No. 880,567.

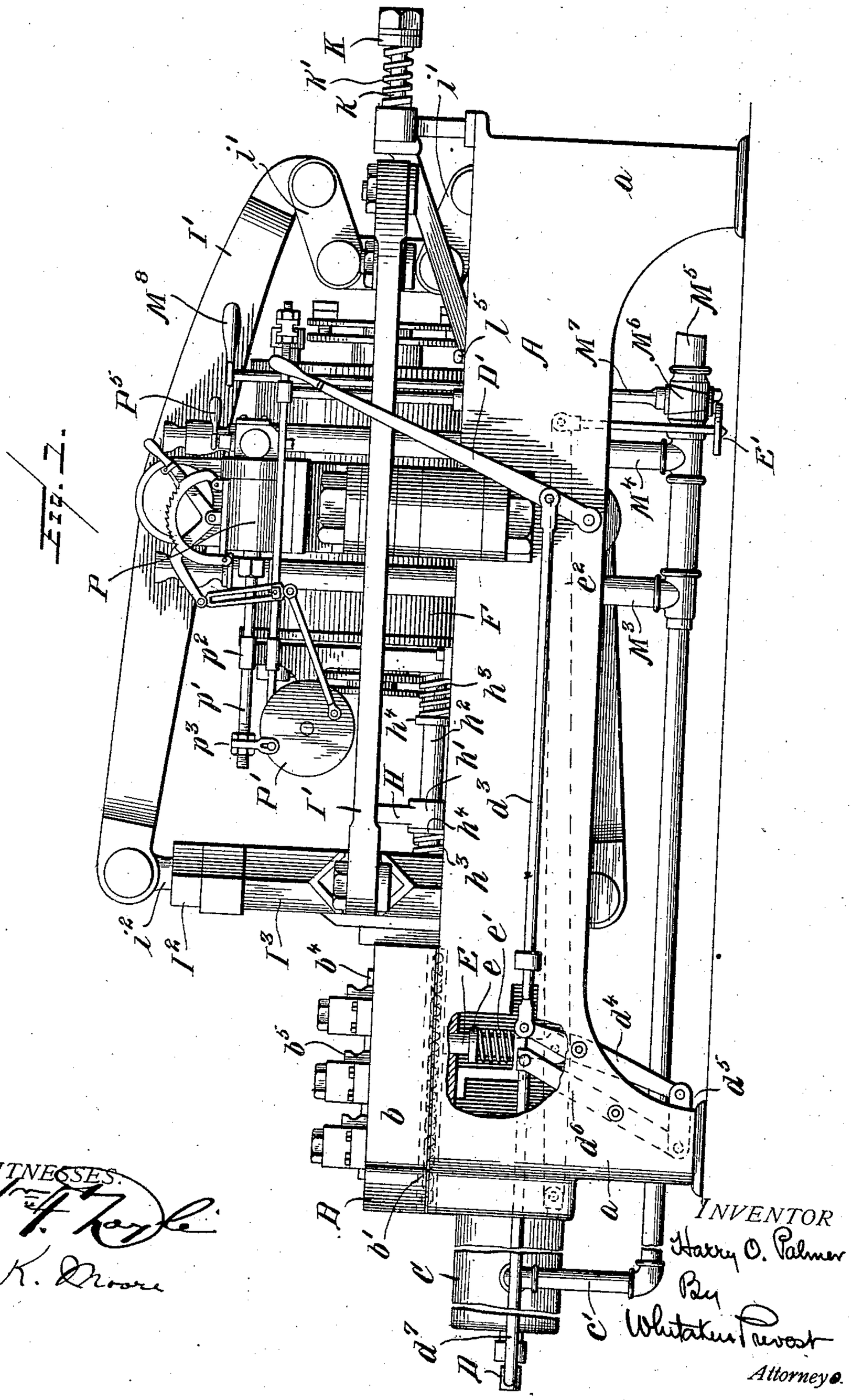
H. O. PALMER. PATENTED MAR. 3, 1908.

MACHINE FOR MANUFACTURING AND SHARPENING STAR BIT DRILLS.

APPLICATION FILED MAR. 31, 1906.

7 SHEETS—SHEET 1.

Fig. 1.



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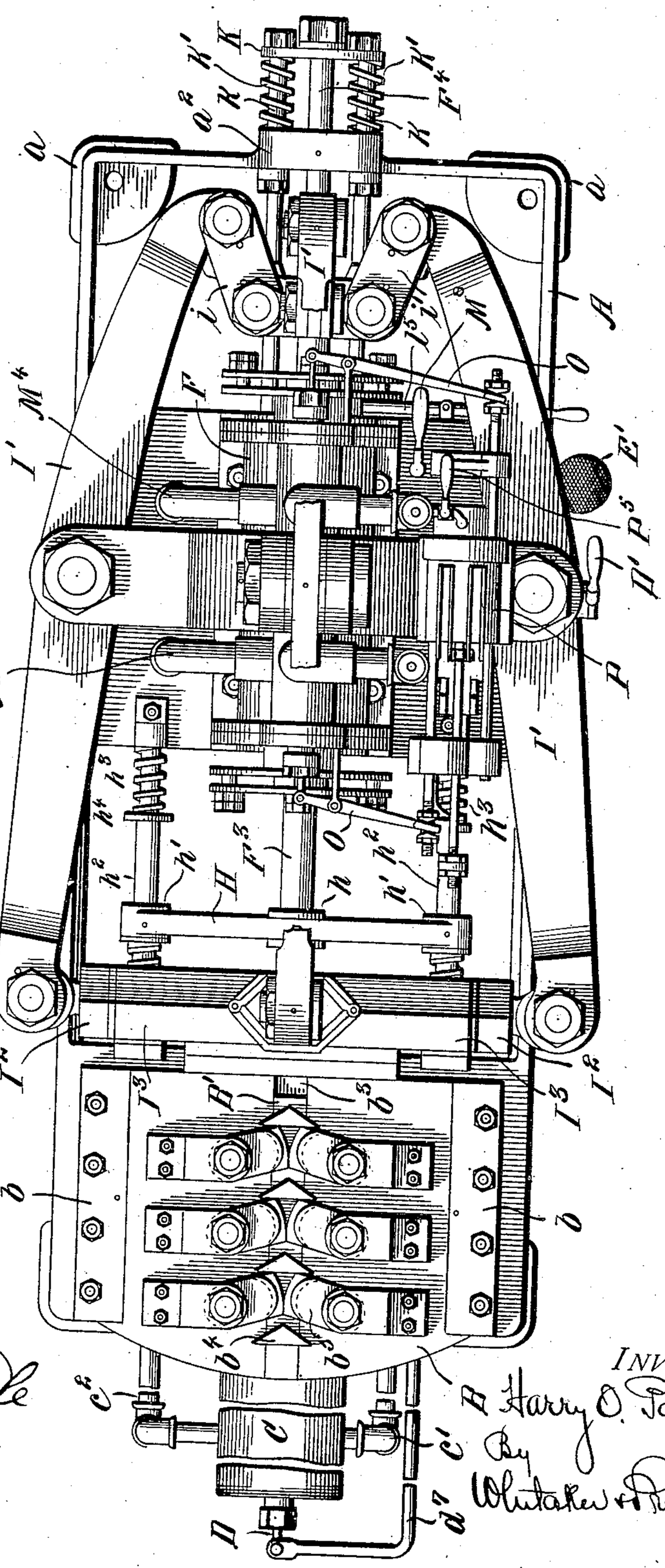
7 SHEETS—SHEET 2.

FIG. 2.



