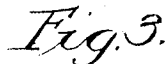


FORGING PRESS.

APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

Patented June 3, 1913.

6 SHEETS—SHEET 1.



Witnesses:

John Enders
Chas. H. Buell.

Inventors.

Morris C. White, and
Otho C. Burysa,

By Symfouth, Lee, Britton & Stiles
Attys. at

M. C. WHITE & O. C. DURYEA.

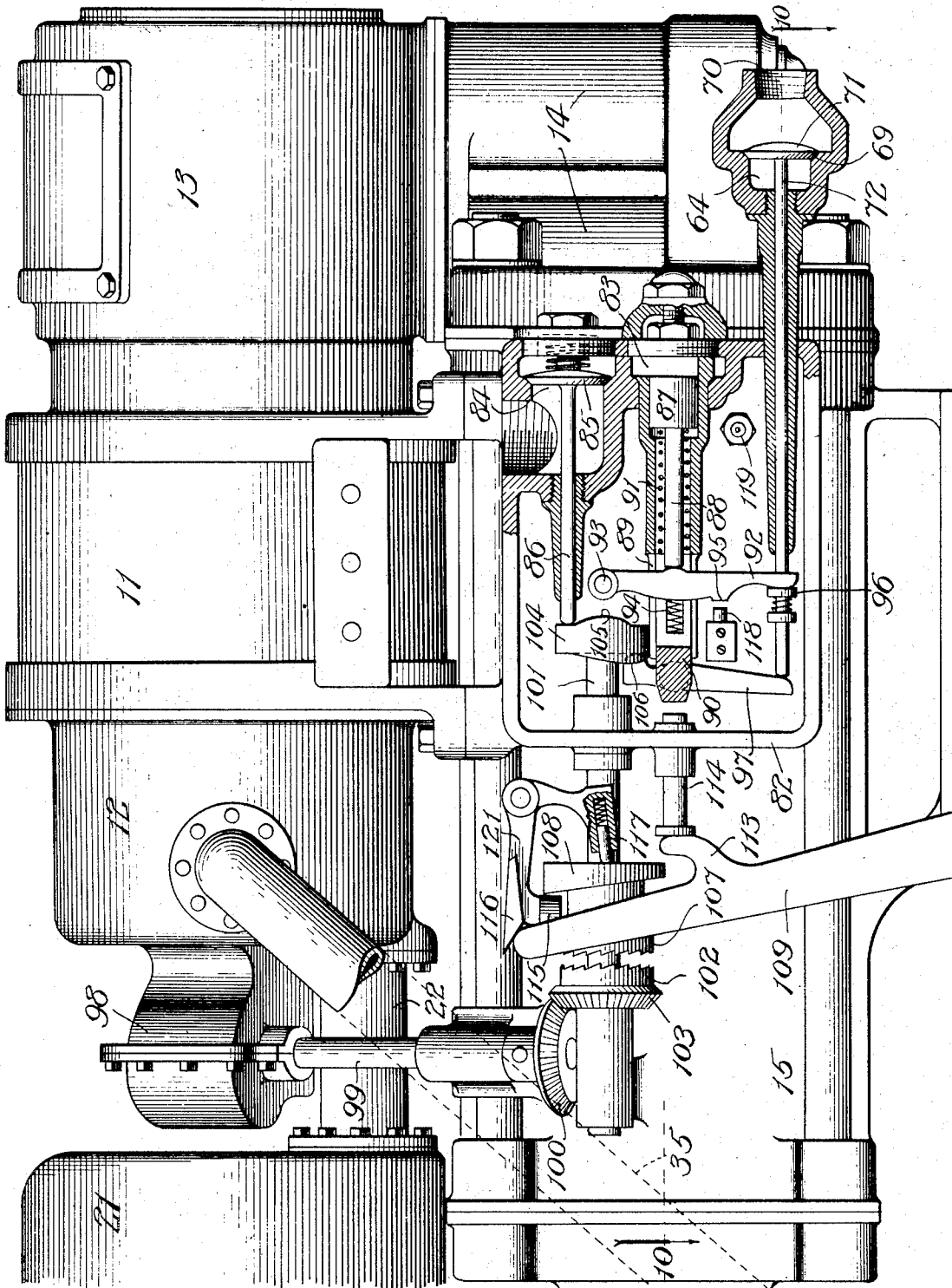
FORGING PRESS.

APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

1,063,632.

Patented June 3, 1913.

6 SHEETS—SHEET 2.



Witnesses:

John Enders
H. H. Bull.

Fig. 4.

Inventors:

Morris C. White,
Otho C. Duryea,
By Dyrenforth, Lee, Chritton & Miles,
Attys.

M. C. WHITE & O. C. DURYEA.

FORGING PRESS.

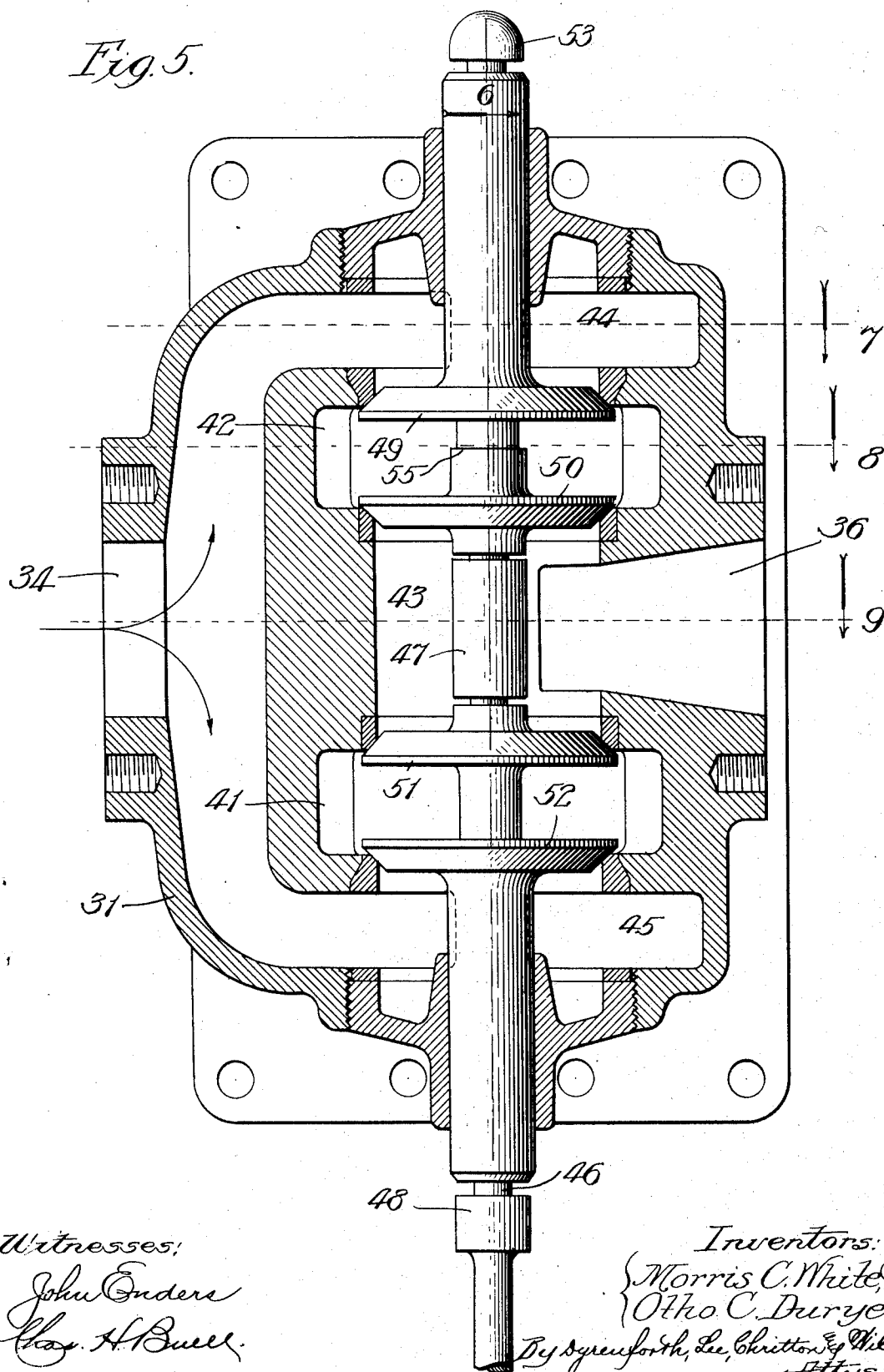
APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

1,063,632.

