. 6, 20, and 21,) the mandrel, however, not being shown in position in Figs. 20 and 21. As it proceeds between the rolls 15 15 the upper edges are brought into contact with each other, and finally as it emerges from the last pair of rolls 16 16 (see Fig. 2) the tube is given its finishing shape with the two edges firmly abutting against each other. These successive steps are very clearly illustrated from 115 to 122, inclusive, in Figs. 15 to 22 of the drawings, upon the assumption, as above stated, that the forming-mandrel 24, which is illustrated in Figs. 5 and 6, is found in position in actual use in Figs. 20 and 21. Referring now to Figs. 8 to 13, inclusive, when taken in connection with Figs. 1 and 2, it will be seen that as the tube advances it passes through a guide-funnel 95, carried by the car, which directs it between the two clutches 63 63 and advances it onward when the free end of the tube finally comes into mechanical contact with the spring 99 and operating-arm 97 of the circuit-controller at the extreme end of the machine, ultimately causing the contact 104

to bridge the two electrical contacts 92, the switches 84 and 93 having been turned to operative position and the arm of the controller 83 rotated for the desired speed of the motor 34 by way of the parallel conductors 85, wires 94, switch 93, wires 91, contacts 92 and 104 through the controlling-solenoid 86, thus causing the core thereof to be lifted to its upper position, so that the valve 88 is lifted and the movable port 89 admits air under pressure from the pipe 77 by way of the pipes 75 74 74 to the two cylinders 54 54, thus causing the pistons 55 in said cylinders to be advanced, and hence through the agency of the piston-rods 56 56 and cranks 57 57 the shaft 58 is rotated, and with it the right and left hand screws 59 59. (See Fig. 9.) Hence the two half-nuts 60 are advanced toward each other, so that the two halves of the clutch 63 are ultimately brought into firm frictional contact with the completed tube, thus mechanically locking the car and the parts carried thereby to the moving tube, so that as the latter advances the car will advance therewith. When the switch 84 was closed and the controller-arm rotated, current was conveyed from the source of electrical energy through the conductors 82, controller 83, trolley-wires 79, and trolley-wheels 81 to the armature and field of the motor 34, so that the armature thereof would continue to rotate so long as said switch remains closed. As the pistons 55 advance in the cylinders they ultimately pass the centers of the same, so that confined air behind them is allowed to flow through the perforations in the inner shells 71 71 and into the surrounding grooves 72 72, said air passing forward through the pipes 73 73 to the annular groove 50, which surrounds the hollow shaft 37, ultimately escaping therefrom through the pipes 49 49 49 to the three cylinders 40 40 40 on the face of the gear-wheel 36, thus causing the three pistons 41 in said cylinders to be advanced, and hence the levers 43 connected thereto, by the piston-rods 42 to be moved about their pivoted supports until the V-shaped cutter-wheels 47 47 are brought firmly against the tube and held in this position with sufficient power to act continuously upon the same and ultimately sever it, it being understood that power is transmitted from the pinion 35 to the gear-wheel 36, and hence to the rotary shaft 37 and cutter-wheels carried thereby, so that they will rotate continuously so long as the armature rotates. In the meantime the free end of the section of the tube which is being thus severed is advanced through the guide-funnel 96, ultimately passing the end of the switch-operating arm 97 a sufficient distance to allow it (the tube) when cut off to tilt said funnel-shaped guideway and deposit the tube upon a roller, (shown at the right of Fig. 11,) so that after it is thus severed its own weight causes it to be advanced and deposited upon a carrier, if preferred, or to be removed by an attendant. As soon as the severing action is effected and the tube is thus deposited the spring 103 causes the pivoted arm 102, and hence the contact 104 carried thereby and also the switch-operating arm 97, to assume their normal positions, so that the circuit is broken at the contacts 92, and hence the valve 88, controlled by the solenoid 86, which is now demagnetized, drops to its normal position, so that the inflow of air is cut off from the pipe 77 and the exhaust-ports 90 are open and all of the air allowed to exhaust from the operative parts of the apparatus. Consequently the strong spiral spring 70 (see Fig. 8) causes the lever 68 to be tilted about its fulcrum and through the agency of the rope or cord 66 and arm 64 to release the clutches 63. The strong spiral springs 48 around the shafts 44 having been put under tension restore the V-shaped cutter-wheels 47 to their normal positions, as shown in Figs. 9 and 10, and all of the parts assume their normal or inoperative positions, the action of the springs 70 and 48 tending also to aid in effecting a complete exhaust. The car after the clutch is thus released is returned to its starting-point through the agency of the cord 112 and weight 114. As tubing is thus continuously made the tube-forming rolls necessarily become heated, and to overcome this trouble the water in the tank 105 is continuously drawn into the force-pump 106 and forced upward through the pipe 110 and ultimately around the several rolls from the nozzles 111, said water returning again by the action of gravity to the tank.