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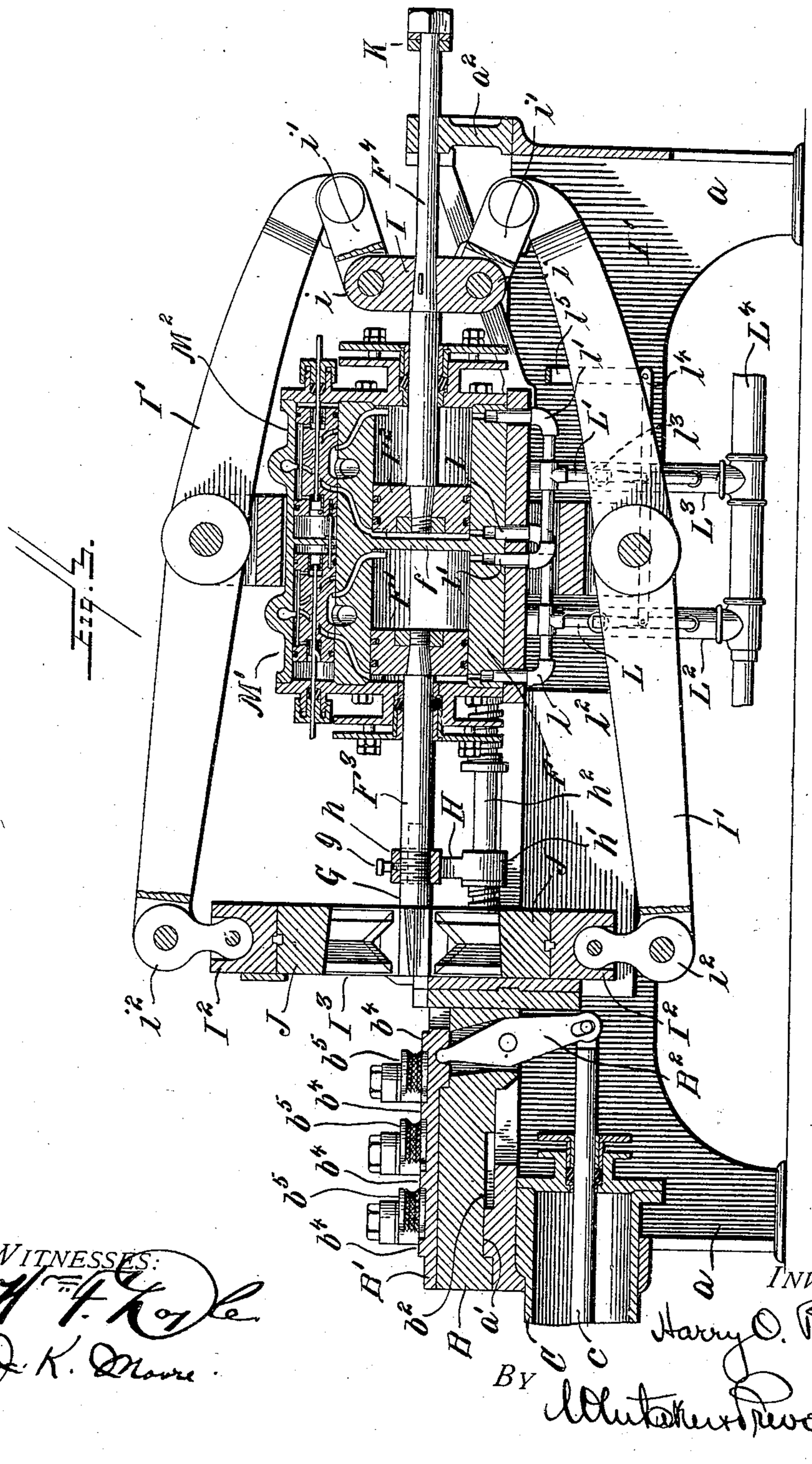

Fig. 7.

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7 SHEETS—SHEET 4.

Fig. 2.

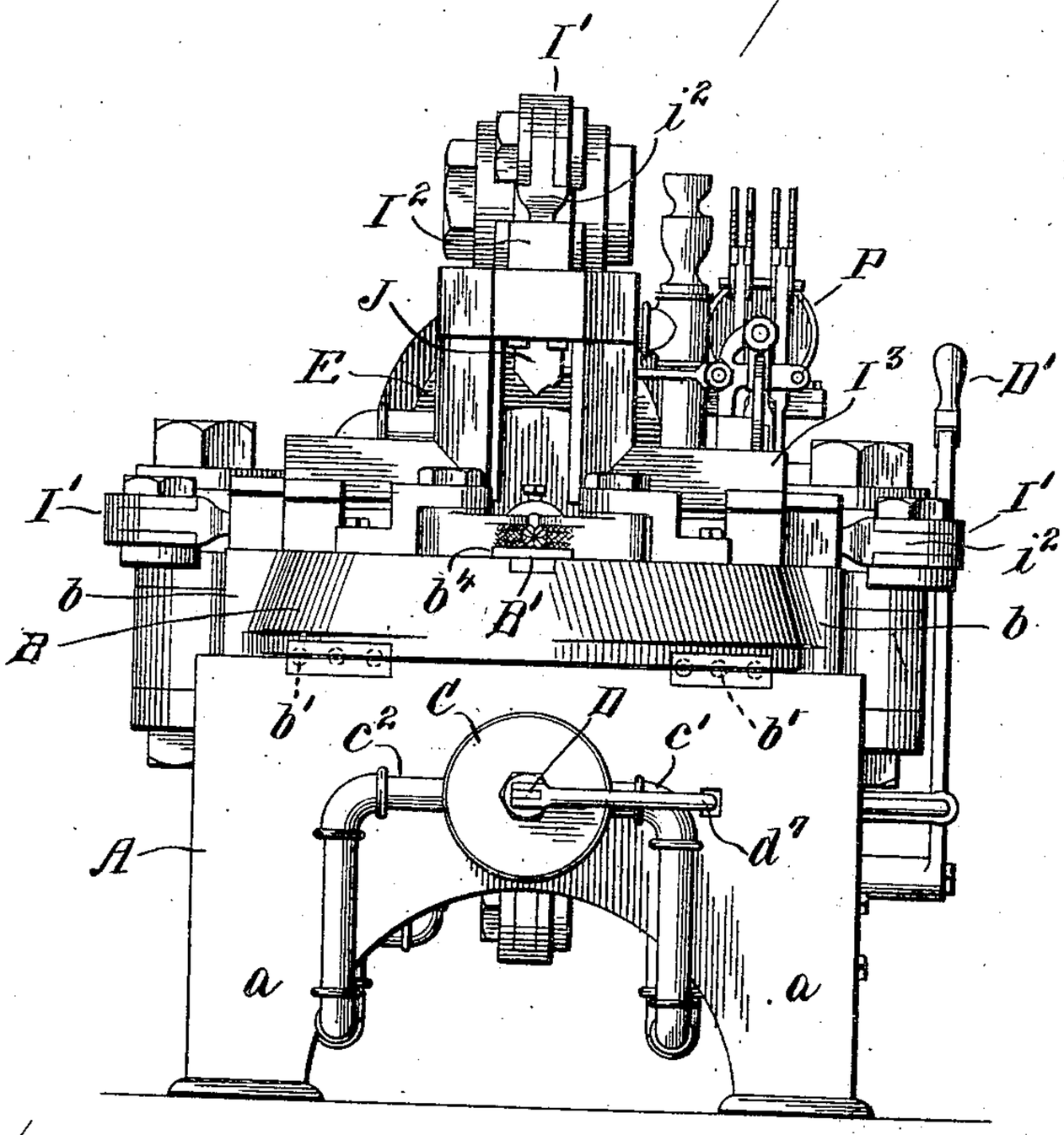


Fig. 17.

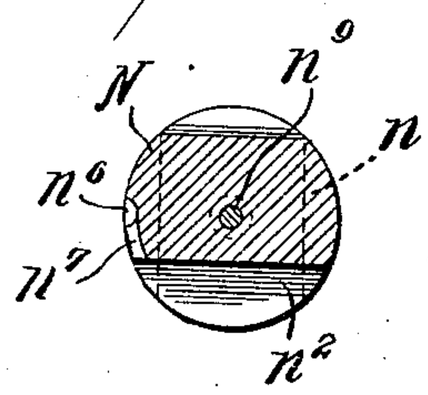


Fig. 18.

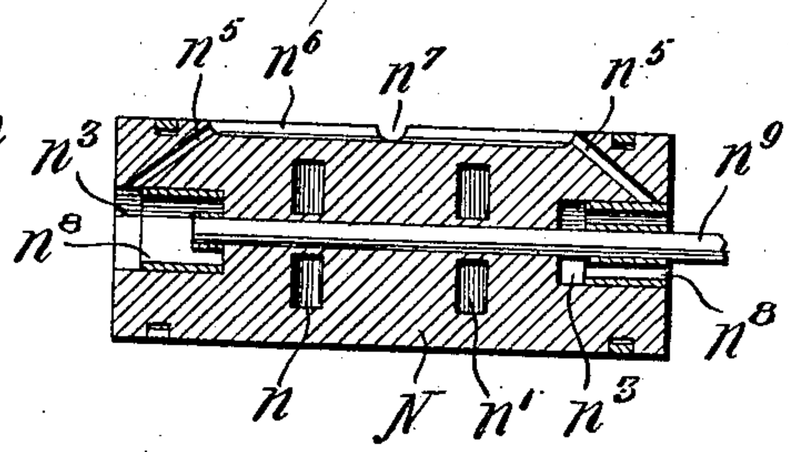
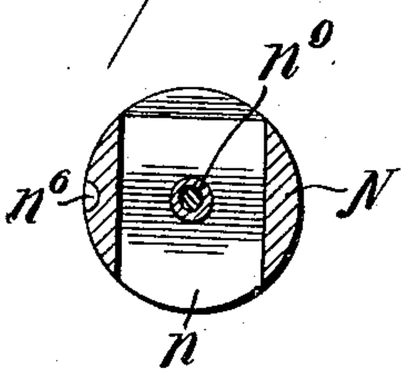


Fig. 19.



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7 SHEETS—SHEET 5.

Fig. 5.

