No. 846,942. PATENTED MAR. 12, 1907.

C. VON PHILP.

MILL FOR ROLLING ANNULAR ARTICLES.

APPLICATION FILED MAY 10, 1905.

11 SHEETS—SHEET 1.

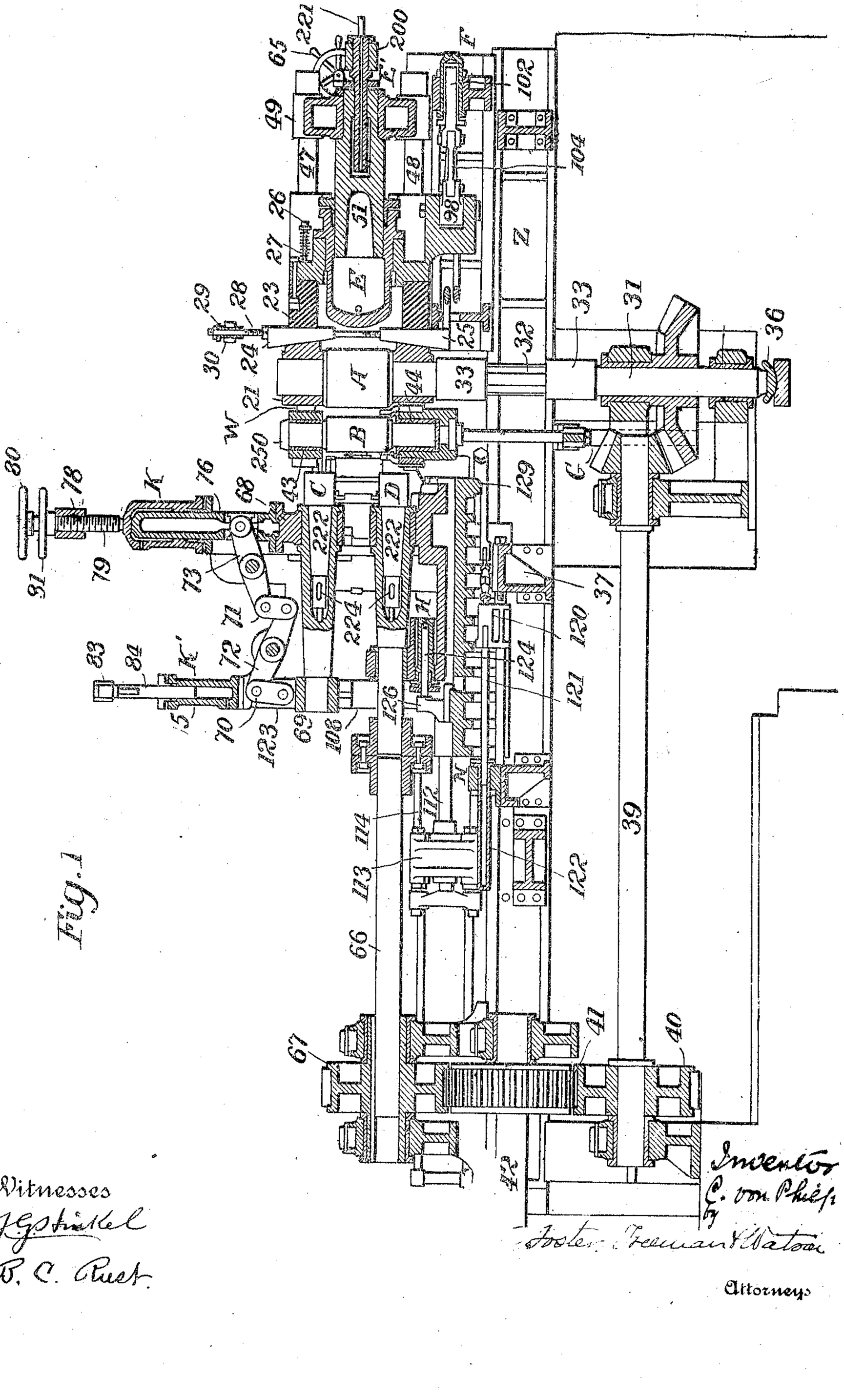

Fig. 1.

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Fig. 2.

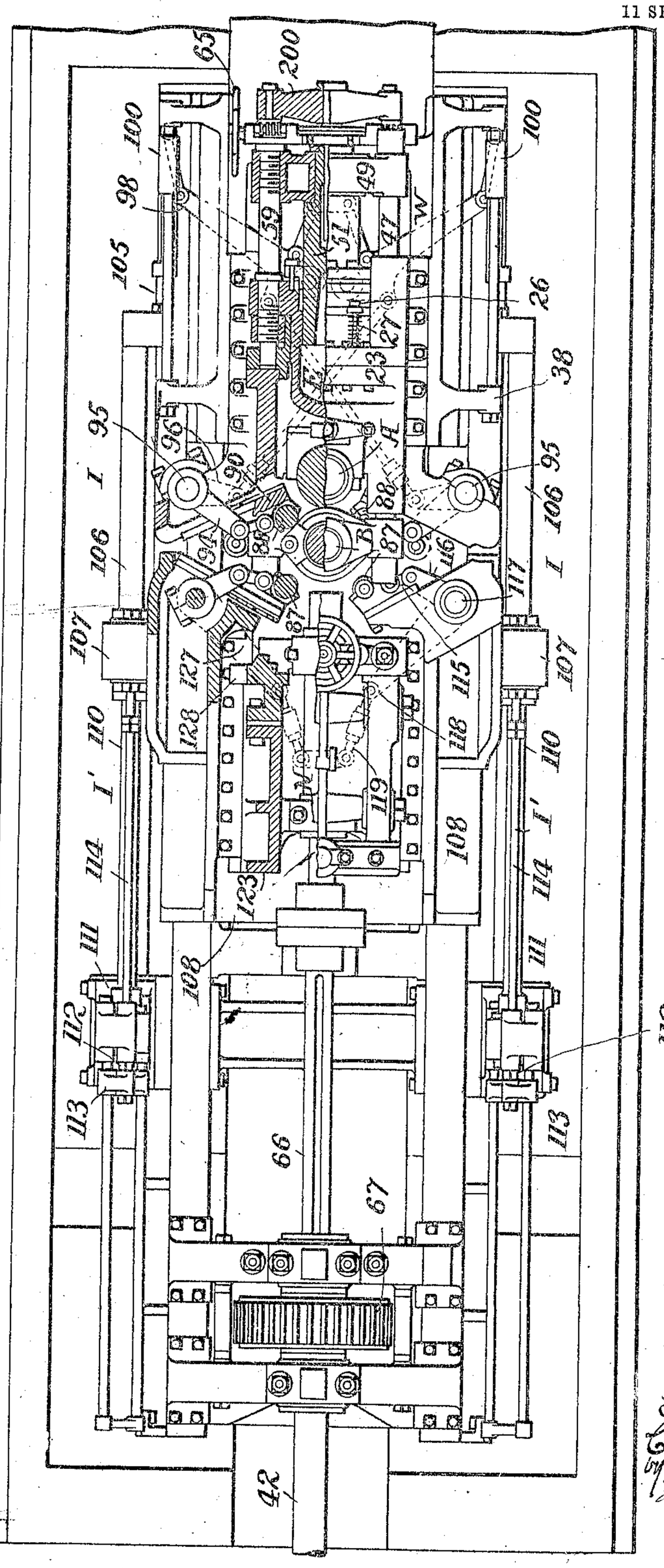

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Fig. 3.