If it is desired to manufacture tubes of shorter length than the greatest length permissible by this machine, it is only necessary to disconnect the cord 112 from the weight 114 and move the car the desired distance to the right, after which the weight is again attached. By thus varying the length of the cord 112 tubes of any length within the limits between the bed-plate 2 and the guide-funnel 96 may be made.

When it is desired to oil the journal-bearings of the shafts 44, it is only necessary to remove the screws 52 and inject sufficient oil into the oil-holes 51 to accomplish the result sought. Additional oiling inlets or holes are shown in Figs. 8, 9, and 10 for oiling the journal-bearings of the hollow shaft 37 and the half-nuts 60, the oiling-inlet for the shaft being provided with a screw-plug for closing the same.

I do not limit my invention to the especial details of construction illustrated in the accompanying drawings and hereinbefore described, as many of the features thereof may be materially departed from and still come within the scope of my claims hereinafter made.

Having thus described my invention, what

I claim, and desire to secure by Letters Patent of the United States, is—

1. A machine for forming tubes from a strip of metal embracing tube-forming means and means for forcing the strip continuously forward therethrough; in combination with means for cutting the completed tube into relatively short lengths and additional means for automatically effecting connection between the cutting means and the moving tube itself as it is fed forward.

2. In a tube-forming machine pairs of tube-forming rolls; means for cutting the completed tube successively into relatively short lengths; in combination with means for causing the cutting means to always move at the same speed with which the strip and completed tube are advanced whereby the tube is continuously formed and simultaneously cut into short lengths.

3. A tube-forming machine embracing tube-forming means and means for forcing a strip of metal therethrough; in combination with cutting means for cutting the completed tube into relatively short lengths, and additional means for connecting the cutting means directly to the tube so that it will move at the same rate of speed as the tube and be propelled thereby; together with an independent source of energy for effecting the operation of the cutting means.

4. A tube-forming machine embracing forming-rolls and interconnected driving-gearing therefor; in combination with means for embedding a supply of brazing material in the outer surface of the tube as it is formed.

5. A tube-forming machine embracing forming-rolls and driving-gearing therefor; in combination with one or more cutters for forming a groove or grooves in the outer face of the tube and additional means for embedding a supply of brazing material in said groove or grooves.

6. A machine for making tubes embracing tube-forming rolls; interconnected driving-gearing; a traveling car carrying power-impelled cutting mechanism; together with means for automatically connecting the car directly to the tube and additional means for actuating the cutting mechanism for a predetermined time whereby tubing is continuously made and cut into predetermined lengths.

7. A machine for making tubes embracing power-driven rolls; automatic cutting mechanism for severing the completed tube into predetermined lengths and interconnecting means between the cutting means and the tube itself whereby the operation of the machine is continuous and the severed tubes all have a definite or predetermined length.

8. A machine for making tubes embracing the following elements—power-driven tube-forming rolls; power-impelled cutting mechanism for severing the completed tubes into predetermined lengths; and interconnected means between the tube-forming and tube-severing means whereby the severing act is accomplished while the tube is being formed and fed forward.

9. In a tube-forming machine power-impelled tube-forming rolls; power-impelled severing mechanism adapted to be operatively connected to and moved with the completed tube; in combination with automatic mechanism for effecting such connection and additional mechanism located in the path of the end of the completed tube for controlling the application of power to the cutting mechanism.

10. In a tube-forming machine means for giving a strip of metal tubular form and additional means for forcing said strip therethrough; in combination with cutting mechanism supported or sustained in close proximity to the completed tube; together with automatically-controlled means for causing the cutting mechanism to be connected to and moved with the tube.

11. In a tube-forming machine tube-severing mechanism driven by a source of power and provided with means for connecting it directly to the completed tube so as to move therewith; together with means for automatically restoring the severing mechanism to its normal position after each severing operation, the arrangement being such that the severing mechanism travels back and forth while the tube is moved continuously in the same direction.

12. In a tube-forming machine means for giving a strip of metal tubular form; additional means driven by a source of power for forcing said strip through the tube-forming means; in combination with severing mechanism driven by an independent source of power; together with automatically-controlled mechanism for connecting the severing mechanism directly to the completed tube so that it will move therewith as the tube is advanced, and automatic releasing and restoring mechanism therefor, the arrangement being such that the severing mechanism travels back and forth while the tube is moved continuously in the same direction.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWIN T. GREENFIELD.

Witnesses:

WM. T. RUETE,

C. J. KINTNER.