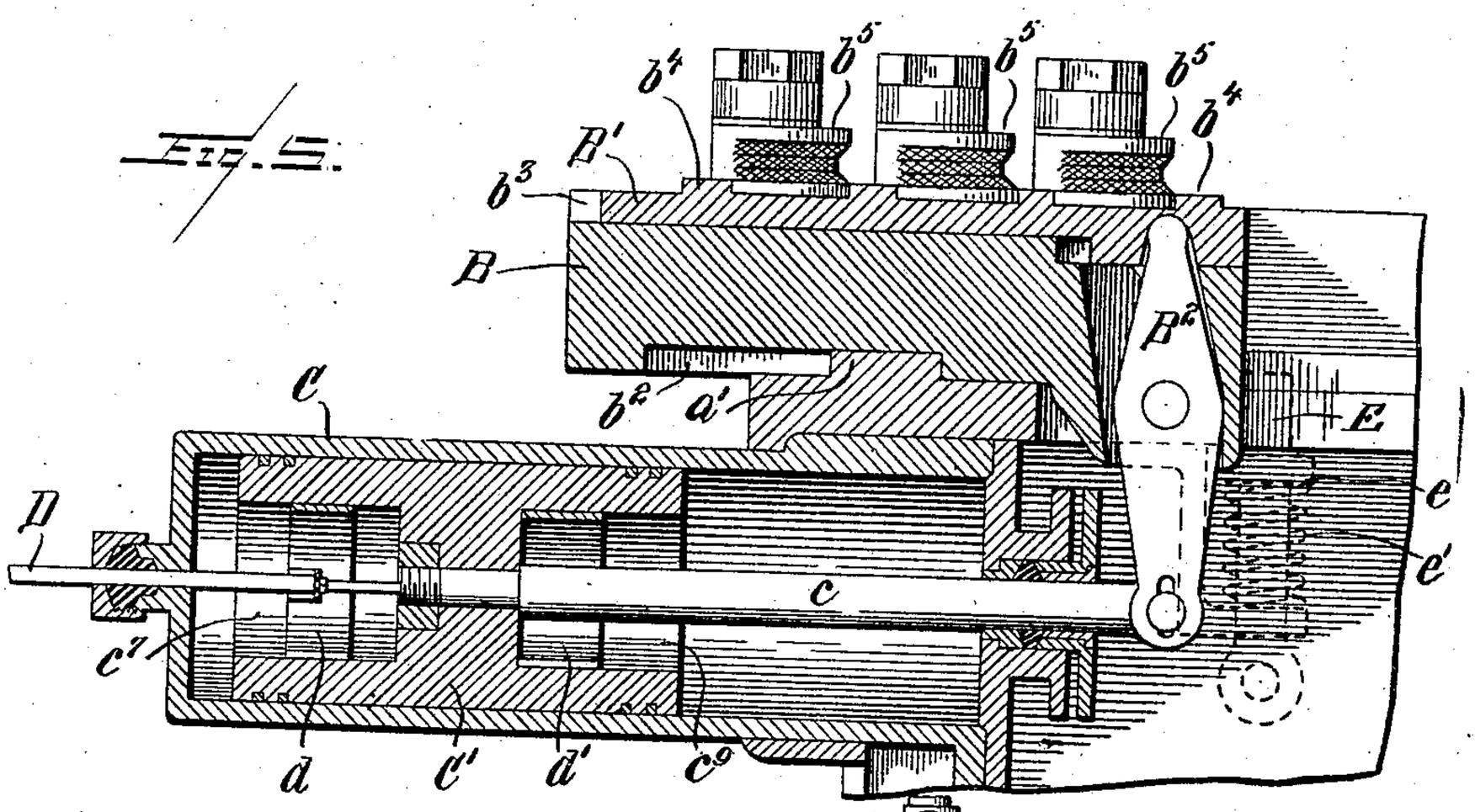


Fig. 6.

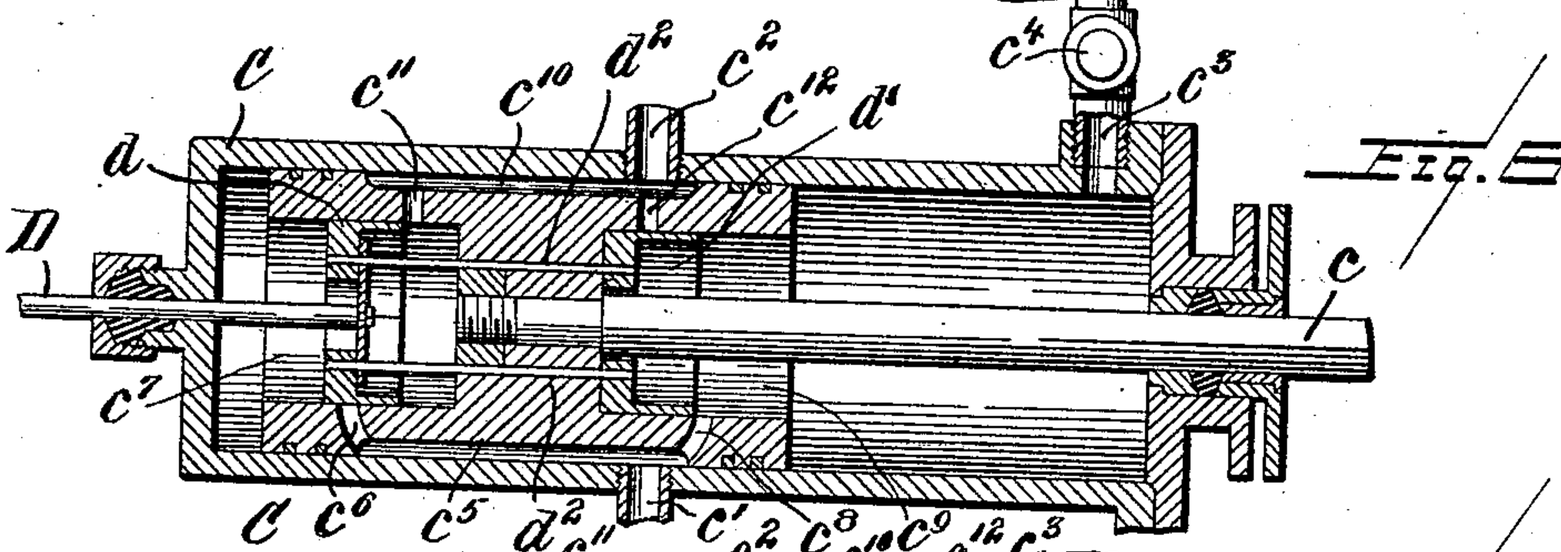


Fig. 7.

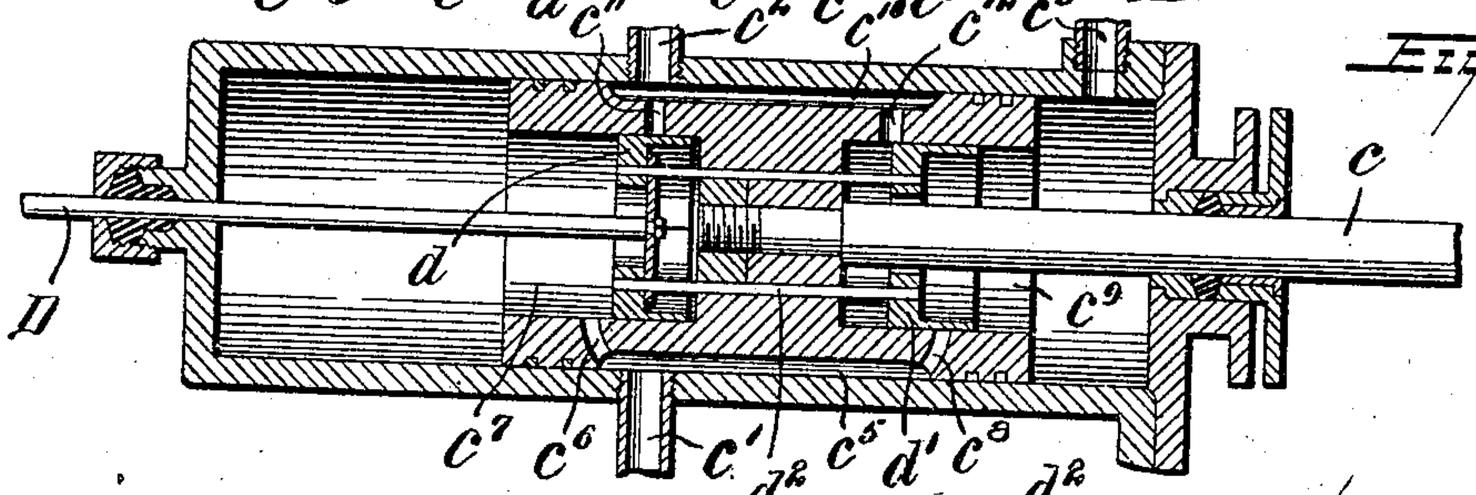
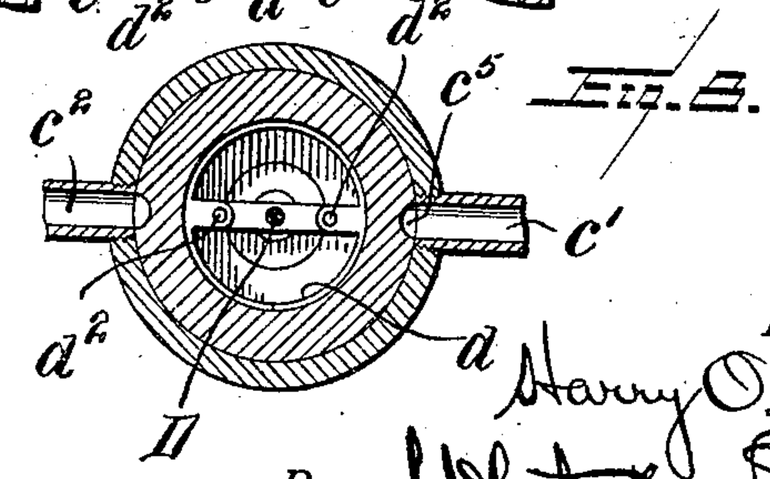


Fig. 8.



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7 SHEETS—SHEET 6.