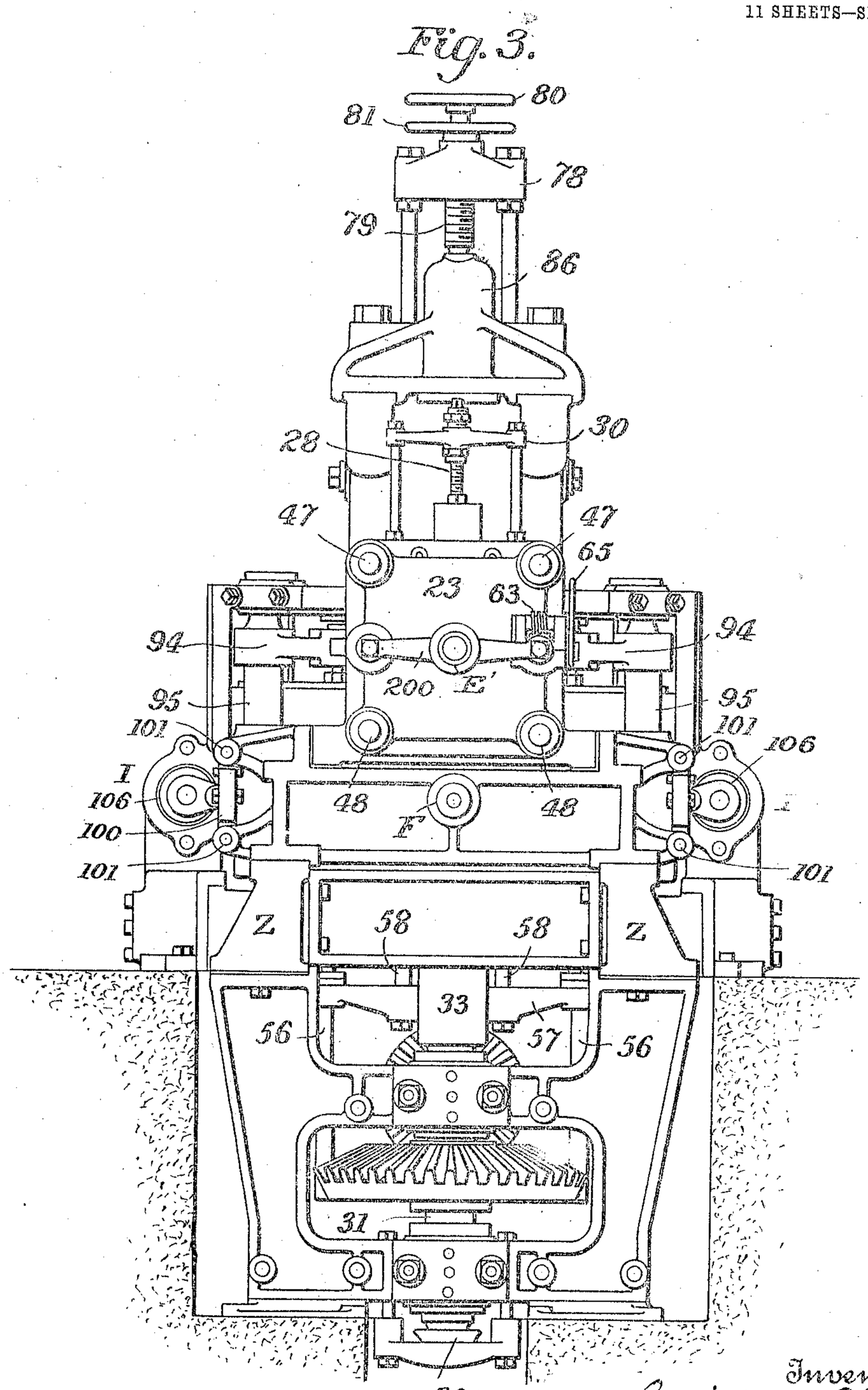

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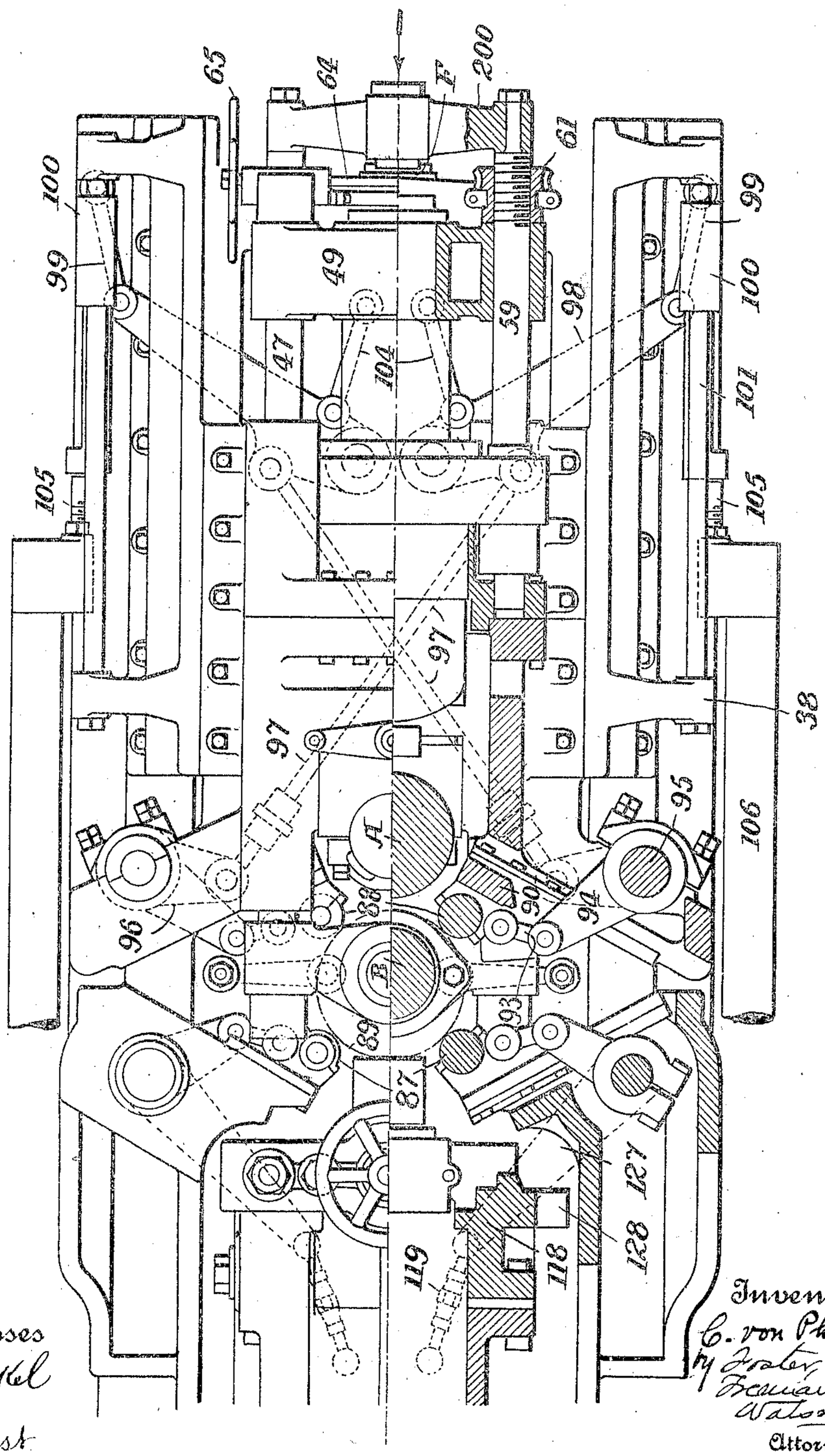
Fig. 4.



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11 SHEETS—SHEET 5.

Fig. 5.

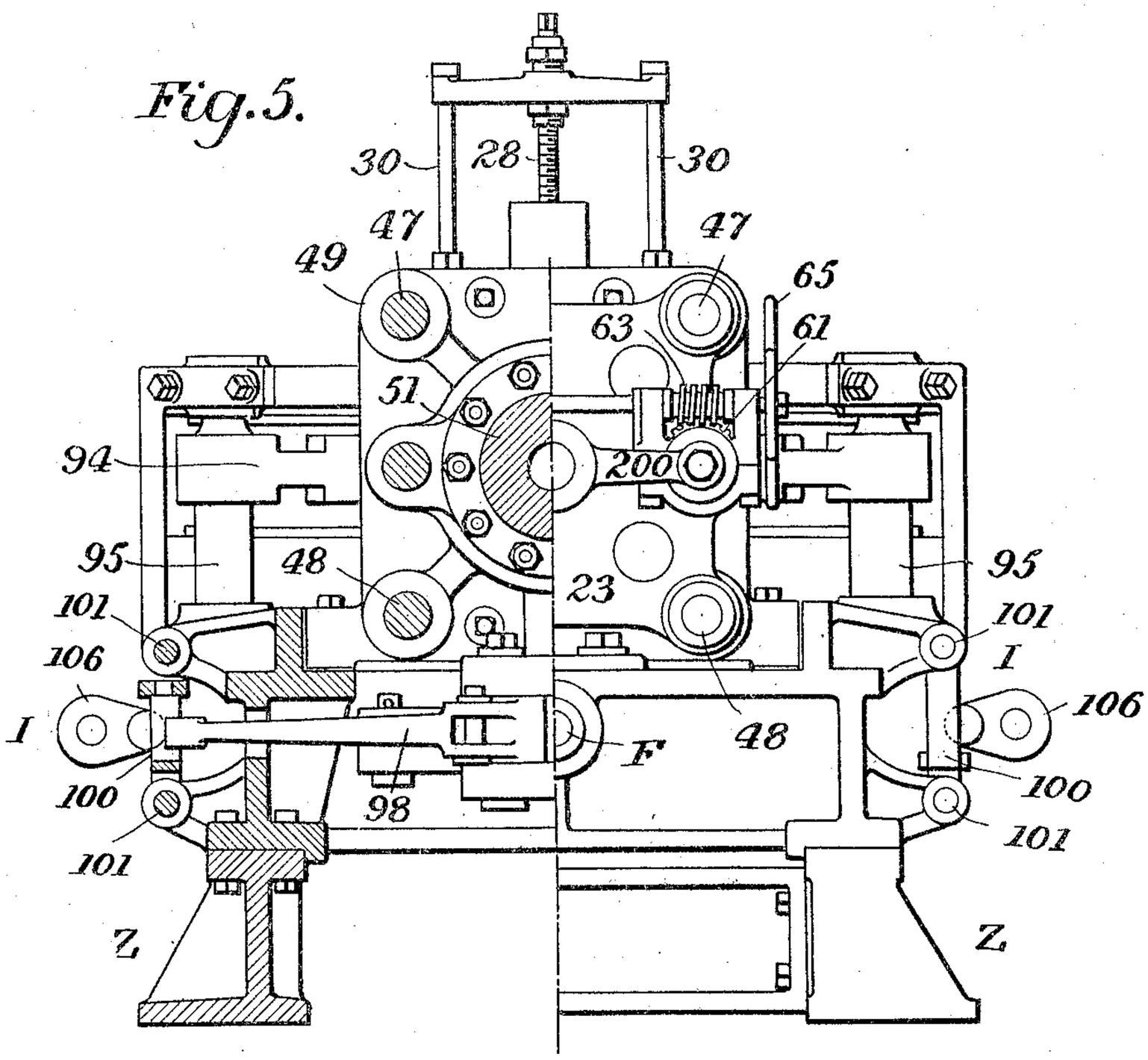

Fig. 10.

