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W. N. GRAVES.

HYDRAULIC BRICK MACHINE.

No. 565,111. Patented Aug. 4, 1896.

Fig. 1.

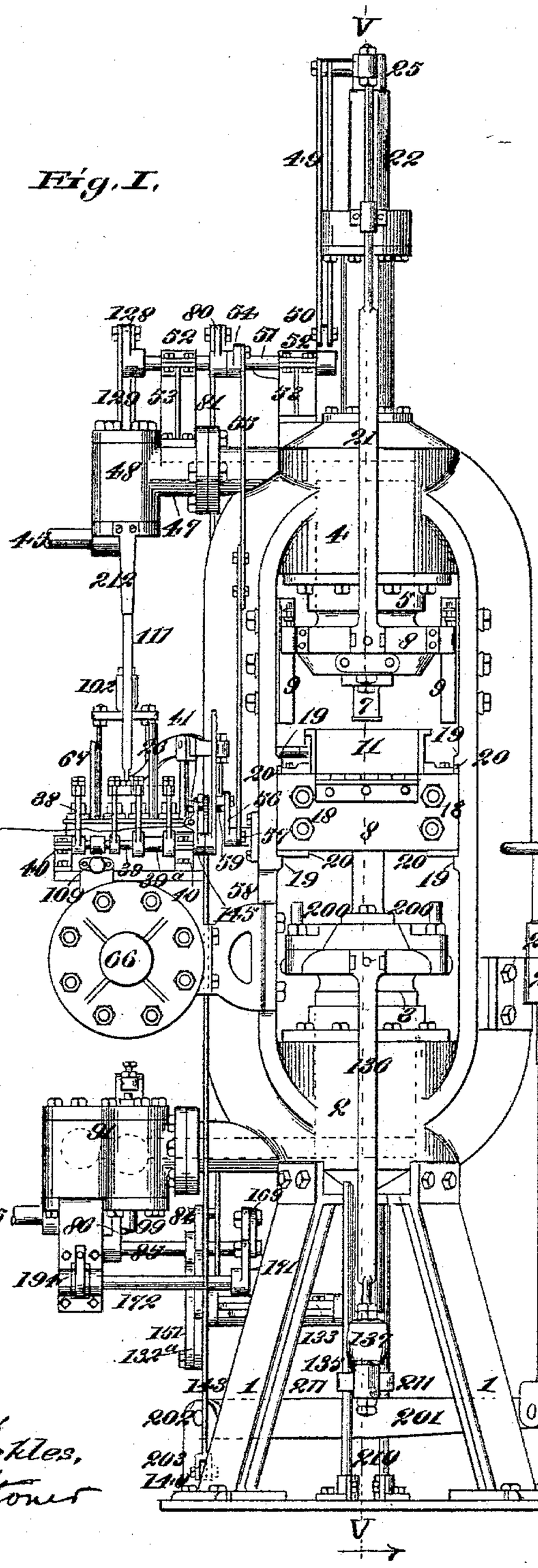

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Fig. II.

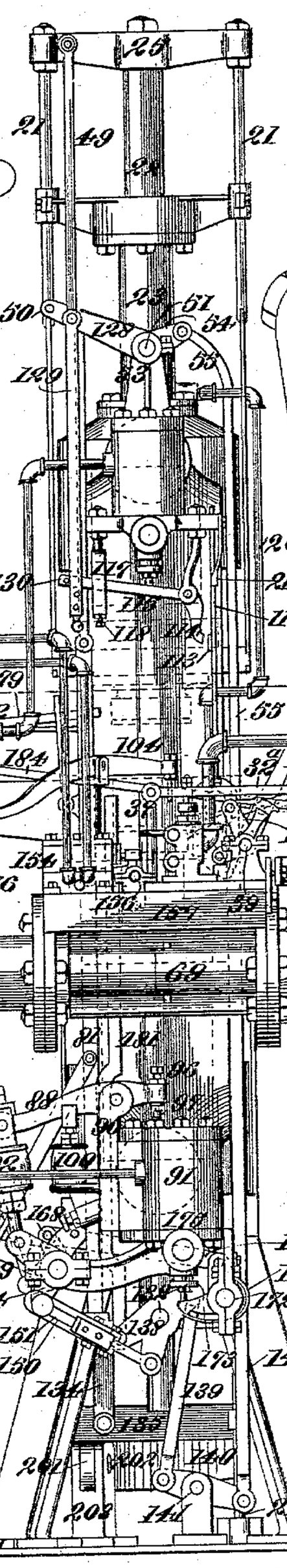

Fig. III.

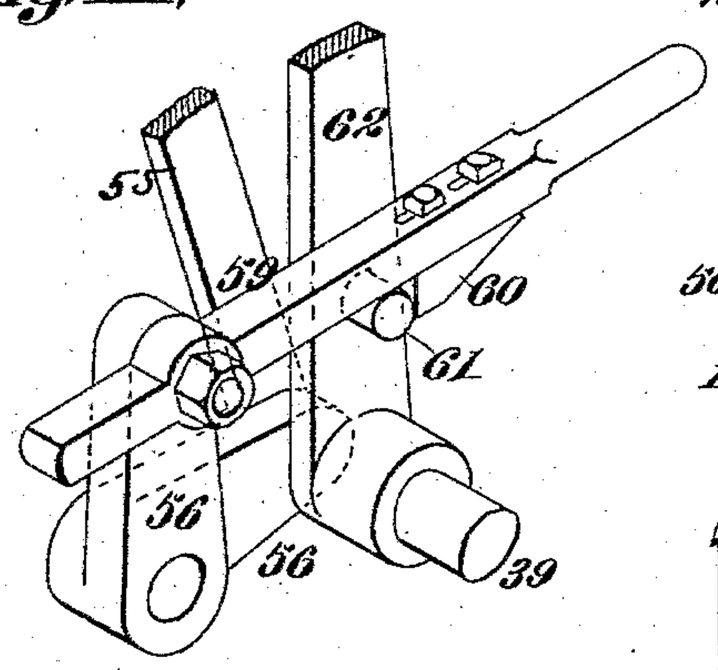

Fig. IV.

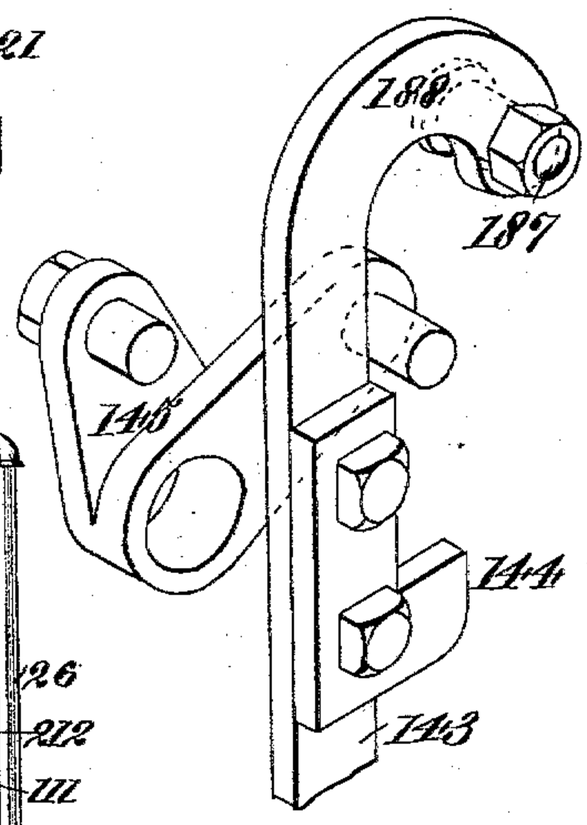

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Fig. V.

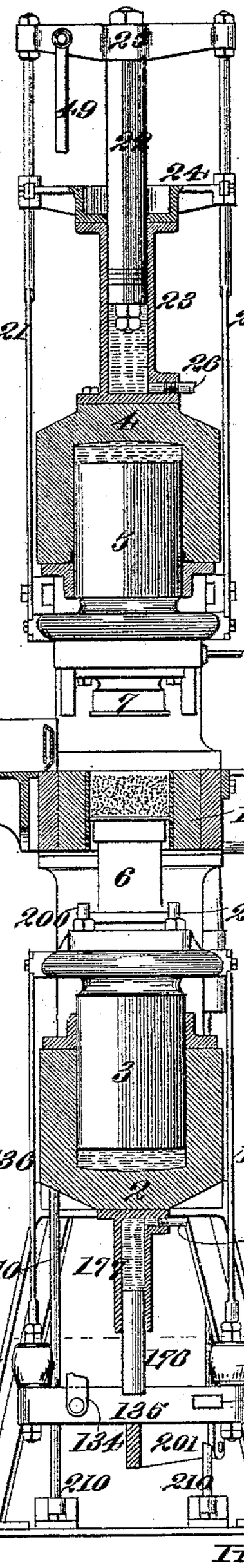
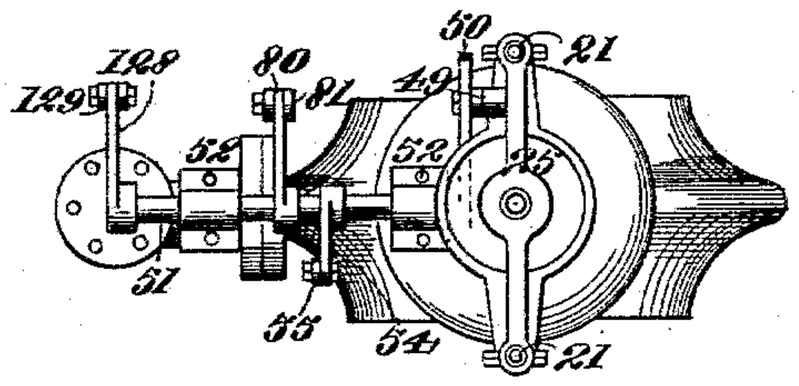