Fig. 9.

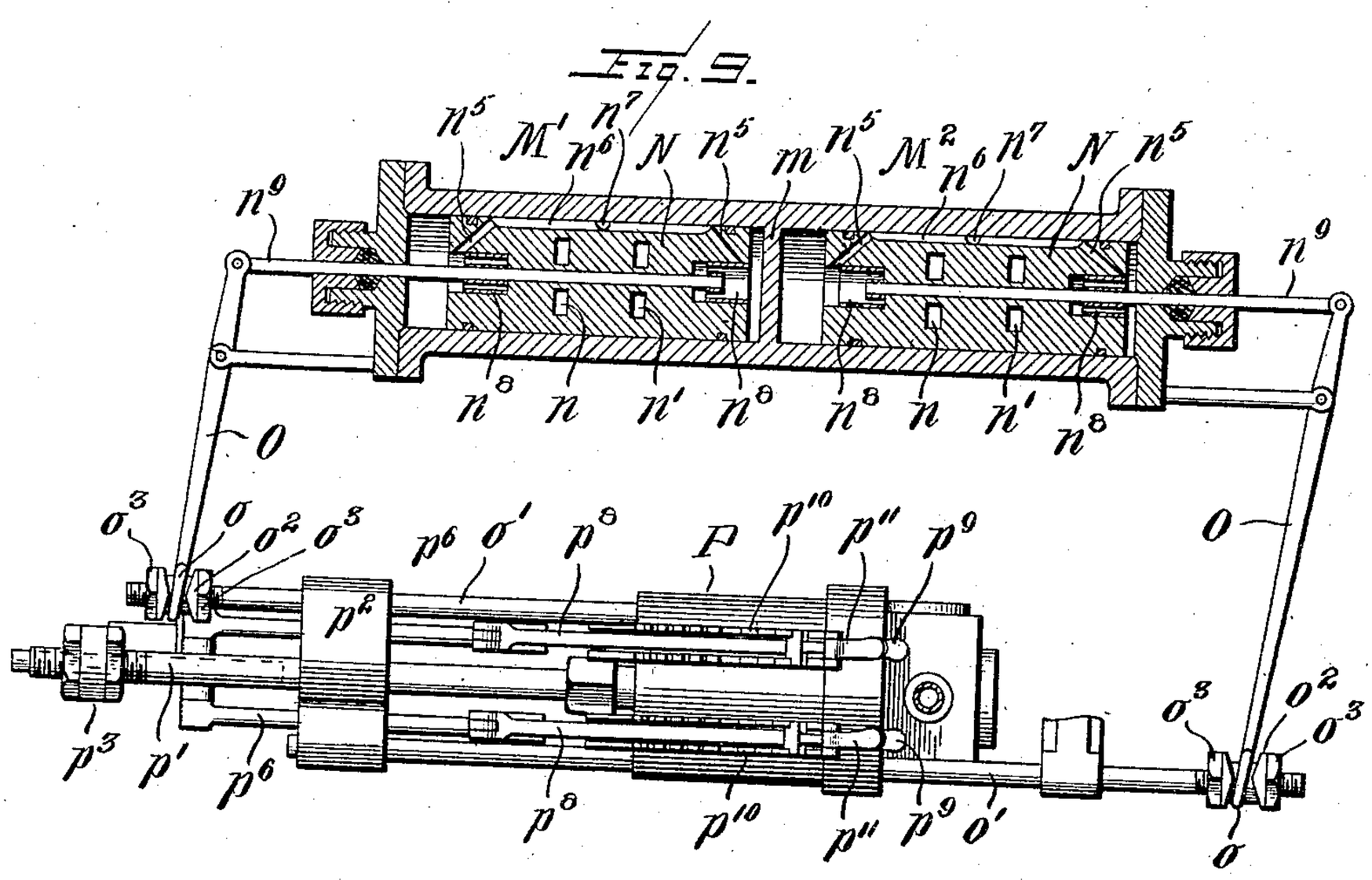
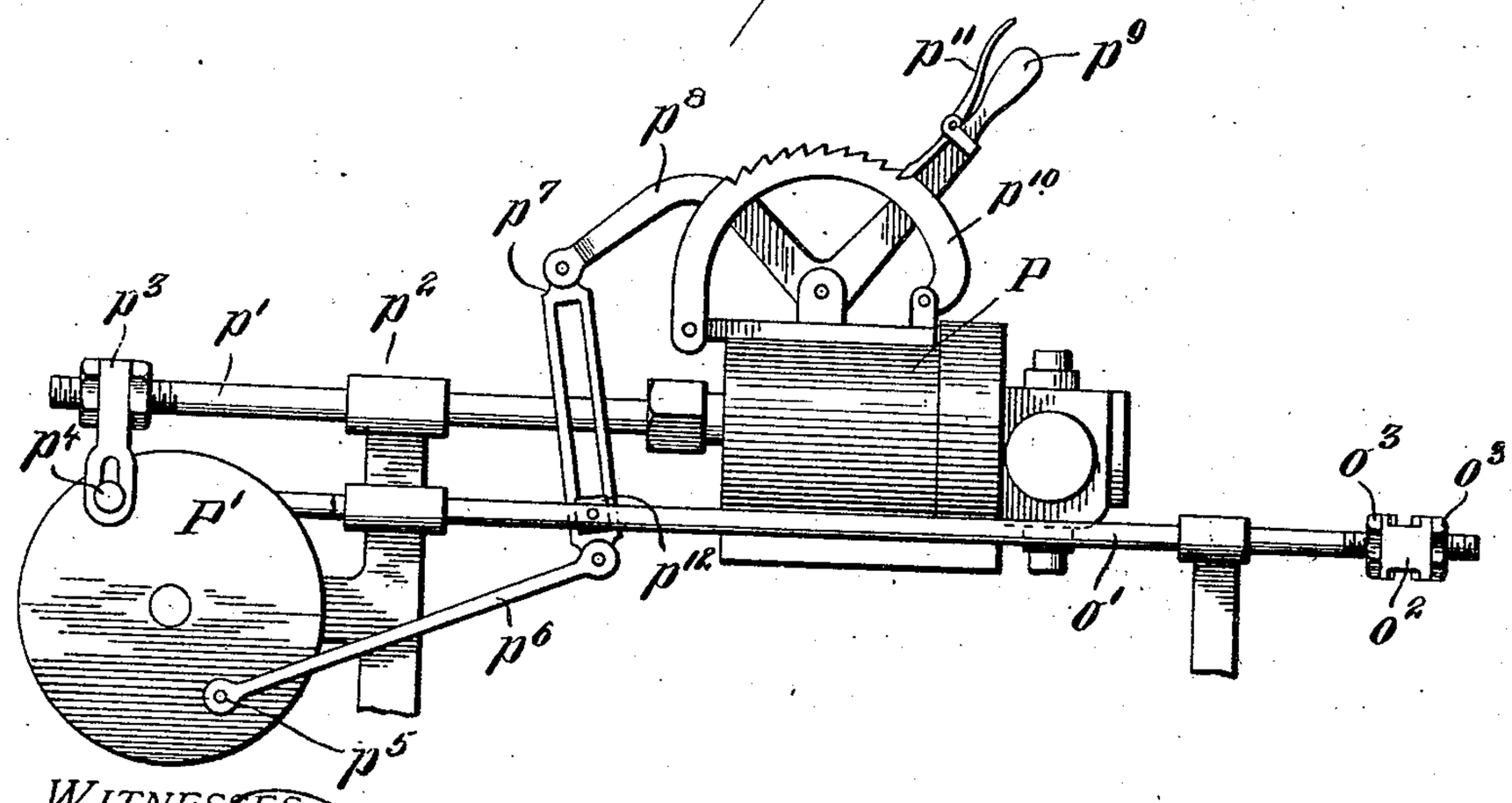


Fig. 10.