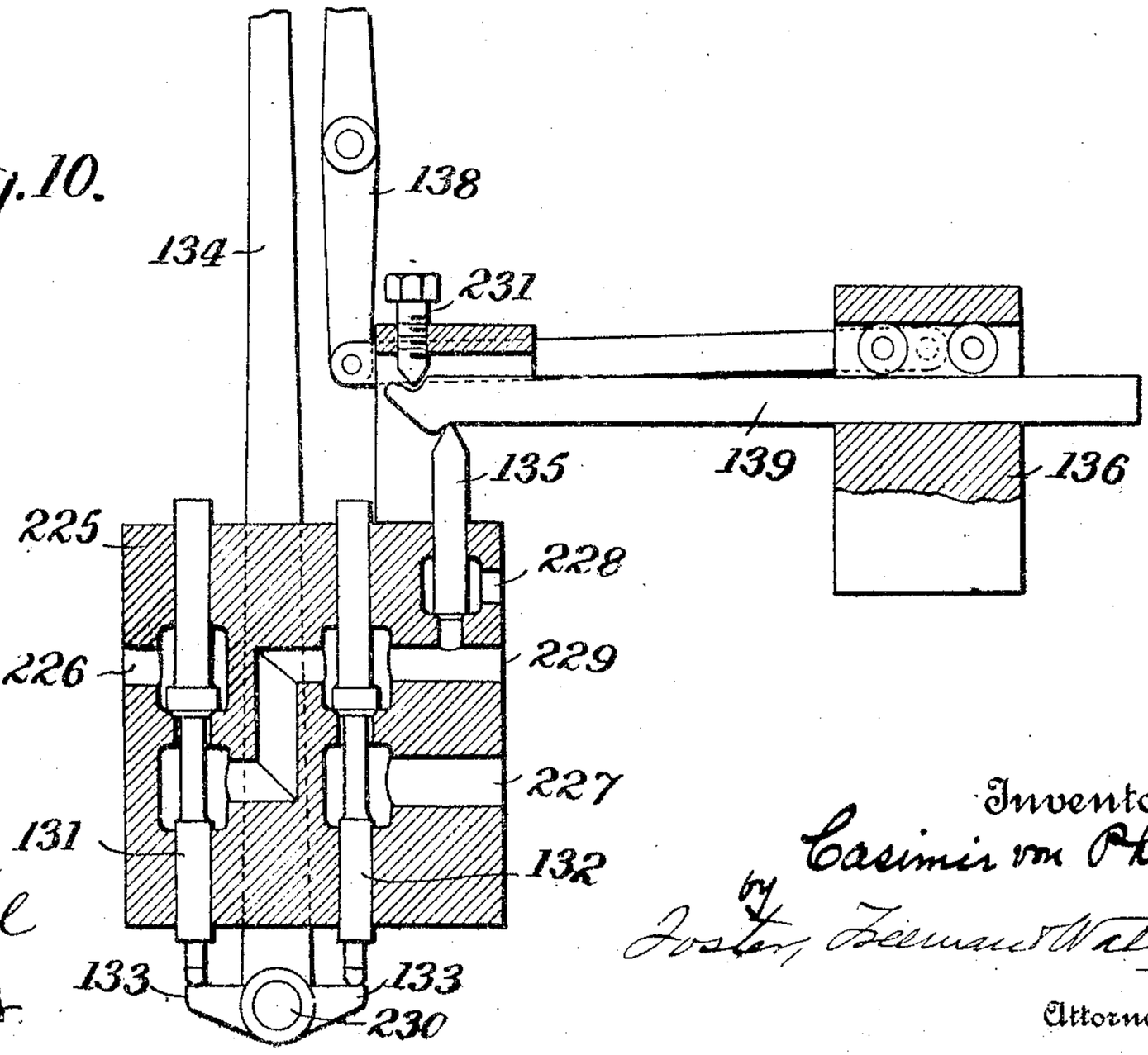

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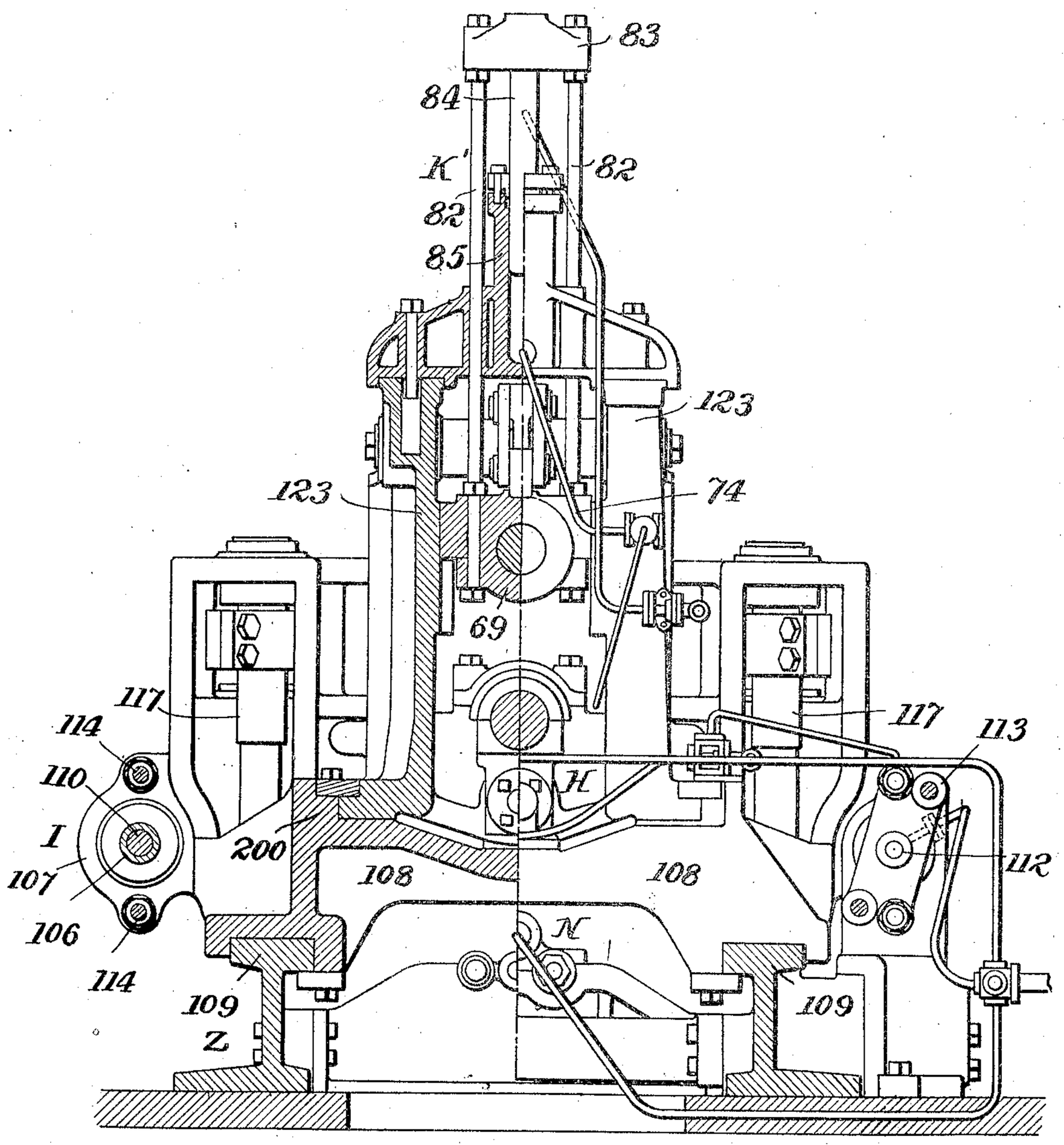
Fig. 6.



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11 SHEETS—SHEET 7.

Fig. 7.