Fig. VI



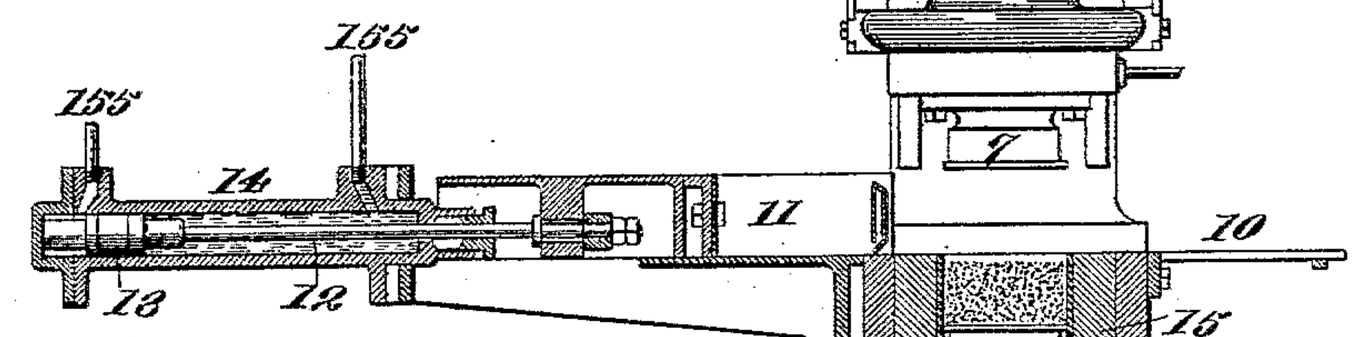


Fig. VII

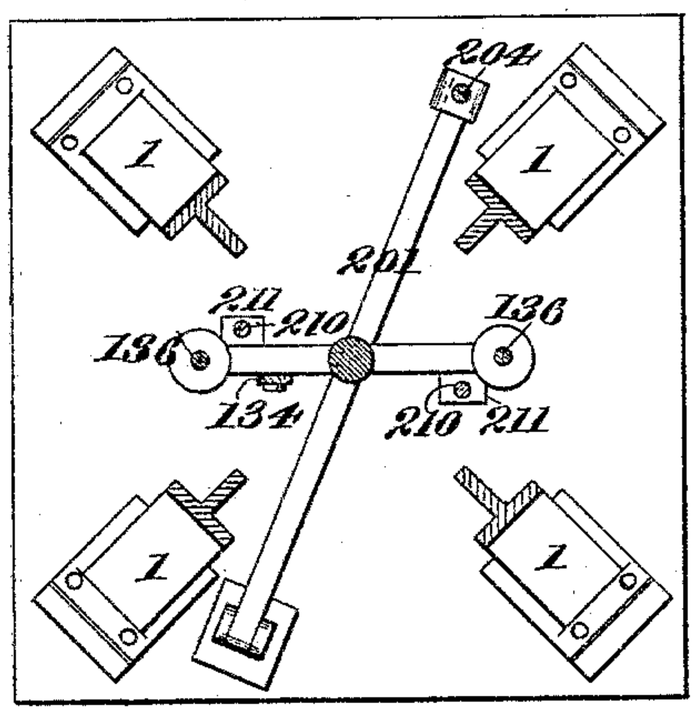


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Fig. VIII.

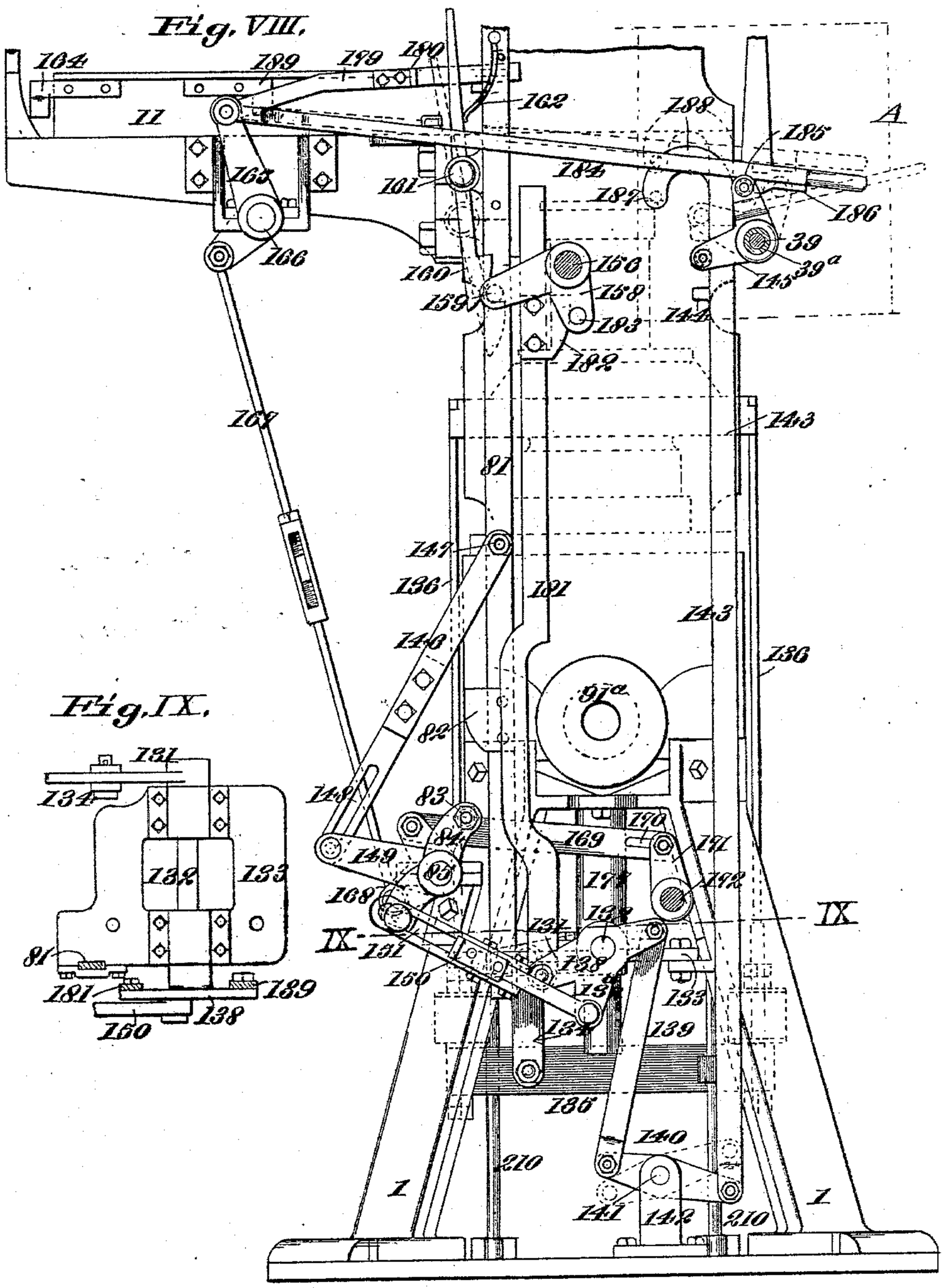

Fig. IX.

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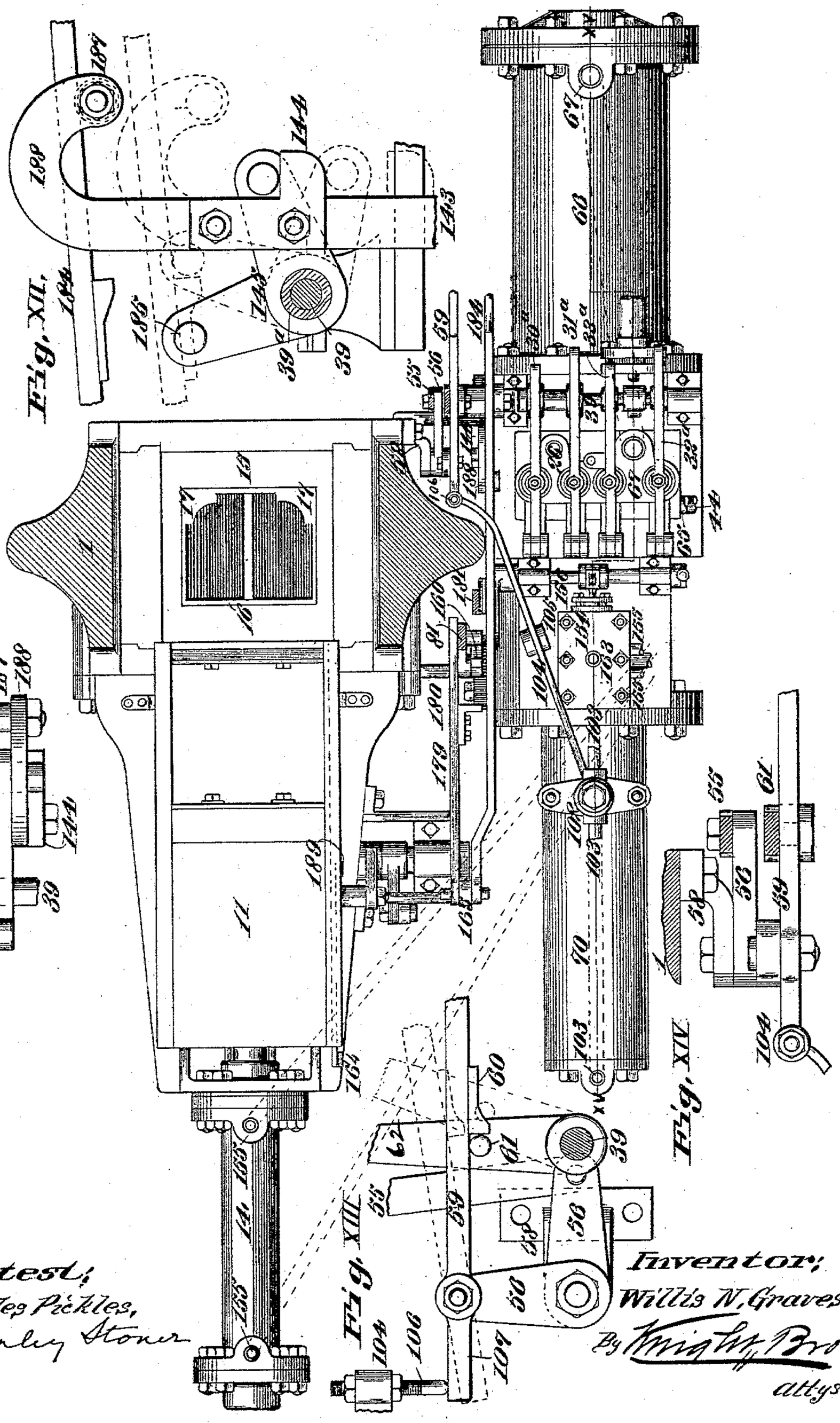