Patented June 3, 1913.

6 SHEETS—SHEET 3.

Fig. 5.



Witnesses:

John Enders
Chas. H. Bull.

Inventors:

{ Morris C. White
{ Otho C. Duryea,
By Ogdenforth, Lee, Chittenden & Miles
Attys.

M. C. WHITE & O. C. DURYEA.

FORGING PRESS.

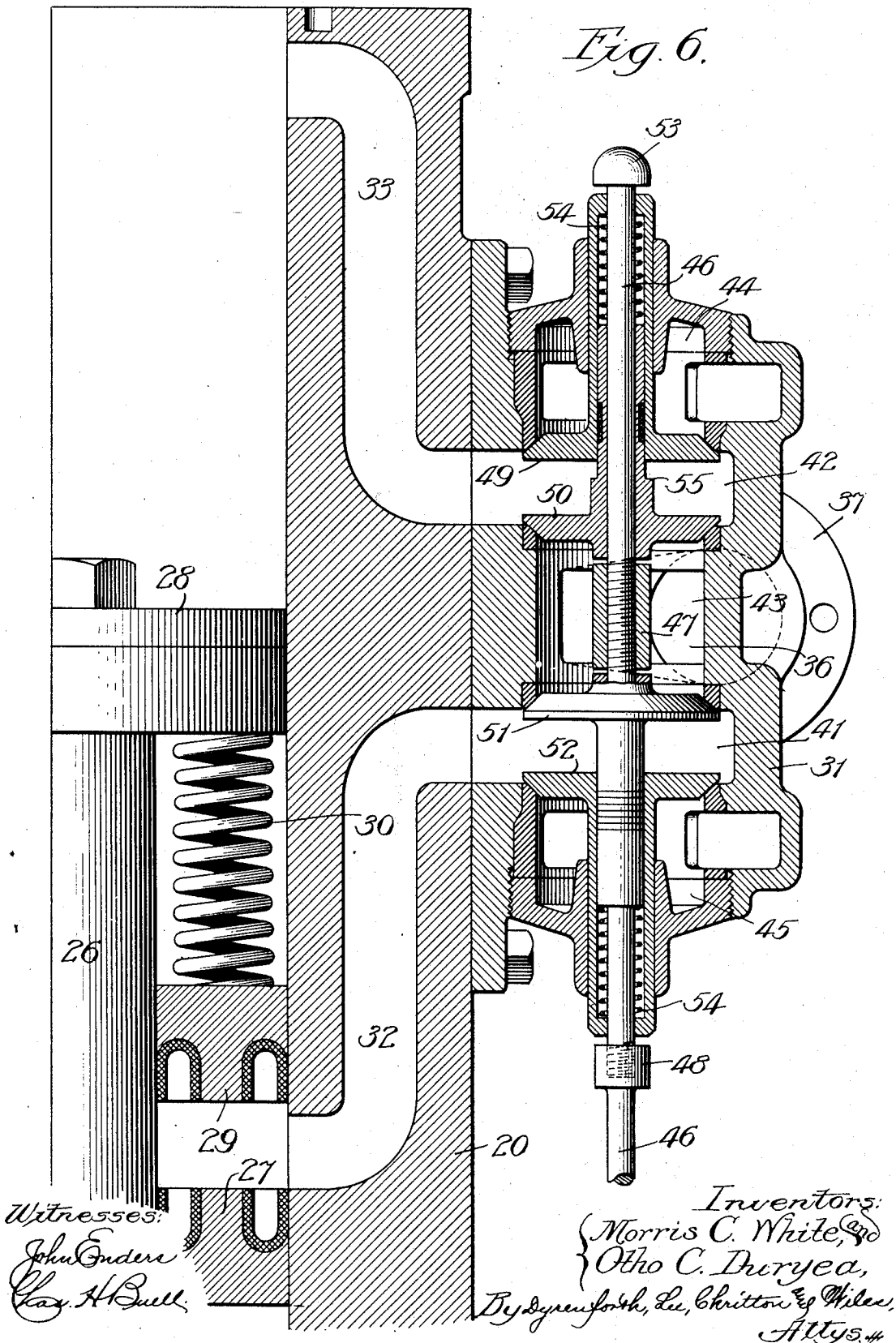
APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

1,063,632.