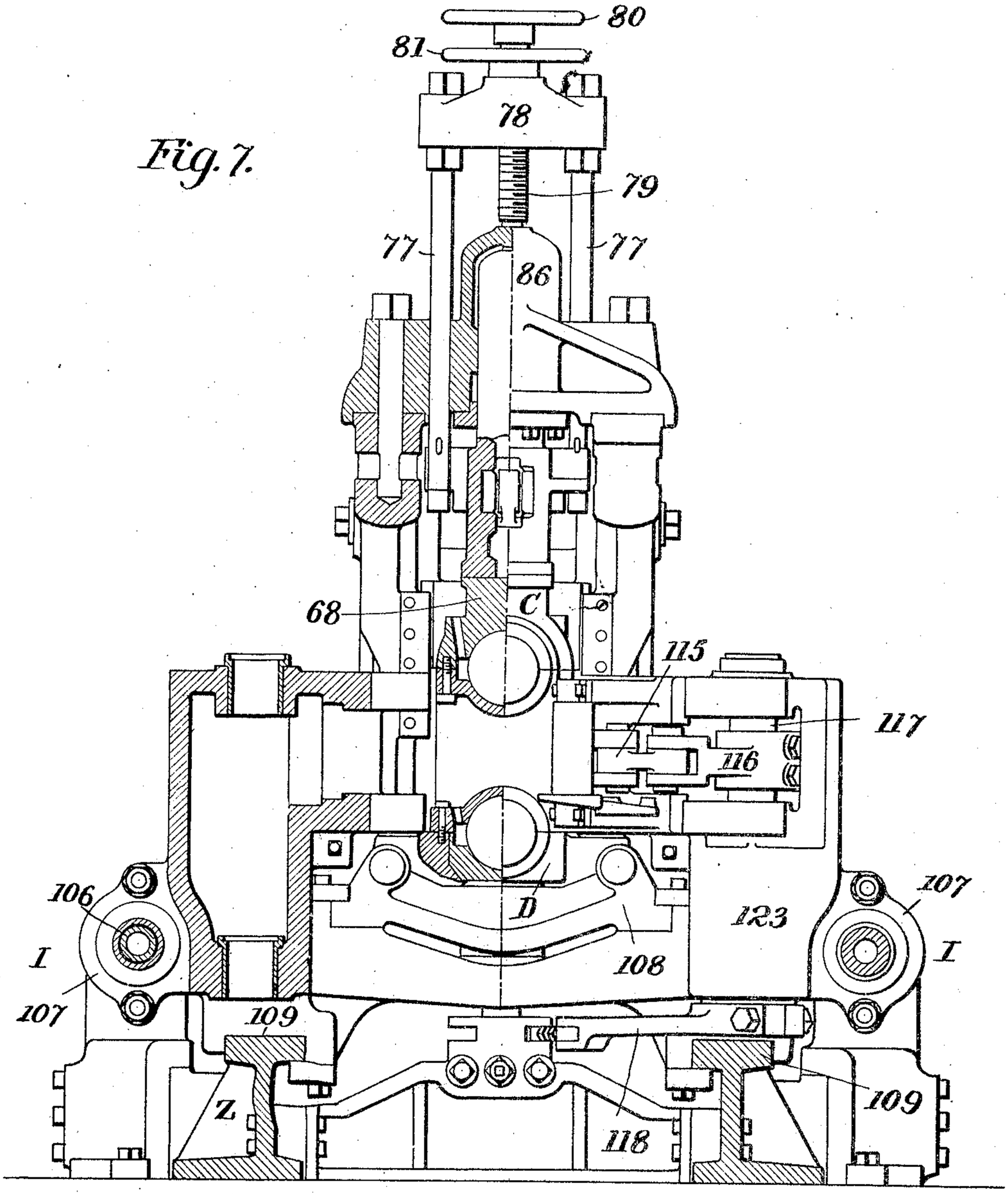

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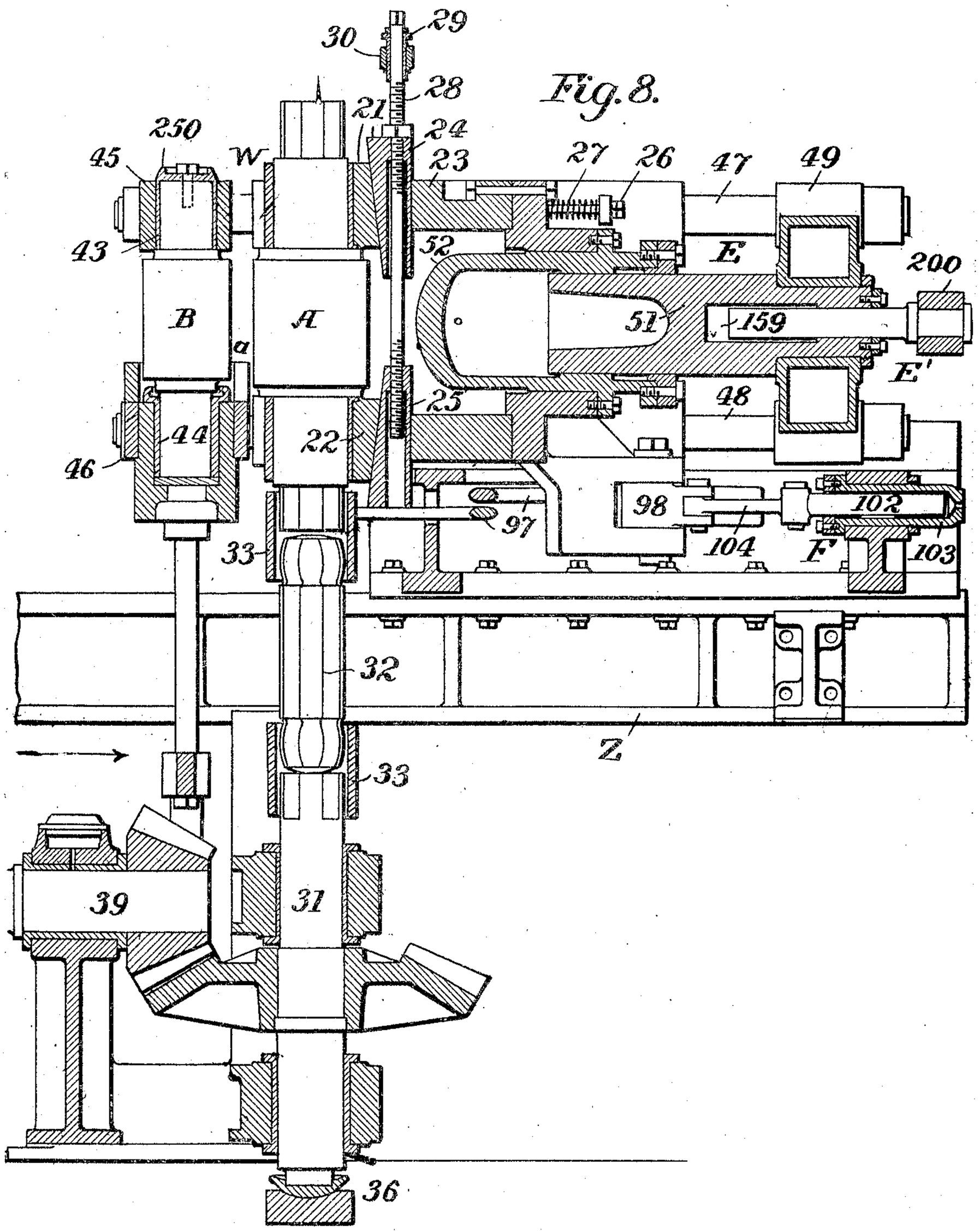
Fig. 8.