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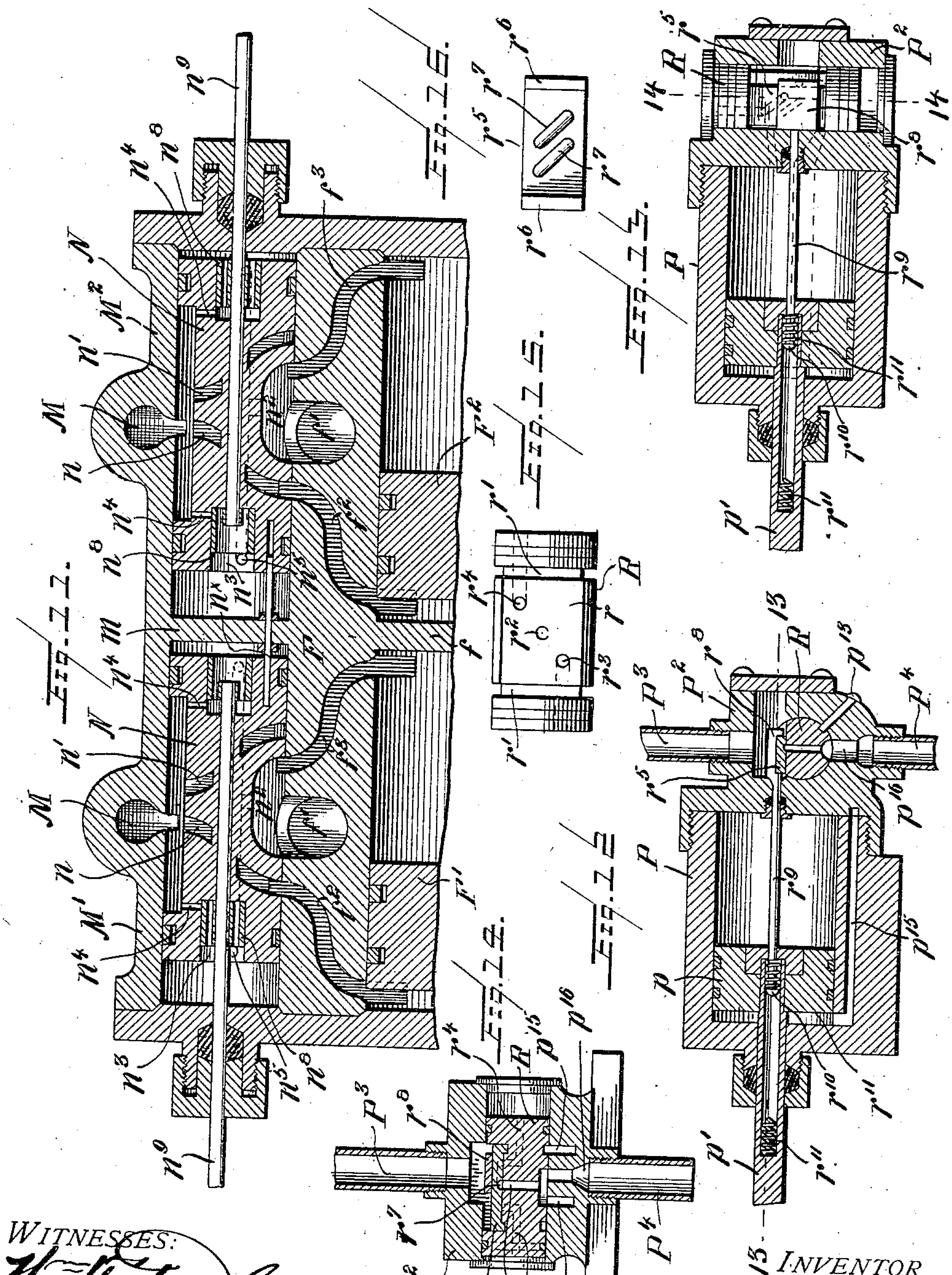
7 SHEETS—SHEET 7.



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UNITED STATES PATENT OFFICE.

HARRY O. PALMER, OF WASHINGTON, DISTRICT OF COLUMBIA.

MACHINE FOR MANUFACTURING AND SHARPENING STAR-BIT DRILLS.

No. 880,567. Specification of Letters Patent. Patented March 3, 1908.

Application filed March 31, 1906. Serial No. 309,137.

To all whom it may concern:

Be it known that I, HARRY O. PALMER, citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Machines for Manufacturing and Sharpening Star-Bit Drills; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention consists in the novel features hereinafter described, reference being had to the accompanying drawings which illustrate one form in which I have contemplated embodying my invention and said invention is fully disclosed in the following description and claims.

Referring to the accompanying drawings, Figure 1 represents a side elevation of a machine embodying my invention, a portion of the cylinder at the left hand end of the said figure being broken away. Fig. 2 is a top plan view of the apparatus as shown in Fig. 1. Fig. 3 is a central vertical longitudinal section of the machine, a portion of the cylinder for actuating the feeding carriage and grippers being broken away. Fig. 4 is an end elevation of the apparatus. Fig. 5 is an enlarged detail sectional view taken in a vertical plane, of the feeding carriage, gripping mechanism and cylinder and piston for operating the same. Fig. 6 is a horizontal sectional view of the cylinder shown in Fig. 5. Fig. 7 is a similar view to Fig. 6 showing the piston and connected parts in a different position. Fig. 8 represents a transverse vertical sectional view through the cylinder shown in Figs. 5, 6 and 7. Fig. 9 is a detail view partly in section showing the valve mechanism for controlling the main cylinders and pistons of the machine and the governing device and connected mechanism for controlling said valves and said main piston. Fig. 10 is a detail view in side elevation of the governing device and connected mechanism for controlling the main piston valve. Fig. 11 is an enlarged vertical sectional view of the main piston valves and portions of the main cylinder and piston. Fig. 12 is an enlarged vertical sectional view of the governing device showing the cylinder, piston and controlling valve mechanism therefor. Fig. 13 is a horizontal sectional view of the governing device taken on the line 13—13 of Fig. 12. Fig. 14 represents a vertical transverse section taken on the line 14—14 of Fig. 13. Fig. 15 is a top plan view of the governor controlling valve detached. Fig. 16 is a bottom plan view of the horizontal slide valve for operating the governor controlling valve. Fig. 17 is an enlarged central transverse sectional view taken through one of the man piston valves. Fig. 18 is an enlarged horizontal sectional view of the same. Fig. 19 is an enlarged transverse section of the valve taken through one of the inlet ports.

The object of my invention is to provide a machine for manufacturing, or forging, or sharpening star-bit rock drills used by miners and others by the use of certain dies and a "dolly-tool" such as are shown and described in my former patent of the United States No. 619,087 dated Feb. 7, 1899.

In carrying out my invention a steel bar from which the drill is to be forged is heated to the desired temperature and is placed in gripping devices upon a sliding carriage and moved or fed forward into proper position and held while the bar is operated upon simultaneously by four dies arranged in pairs opposite to each other and working in planes perpendicular to each other, said dies being substantially identical with those shown in my former patent and which are so constructed as to form lateral grooves in the stock or bar and forge it into the form of a star-bit drill. In conjunction with these four dies, which are reciprocated toward and from the bar and transversely thereto, I also employ what is termed a "dolly-tool" arranged axially of the bar or stock and having V-shaped grooves crossing one another, being substantially the "dolly-tool" disclosed in my former patent, the said tool being caused to strike against the shaped end which the said four dies are in process of making, and in intervals between the blows of the said dies.

My present invention relates more particularly to mechanism by which the operation of the lateral dies, and the "dolly-tool" can be controlled so that said parts shall operate continuously to strike alternating blows as before indicated, or so that either the dies or the "dolly-tool" may be thrown out of operation and the other device or devices continued in operation at the will of the operator, in order that the drill being forged may be drawn out further by the use of the lateral dies while the "dolly-tool" is inactive, or on the other hand, the star point of the drill can be further upset by the "dolly-tool" while

the lateral dies are inactive. My invention also contemplated certain details of construction all of which are hereinafter fully described to the end that the machine shall be fully under the control of the operator at all stages of the forging operation and that the drills may be accurately formed so that all of the four outer corners thereof shall be fully brought up and defined at the sharpened end of the drill as is necessary for the production of a high class drill.

In the accompanying drawings, A represents the main frame of the machine which is preferably a casting resting upon the feet *a*, as shown. At one end of the machine is a horizontal sliding carriage B supported between dovetailed guides *b* upon a plurality of rows of balls *b'* located in semi-cylindrical grooves in the top face of the frame A and bottom face of the carriage B respectively, as indicated in Fig. 1, for the purpose of insuring an easy movement of the carriage. The bottom face of the carriage is also provided with a slot or recess b^2 which engages a stop lug *a'*, see Fig. 5, on the main frame, and of less longitudinal extent than the recess b^2 so that this lug will limit the longitudinal movement of the carriage in both directions. A longitudinal groove b^3 is formed in the center of the top face of the carriage and in this groove is located a longitudinal bar B' provided with transversely disposed projections b^4 on its upper face. This bar I term the gripper operating slide.

On the upper face of the carriage B are pivotally mounted a series of pairs of gripping devices b^5, the members of each pair being located on opposite sides of the slide B'. The outer end of each of these gripping devices is curved eccentrically to its point of pivoting and is concaved and roughened in such manner as to effectively grip the stock or bar of steel from which the drill is to be forged and which is ordinarily an octagonal steel bar. The outer end of each one of these gripping devices lies between two adjacent projections b^4 of the gripper operating slide B' and the construction is such as will be readily seen from an examination particularly of Figs. 2 and 5, that when the slide B' is moved forward with respect to the carriage the outer ends of the gripping devices will be moved away from the stock while the opposite or rearward movement of the slide B' will cause the gripping devices to simultaneously clamp the stock or bar between them.

The forward end of the carriage B is recessed centrally to receive a pivoted lever B^2 the upper end of which is rounded and engages a recess in the bottom of the gripper operating slide, see Fig. 5, for the purpose of shifting said slide with respect to the carriage in both directions. The front and rear walls of the recess in which this shifting lever B^2 is located are so constructed that they will limit the forward and backward movement of the upper end of this lever as is clearly shown in Fig. 5.

Below the carriage B is located a cylinder C provided with a piston C' working therein and a piston rod *c* which extends forward through the usual gland and is connected to the lower end of the shifting lever B^2. The cylinder C is provided on one side with an inlet pipe *c'* for steam, compressed air or other operating fluid, preferably steam, and on the side opposite is an exhaust pipe c^2. The cylinder is also provided at its inner end with a water inlet pipe c^3 which is connected with a supply of water under pressure, such as an ordinary water main and is provided with a suitable check valve c^4. The piston C' is bored at each end to form annular recesses leaving a solid web in the center to which the piston rod *c* is secured. The piston is also provided on the side adjacent to the steam inlet *c'* with a longitudinal groove c^5 which communicates by an inlet port c^6 with the recess c^7 at the outer end of the piston and by an inlet port c^8 with the recess c^9 at the inner end of the piston. On the opposite side of the piston it is provided with a longitudinal groove c^{10} communicating by an exhaust port c^{11} with the recess c^7 and by an exhaust port c^{12} with the recess c^9. The longitudinal groove c^5 does not extend throughout the entire length of the piston but is of such length that it is always in communication with the steam inlet *c'* and the groove c^{10} on the opposite side is always in communication with the exhaust pipe c^2 for the cylinder.