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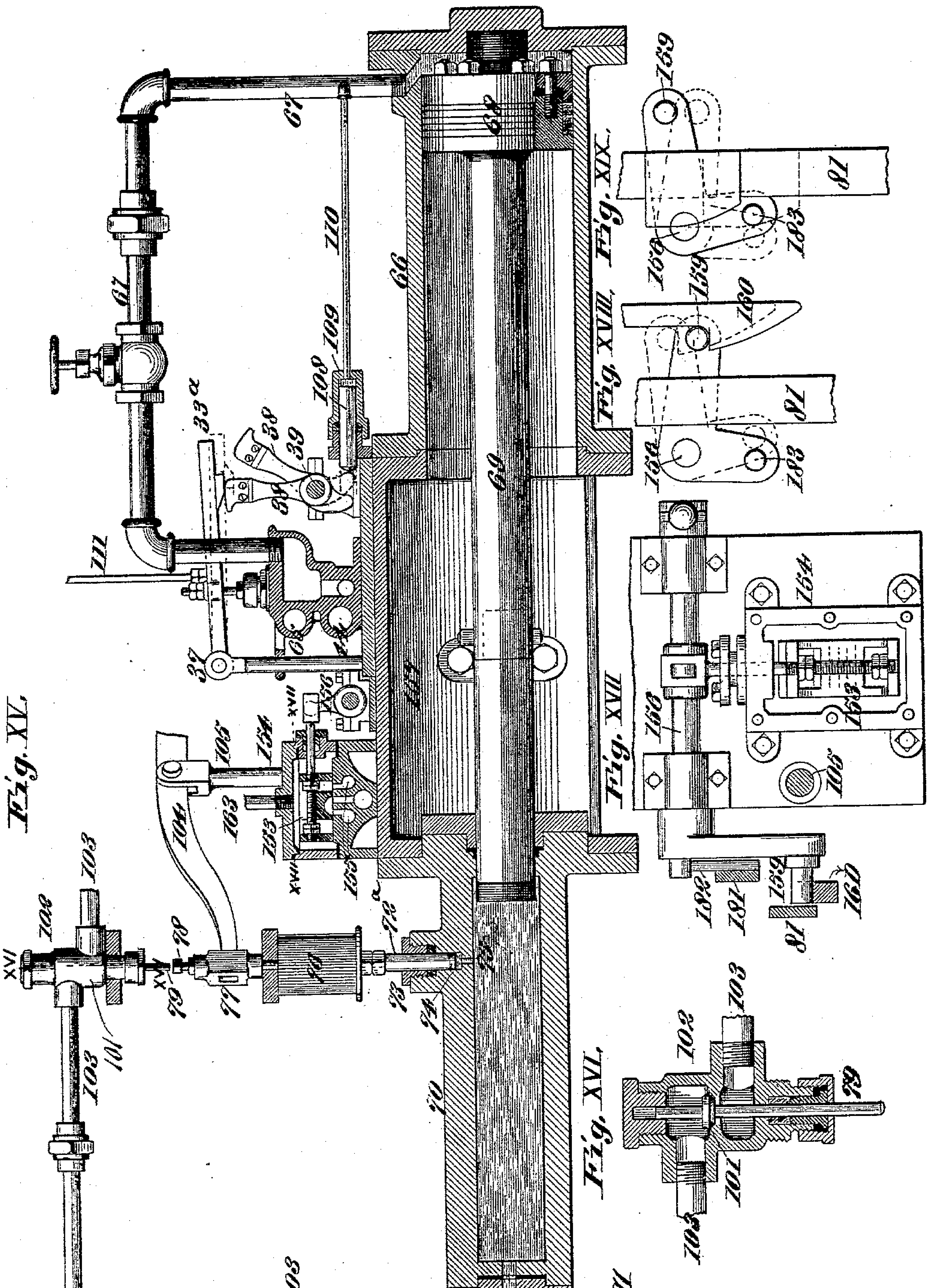

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Fig. XX.

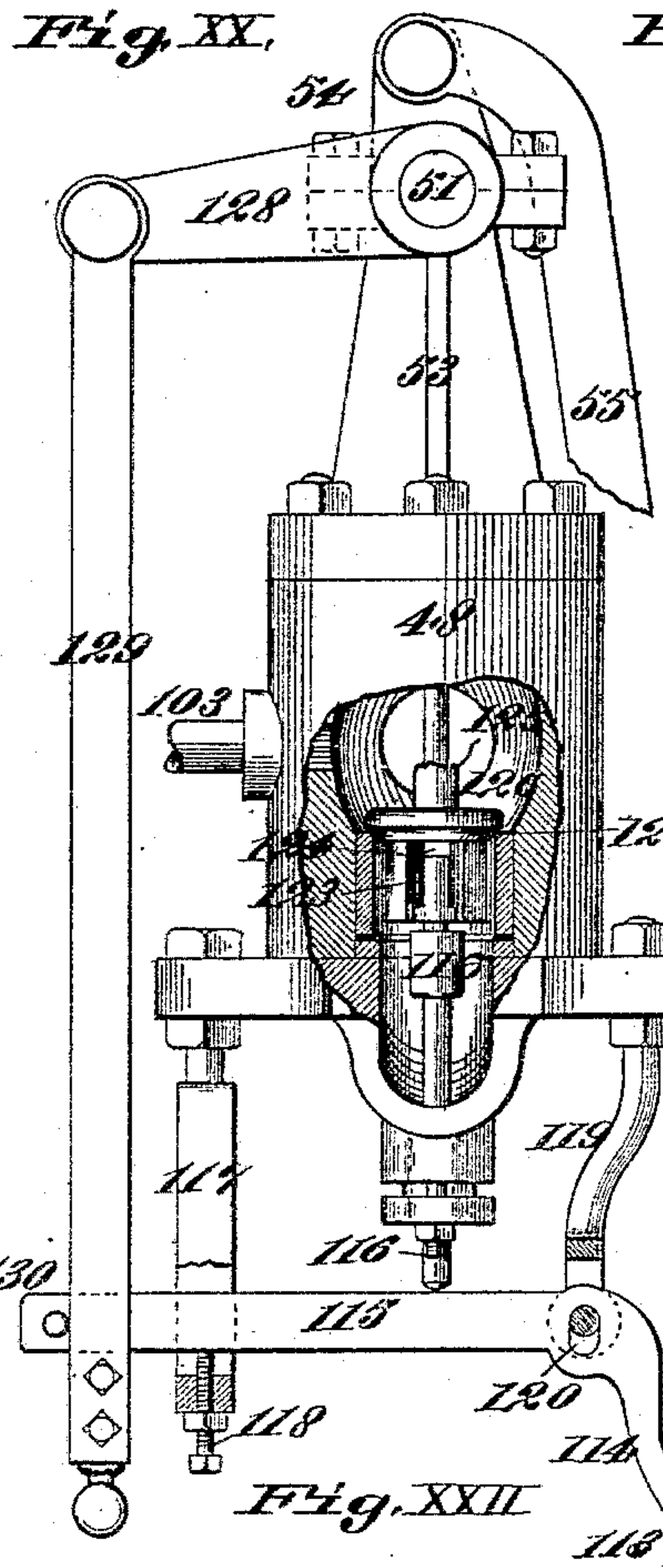


Fig. XXI.

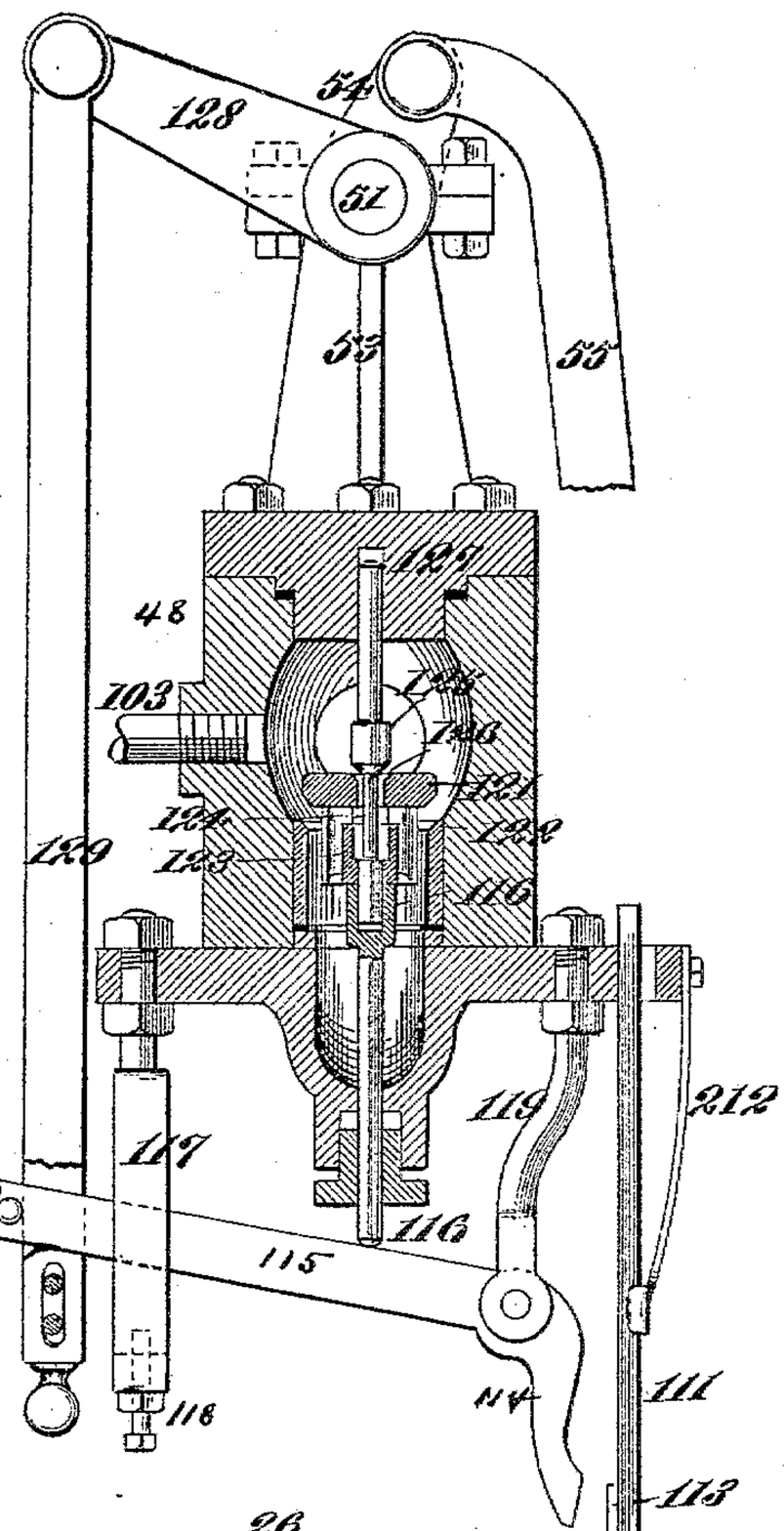
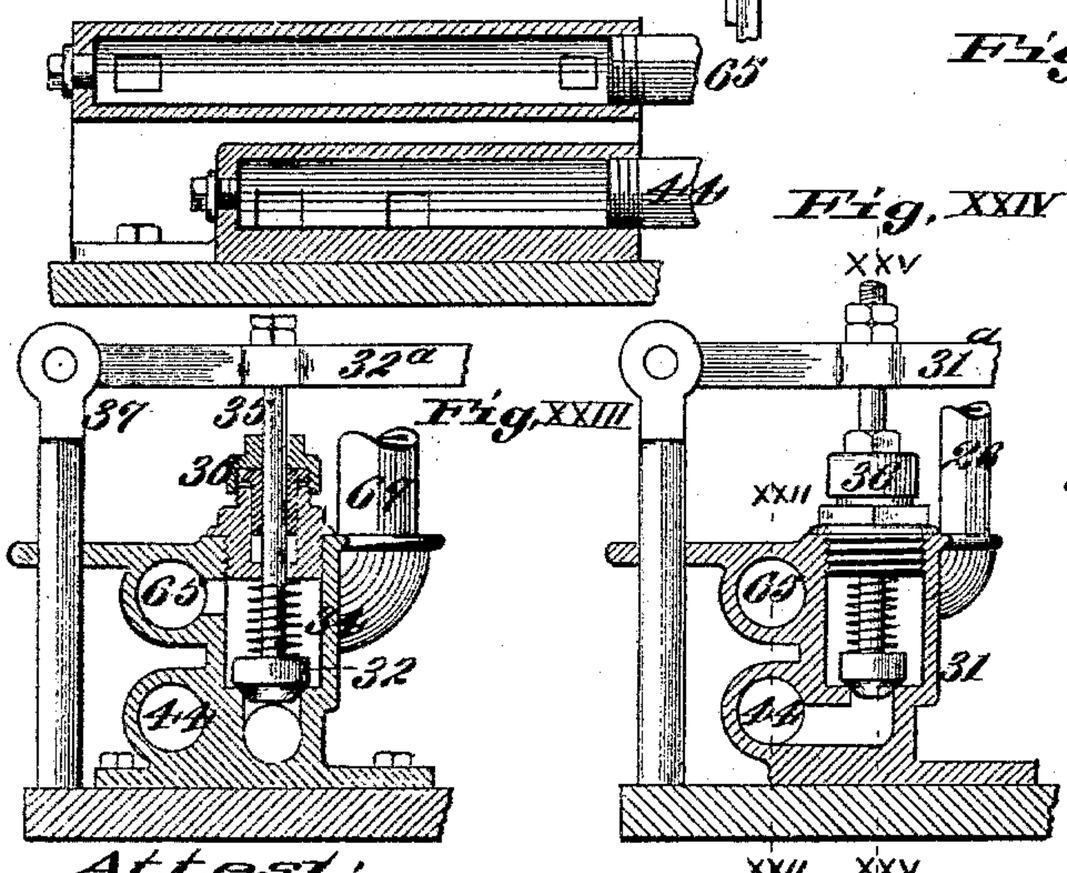