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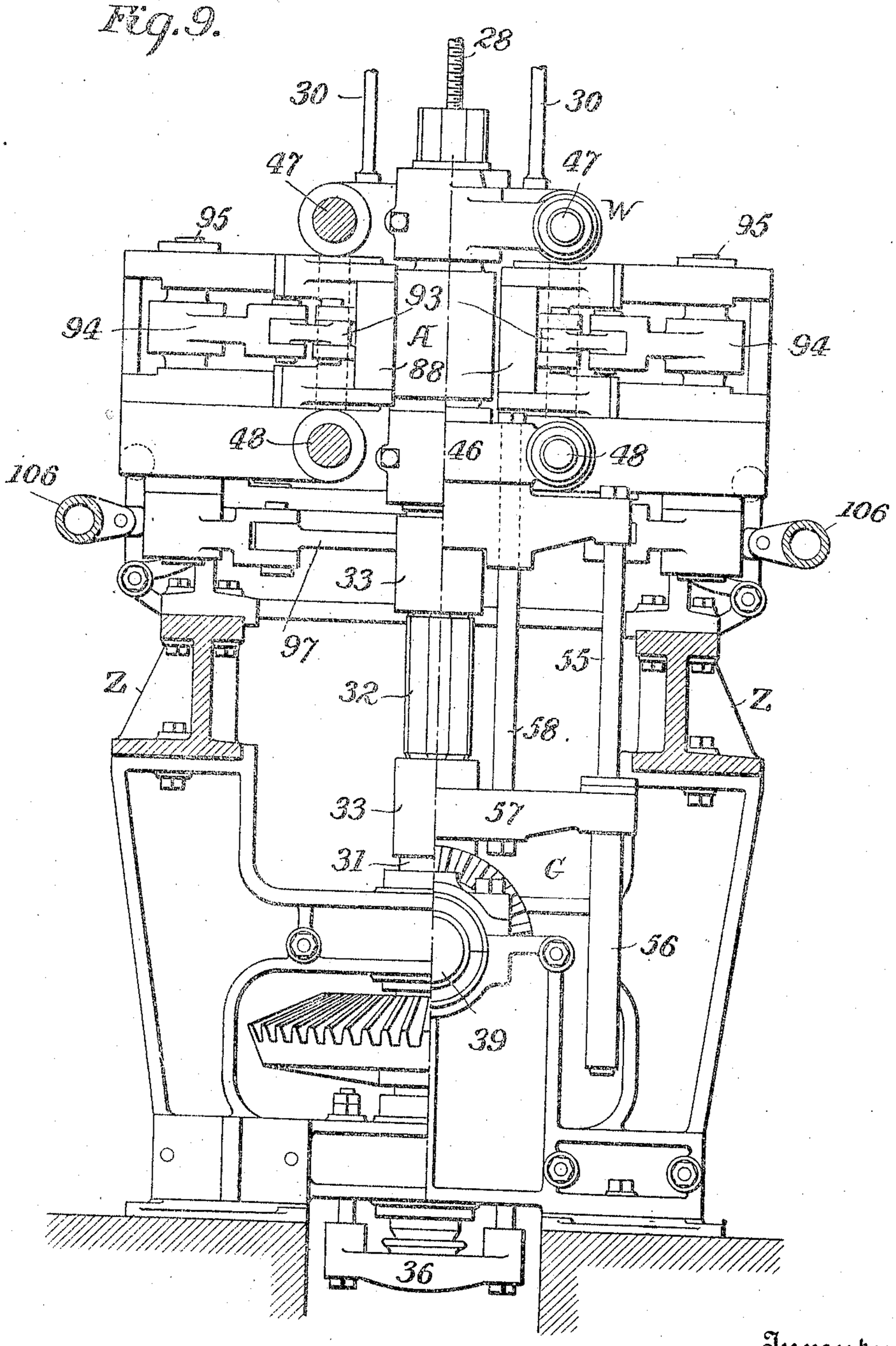
11 SHEETS—SHEET 9.

Fig. 9.



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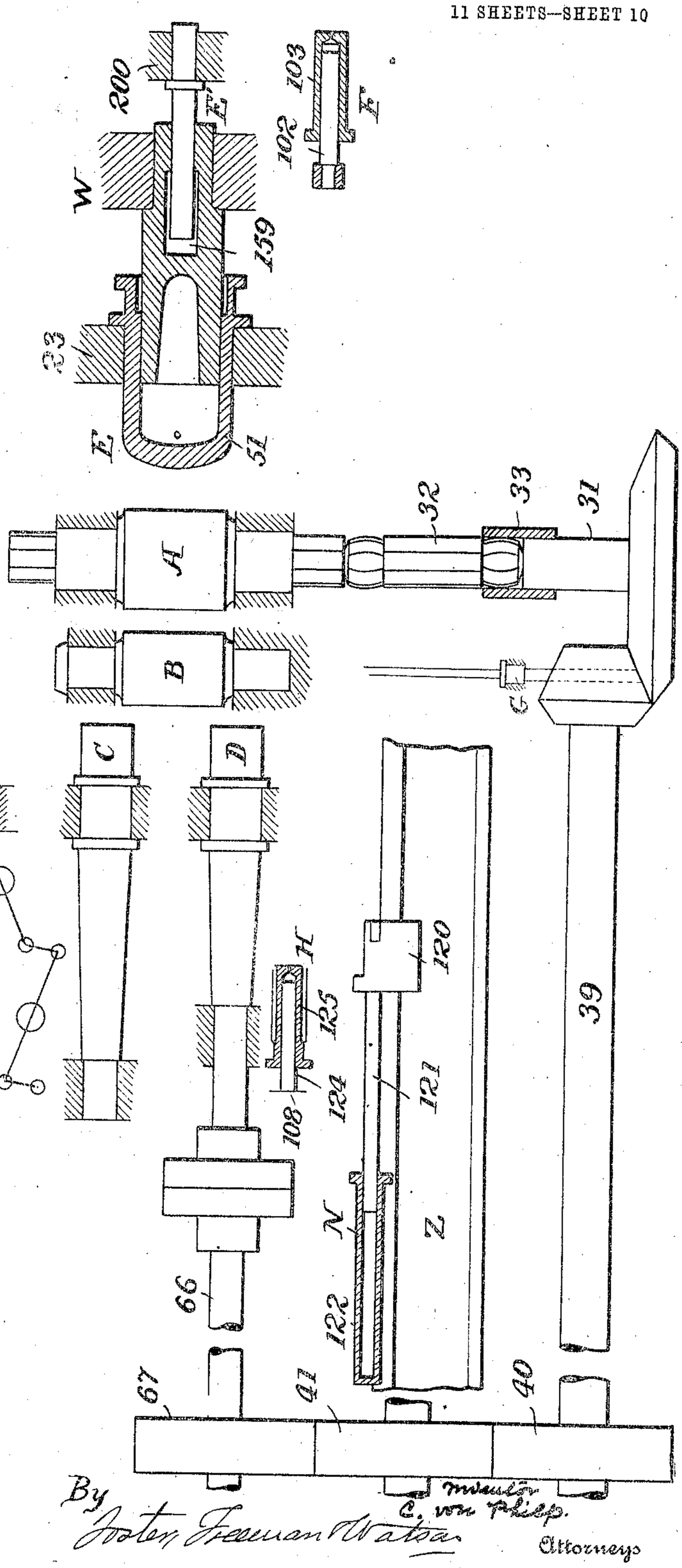
11 SHEETS—SHEET 10

Fig. 11.



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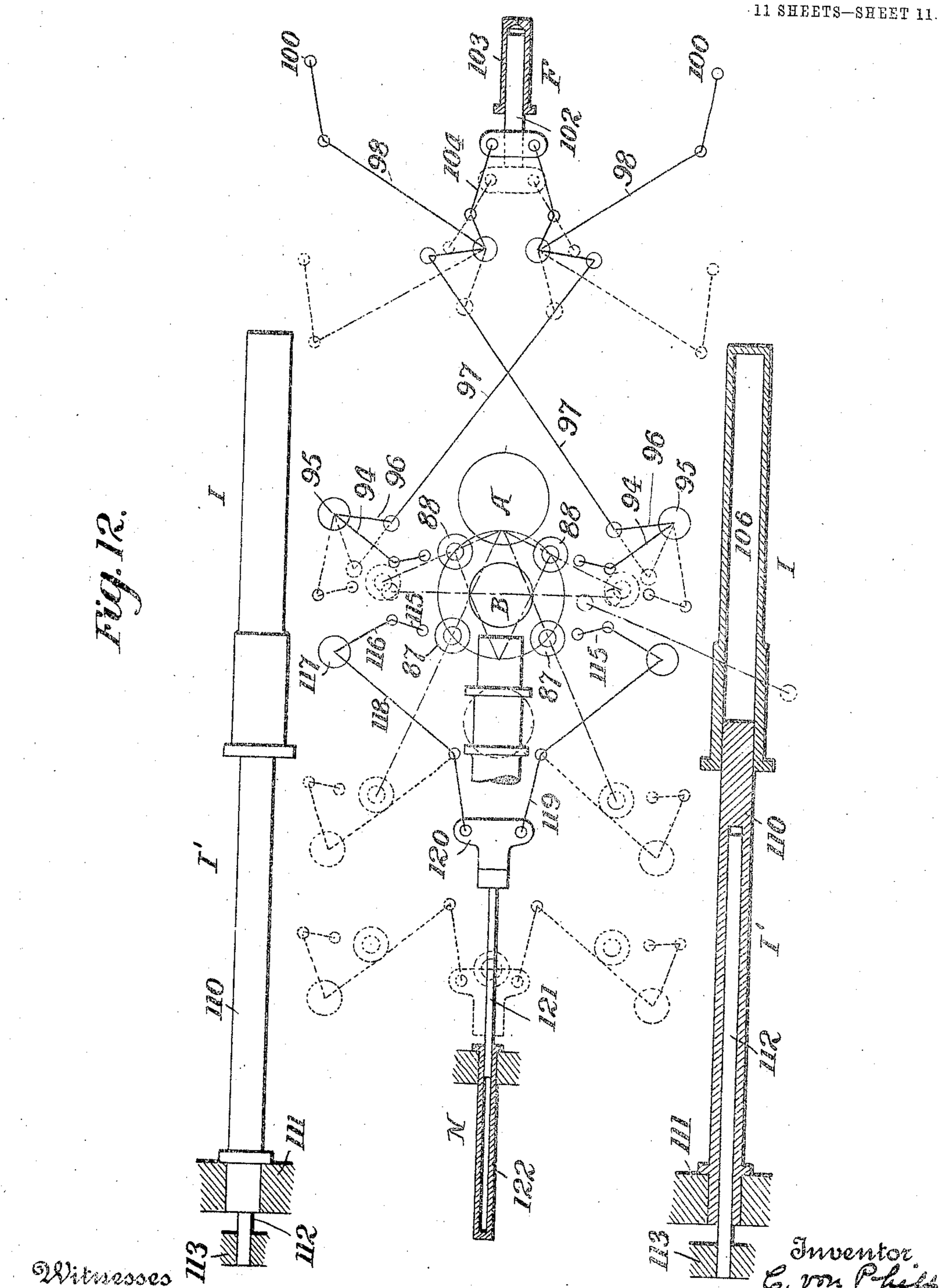
11 SHEETS—SHEET 11.