Patented June 3, 1913.

6 SHEETS—SHEET 4.

Fig. 6.



M. C. WHITE & O. C. DURYEA.

FORGING PRESS.

APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

1,063,632.

Patented June 3, 1913.

6 SHEETS—SHEET 5.

Fig. 7.

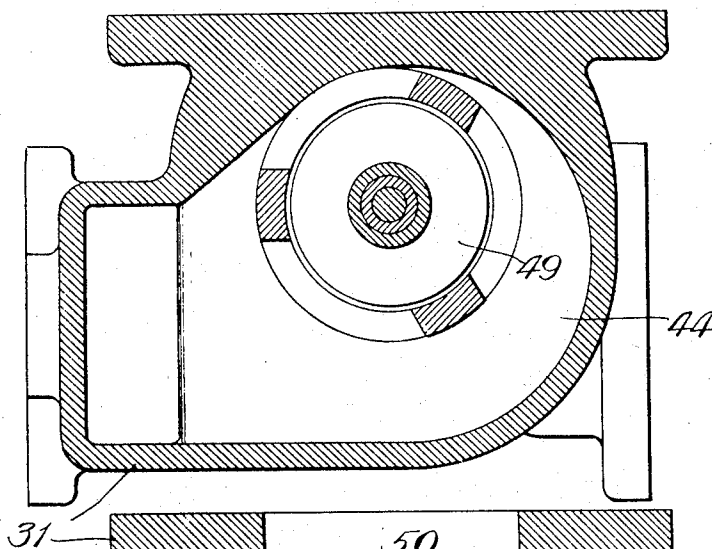


Fig. 8.

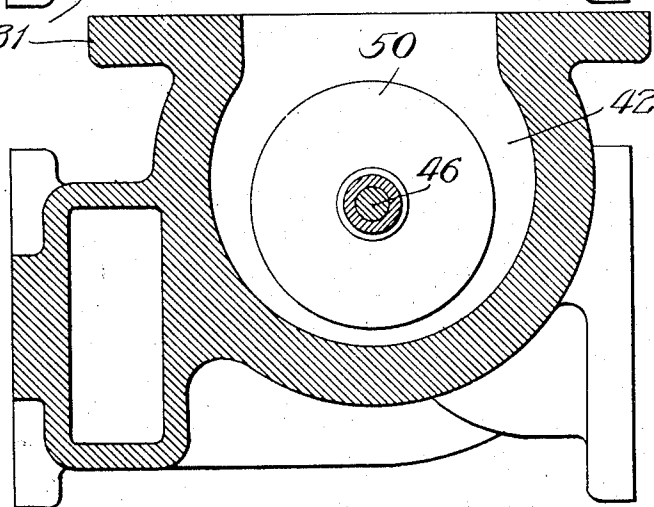
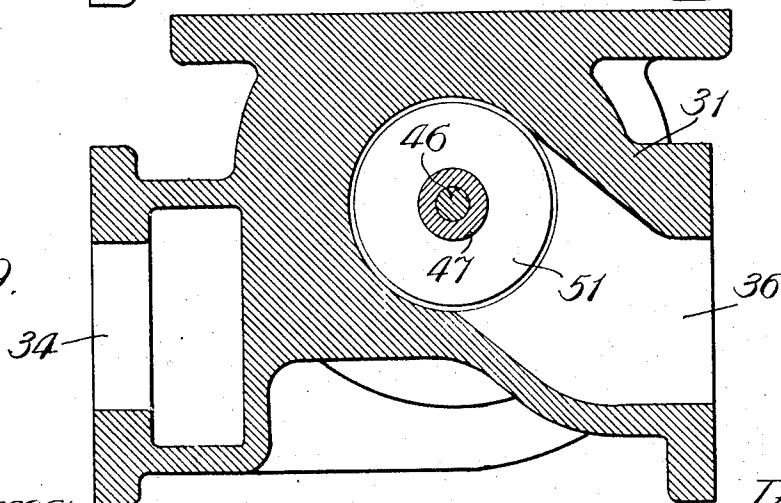


Fig. 9.