Fig. XXII

Fig. XXIII



XXII XXV

Fig. XXIV

Fig. XXV.

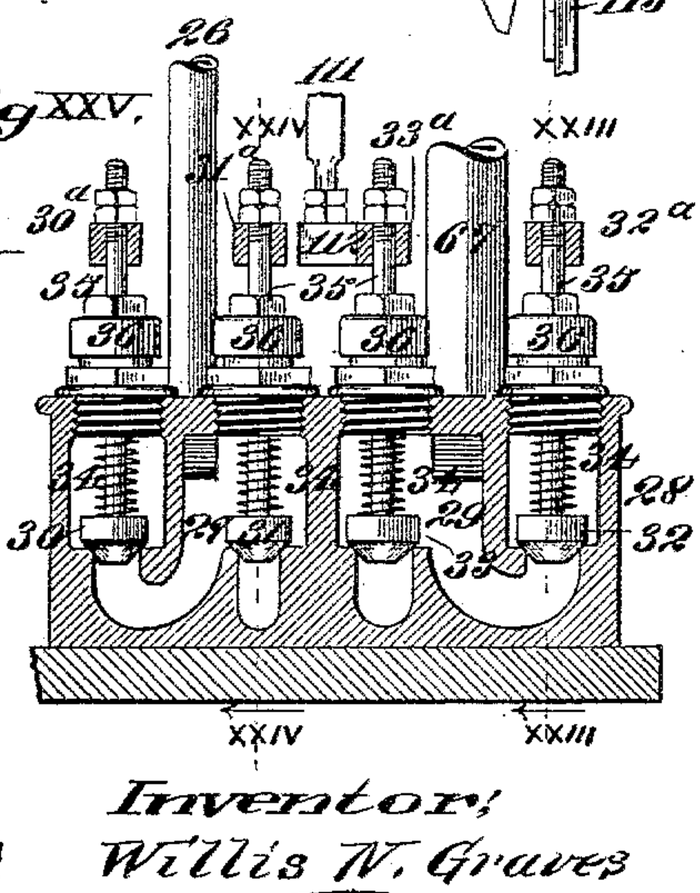


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Fig. XXVI.

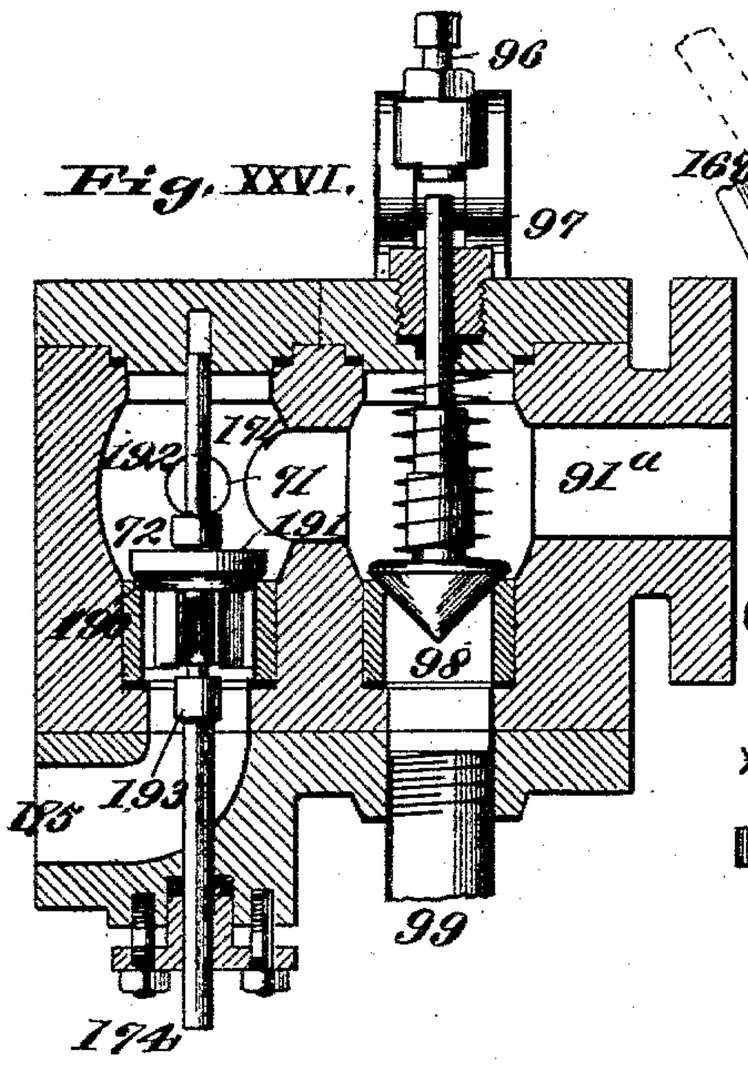

Fig. XXIX.

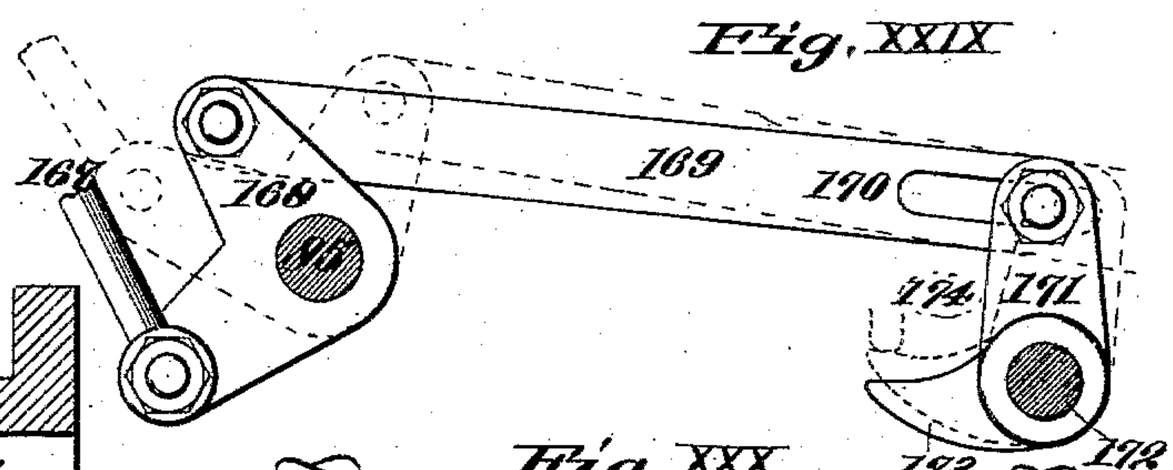

Fig. XXX.

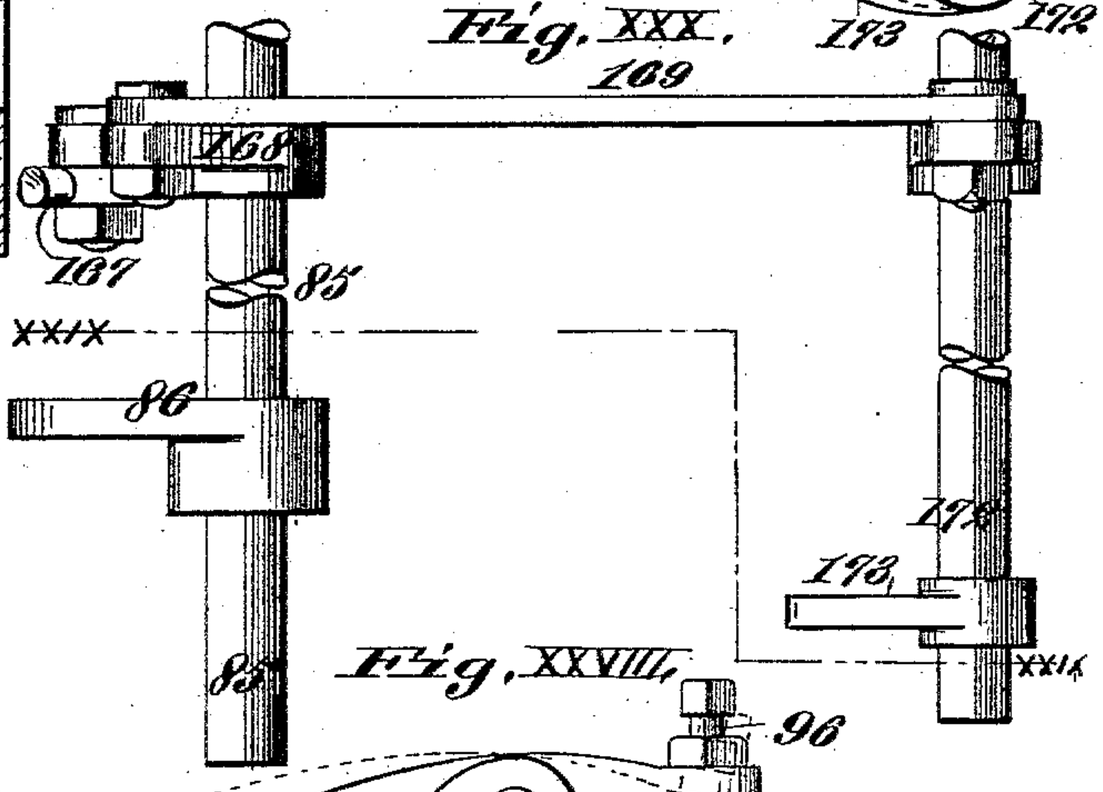

Fig. XXVII.