Fig. 12.



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UNITED STATES PATENT OFFICE.

CASIMIR VON PHILP, OF BETHLEHEM, PENNSYLVANIA, ASSIGNOR TO BETHLEHEM STEEL COMPANY, OF SOUTH BETHLEHEM, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

MILL FOR ROLLING ANNULAR ARTICLES.

No. 846,942. Specification of Letters Patent. Patented March 12, 1907.

Application filed May 10, 1905. Serial No. 259,686.

To all whom it may concern:

Be it known that I, CASIMIR VON PHILP, a citizen of the United States, residing at Bethlehem, in the county of Northampton and State of Pennsylvania, have invented certain new and useful Improvements in Mills for Rolling Annular Articles, of which the following is a specification.

My invention relates to rolling-mills, and more especially to that class of rolling-mills adapted to roll annular objects, such as steel tires; and my invention consists in the combination, with a pair of substantially vertical rolls and a pair of horizontal rolls, of certain guide-rolls and means for operating and adjusting said rolls, and certain details of construction and arrangement fully set forth hereinafter and illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional elevation of a tire-mill embodying my improvements. Fig. 2 is a plan in part section. Fig. 3 is an end elevation. Fig. 4 is a plan of that part of the apparatus more immediately connected with the vertical rolls. Fig. 5 is an elevation in part section looking in the direction of the arrow, Fig. 4. Fig. 6 is an elevation looking at the opposite end of the machine and in part section. Fig. 7 is an elevation in part section on the line 7 7, Fig. 2. Fig. 8 is a longitudinal sectional elevation of parts more immediately connected with the vertical rolls. Fig. 9 is an elevation in part section looking in the direction of the arrow, Fig. 8. Fig. 10 is a sectional view illustrating one of the valve devices. Fig. 11 is a diagrammatic sectional view in elevation, illustrating the relative positions of the main operating parts. Fig. 12 is a diagrammatic sectional plan view of a like character.

Referring first to the main operating parts of the mechanism and to the diagrammatic views, Figs. 11 and 12, A and B are the rolls which act upon the periphery and inner face of the tire-blank, and C and D the rolls which act upon the two side faces, the roll A being supported in a housing 23, Fig. 2, fixed to the base of the machine and constituting part of the frame. The roll B is movable to and from the roll A, being gradually carried toward the latter in rolling and may be dropped vertically to permit the removal of a tire and the placing in position of a tire-blank to be rolled, after which the roll is lifted. The ring-blank is supported while the roll B moves vertically into and out of position by a bearing *a*, supported by the housing 23. The roll C is carried gradually toward the roll D as the blank is reduced in width, and both the rolls C and D are carried away from the roll B as the blank expands in diameter. The tire is guided and kept in circular shape by two pairs of guide-rolls 87 88, which are symmetrically disposed—that is, equally set apart and gradually and positively moved outward during the rolling by appliances which insure that the guide-rolls in their different positions shall always maintain the circular form of the tire. The movements of these different parts are effected through the medium of suitable hydraulic motors and each consisting of one or more cylinders and plungers connected to operate the part to be shifted, with valve devices controlling the flow of the motor fluid. The bearings or boxes of the roll B are carried by a carriage W, sliding longitudinally upon the base-plate under the action of the motors E E′, and said roll, with its bearings, may be carried vertically to and from its position by means of a motor G, Figs. 1 and 11. The brasses being thus held in connection with the rolls remain lubricated, and the bearing-faces are not exposed. The supports of the rolls C and D slide horizontally under the action of motors I and I′. The bearings of the upper roll C are carried downward by a motor K to secure the desired pressure upon the blank and are elevated by a smaller motor K′. The movements of the guide-rolls 87 88 are controlled by the change in position of the sliding support for the rolls C D and its connections operating through levers and connecting devices hereinafter set forth. Rotation is imparted to one of each pair of rolling-rolls from a main shaft 42, a gear 41, on which engages gears 40 and 67 on counter-shafts 39 and 66, respectively, the roll A, being driven from the shaft 31, receiving motion from a shaft 39 and the roll D from the shaft 66, the latter sliding with the said roll D, and therefore being keyed to turn with and slide in the gear 67, the rolls B and C turning in frictional contact with the tire.

It is important to maintain the working face of the roll A always in the same position, and as the face wears away and as the bearings also wear the axis of the roll A must be shifted or moved occasionally toward the roll B while maintained parallel therewith. As the driving-shaft 31 of the roll A is in stationary bearings, it is connected with the roll A by flexible connections.

Having described the above general features, I will now refer particularly to the details of construction connected with the main devices; but I wish it to be understood, however, that while these details relate to constructions and arrangements which have proved effective they may be varied in different ways to secure like results.

The base Z of the machine is a suitable metallic frame, to which is bolted the housing 23, supporting the bearings of the roll A and provided with parallel guides 109 for the carriage 108, (see Fig. 6,) the latter having guides 200 for the sliding housing 123. The bearings 21 and 22 of the roll A slide in recesses in the housing 23 and bear against reverse wedges 24 and 25, connected to and actuated by a screw-rod 28, having reverse threads fitted to those in the wedges, so that by turning the rod the bearings of the roll A can be moved horizontally, while the axis of the roll is not changed vertically. The roll A may be shifted to maintain it vertical by moving the wedges vertically in the same direction by carrying the screw-rod 28, Fig. 8, through a sleeve 29, so as to turn freely therein, the said sleeve being externally threaded to fit a yoke 30, secured to the housing, so that by turning the said sleeve both wedges may simultaneously be raised or lowered. The bearings 21 22 of the roll A are held against the wedges by the action of springs 27, Figs. 1, 2, and 4, which bear upon shoulders on rods 26, which are secured to and extend through the said bearings and slide in openings in the housing 23. This allows for adjustment to compensate for wear, difference of diameter of roll-bearings, or change of vertical alinement.

The roll B, which works upon the inside faces of the tire, is provided with annular brasses secured on reduced parts of the rolls by caps 250 and adapted to boxes 43 44, and said boxes are fitted to vertical sockets in a carriage W, consisting of yokes 45 46, and two pairs of parallel tension-rods 47 48, and a yoke 49, through which the tension-rods extend. From the yoke 49 extends inward the plunger 51, which fits the cylinder 52, carried by the frame, said plunger and cylinder constituting the motor E, and to a smaller bore 159 of the cylinder is fitted the plunger of the motor E′, the said plunger supported by a stationary cross-piece 200 and receiving a motor fluid through a pipe 221 under constant pressure. The motor fluid is admitted to the motor E through a suitable supply pipe and port controlled by a suitable control-valve, as hereinafter set forth.

The proper thickness of the tire is determined by the adjustment of stop devices, which limit the movement of the carriage carrying the roll B. These stop devices may be arranged in any suitable way and be of any suitable character; but, as shown, they consist of nuts 61, Figs. 2, 4, and 5, adjustable upon the threaded ends of rods 59, bolted to the frame and extending freely through the yoke 49. The two nuts may constitute worm-wheels which engage worms 63 upon a shaft 64, provided with a hand-wheel 65, whereby both nuts may be turned simultaneously, the abutting of the yoke 49 against the nuts determining the extent of outward movement of the carriage W and the extent to which the roll B shall approach the roll A. The cross-piece 200 is shown as bolted to the ends of the rods 59.

The motor G, which imparts vertical movement to the roll B, Figs. 1 and 9, and its bearings is carried by the frame that supports the roll, the said motor consisting of two cylinders 56, Fig. 9, supported by a cross-piece 57, suspended from the yoke 46 by suspension-rods 58, and each cylinder receives a plunger 55, connected at its upper end to the bearing 44. Motor fluid is admitted to the cylinders of the motor through supply-pipes controlled by a suitable valve.

By the operations of the motor the roll B, with its bearings, can be dropped downward out of the sockets in the yokes 45 46 to permit the placing of a tire-blank in position to be rolled, after which the roll B can be lifted into place. By allowing the pressure to escape from the motor E the pressure in the smaller motor E′, which is constant, will force inward the plunger 51 and the carriage W and move the roll B away from the roll A. As the tire is rolled pressure is admitted to the motor E, and the plunger 51 is forced outward against the pressure in the motor E′, carrying the carriage with it and carrying the roll B forcibly toward the roll A, the pressure continuing as the rolling operation on the tire takes place, gradually reducing the tire until the proper thickness is reached.

Inasmuch as the roll A is adapted to be shifted slightly to and from the roll B, I couple it flexibly to the driving means. As shown, motion is transmitted from the horizontal shaft 39 through bevel-gears to a vertical shaft 31, resting in a step 36 and provided with a box 33, to which is jointed flexibly the lower end of a coupling-rod 32, the upper end of which is jointed flexibly in a box 33 at the lower end of the shaft of the roll A.