Witnesses:

John Enders
Chas. H. Buell

Inventors:

{ Morris C. White,
Otho C. Duryea,
By Dyrenforth, Lee, Britton & White,
Attys. #

M. C. WHITE & O. C. DURYEA.

FORGING PRESS.

APPLICATION FILED JAN. 7, 1910. RENEWED NOV. 4, 1912.

1,063,632.

Patented June 3, 1913.

6 SHEETS—SHEET 6.

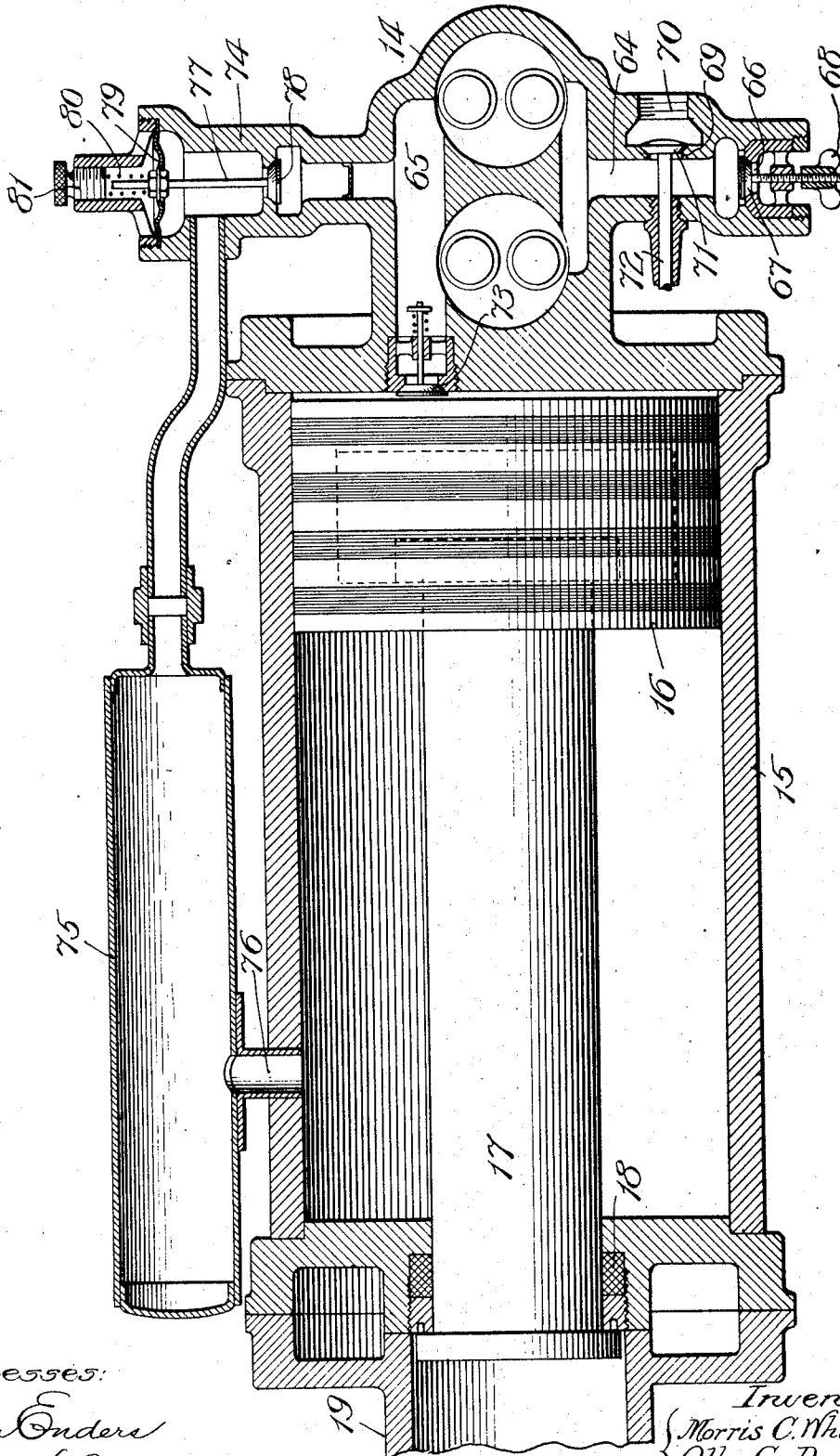


Fig. 10.

Witnesses:

John Enders
Chas. H. Buell

Inventors:

Morris C. White, Jr.
Otho C. Duryea,

By Sydenforth, Lee, Chittum & Wiles,
Attys.

UNITED STATES PATENT OFFICE.

MORRIS C. WHITE AND OTHO C. DURYEA, OF CHICAGO, ILLINOIS.

FORGING-PRESS.

1,063,632.

Specification of Letters Patent.

Patented June 3, 1913.

Application filed January 7, 1910, Serial No. 536,947. Renewed November 4, 1912. Serial No. 729,471.

To all whom it may concern:

Be it known that we, MORRIS C. WHITE and OTHO C. DURYEA, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Forging-Presses, of which the following is a specification.

Our invention relates to improvements in the construction of internal combustion power machines, and we show our improvements embodied in a press designed for use, more especially, in the forging of metals.

The machine as illustrated possesses the following characteristics: The forging tool, or hammer, rises and descends over a stationary anvil and is directly connected with a piston in a hydraulic cylinder. A continuously-rotating electric motor operates a rotary liquid pump and an air-compressor. An internal combustion cylinder contains a movable piston operating directly against a column of liquid, which may be a suitable oil, forming the power-transmitting medium between the said piston and that in the hydraulic cylinder. The pump operates to maintain the oil column and supplies oil under pressure, which, by