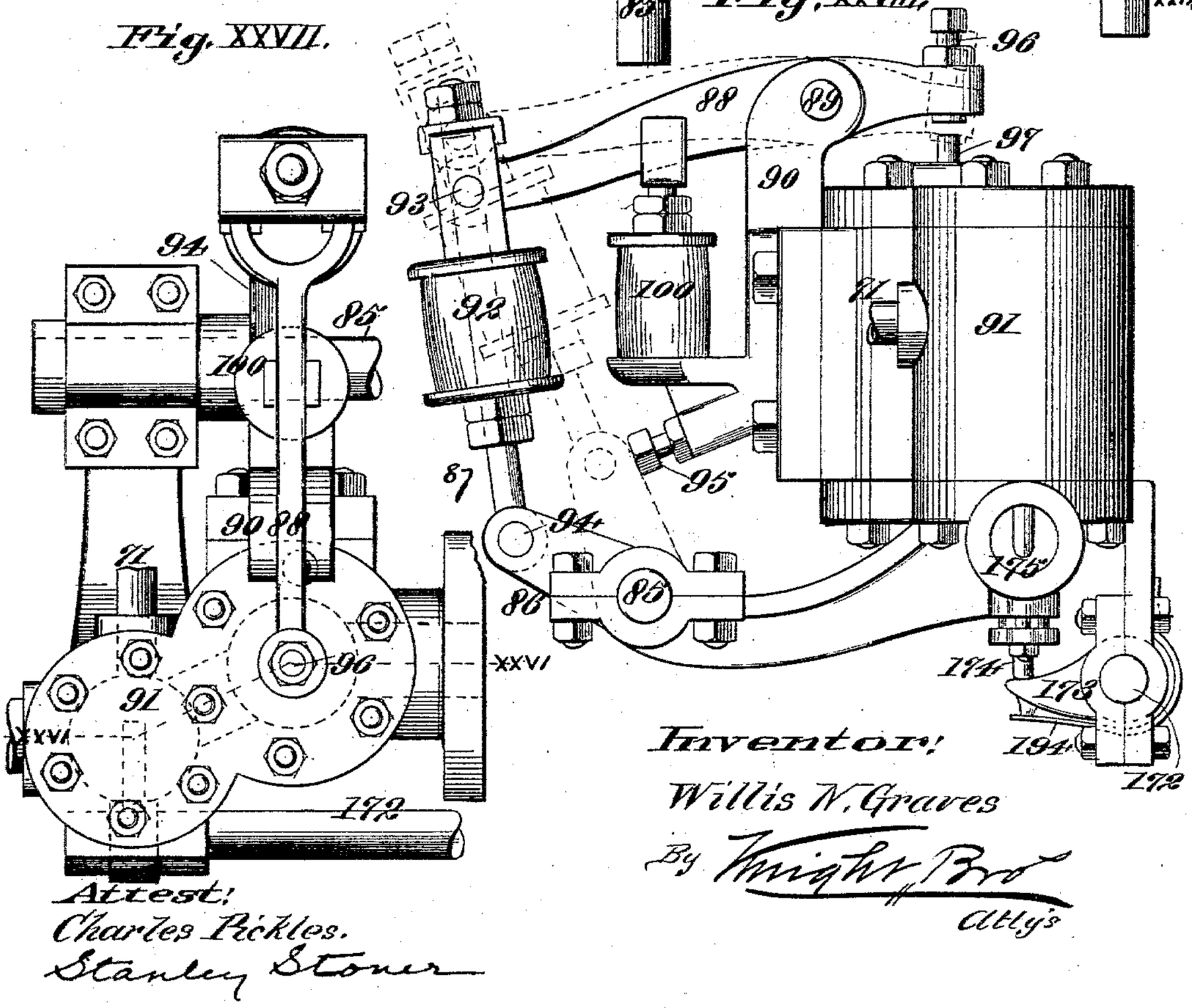

Fig. XXVIII.

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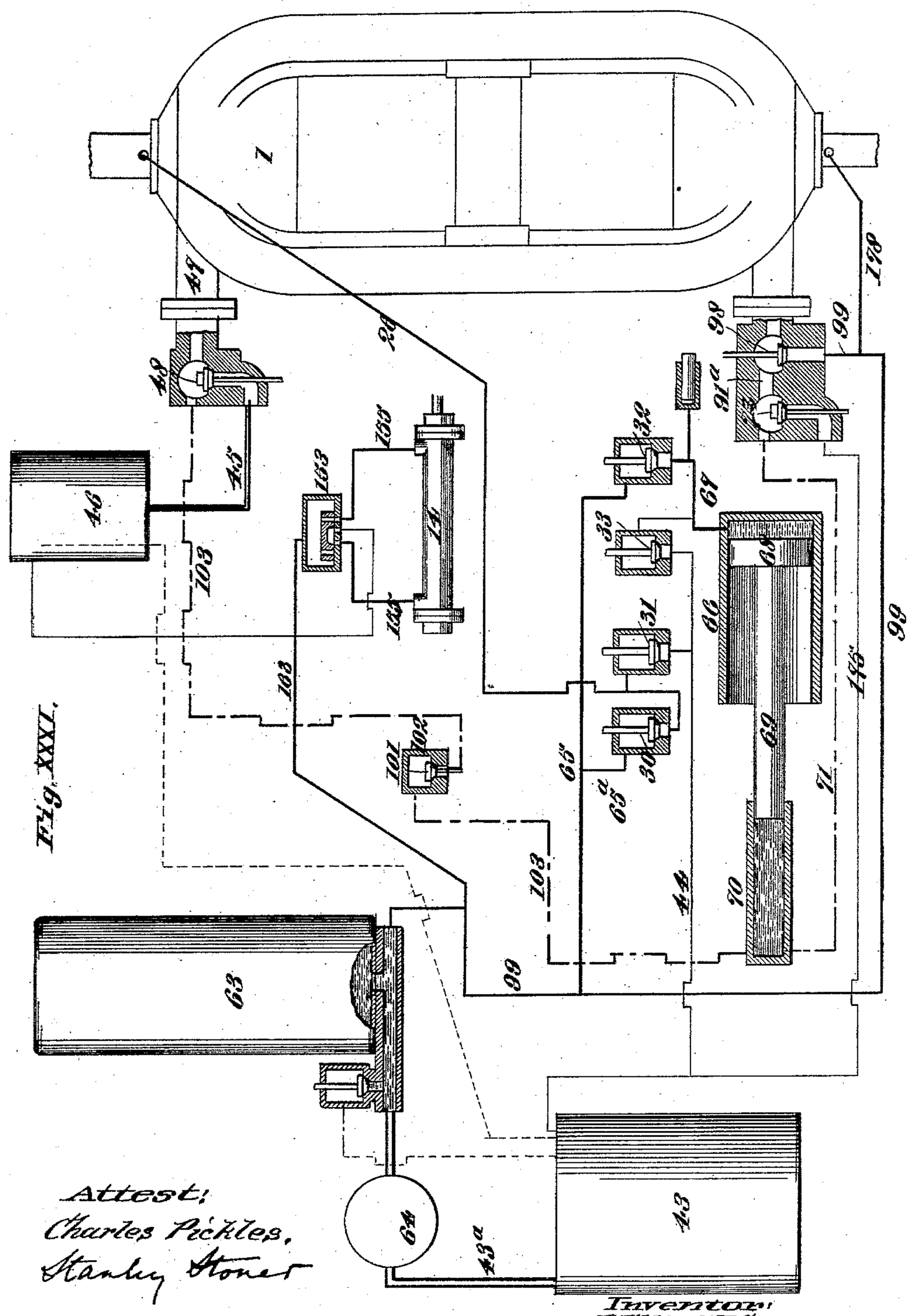

UNITED STATES PATENT OFFICE.

WILLIS N. GRAVES, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE HYDRAULIC PRESS BRICK COMPANY, OF SAME PLACE.

HYDRAULIC BRICK-MACHINE.

SPECIFICATION forming part of Letters Patent No. 565,111, dated August 4, 1896.

Application filed March 26, 1895. Serial No. 543,288. (No model.)

To all whom it may concern:

Be it known that I, WILLIS N. GRAVES, of the city of St. Louis, in the State of Missouri, have invented certain new and useful Improvements in Hydraulic Brick-Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My present invention relates to a hydraulic brick-machine that is particularly well adapted for making fancy bricks, and can be readily and quickly changed to make different designs of bricks, and the construction is such that while the usual great pressure existing in hydraulic machines exists, yet the machine is comparatively simple and inexpensive.

My invention consists in features of novelty hereinafter fully described, and pointed out in the claims.