Within the recess c^7 is a ring *d* fitted therein and of a width sufficient to enable it to close both the inlet port c^6 and the exhaust port c^{11} at the same time and in the recess c^9 is located a similar ring *d'* fitted therein and adapted to close the inlet and exhaust ports c^8 and c^{12} respectively. These two rings are provided with inwardly extending lugs and are connected by rods d^2 d^2 which extend through the solid web or central portion of the piston and have a sliding engagement therein. The ring *d* is also provided with a cross piece to which is connected an operating rod D which extends through a stuffing box in the end of the cylinder, so that by means of this rod the two rings may be simultaneously moved with respect to the piston. The movement of the rod D is controlled by a hand lever D' pivotally secured to the main frame adjacent to the other end of the machine at a point convenient to the operator. A link d^3 extends from this hand lever toward the cylinder and is connected to one end of a pivoted lever d^4, the lower end of which is connected by a link d^5 to another pivoted lever d^6, the upper end of which is connected by a link d^7 with the rod D, the points of pivoting of the

levers d^4 and d^6 being such that a slight movement of the hand lever D′ produces a greater movement of the rod D in the same direction.

The operation of the mechanism thus far described in gripping the stock and moving it forward into position to be operated upon will now be described and is as follows:— When the carriage is at its extreme outermost position the parts will be in a position illustrated in Figs. 5 and 6. When the carriage is in this position, it is therein locked by means of a sliding bolt E illustrated in dotted lines in Fig. 5 and also shown in Fig. 1. This bolt is vertically arranged in the frame and is provided with a collar e between which and a portion of the frame a spiral spring e' is arranged which normally holds the bolt in its highest position in which it is shown in Fig. 5, so as to engage the inner edge of the carriage B and prevent it from moving towards the dies. This bolt is connected with a foot lever E′ shown in Fig. 1, by means of a pivoted lever e^2 so that by pressing on the foot lever E′ the bolt may be withdrawn from the path of the carriage.

The parts being in the position shown in Figs. 5 and 6, the piston C′ will be at its outermost position and the inner end of the cylinder will be filled with water supplied by the pipe c^3. A bar of steel to be used for the formation of a drill and heated to the desired temperature, is laid upon the carriage B between the opposing gripping devices b^5 and the operator will then move the lever D′ to the right (see Fig. 1), thus causing the two rings d and d' to move inwardly in the piston recesses. The result of this movement of the ring will be that the steam inlet port c^6 at the outer end of the piston will be uncovered by the ring d, but the ring d' is of greater width than the ring d and this movement sufficient to uncover the inlet port c^6 is not sufficient to open the exhaust port c^{12} and therefore while steam at boiler pressure (or other motive fluid) is admitted at the outer end of the cylinder, the piston cannot move on account of the resistance of the water contained in the inner end of the cylinder. A further movement of the lever D′ to the right will slightly open the exhaust port c^{12} and permit a small quantity of the water to pass into the exhaust pipe c^2 when the piston will begin to move inward and it will be noticed that by reason of this construction, the movement of the piston in a direction toward the dies of the machine, will always be controlled by the operator and regulated by allowing a larger or smaller quantity of the water to escape into the exhaust pipe, which at the same time controls the speed of movement of the piston. It will also be noted that the inward movement of the piston can be instantly checked by a slight reverse movement of the hand lever D′ sufficient to close the exhaust port c^{12}, without closing the steam inlet port c^6 (see Fig. 7), thus holding the piston in the position at which it is arrested with the full force of the steam at boiler pressure behind it. This construction enables the operator to move the piston inwardly slowly or rapidly and to cause it to move very short distances when required, the speed and amount of movement being perfectly under control while maintaining the full initial pressure of the motive fluid behind the piston.

As before stated, at the moment the piston first begins to move forward the carriage B is held from movement by the locking bolt E, so that the movement of the piston is transmitted by the piston rod c to the lower end of the shifting lever B^2, see Fig. 5 which causes the upper end of said lever to move rearwardly, carrying with it the gripper operating slide B′, the projections b^4 of which move the gripping devices b^5 and cause them to firmly grip the steel bar or stock which has been placed between them, as will be readily understood. The steel bar being now firmly gripped upon the carriage so as to be held from any outward movement and enable it to resist the blows of the die tools, hereinafter described, the operator places his foot on the foot lever E′ and withdraws the bolt E and the further movement of the piston inward then causes the entire carriage B to move toward the dies passing over the top of the bolt E which engages a plane bottom surface of the carriage at one side of the gripper operating slide, thus preventing the bolt from rising and making it unnecessary for the operator to keep his foot on the lever E′. The operator will open the exhaust port c^{12} so as to allow the carriage to move quickly inward until the steel bar is in proper position to be operated upon, when he will cut off the exhaust port c^{12} by a reverse movement of the lever D′, permitting the steam inlet port c^6 to remain open and allowing the pressure of steam behind the piston to hold the piston in position and through its connection with the carriage to resist the blows of the "dolly-tool".

During the formation of the star-bit drill by means of the dies and tool before referred to, the operator by means of the hand lever D′ can feed up the stock from time to time as may be necessary and when the drill is completed the lever D′ will be reversed so as to throw the rings d, d' into the position shown in Fig. 6, causing the ring d to close the inlet port c^6 and open the exhaust port c^{11}, and the ring d' to close the exhaust port c^{12} and open the inlet port c^8. This admits steam into the inner end of the piston cylinder and causes the return movement of the piston carrying with it the carriage B until the inner end of the recess b^2 engages the stop lug a', when the carriage will be ar-

rested and the further outward movement of the piston will shift the lever B^2 causing its upper end to move inward carrying with it the gripper operating slide and automatically releasing the gripping devices b^5 from the finished drill. At the instant that the carriage B is arrested by the stop lug a', the spring actuated locking bolt E will move upwardly so as to lock the carriage in its outermost position. As the steam in the inner end of the cylinder condenses, additional water will enter under the supply pressure through the check valve c^4 and pipe c^3 so as to maintain the pressure of the water in the inner end of the cylinder.

Situated over the central portion of the main frame and at some distance from the feeding carriage B is the main cylinder F which is divided by a central partition f into two separate cylinders axially alined and provided at each end with the usual stuffing box. F′ and F^2 are the two pistons working in the two halves of the cylinder and provided respectively with the piston rods F^3 and F^4. The piston F^3 is provided with a socket to receive the "dolly-tool" G the shank of which extends into said recess and is secured by a set screw g which also passes through a threaded collar h in the center of a yoke H, see Fig. 2 and Fig. 3. The outer ends of said yoke are provided with collars h' which encircle guide rods h^2 rigidly supported in a horizontal position and each of said guide rods is provided adjacent to each end with a spiral spring h^3 and washer h^4 for the purpose of serving as a buffer to prevent the piston F′ from striking either end of the cylinder. The piston rod F^4 has its rear end supported in an auxiliary guide a^2, secured to the main frame, and said piston rod is provided within said guide with a collar I pinned thereto and provided with four perforated lugs i arranged in pairs on opposite sides of the center of the rod, the lugs of one pair being in a plane at right angles to the lugs of the other pair. These lugs are connected by links i' to the outer end of four die operating levers I′, see Figs. 1, 2 and 3 which are pivoted at or about their centers in supports provided on the main frame and have their opposite ends extending in a direction toward the end of the machine where the carriage B is located. These ends of the levers, which I term their inner ends, are connected by links i^2, best seen in Fig. 3, with four sliding die carriers I^2 working in a four-way guide I^3 supported in the main frame and each of said die holders or carriers is provided with means, preferably a dovetailed groove, for receiving one of the four lateral forming dies J, said dies being constructed substantially as illustrated and described in my former application above referred to. It is obvious from the foregoing construction that when the piston F^2 moves outwardly or to the right in Fig. 3 the four dies J will be brought together simultaneously upon the heated bar of steel or stock, so as to give it a compressing blow from four directions at once and the dies are so shaped that the lateral grooves of the star-bit form of drill, can thus be rapidly formed by the successive action or operation of these dies. The extreme end of the piston rod F^4 is provided with a cross bar or yoke K, the outer ends of which are perforated and through these perforations pass stationary guide rods k, k, each of which is provided with a buffer spring k' to prevent the piston F^2 from striking the partition f in the cylinder.

The main cylinders are provided on their lower side with the branch drain pipes l and l' which communicate with the main drain pipes L and L′ controlled by the drain cocks l^2 l^3, each provided with a lever connected to a common operating rod l^4 and operated by a lever l^5 for the purpose of draining the cylinders of water of condensation as required. The drain pipes L and L′ communicate with the main exhaust pipes L^2, L^3 which in turn communicate with the main common exhaust pipe L^4 to which the condensed steam from all the exhaust ports of the various operating cylinders of the machine is conveyed and from which the exhaust steam and water of condensation is carried off.