the manipulation of a manually-operated valve, may be caused to enter the hydraulic cylinder below the piston to raise the forging hammer, or directed into the said cylinder above the piston to lower the hammer against the work in advance of an explosion in the internal combustion cylinder. By means of a manually-operated lever the explosive mixture is directed from the compressor into the internal combustion cylinder and exploded against the movable piston therein, the force of the explosion being communicated to the forging-hammer piston through the oil-column. The distance of movement of the operating-handle regulates the degree of compression of the explosive mixture at the time of an explosion, thereby regulating the force of the explosion and therefore the pressure of the hammer against the work in each instance.

The construction illustrated in the accompanying drawings, and hereinafter described, may be variously modified in the matter of details and combinations of parts without departing from the spirit of our invention as defined in the appended claims.

Referring to the drawings Figure 1 is a partly sectional side elevation of our inter-

nal combustion forging-press; Fig. 2, an enlarged broken view of interlocking operating levers; Fig. 3, a section taken on line 3 in Fig. 2; Fig. 4, an enlarged broken partly sectional view of the power-generating portion of the machine; Fig. 5, an enlarged section, taken on line 5 in Fig. 1, showing the construction of the valve-mechanism for raising and lowering the hammer-piston; Fig. 6, a section taken on line 6 in Fig. 5, on a somewhat reduced scale; Figs. 7, 8 and 9 plan-sections taken on lines 7, 8 and 9, respectively, in Fig. 5; and Fig. 10, a broken section on irregular line 10, 10 in Fig. 4.