Figure I is a front elevation of my improved machine, the low-pressure pump not being shown. Fig. II is a side elevation. Fig. III is an enlarged perspective view of the high-pressure trip. Fig. IV is an enlarged perspective view looking at the inside of the trip that operates the inlet-valve of the cylinder of the upper ram. Fig. V is a vertical longitudinal section of the machine, taken on line V V, Fig. I, looking in the direction of the arrow that crosses the section-line. Fig. VI is a top view of the upper end of the machine. Fig. VII is a transverse horizontal section taken on line VII VII, Fig. V. Fig. VIII is an enlarged detail elevation, part in section. Fig. IX is a detail horizontal section taken on line IX IX, Fig. VIII, the main frame of the machine not being shown. Fig. X is a horizontal section taken on line X X, Fig. II. Fig. XI is a top view of the part shown in Fig. XII with the charger-bar removed. Fig. XII is an enlarged detail elevation showing the part embraced within the dotted line A, Fig. VIII, but looking at the parts from the opposite side to that shown in Fig. VIII. Fig. XIII is an enlarged elevation of the high-pressure trip. Fig. XIV is a plan view of the parts shown in Fig. XIII. Fig. XV is a vertical longitudinal section of the high-pressure pump, this section being taken on line XV XV, Fig. X. Fig. XVI is an enlarged vertical section through the high-pressure valve, taken on line XVI XVI, Fig. XV. Fig. XVII is an enlarged section through the slide-valve and its accompanying parts, taken on line XVII XVII, Fig. XV. Figs. XVIII and XIX are enlarged detail side elevations of the mechanism for operating the slide-valve shown in Fig. XVII. Fig. XX is an enlarged side elevation, part in section, of the inlet-valve and accompanying parts of the cylinder of the upper ram, the valve being shown in its closed position. Fig. XXI is a similar view with the valve open. Fig. XXII is a detail section taken on line XXII XXII, Fig. XXIV. Fig. XXIII is a similar view taken on line XXIII XXIII, Fig. XXV. Fig. XXIV is a similar view taken on line XXIV XXIV, Fig. XXV. Fig. XXV is a section of the inlet and outlet valves, taken on line XXV XXV, Fig. XXIV. Fig. XXVI is an enlarged vertical section of the lower inlet and outlet valves. Fig. XXVII is a top or plan view of the same. Fig. XXVIII is an elevation of the same. Fig. XXIX is a detail section taken on line XXIX XXIX, Fig. XXX. Fig. XXX is a top or plan view of the parts shown in Fig. XXIX. Fig. XXXI is a diagram illustrating the operation of the machine.

Referring to the drawings, 1 represents the main frame of the machine, supporting the lower cylinder 2, having a piston 3, and the upper cylinder 4, having a piston 5. (See Figs. I and V.)

6 represents the lower ram or plunger, carried by the piston 3, and 7 the upper ram or plunger, carried by the piston 5. The upper ram is held from lateral movement and guided in a vertical plane by means of a suitable cross-head 8 and slides 9, as shown in Fig. I.

10 represents the table of the machine onto which the bricks are shoved by the advance movement of the charger 11. The charger is connected by a rod 12 to a piston 13, located in a cylinder 14. (See Fig. V.)

15 represents the mold, having a lining 16, in which is formed the design 17 for producing the desired configuration of the bricks. The sides and ends of the mold are secured together by connecting-bolts 18, (see Fig. I,)

and the mold is supported in the main frame of the machine between lugs or projections 19, where it is held by keys 20. It will be seen that the mold can be readily removed for the purpose of supplying linings of different designs to make any configuration of brick that may be desired.

The upper ram 7 is connected by means of rods or straps 21 (see Fig. V) to a piston 22, fitting and working in a cylinder 23, the rods passing through a guide-arm 24, secured to the upper end of the cylinder 23, and the rods being made fast to the upper end of the piston 22 by means of a cross-head 25. The cylinder 23 is supported on the cylinder 4, as shown.

26 represents a pipe communicating with the lower end of the cylinder 23 and extending down to and communicating with a chamber 27 in a valve-box 28. (See Fig. XXV.) The location of the valve-box 28 with relation to the machine is shown in Fig. I. The valve-box has also a chamber 29, and within the chamber 27 is an inlet-valve 30 and an outlet-valve 31, while within the chamber 29 is an inlet-valve 32 and an outlet-valve 33, these valves being all held to their seats, except when raised by force, by means of springs 34. (See Fig. XXV.) The stems 35 of these valves extend through stuffing-boxes 36 and pass through levers, the lever of the valve 30 being indicated by 30^a, the lever of the valve 31 being indicated by 31^a, the lever of the valve 32 being indicated by 32^a, and the lever of the valve 33 being indicated by 33^a. These levers are all hinged to the valve chest or box, as shown at 37, Fig. X, and under their free ends are four cams 38, two on a rock-shaft 39 and two on a rock-shaft 39^a, that is sleeved on the shaft 39, (see Figs. I, II, and XV,) the rock-shafts being journaled in boxes 40, as shown in Fig. I. During the operation of the machine the rock-shafts are automatically operated by mechanism hereinafter described, and as they are moved they operate alternately the different valves by means of the cams 38 and the levers against which the cams operate, so as to open the valves at the proper times.

In starting the machine the upper ram first descends into the mold by gravity, and to permit this movement of the ram the water must be allowed to escape from beneath the piston 22 through the pipe 26, and this water is permitted to escape by opening the valve 31, this movement of the valve being effected (as the machine is not yet in operation) by turning the shaft 39^a manually, for which purpose a lever 41 on the shaft (see Fig. I) is provided with a perforation 42 to receive a rod, which may be removed after the machine is started, for after once starting the machine the movement of the valve 31, as well as the other valves in the valve-chest 28, will be automatic. As the water escapes through the valve 31 it passes to the reservoir or tank 43 through a pipe (illustrated in the diagram view Fig. XXXI) at 44. Permitting the water to escape from beneath the piston 22 allows the upper ram to fall, as stated, by gravity onto the clay in the mold, and as the ram descends the cylinder 4 above the ram is filled with water passing through a pipe 45. (See Figs. I and XXXI.) The pipe 45 forms a communication between a water-tank 46 and a short pipe 47 at the upper end of the cylinder 4, in which latter pipe is a valve 48, with the under side of which the pipe 45 communicates, as clearly shown in Fig. XXXI, so that as the upper ram descends water passes readily from the tank 46 through the pipe 45, through the valve 48, and through the pipe 47 into the cylinder 4 above the piston 5, this water accelerating the gravity movement of the upper ram. As soon as the ram is checked in its downward movement by coming against the clay in the mold the water ceases to pass from the tank 46, and the valve 48 closes automatically by gravity, thus imprisoning the water in the cylinder 4 above the piston 5, and the ram is thus held from upward movement when the lower ram commences to ascend.

Secured to the cross-head 25 is a link or strap 49, connected at its lower end to a crank 50 (see Fig. I) on a rock-shaft 51, journaled in boxes 52, secured to the upper end of the cylinder 4 and to the pipe 47, respectively, by means of standards 53. (See Fig. I.) It will be understood that as the ram descends the described connection will cause the shaft 51 to be turned or rocked. On the shaft 51 is a crank 80, to which is connected the upper end of a rod or strap 81, that extends down almost to the lower end of the machine and which is held and guided in a vertical position by any suitable clamp or bracket by which it may be made fast to the frame of the machine, this clamp or bracket not interfering with the free vertical movement of the strap.

Secured to the strap 81 not far from its lower end is a tappet 82, (see Fig. VIII,) that, when the strap 81 is caused to move downward by the descent of the upper ram, comes against a pin 83 on an arm 84, secured to a rock-shaft 85. The shaft 85 is provided with a crank 86, (see Fig. XXVIII,) connected by a rod 87 to one end of a lever 88, pivoted at 89 to a lug 90 on a valve-housing 91. The rod 87 is provided with a suitable spring-cushion 92, the upper end of the rod being pivoted to the lever 88 at 93 and the lower end of the rod being pivoted to the crank 86 at 94. When the crank 86 and rod 87 are in the position shown by dotted lines, Fig. XXVIII, they hold the lever 88 in the position shown by dotted lines, same figure, and at this time the joint 94 is slightly inward beyond a straight line drawn longitudinally through the crank and rod, so that the parts are self-locking, the crank at this time bearing against a set-screw 95, by which the upward movement of the joint 94 is arrested.

On the inner end of the lever 88 is a set-

screw 96, which when the parts are in the position shown by dotted lines, Fig. XXVIII, bears against the stem 97 of a valve 98, located in the housing 91, and the valve is thus held to its closed position by the lever 88. When the tappet 82 comes against the pin 83 and turns the shaft 85, the joint 94 is forced outwardly beyond a straight line through the crank 86 and rod 87, and the parts then quickly move from the position shown in dotted lines, Fig. XXVIII, to the position shown in full lines, and the valve 98 opens and permits water to pass from a low-pressure pipe 99 through the valve 98 and into the cylinder 2 beneath the piston 3 of the lower ram. The low-pressure pipe 99 connects with the tank or reservoir 63, (see Diagram Fig. XXXI,) this tank communicating with the low-pressure pump 64, that also connects with the overflow-tank 43 by means of a pipe 43ª. The tappet 82 does not come against the pin 83 until shortly before the upper ram has about reached the limit of its gravity movement referred to, and it will be understood from the foregoing description that before the upper ram reaches the limit of its gravity movement it will cause the low pressure to be admitted to the under side of the piston of the lower ram and the lower ram will commence moving upward under low pressure.

100 represents a spring-bumper (see Fig. XXVIII) against which the lever 88 cushions when the parts move to the position shown in full lines, Fig. XXVIII.

Just before the upper ram reaches the limit of its gravity movement it causes high-pressure water to be admitted to the cylinder of the lower ram, this being effected by a crank 54 on the shaft 51, to which is connected the upper end of a rod or strap 55, the lower end of which is connected to one arm of a bell-crank lever 56 at 57, (see Figs. I, III, and XIII,) the lever being pivoted to the frame of the machine by means of a bracket 58, and having connected to its other end a bar 59, (see Figs. III and XIII,) having an adjustable catch 60, adapted to engage a pin 61 on a lever 62, secured to the shaft 39. As the upper ram rocks the shaft 51 the bar 55 will be raised, moving the crank 56 and lever 62 and rocking the shaft 39, and this movement causes the opening of the valve 32, permitting water to pass from the tank 63 of the low-pressure pump through the pipe 99 and branch 65 to the large cylinder 66 of the high-pressure pump, the valve 32 connecting with the cylinder 66 through a pipe 67. (See Figs. II, XV, and XXXI.)