The rolls C D turn in bearings carried by the housing 123, which slides to and from the roll B upon a carriage 108, the latter sliding on the guides 109, Fig. 6, of the base Z.

Movement is imparted to the carriage 108 by the motor 1, Figs. 2 and 12, consisting of two cylinders 106 and plungers 110, the cylinders being secured to brackets 107, extending from the carriage 108, and each plunger being secured to a bracket 111 on the stationary bed or base. The admission of motor fluid to the cylinders 106, regulated by a suitable valve, carries the said cylinders to the right, Fig. 2, together with the carriage 108, and thereby moves the rolls C D toward the roll B. The reverse movement of the carriage is secured by the motor 1', consisting of the plungers 110, which are bored out to form cylinders, and plungers 112 fit said cylinders, and each is secured to a cross-piece 113, connected by tension-rods 114 to the carriage 108.

Motor fluid under constant pressure is admitted to the cylinders of the motor 1' and tends to move the carriage 108 outward, carrying the rolls C D away from the roll B. During the first part of the outward movement of the carriage 108 the housing 123 is held stationary by a pressure device H of a suitable character, and the housing is only carried with the carriage 108 when the bearings 127, Fig. 2, on the carriage are brought against bearings or contact-pieces 128 upon the housing. The rolls C D are of such length that as the tire-blank increases in diameter it can move outward without necessitating the immediate lifting of the longitudinal positions of the rolls, so that the preliminary movement of the carriage 108 may be effected independently of the position of the housing 123, as above described.

The pressure device H may be of any suitable character, but is shown, Figs. 1 and 11, as a cylinder 125, carried by the housing 123 and provided with a plunger 124, which bears against a bracket 126, Fig. 1, upon the carriage 108. There is a constant pressure in the cylinder 125, so that the housing 123 is held with projections near the ends of the rolls C D in contact with the ends of the tension-rods 47 48 or with any other bearing-points until the bearings 127 of the carriage 108 make contact with those upon the housing, when the latter will be moved against the force of the pressure device 4. The rolls C D thus remain stationary until the ring in expanding passes fully between them, and they are then carried outward as the ring further increases in diameter.

The roll D is driven by the shaft 66, coupled to the end of the shaft of the roll, as shown.

One of the rolls C D is movable to and from the other, and, as shown, the movable roll is the upper roll C, the bearings 68 69 on which are vertically adjustable in the housing 123 under the action of the motors K K'. To insure the parallelism of the roll C with the roll D under all adjustments, the bearings 68 69 are coupled to move together simultaneously to the same extent under the action of the motors. As shown, two levers 72 73, pivoted to the housing, are coupled at their inner ends to a link 71. The lever 72 is coupled by a link 70 to the bearing 69, and the lever 73 is pivoted at the end to a slide sliding in transverse guides of the connection between the plunger 76 of the motor K and the bearing 68. The bearing 69 is connected by tension-rods 82, Figs. 1 and 6, with a cross-head 83, supporting the plunger 84, which fits the cylinder 85 of the motor K', said cylinder supported by the housing 123, and the motor fluid is admitted under constant pressure through a pipe 74 to the cylinder 85 and tends to lift the plunger 84 and the bearing 69 and through the connections the bearing 68 with the upper roll.

During the rolling operation the upper roll is gradually pressed against the tire by the admission of motor fluid to the motor K, depressing the plunger 76 and through the connections the plunger 85 and carrying down the bearings 68 69 and the roll C.

The lower position of the roll C is limited by any suitable adjustable stop device. As shown, (see Fig. 7,) two rods 77, connected with the bearing 68, carry a cross-head 78 in which may be turned by a hand-wheel 80 a stop-screw 79, the contact of the lower end of which with the top of the cylinder 86 limits the downward movement of the bearing 68 and its connections. A hand jam-nut 81 serves to secure the stop-screw 79 after adjustment.

When it is desired to raise the roll C, pressure is allowed to escape from the cylinder 86, when the constant pressure in the cylinder 85 forces upward the plunger 84 with the bearings and the top roll.

While the guide-rolls 87 88, Figs. 2 and 12, may be carried outward in any suitable manner so as to maintain them in constant contact with the periphery of the tire and yet all at the same gradually-increasing distance from the center of the tire, I make use of devices whereby these movements are effected by the gradual outward movement of the carriage 108, and I will now describe the appliances employed for this purpose.

Each of the guide-rolls 88 88, Fig. 4, is carried by a bearing 90, sliding upon a suitable guiding-face, and each bearing is connected by a link 93 with an arm 94 of a vertical rock-shaft 95, and each of the latter carries an arm 96, to which is pivoted a connecting-rod 97, extending diagonally and connected to the short arm of a lever 98, pivoted to the frame of the machine below the motor E. The outer end of such lever 98 is connected by a link 99 with a slide 100, sliding upon stationary guides 101 and bearing upon a stop-pin 105, carried by the adjacent cylinder 106, and the slides 100 are maintained in contact with the end of this stop-pin (so that the le-

vers 98 will swing inward as the cylinders 106 move toward the left with the carriage 108) by means of a suitable centrally-arranged pressure device F, Figs. 1, 4, and 8. As shown, this pressure device consists of a cylinder 103, supported on the base, and a plunger 102, which is connected by links 104 with the levers 98, the cylinder 103 receiving fluid under constant pressure. As a result of this arrangement, the movement of the carriage 108 toward the left will permit the ends of the levers 98 to swing toward the left, carrying the bearings of the guide-rolls gradually outward as the rolling operation increases the diameter of the tire.

The guide-rolls 87, Fig. 2, are carried by bearings 89, which slide upon faces of the frame, and each of these bearings is connected by a link 115 to the arm 116 of a vertical shaft 117, turning in bearings of the carriage 108, and an arm 118 on each shaft 117 near the lower end is controlled by a suitable centrally-arranged pressure device N, Figs. 1, 2, and 12, consisting of a cylinder 122, secured to the base, and a plunger 121, carrying a cross-head 120, connected with the arms 118 by links 119. There is a constant pressure in the pressure device N tending to carry the ends of the arms 118 inward and to maintain the cross-head 120 in contact with a lug or bracket 37, Fig. 1, on the bed. As a result of this arrangement on the outward movement of the carriage 108 the inner ends of the arms 118 are prevented from movement by the cross-head 120 and there is such a rocking of the shafts 117 as results in the outward movement of the guide-rolls 87. This movement continues until the guide-rolls 87 are at the limit of their outward travel, at which time a lug 129, Fig. 1, on the carriage 108 will make contact with a lug 130 on the cross-head 120 and will then carry the latter outward with the carriage 108, and there is no further outward movement of the guide-rolls and the rolled ring can be removed.

In Figs. 1 and 2 the rolling-rolls and the guide-rolls are shown in their extreme inner position at the beginning of the rolling of the tire.

It will be seen that the guide-rolls are symmetrically disposed—that is, are equally separated—which I have found to prevent the ring or tire from swinging out to a greater extent between some of the rolls than between others, which results when the rolls are unevenly placed. It will further be seen that the guide-rolls are shifted by lever connections—that is, by differential levers operatively connected with some moving part of the apparatus, as the carriage of the rolls C D—so that it is possible to so proportion the leverages as to secure the precise movements required of the guide-rolls without the use of cams, the latter being objectionable from their excessive wear, causing variations in the movements of the guide-rolls which result in imperfect work. By the combination of such differential levers as described the guide-rolls are carried outward in direct proportion to the increase of diameter of the ring and an absolutely true ring is rolled.

Operation: After the tire is inserted and the rolling begins the motor fluid is allowed to escape from the pressure-cylinder 106 of the motor I, and the pressure which is constant in the motor I', acting on the plungers 112, carries the carriage 108 toward the left. The slides 100 being held against the stops 105, the guide-rolls 88 will be carried outward, as before described, while the movement of the vertical shafts 117 with the carriage 108, but with the cross-head 120 stationary, insures that the guide-rolls 87 shall also move outward. The housing 123 remains stationary until the tire so increases in diameter that it is well toward the inner portions of the rolls C D, when the contacts or bearings 127 of the carriage 108, striking the bearings 128 of the housing, will carry the latter and the rolls C D along with the carriage until the guide-rolls reach their extreme outer position, when the movement of the guide-rolls will be stopped by the movement of a cross-head 120 of the carriage, the plunger 121 being driven inward against the force of the liquid in the cylinder 122. In Fig. 12 the positions of the guide-rolls 87 88 at the beginning of a rolling operation are shown in full lines, and from this position the said rolls diverge while maintaining their symmetrical relation, as before described, until they reach the position shown by dotted lines adjacent the numeral 119. The ring is then complete and no further rolling takes place; but to facilitate its removal the rolls 87 are carried back to the position shown in dotted lines adjacent the numeral 121. The slides 100, Figs. 2 and 4, are limited in their inward movement by striking stops 38 on the guides 101, which through the intermediate devices then arrest the further outward movement of the guide-rolls 88. It will be seen that the guiding-faces for the sliding bearings of the guide-rolls are inclined, and this inclination is such and the angularity of the various levers and links and the positions of the vertical shafts are also such and so proportioned that the guide-rolls in all of their different positions will always hold the tire in circular form. It will also be seen that the working face of the roll A is maintained always in the same position, so as to effectually coöperate with the guide-rolls in rolling the tire to a true circle.