The mechanism for admitting steam to and exhausting it from the main cylinders and the valves immediately controlling the inlet and exhaust ports will now be described, special reference being had to Fig. 11, in which these parts are shown drawn to an enlarged scale. The cylinders are each provided on their upper side with an exhaust passage f' which passages communicate directly with the main exhaust pipes L^2 and L^3 and each cylinder is also provided with ports f^2, f^3 similar to those of an ordinary steam engine. Above each of the main cylinders is located a main valve chest M′ and M^2 respectively, of cylindrical form and separated by the partition m. Each of said valve chests is provided with a main steam inlet M supplied with steam by means of pipes M^3 and M^4 from the main common steam pipe M^5 of the machine, see Fig. 1, which supplies steam to all the steam actuated piston cylinders of the machine and is controlled by a main cock or cut off M^6 operated by a vertical rod M^7 extending upward through the machine and provided at its upper end with a handle M^8. In each of the valve chests M′ and M^2 is located a valve mechanism and as the construction of these valve mechanisms is identical, a description of one will serve for both. The construction of this valve mechanism is illustrated in detail in Figs. 17, 18 and 19 on Sheet 4.

N represents the piston valve which is

itself a piston and works in the cylindrical valve chest being held from rotation within the chest by a guide rod $n^{\times}$ secured in the partition m and having a portion extending into each of the valve chests and engaging a guiding recess in each of the valves as shown, particularly in Fig. 11. The valve N has the central portion of its upper face cut away leaving a flat upper face which forms an inlet passage at all times in communication with the main steam inlet M. The valve is provided with the main steam ports n and n' which are placed in communication with the ports f^2, f^3 communicating with the opposite ends of the main piston cylinder. The bottom part of the valve is provided centrally with an exhaust port n^2 adapted to be placed alternately in communication with the cylinder ports f^2, f^3. The longitudinal movement of the valve N is produced by the steam or other motor fluid acting upon the opposite ends of the valve and controlled by a governor, hereinafter described. At each end of the valve N an annular recess is provided which is indicated at n^3 n^3; each of said recesses communicates by a small auxiliary inlet port n^4 with the steam inlet recess at the top of the valve and each recess also communicates with a transversely extending auxiliary exhaust port n^5 which is drilled through the lateral wall of the recess, see Fig. 18, and communicates with a longitudinal groove n^6 in the side of the valve, and this groove communicates by a short groove n^7 extending downwardly around the piston with the exhaust port n^2, see Figs. 17 and 18. Within each of the recesses n^3 of the piston, is a ring n^8 capable of longitudinal movement therein for the purpose of alternately opening and closing the auxiliary inlet and exhaust ports n^4, n^5 before referred to, and these rings are connected for joint movement by a rod n^9 which extends through a central portion of the piston valve N and through a stuffing box at the outer end of the valve chest, the rod n^9 being operated by a governing device, as hereinafter described. The rings n^8 are so attached to the rod n^9 that when one of said rings is in position to open the auxiliary inlet port n^4, the exhaust port n^5 will be closed and the ring at the opposite end of the valve will be in position to close the inlet n^4 and open the auxiliary exhaust port n^5.

In will be seen by reference to Fig. 11 that when the rings are in the position therein shown, steam can enter the recess n^3 at the right hand end of the valve N and pass through the ring to the steam space at the end of the valve, thus driving the valve to the other end of the steam chest, the exhaust steam at the other end of the valve escaping through the auxiliary exhaust port n^5 and the shifting of the valve will shift the main inlet ports n, n' and exhaust port n^2 and thus control the movement of the main piston of the machine. The shifting of the valve rod n^9 in the opposite direction will admit steam to the opposite end of the valve and thus the valve N will be shifted from one end of its chest to the other whenever the valve rod n^9 is shifted, thus controlling the action of the main piston in the cylinder. It may also be stated that the governing or controlling device, hereinafter described, is so constructed as to shift the valve rod n^9 always in the same direction so that the valve N will work in the same direction and simultaneously and the main pistons F', F^2 are thus caused to move simultaneously in the same direction whenever both are in operation, or in other words in step with each other.

In Fig. 9 I have shown a top plan view of the two valve chests M', M^2 and valves N with the governing or controlling device therefor, detached from the other portions of the machine and Fig. 10 represents a side elevation of the governing device and connected parts, while Figs. 12 to 16 inclusive illustrate in detail the construction of the governor piston and its controlling valves. Referring now to these figures, it will be seen that each of the valve rods n^9 is connected to a pivoted lever O, the outer end of which is provided with an eye or yoke o through which passes a shifting rod o' mounted in horizontal guides so as to be capable of longitudinal movement and provided with a yoke engaging collar o^2 held adjustably between nuts o^3 engaging a threaded portion of the rod. The longitudinal movements of these shifting rods effect the shifting of the valve rods n^9 and the rings n^8 of the valves N.

P represents the cylinder of the governing device proper provided with a piston p and piston rod p'. The piston rod extends through a guide p^2 and is provided at its outer end with a downwardly extending slotted arm p^3 adjustably secured to the piston rod and having its slot engaging a crank pin p^4 on a crank disk P' mounted on a bracket and provided on opposite sides with link operating crank pins p^5. To each of these pins p^5 is connected one of the rods o' by devices similar to the ordinary link mechanism which is used in steam engines. These link mechanisms are exactly similar and each comprises the following elements. A link p^6 is connected at one end to one of the crank pins p^5 and at the other end to the bottom of the ordinary slotted link p^7, the upper end of which is pivoted to a shifting lever p^8 pivoted on top of the cylinder P or other stationary portion of the frame and provided with the usual hand lever p^9, ratchet segment p^{10} and pawl p^{11}. p^{12} represents a block mounted in the slot of the link p^7 and pivotally connected to one of the shifting rods o'. It will thus be seen that when the piston p of the cylinder P is in

operation, the crank disk P′ will be oscillated and supposing both of the links p^7 to be in their raised position, as shown in Fig. 10, the two shifting rods o' will be simultaneously moved in the same direction, and reciprocated as will be readily understood, thus causing corresponding reciprocation of the valves N and the main piston of the machine. It will also be seen that the stroke of either or both main pistons may be regulated by means of the hand lever p^9, the shifting of which varies the position of the link mechanism, so that a harder or easier blow may be struck with the "dolly tool" and harder or easier compressing blows may be struck with the lateral dies. If now, it is desired to discontinue temporarily the operation of either the "dolly tool" or the dies, the corresponding lever p^9 will be operated to move down the slotted link to its lowest position when the point of pivoting at the upper end of the link will so nearly coincide with the pivotal connection of the block p^{12} with the corresponding shifting rod o', that the shifting rod will not be operated and the corresponding tool or dies, as the case may be will be held out of operation while the rest of the apparatus will operate in its usual manner, thus placing the control of the forging devices directly under the operator and enabling him to use the lateral dies alone or the "dolly tool" alone or both alternately to effect the perfect formation of the star-bit drill. It will also be noted that after one of the pistons F or F^2 has been thrown out of operation temporarily by shifting its corresponding link mechanism, when the link mechanism is returned to normal the crank disk P′ will cause the piston which has not been operating to begin to operate at the proper point in the cycle of movement of the pistons, so as to again work in step with the other piston.

The cylinder P, which I term the governor cylinder, is provided at one end with a valve chest P^2 in which is a piston valve R, shown detached in Fig. 15, working transversely of the cylinder P and held from rotary movement in the valve chest by means of a pin p^{13}. The valve chest is provided on its upper side with a steam inlet pipe P^3 and at its lower side with an exhaust pipe P^4, the former communicating with the main steam inlet pipe of the machine and the latter with the main exhaust pipe of the machine, and the steam inlet pipe P^3 is provided with a cut off or controlling cock P^5, see Fig. 2. The valve chest P^2 is also provided with two inlet ports p^{14} and p^{15} communicating with opposite ends of the cylinder P and with an exhaust port p^{16} communicating with the pipe P^4.

The governor valve R has at its upper portion a flat, central face r, at each end of which is a transverse groove r'. The valve is provided with a central vertically disposed exhaust port r^2 extending through the valve and having a recess at its lower end, as shown in Fig. 14, constructed so as to place either of the ports p^{14} or p^{15} in communication with the exhaust port p^{16}. The valve R is also provided at one side of the center with an inlet port r^3 having an opening in the flattened portion of the valve and extending to one end of the valve, and on the other side of the center is another inlet port r^4 having an opening in the flat face of the valve and extending to the opposite end thereof, the three ports r^3, r^2 and r^4 being arranged in a line diagonally across the flattened upper surface of the valve. r^5 represents what I term a D-valve or plate valve which is placed upon the flat upper face of the piston valve R and is provided at each end with guiding lugs r^6 engaging the groove r' in the latter. The under face of the D-valve r^5 is provided with two inclined or obliquely disposed parallel recesses r^7 r^7. The D-valve r^5, which is shown detached in Fig. 16, is of less width than the flat upper face of the valve R and is of a width sufficient to cover the central exhaust port r^2 and one of the inlet ports r^3, r^4 thus exposing the other inlet port. When the D-valve is in this position, as shown for example in Figs. 12 and 13, the two ports which are covered by it are placed in communication by means of one of the recesses r^7 before described. It will thus be seen that by shifting the D-valve transversely of the valve R, steam can be admitted alternately to opposite ends of the valve R to effect its longitudinal movement, the inlet port r^3 or r^4 which is covered by the D-valve being placed in communication with the exhaust through one of the grooves r^7. The reciprocation of the D-valve r^5 across the upper face of the valve R is effected by means of a yoke r^h, see Figs. 12, 13 and 14, which engages the D-valve but permits the D-valve to move under it longitudinally when the valve R is reciprocated. The yoke r^8 has attached to it a stem r^9 which passes through a stuffing box into the interior of the cylinder P and extends into a hollow portion of the piston p' where it is provided with a head r^1. Springs r^{11}, r^{11} are provided at each end of the hollow portion of the piston rod, with which the head r^{10} engages yieldingly, and it will thus be seen that at each end of the stroke of the piston p one of these springs will strike the head r^{10} of the valve stem r^9 and shift laterally the D-valve, thus causing the change in the relation of the ports effected thereby, to longitudinally shift the valve R which in turn causes the reverse movement of the piston p.