Within the cylinder 66 is a piston 68, having a stem 69, that extends into the small cylinder 70 and forms the piston of the latter cylinder. The differential area of the piston 68 and its stem 69, with the differential area of the cylinders 66 and 70, afford the high pressure in the cylinder 70, and this high pressure is obtained, as will be understood from the foregoing description, from the low-pressure pump. As the piston 68 is forced forward water is caused to pass from the cylinder 70 through the pipe 71 and through the chamber 91ª (see Figs. XXVII and XXXI) of the valve-housing 91 into the cylinder of the lower ram, the lower ram being now forced upward under high pressure. As the high pressure is admitted to the lower ram the valve 98 drops to its closed position, owing to the excess of pressure on top, and remains closed by gravity, the high-pressure water passing over it, and passing also over the relief or outlet valve 72, located in the chamber 91ª of the housing 91. It will be understood that at the time the lower ram is subjected to the high pressure the upper ram is held to the position to which it moved by gravity by the imprisoned water which flowed into the cylinder of this ram as the ram descended, this water being held from returning to the tank 46 by the valve 48. As the pressure increases in the cylinder 70 it causes an upward movement of a rod 72ª, (see Fig. XV,) the lower end of the rod extending through a stuffing-box 73 into a small chamber 74 in the upper wall of the cylinder 70, this chamber 74 communicating with the interior of the cylinder through means of a port or passage 75. The rod 72ª has inserted in it an elastic cushion 76, above which is a head 77. Fitted into the head 77 is a set-screw 78, that is directly beneath the stem 79 of a valve 101, located in a housing 102. (See Figs. XV, XVI, and XXXI.) The valve 101 is located in a pipe 103, that forms a communication between the cylinder 70 and the pipe 47 of the upper-ram cylinder, this pipe being shown by broken line in Fig. XXXI, and it communicates with the pipe 47 above the valve 48. When the pressure in the cylinder 70 lifts the rod 72ª and causes it to impinge against the stem of and lift the valve 101, high-pressure water will pass from the cylinder 70 into the cylinder of the upper ram. Both the upper and lower rams are now subjected to high pressure, and this pressure is exerted until the bricks are fully pressed, and then the upper ram is relieved and commences to ascend, while pressure remains on the lower ram and causes it to move upward to lift the bricks out of the mold; but the force that is exerted on the lower ram, after the pressing of the brick is completed, is low water-pressure, as the high water-pressure is released from the upper and lower rams practically simultaneously. This releasing of the high water-pressure and the application of low water-pressure to the lower ram is accomplished by means of the following mechanism: 104 represents a lever that is pivoted or fulcrumed to a standard 105, (see Figs. X and XV,) and one end of which engages the head 77 of the rod 72ª. The other end of this lever is provided with a set-screw 106, (see Fig. XIII,) that is directly over the extended end 107 of the bar 59. (See Fig. XIII.)

The movement of the rod 72ª not only opens the valve 101, but after opening this valve

continues to move the lever 104, and by raising the long end of the bar 59 disengages the catch 60 from the pin 61 and the rock-shaft 39 is free to move back to its original position, and as it does so the valve 32 closes and the exhaust or outlet valve 33 opens, and the pressure behind the piston 68 is thus relieved, and the high water-pressure on the machine is thus removed. This movement of the shaft 39, when the catch 60 is disengaged from the pin 61, is effected by a small plunger 108 in a cylinder 109, (see Fig. XV,) the cylinder communicating with the low-pressure pipe 67 by means of a pipe 110. The plunger 108 bears against the lower projection or toe of one of the levers 38, so as to rock the shaft 39 when it is released, as stated. As soon as the high pressure is removed from the lower ram and from above or over the valve 98 the valve will open again under the low-pressure force and the lower ram will be subjected to low-pressure force to raise it and eject the bricks from the mold, and the piston 68 will be moved back by water passing back through the pipe 71 into the cylinder 70. As the valve 33 is raised it releases the high pressure from the upper ram through means of a bar or rod 111, (see Figs. XX and XXV,) the lower end of this bar being connected to the stem of the valve 33, as shown at 112, Fig. XXV, and the upper end of the bar having a tappet or projection 113, that engages the end 114 (see Fig. XX) of a bar 115, supported beneath the stem 116 of the valve 48. The bar 115 is supported at one end in a yoke 117, having a set-screw 118 at its lower end, against which the bar 115 bears when the latter is in its lower position, and at the other end the bar 115 is supported by a bar 119, to which the bar is united by a slot-and-pin connection 120.

Before the valve 33 commences to raise and lift the bar 111 the bar 115 and accompanying parts are in the position shown in Fig. XX, (to which position they moved on the descent of the upper ram,) with the tappet 118 engaging beneath the opposite end 114 of the bar 115. As soon as the bar 111 commences to rise it forces upward on the stem 116 of the valve 48 by lifting the end 114 of the bar 115, the screw 118 acting at this time as a pivot upon which the bar 115 moves. The valve 48 is made in two parts, as illustrated in Fig. XXI. It is composed of a main part 121, which seats at 122. This part of the valve has a hub 123 connected by wings, and through this part of the valve and the hub passes a stem 124, that enters the hollow upper end of the stem 116. On the stem 124 is a valve part 125, that seats against the upper end of the opening in the part 121 of the valve, as shown at 126. The stem 124 extends upward beyond the valve part 125 and enters a socket 127 in the head of the housing of the valve 48. When the end 114 of the bar 115 is raised by the bar 111, it lifts the part 125 of the valve 48 from the part 121, as shown in Fig. XXI, and thus releases the high pressure from the upper ram.

As the upper ram ascends, it, by virtue of the connecting-bar 49, rocks the shaft 51 in the opposite direction from which it rocked the shaft in its downward movement, and there is secured to the shaft 51 a crank 128, and connected to this crank is a bar 129, the lower end of which engages the bar 115, as shown in Figs. XX and XXI. When the bar 129 is raised by the shaft 51 being rocked by the upward movement of the upper ram, it lifts the end 130 of the bar 115, the rod 119 now serving as the pivot of the bar 115, and this movement of the bar 115 lifts the part 121 of the valve 48 from its seat 122, and opens a free escape of the water from the cylinder 4 above the piston 5 of the upper ram, this water passing back through the pipe 45 to the tank 46. Up to this time the upward movement of the upper ram is being caused by the low water-pressure on the lower ram, but just about the time the lower face of the upper ram reaches the top of the mold water is admitted to the lifting-cylinder 23 of the upper ram and the upper ram is then quickly raised independent of the lower ram.

Water is admitted to the lifting-cylinder 23 through means of the following mechanism: 131 represents a lever on a shaft 132, journaled to a frame 133, (see Figs. VIII and IX,) secured to the main frame of the machine. The outer end of the lever 131 is connected by a link 134 to a cross-head 135, secured to and carried by the lower ram, the cross-head being united to the ram by means of rods 136, (see Fig. V,) the rods being preferably provided with spring-cushions 137 to afford an elastic connection between the lower ram and the cross-head 135. As the lower ram ascends it rocks the shaft 132 through means of the connection just described, and on the shaft 132 is an arm 138, to one end of which is connected the upper end of a link 139, the lower end of which is connected to a lever 140, pivoted at 141 to a standard 142, made fast to the bed-plate of the machine. To the other end of the lever 140 is connected the lower end of a strap or rod 143, on which near its upper end is a tappet 144, that is adapted to engage one arm of a bell-crank lever 145 on the sleeve-shaft 39^a. As the tappet engages the lower arm of the bell-crank lever 145 it turns the shaft 39^a and opens the valve 30 in the valve-chest 28, and causes the valve 31 to close. Water now passes from the low-pressure pipe 99 through the branch 65 and sub-branch 65^a, (see Fig. XXXI,) through the valve 30 and up through the pipe 26 to the cylinder 23 beneath the piston 22, and the upper ram is thus raised to its extreme upper position. (Shown in Fig. V.)

The first movement of the crank 86 and rod 87 (to bring the parts back to the position shown in full lines, Fig. XXVIII) is accomplished by means of a link 150, having a slot-

and-pin connection 151 with the lower end of the arm 84. (See Fig. VIII.) The inner end of the link 150 is connected to a prong 132^a of the arm 138. Before the lower ram reaches the limit of its upward movement the inner end of the slot 151 comes against its pin (designated by the same numeral) and by rocking the shaft 85 causes the joint between the crank 86 and the rod 87 to be forced inward until the crank and rod are about in line, leaving this further movement of the crank and rod to be accomplished by the last part of the movement of the upper ram, so that when the lower ram has reached the extreme limit of its upward movement the upper ram will cause the valve 98 to be closed, shutting off the low water-pressure which is moving the lower ram. This final movement of the crank 86 and rod 87 is effected by the last part of the upward movement of the upper ram through means of a link 146, pivoted at 147 to the rod or bar 81, (see Fig. VIII,) the lower end of the link having a slot-and-pin connection 148 with a crank 149, secured to the shaft 85. The last part of the upward movement of the upper ram is quick, and during this time the lower ram is ejecting the bricks from the mold, and the face of the lower ram just reaches the top of the mold as the upper ram reaches the limit of its upward movement, and the end of the slot 148 comes against its pin in the arm 149, and rocking the shaft 85 gives the final movement to the crank 86 and the rod 87, causing the lever 88 to close the valve 98, the crank 86 coming against the set-screw 95, and the set-screw 96 on the lever 88 being brought down on the stem of the valve 98, and the valve is thus closed and locked in its closed position, shutting off the low water-pressure to the lower ram. The water is now confined in the lower-ram cylinder, being unable to escape either through the valve 98, the valve 72, or through the pipe 71, and the lower ram is held in its extreme elevated position until the charger can come forward and force the bricks from over the mold.

I will now describe the mechanism by which the charger is operated.

153 (see Fig. XV) represents an ordinary D slide-valve located in the chest 154, having pipe connections 155 with the opposite ends of the cylinder 14. The stem of the valve 153 is connected to a rock-shaft 156, held in journal-boxes secured to a casting 157, that also supports the chest 154 and the cylinders 66 and 70. Secured to the rock-shaft 156 is a bell-crank lever 158, (see Fig. VIII,) one arm of which is provided with a pin 159, adapted to be engaged by a hook 160, pivoted at 161 to the bar 81, and the lower end of which is pressed inwardly by a spring 162, secured to the bar 81. As the bar 81 is raised by the upward movement of the upper ram, and just before the upper ram reaches the limit of its upward movement, the hook 160 engages the pin 159 and rocks the shaft 156, moving the slide-valve 153 so as to admit water to the outer end of the charger-cylinder 14, and the charger commences to move forward. The water that effects this movement of the charger is low water-pressure derived from the pipe 163, that connects with the pipe 99. (See diagram view Fig. XXXI.) Just as the charger reaches the limit of its forward movement a projection 164 on the rear end of the charger comes against the upper end of a bell-crank lever 165, pivoted at 166 to the under side of the charger-support. To the lower arm of the lever 165 is connected the upper end of a rod 167, the lower end of which is connected to one arm of a bell-crank lever 168 on the shaft 85. The upper arm of the lever 168 is connected to one end of a bar 169, the other end of this bar having a slot-and-pin connection 170 with a lever or crank 171, secured to a shaft 172, journaled to the main frame of the machine, as shown in Fig. VIII. The lever 171 has a toe-piece 173, (see Figs. XXVIII and XXIX,) which bears against the stem 174 of the valve 72. When the charger comes against the bell-crank lever 165 and rocks the shaft 172 through means of the mechanism just described, the toe-piece 173 of the lever 171 raises the valve 72 from its seat and permits the water to pass from beneath the piston of the lower ram through the pipe 175 to the tank 43. (See diagram Fig. XXXI.) The lower ram will now move to its lower position, and to accelerate its movement I secure a piston or plunger 176 to the cross-head 135, (see Fig. V,) that fits in a cylinder 177 beneath the cylinder 2. The upper end of the cylinder 177 communicates by means of a pipe 178 with the pipe 99. (See Fig. XXXI.) The cylinder 177 is always in communication with the pipe 99 without the intervention of any valve, and the water that is in this cylinder when the lower ram ascends is simply displaced back into the pipe 99, the resistance caused by this displacement being of practicable unimportance, owing to the very small size of the cylinder 177 as compared with the size of the cylinder 2 and its piston 3.