It will be seen that the levers are so proportioned and connected that the tire is rolled to the proper size by the time the rolls have moved radially to their final position and that thereafter the rolls 87 may be carried by the movement of the carriage 108

away from the rolls 88, thus so separating the rolls as to permit the removal of the tire without the necessity of moving all of the rolls radially outward, as has hitherto been required and which necessitates an extended width of the machine and extended movement of the roll-operating devices. It will be seen further on reference to Fig. 12 that the rolls 88 move upon lines which are parallel to lines diverging from the inner working point or face of the roll A, and the operating-levers and parts are so proportioned that as the rolls 87 move from the rolls 88 the center of the circle which touches the bearing-faces of the rolls 88 87 will progress in the direction from the roll A to the roll B in the same proportion as each roll 88 travels upon its guide, so that however the tire may expand there will be a substantially symmetrical disposition of the rolls in respect to the same which will prevent the bending outward or buckling of the tire in rolling, which occurs when there is a material difference in the distance between the adjacent rolls. This is a most important feature of this invention and corrects a defect which has heretofore existed in many forms of tire-rolling apparatus.

To afford means for the easy change of the horizontal rolls in case of wear or breakage, these rolls have tapered stems 222, adapted to tapered sockets in the roll-shafts and are secured therein by cross-keys 224.

While I have shown the cylinders of the motors of different diameters to secure a constant pressure in the smaller motors that can be overcome by the greater force of the larger motors, it will be evident that the cylinders of the different motors may be of the same size using motor fluids under different pressures.

For controlling the flow of the motor fluid to the different cylinders any suitable device may be employed. For use in connection with the arrangement shown I prefer a control device such as illustrated in Fig. 10, which is used for controlling the movements of the carriage 108. In this construction there is a casing 225, having an inlet-port 226, discharge-ports 227 and 228, and a port 229 for communicating with the cylinder. There are two valve-stems 131 132 with valves, that on the former controlling the flow from the inlet and the valve on the latter controlling the flow from the cylinder-port 229 to the discharge 227, and rocker-arms 133 on a rock-shaft 230 serve to lift the stems alternately, the hand-lever 134 serving to rock the shaft. The discharge from the port 229 to the port 228 is controlled by a safety-valve 135, which is depressed by a weighted lever 139, having its fulcrum upon a set-screw 231. The weight 136 of the lever 139 may be shifted by means of a hand-lever 138, connected to the weight by a link 159, thus permitting the valve to be loaded with different pressures and enabling the water to be discharged from a cylinder under suitable pressure.

During the rolling of the tire the increase in the diameter of the latter will press the guide-rolls and cause the carriage 108 to move toward the left, and by the above-described valve arrangement it is possible to oppose to this tire-pressure any resistance from the full cylinder capacity down to nothing, as may be desired.

While I have illustrated the construction as used for producing a tire of substantially rectangular cross-section, it is my purpose to use the apparatus for rolling other annular objects and of any suitable cross-sectional shape, the rolling-rolls being formed accordingly, and while I have shown my various improved devices as all combined in a mill it will be evident that some of them may be employed separately in connection with mills of other constructions.

I do not here claim the construction and arrangement of devices for shifting the bearings of the rolls C D, as the same will constitute the subject-matter of a separate application for Letters Patent.

Without limiting myself to the precise construction and arrangement shown, I claim—

1. The combination in a tire-rolling mill, of an outer roll A in stationary bearings, an inner roll B, means for carrying it gradually toward the roll A, guide-rolls 88 movable in guides parallel to lines diverging from the working face of the roll A, other guide-rolls 87, a carriage supporting the rolls 87, means for moving the carriage away from the roll B, and for moving the rolls 87 outward, and means for imparting to the rolls 88 a movement in their guides proportional to the change of position of the center of the tire rolled by the rolls A, B, substantially as set forth.

2. A tire-rolling mill provided with reducing-rolls A, B, C, D, and two pairs of guide-rolls for bearing on the periphery of the tire and having bearings sliding in guides arranged in respect to the reducing-rolls as described, the guide of one pair parallel to lines diverging from the working face of one of the reducing-rolls, and a combination of levers and connections arranged to shift all of said guide-roll bearings in proportion to the increasing diameter of the tire to maintain the rolls at substantially equal distances apart.

3. In a tire-mill, the combination of a pair of rolls C, D, for reducing the width of the tire, a pair of rolls A, B, for reducing its thickness, means for carrying the inner roll B, toward the outer roll A, a pair of guide-rolls at each side and guides therefor, and means for shifting the two guide-rolls at each side outward as the rolling progresses, constructed to preserve throughout the roll-

ing operation the substantial symmetrical position of the guide-rolls about the tire.

4. The combination with the vertical rolls A, B and horizontal rolls C, D and a carriage supporting the latter, of two pairs of guide-rolls, means for moving the guide-rolls adjacent the vertical rolls A, B outward upon stationary bearings, and means for moving the other guide-rolls in bearings upon the carriage, said means proportioned to maintain the rolls at increasing but equal distances from each other as the rolling operations proceed, for the purpose set forth.

5. The combination with the rolls A, B, of a tire-rolling machine, of means for carrying one of said rolls toward the other under pressure, two pairs of symmetrically-disposed guide-rolls, and a series of levers connected and proportioned to hold the same in contact with the periphery of the tire at equal but increasing distances from each other during rolling, substantially as set forth.

6. The combination in a tire-mill, of rolls A and roll B, two pairs of guide-rolls and bearings therefor, a carriage movable to and from the rolls A, B, and levers operatively connected with bearings of all the guide-rolls and with said carriage to shift all the rolls to an extent proportioned to the extent of movement of the carriage, substantially as set forth.

7. The combination with the rolls A and B, the rolls C and D and a carriage therefor, two pairs of guide-rolls, bearings therefor, and levers operatively connected with said bearings and with said carriage to be operated to shift the guide-rolls to an extent determined by and proportioned to the movement of the carriage, substantially as set forth.

8. The combination with the rolls A, B and C, D, of two pairs of guide-rolls, a carriage for the rolls C, D, and means operatively connected with the carriage and with the guide-rolls to shift the latter to an extent determined by the movement of the carriage, substantially as set forth.

9. The combination of the frame, reducing-rolls A, B, reducing-rolls C, D, and carriage therefor, the guide-rolls 87, 88, and sliding bearings therefor on the frame and carriage, rock-shafts turning in the frame and carriage and having arms connected with the bearings of the rolls, and means connected with said rock-shafts to rock the same as the carriage moves outward, substantially as set forth.

10. The combination of the frame, reducing-rolls A, B, reducing-rolls C, D, and carriage therefor, the guide-rolls 87, and sliding bearings and supports therefor on the carriage, rock-shafts turning in the carriage and having arms connected with the bearings of said rolls 87, a cross-head and rods connecting it to arms on the rock-shafts, a pressure device arranged to hold the cross-head in position during part of the movement of the carriage, and means to thereafter carry the cross-head with the carriage, substantially as set forth.

11. The combination of the frame, a carriage sliding thereon, a housing sliding on the carriage and reducing-rolls carried by the housing, guide-rolls 87 and bearings therefor movable on the frame, a stop on the carriage, rock-shafts carried by the carriage and connected with said bearings and having arms, rods connecting said arms and a cross-head, a hydraulic cylinder and plunger supplied with motor fluid under constant pressure and arranged to maintain the cross-head against the stop during the preliminary movement of the carriage, and a bearing on the latter arranged to engage and shift the cross-head during the final movement of the carriage, substantially as set forth.

12. The combination with the sliding carriage for the rolls C, D, and with the guide-rolls 87 and bearings therefor, of rock-arms carried by the carriage and connected with the guide-roll bearings, a cross-head connected with the rock-shaft, a fixed stop, a pressure device for holding the cross-head against the stop, and contact parts arranged to cause the cross-head to move with the carriage after the guide-rolls have reached their outer positions, substantially as set forth.

13. The combination of the frame, rolls A, B, carriage sliding on the frame, housing sliding on the carriage, rolls C, D, carried by said housing, motors for moving the carriage on the frame in reverse directions, a pressure device arranged to hold the housing in position in respect to the rolls A, B, during the first part of the movement of the carriage away from said rolls, and contacts on the carriage and housing insuring the movement of the latter with the former during the final part of the movement of the carriage, substantially as set forth.

14. The combination in a tire-mill, of vertical rolls A, B, and housing therefor, horizontal rolls C and D, and a carriage therefor, two pair of guide-rolls and bearings therefor, lever devices supported by the housings of the vertical rolls, and other lever devices supported by said carriage, said devices independently connected with the guide-roll bearings, and means whereby the lever devices are operated to shift the same to an extent proportioned to the position of the carriage, substantially as set forth.

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

CASIMIR VON PHILP.

Witnesses:
CHARLES E. FOSTER,
EDWIN S. CLARKSON.