The stock holding and feeding mechanism herein shown and described, is not specifically claimed herein as the same will form the subject matter of another application.

What I claim and desire to secure by Letters Patent is:—

1. In a forging machine the combination with a plurality of laterally movable die holders, arranged to reciprocate toward and from the stock, in a plane perpendicular thereto, and a longitudinally movable dolly tool holder, arranged to reciprocate in line with the stock, of operating mechanism for producing a continuous reciprocation of said die holders, a separate operating mechanism for producing a continuous reciprocation of the dolly tool holder, connections between said operating mechanisms for causing the blows of the said die holders to alternate with those of the dolly tool holder when the said mechanisms are operated simultaneously and a controlling device for said operating mechanisms for causing them to operate separately and also simultaneously, substantially as described.

2. In a forging machine the combination with a plurality of laterally movable die holders, arranged to reciprocate toward and from the stock, in a plane perpendicular thereto, and a longitudinally movable dolly tool holder, arranged to reciprocate in line with the stock, of operating mechanism for producing a continuous reciprocation of said die holders, a separate operating mechanism for producing a continouus reciprocation of the dolly tool holder, connections between said operating mechanisms for causing the blows of the said die holders to alternate with those of the dolly tool holder when the said mechanisms are operated simultaneously and a controlling device for said operating mechanisms for causing them to operate separately and also simultaneously and independent devices for regulating the blow produced by each of said mechanisms, substantially as described.

3. In a forging machine, the combination with laterally movable die holders arranged to reciprocate toward and from the stock in a plane perpendicular thereto and a longitudinally movable dolly tool holder, arranged to reciprocate in line with the stock, and substantially perpendicularly to the plane of movement of said die holders, of a piston and cylinder for continuously reciprocating said die holders, a separate piston and cylinder for continuously reciprocating said dolly tool, connections between said cylinders for causing the blows of said dies to alternate with those of the dolly tool when the said pistons are simultaneously operated, and means for operating said pistons simultaneously and means for operating each of said pistons separately and independently, substantially as described.

4. In a forging machine the combination with laterally movable die holders arranged to reciprocate toward and from the stock in a plane perpendicular thereto and a longitudinally movable dolly tool holder, arranged to reciprocate in line with the stock, and substantially perpendicularly to the plane of movement of said die holders, of a piston and cylinder for continuously reciprocating said die holders, a separate piston and cylinder for continuously reciprocating said dolly tool, connections between said cylinders for causing the blows of said dies to alternate with those of the dolly tool when the said pistons are simultaneously operated, means for operating said pistons simultaneously and means for operating each of said pistons separately and independently, and independent adjustable devices, connected with said cylinders for regulating the force of the blows produced thereby, substantially as described.

5. In a forging machine, the combination with a plurality of separate main cylinders, and pistons and a separate controlling valve mechanism for each cylinder, of a governing device comprising a cylinder and a piston working therein, connections between said piston and the said separate valve mechanisms, for the main cylinders, and manually operated devices for varying the control of said main cylinders and pistons by said governing device, substantially as described.

6. In a forging machine, the combination with a plurality of separate main cylinders and pistons and controlling valve mechanism for each cylinder, of a governing device comprising a cylinder, a reciprocating piston therein, connections between said piston and the controlling valve mechanisms for said separate main cylinders, and manually operated devices in said connections for varying the operation of the main pistons under the control of said governing device, substantially as described.

7. In a foregoing machine, the combination with a main cylinder and piston and a separate main cylinder and piston, of a governing device comprising among its members a cylinder, a piston working therein and operatively controlling the admission of motor fluid to the main cylinders, and independent adjustable devices between said governor piston and each of said main cylinders for regulating the stroke of, and stopping the action of their pistons, substantially as described.

8. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a valve chest and controlling valve for each of said main cylinders and a governing device including among its members, a cylinder, a piston working therein, operative connections between said piston and said controlling valves, for normally effecting the joint action of said valves and the main pistons, and independent hand operated adjusting devices interposed between said governor piston and said con-

trolling valves for regulating the stroke of the main pistons, and stopping the operation thereof, substantially as described.

9. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a valve chest and controlling valve for each of said main cylinders and a governing device including among its members, a cylinder, a piston working therein, operative connections between said piston and said controlling valves, for normally effecting the joint action of said valves and the main pistons, and independently operable link motions, interposed between said governor piston and said controlling valves, for regulating the stroke of said main pistons or throwing either of them out of operation, substantially as described.

10. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a valve chest for each of the main cylinders, a controlling piston valve in each of said valve chests, provided with controlling ports for the main cylinder, and with separate ports for securing the reciprocation of said piston valve, rings movable with respect to said valves for controlling the movements of said valves, a governing device including among its members, a cylinder and a piston operating therein, connections between said piston and said rings, including independent link motions, and independent hand levers for shifting the links of said link motions, substantially as described.

11. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a valve chest for each of the main cylinders, a controlling piston valve in each of said valve chests, provided with controlling ports for the main cylinder, and with separate ports for securing the reciprocation of said piston valve, rings movable with respect to said valves for controlling the movements of said valves, a governing device including among its members, a cylinder and a piston operating therein, an automatically operated controlling valve for said governor cylinder and piston, cranks operated by said governor piston, connections between said cranks and said valve controlling rings, including link motions, and independent hand levers for shifting the links of said link motions, substantially as described.

12. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a governing device comprising among its members, a cylinder, a piston working therein, an automatic controlling valve for causing the continuous reciprocation of said governor piston, and connections between said governor piston and the main cylinders, for controlling the admission of motor fluid to the latter and manually operated devices for varying the control of said main pistons by said governing device, substantially as described.

13. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of a governing device comprising among its members, a cylinder, a piston working therein, an automatic controlling valve for causing the continuous reciprocation of said governor piston, connections between said governor piston and the main cylinders for controlling the admission of motor fluid to the latter, and independent hand operated devices for adjusting said connections to independently control the stroke of each main piston or stop its action, substantially as described.

14. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of independent valve chests and controlling valves for said main cylinders, and a governing device including among its members, a cylinder, a piston working therein, an automatic valve for said governor cylinder for causing the continuous reciprocation thereof, and independently adjustable connections between said governor piston and said controlling valves for the main cylinders, substantially as described.

15. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of independent valve chests and controlling valves for said main cylinders, and a governing device including among its members, a cylinder, a piston working therein, an automatic valve for said governor cylinder having a part operated automatically by the reciprocations of the governor piston, and independently adjustable connections between the governor piston and the said controlling valves for the main cylinders and manually operated devices for adjusting said connections, while the machine is in operation to vary the action of said main cylinders or either of them, substantially as described.

16. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of independent valve chests and controlling valves for said main cylinders, and a governing device including among its members, a cylinder, a piston working therein, an automatic valve for said governor cylinder having a part provided with a stem working in a hollow portion of the governor piston, and adapted to be shifted by the reciprocations thereof, and independently adjustable connections between said governor piston and the controlling valves for the main pistons and independent hand operated devices for adjusting said connections while the machine is in

operation to vary the action of said main cylinders or either of them, substantially as described.

17. In a forging machine, the combination with a main cylinder and piston, and a separate main cylinder and piston, of independent valve chests and controlling valves for said main cylinders, and a governing device including among its members, a cylinder, a piston working therein, an automatic valve for said governor cylinder in the form of a piston and provided with port s for controlling the admission of fluid to the governor cylinder, and independent ports for reciprocating said automatic piston valve, a D-valve coöperating with said automatic valve, and provided with a part adapted to be operated by the governor piston to shift said D-valve at each stroke thereof, and connections between said governor piston and the controlling valves for the main cylinders, having independent hand adjusting devices for regulating the stroke of and stopping the main pistons, substantially as described.

18. In a forging machine, the combination with a main cylinder and piston, a separate main cylinder and piston, separate steam chests for said cylinders, a piston valve in each of said chests, rings in each of said valves for controlling its movement, a governor including among its members a cylinder, a piston working therein, an automatic valve controlling said governor cylinder and piston, cranks operatively connected with the governor piston, separate connections between said cranks and said valve rings, including slotted links and independent hand operated devices for shifting said slotted links to independently regulate the stroke of or throw out of operation the main pistons, substantially as described.

In testimony whereof I affix my signature, in the presence of two witnesses.

HARRY O. PALMER.

Witnesses:
L. P. WHITAKER,
J. K. MOORE.