Secured to the upper arm of the bell-crank lever 165 is a bar 179, having a tappet 180, (see Fig. VIII,) that just before the charger reaches the limit of its forward movement comes against the upper end of the catch 160, and by pressing the spring 162 causes the hook to be disengaged from the pin 159, and as the lower plunger descends and rocks the shaft 132 through means of the crank 131 and link 134 it pulls down on a bar 181, secured to one end of the arm 138. On this bar 181 is a cam 182, that engages a pin 183 on the arm of the bell-crank lever 158, that does not carry the pin 159. This cam 182 comes against the pin 183 just after the catch 160 is released and rocks the shaft 156 in the opposite direction from that in which it was moved by the catch 160, as described, and moves the slide-valve 153 back to its original position, thus

admitting water to the forward end of the cylinder 14 and causing the charger to recede. Secured also to the upper arm of the bell-crank lever 165 is a bar 184, the free end of which rides on a pin 185 on the upper arm of the bell-crank lever 145. This bar 184 carries a tappet 186, and this tappet, it should be stated, was raised out of engagement with the pin 185 when the bar 143 ascended through means of a pin 187 on the gooseneck end 188 of the bar, the pin 187 coming against the under side of the bar 184, so that the bar 184 need not interfere with the turning of the sleeve-shaft 39^a when the tappet 144 comes against the lower arm of the bell-crank lever 145.

When the charger was advancing and the projection 164 came against the upper arm of the bell-crank lever 165, it forced the bar 184 forward, so that the tappet 186 rode over and fell behind the pin 185 on the lever 145. Now, as the charger recedes, the projection 189 thereon comes against the inner side of the upper arm of the bell-crank lever 165 and moves it back to its original position, and in doing so the bell-crank lever 145 is moved by the bar 184, causing the sleeve-shaft 39^a to be rocked back, opening the valve 31 and allowing the water to escape from the under side of the piston 22, when the upper ram will commence to descend again, and thus the operation goes on continuously. This moving of the valve 31 by the movement of the charger corresponds to the moving of the valve by hand when the machine is first started, as already explained.

It will be understood that as the bell-crank lever 165 is shifted by the backward movement of the charger it rocks the shaft 172 back to its original position, allowing the valve 72 to close again against its seat 190. I have shown the valve 72 composed of a main part 191 and a small valve part 192, that is on the stem 174 of the valve 72. This valve part 192 seats against the upper end of the opening in the body 191 of the valve, and on the stem 174 beneath the body 191 of the valve is a collar 193, which comes against the main body of the valve when the toe-piece 173 lifts the stem 174, thus causing the main body of the valve to be opened. The part 192 of the valve and the collar 193 are sufficiently far apart to permit the part 192 to be held from its seat without raising the main body of the valve, and this part 192 is normally held from its seat by a spring 194, that keeps the toe-piece 173 pressed lightly against the stem 174, and the object of thus holding the valve 192 from its seat is to permit the escape of any water that may leak through the valve 98 when the latter is closed, so that this leakage will not act upon or affect the lower ram.

The upward movement of the lower ram is checked by pins or projections 200 on the upper end of the ram 3 coming against the bottom of the mold 15, (see Fig. V,) and the downward movement of the ram is checked by the cross-head 135 coming against a beam 201, located crosswise of the head 135. (See Fig. I.) For the purpose of regulating the downward movement of the ram, and thereby regulating the amount of clay that enters the mold, I pivot the beam 201 at 202 to a standard 203, secured to the bed-plate of the machine, and the other end of the beam 201 is supported by a rod 204, passing through a lug 205 on the main frame of the machine and threaded at its upper end to receive a nut 206, provided with a hand-wheel 207 or other means for turning it. The nut 206 rests on the lug 205, and by adjusting the nut the beam 201 is raised or lowered to regulate the downward movement of the lower ram.

210 represents guide-rods extending from the under side of the cylinder 2 to the bed-plate 3, and which pass through lugs or ears 211 on the cross-head 135, these rods holding the cross-head from lateral movement during the operation of the machine.

212 represents a spring that presses the bar 111 inwardly, so as to cause the tappet 113 to engage the end 114 of the bar 115.

I claim as my invention—

1. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, and valves located in said communications provided with means for operating them; whereby the lower ram is first moved by low pressure and both rams then moved by high pressure exerted through force from the low-pressure pump, substantially as set forth.

2. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, and means for controlling the passage of water through said communications; whereby the lower ram is first moved by low pressure, and both rams then moved by high pressure exerted through force from the low-pressure pump, substantially as set forth.

3. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a lifting-cylinder over the upper ram, a supply-tank communicating with the upper-ram cylinder, a low-pressure pump communicating with the cylinder of the lower ram and with the lifting-cylinder of the upper ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams,

and valves located in said communications; whereby in the operation of the machine the upper ram is first allowed to descend by gravity and is held by imprisoned water above its piston, and the lower ram then moved by low pressure, and then both rams moved by high pressure exerted through force from the low-pressure pump, substantially as set forth.

4. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, valves located in said communications, and a plunger communicating with and operated by the high-pressure pump and adapted to operate the valve in the communication between the high-pressure pump and the upper ram, substantially as and for the purpose set forth.

5. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, valves located in said communications, and a plunger-rod 72^a communicating with and operated by the high-pressure pump and adapted to operate the valve 101 in the communication between the high-pressure pump and the upper ram, substantially as and for the purpose set forth.

6. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, valves 48 and 101 located in the communication between the high-pressure pump and the upper ram, and a plunger-rod communicating with and operated by the high-pressure pump and which is adapted to operate said valve 101 to admit high water pressure to the upper ram, substantially as set forth.

7. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a high-pressure pump communicating with the cylinders of the upper and lower rams, valves 48 and 101 located in the communication between the high-pressure pump and the cylinder of the upper ram, a plunger-rod communicating with and operated by the high-pressure pump and adapted to operate said valve 101, and means for operating the valve 48; said valve 48 being formed in two parts so as to first relieve the high pressure on the upper ram and then open a free discharge from the upper-ram cylinder, substantially as and for the purpose set forth.

8. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a high-pressure pump communicating with the cylinders of the upper and lower rams, a valve located in the communication between said pump and the upper-ram cylinder, and mechanism communicating with said pump and operated thereby to move said valve after high water pressure is admitted to the lower-ram cylinder, substantially as set forth.

9. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a high-pressure pump communicating with the cylinders of the upper and lower rams, and a valve 101 adapted to be operated by said pump to admit water to the upper-ram cylinder substantially as set forth.

10. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams; and means for releasing low pressure from the high-pressure pump, consisting of a plunger 108 a valve operated by said plunger and a cylinder 109, in which said plunger fits, said cylinder communicating with the low-pressure pump, substantially as set forth.

11. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump with which the low-pressure pump communicates, communications between the high-pressure pump and the cylinders of the upper and lower rams, and means for releasing the low pressure from the high-pressure pump, consisting of a plunger-rod 72^a and a lever 104 for releasing the valve mechanism, a cylinder communicating with the low-pressure pump, a plunger 108 in said cylinder and a discharge-valve for the low-pressure pump and adapted to be operated by the said plunger, substantially as set forth.

12. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a valve in said communication, and means for holding said valve, consisting of a rock-shaft 85, a crank on said shaft, a lever 88 having a set-screw adapted to engage the stem of said valve, a rod connecting said lever to said crank, mechanism operated by the lower ram to move said crank and rod the greater

part of its distance, to release the valve and mechanism operated by the upper ram to give said crank and rod their last movement, substantially as and for the purpose set forth.

13. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a valve in said communication, mechanism for holding said valve to its seat, mechanism operated by the lower ram to move said valve mechanism the greater part of its distance, and mechanism operated by the upper ram to move said valve device the last part of its distance, substantially as and for the purpose set forth.

14. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a valve for releasing the pressure from the lower ram, and mechanism operating said valve, consisting of a rock-shaft, means for rocking the shaft a toe-piece secured to the shaft and adapted to bear against the stem of said valve, and a spring 194 for keeping the toe-piece constantly pressed against said stem; said valve being composed of a main part 191 and a part 192 secured to the stem of the valve and adapted to seat against the main part of the valve, substantially as and for the purpose set forth.

15. In a hydraulic brick-machine, the combination of upper and lower rams, pistons carrying the rams, cylinders in which the pistons fit, a low-pressure pump communicating with the cylinder of the lower ram, a high-pressure pump communicating with the low-pressure pump, communications between the high-pressure pump and the cylinders of the rams, and means for releasing the high pressure from the upper ram consisting of a valve composed of a main part 121 and a part 125 on a sectional stem, and means for moving the two parts of the valve consisting of a bar 111 having a tappet, a bar 115 with which said tappet engages, a yoke 117 and a rod 119 for supporting said bar 115, and a bar 129 connected to a rock-shaft; said bar 115 having slot-and-pin connection with the rod 119, substantially as and for the purpose set forth.

16. In combination with a hydraulic brick-machine, a valve 48, a rock-shaft 51, means for rocking said shaft, a bar 115 located beneath the stem of said valve, a connection between said bar and shaft, and a bar 111 adapted to engage one end of the first-mentioned bar, substantially as and for the purpose set forth.

17. In combination with a hydraulic brick-machine, a valve 48, a bar 115 located beneath the stem of said valve, a rock-shaft, means for rocking the shaft, a connection between said bar and shaft, and a bar 111 adapted to engage one end of the first-mentioned bar; said valve being made in two parts, substantially as and for the purpose set forth.

18. In a hydraulic brick-machine, a valve 48 in combination with a bar 115 located beneath the stem of said valve, independent means for moving the opposite ends of said bar, and pivotal supports for said bar, consisting of a yoke 117 and a rod 119, substantially as set forth.

19. In a hydraulic brick-machine, a valve 48 made in two parts, in combination with a bar 115 located beneath the stem of said valve, means for moving the ends of said bar independently, and means for pivotally supporting said bar, consisting of a yoke 117 having a set-screw 118, and a bar 119 having a slot-and-pin connection with said bar, substantially as and for the purpose set forth.

In testimony whereof I have hereunto set my hand, at St. Louis, Missouri, this 18th day of March, A. D. 1895.

WILLIS N. GRAVES.

In presence of—

B. L. FREDERICK,

STANLEY STONER.