In Figs. 1 and 4, 11 is the casing of an electric motor, the armature shaft of which carries a centrifugal pump in the casing 12. In the casing 13 the armature shaft is shaped into a double-crank to operate pistons in the compressor-cylinders 14. (Fig. 10) is an internal combustion cylinder, containing a piston 16, and a stem 17 working through a stuffing-box 18. The piston 16, shown, is chambered and the stem 17, which enters said chamber through a contracted opening in the piston wall, has an enlarged end which prevents separation of the piston and stem. The piston may move upon the stem a distance limited by the depth of its chambered portion. Extending from the stuffing-box 18 is a pipe or cylinder 19 entering the top of a vertical cylinder 20. The stem 17 forms an oil-displacing plunger in the pipe or cylinder 19. 21 is an oil-reservoir communicating through a pipe 22 with the pump-chamber 12. 24 is a stationary anvil, and 25 a forging-hammer, or work-performing member, on a stem 26. The stem 26 passes through a relatively stationary and suitably packed guide-ring 27 in the cylinder 20, and fixed to the upper end thereof is a piston 28. Surrounding the stem 26 between the piston 28 and guide 27 is a relatively-yielding follower 29, interposed between which and the piston 28 are the springs 30. At the side of the cylinder 20 is a valve-shell 31 having a port or passage 32 communicating with the cylinder 20 directly above the guide 27, and having a port or passage 33 communicating with the upper end of the cylinder 20. In one side of the shell 31 is an inlet-port 34 communicating through a pipe 35 with the pump-chamber 12; and in the opposite side of the shell is an outlet port 36 communicating through a pipe 37 with the oil-chamber or reservoir

21. Communicating at opposite ends with the pipes 35, 37, respectively, is a pipe or by-pass 38 fitted with a one-way plug-valve 39, the stem of which carries a pinion 40. The ports or passages 32, 33 communicate respectively with lower and upper chambers 41 and 42 in the valve-shell 31. Between said chambers is a chamber 43 communicating with the outlet-port 36; above the chamber 42 is a chamber 44 communicating with the inlet-port 34 and below the chamber 41 is a chamber 45 also communicating with the inlet-port 34. Extending centrally through the valve-shell 31 is a stem 46. Fixed to the stem 46 in the chamber 43 is a collar 47, and below the shell the stem carries a stop 48. On the stem are the relatively-yielding valves 49, 50, 51 and 52, which, when the stem 46 is in normal position, close, respectively, communication between the chambers 42 and 44, 42 and 43, 41 and 43 and 41 and 45. Upward movement of the stem 46 from the normal position causes the stops 47, 48 to simultaneously open the valves 50, 52, and downward movement of the stem from normal position causes a stop 53, at its upper end, to open the valve 49 and the stop 47 to open the valve 51. It will be understood that while the stem 46 is in normal position the confined springs 54, 54 shown hold all the valves seated, and when the stem is raised the shoulder 55 on the sleeve of the valve 50 locks the valve 49 closed. 56 is an operating handle or lever fulcrumed between its ends at 57 and pivotally connected by means of a link 58 with the lower end of the stem 46. The lever 56 passes through a quadrant 59 and is equipped with a handle-grip 60 and catch 61, actuated thereby, to release a notch in the quadrant to permit the handle to be swung, to raise or lower the stem 46 from the normal position described. Fixed to the stem 46 is an arm or bracket 62 on the end of which is mounted a rack-bar 63 engaging the pinion 40. The parts are so constructed and arranged that when the lever 56 and stem 46 are held, by the catch 61, in normal position, the plug-valve 39 opens the by-pass 38 around the valve-casing 31; but when the stem 46 is either raised or lowered to open valves in the valve-shell 31, the valve 39 is turned to close the said by-pass. As before stated, the motor and pump work constantly, and when the lever or operating handle 56 is in normal position, and the by-pass 38 therefore open, the pump circulates oil from the pump-chamber through the pipe 35, by-pass 38, pipe 37, reservoir 21 and pipe 22. To raise the forging-hammer from the position shown in Figs. 1 and 6, the operating handle 56 is released from the quadrant notch and lowered to open the valves 52, 50, at the same time closing the by-pass 38. This causes oil

from the pump-chamber 12 to be forced through the valve 52 and port 32 against the under side of the follower 29 and raise the same, the piston 28, the stem 26 and the hammer 25. Oil above the piston 28 is forced outward through the port 33, valve 50 and pipe 37 to the reservoir 21. When the hammer is raised to the desired extent the operating handle 56 is again moved to normal position. To lower the hammer against the work on the anvil the operating handle 56 is raised to open the valves 49, 51, when oil will be forced through the port 33 and withdrawn through the port 32. When the hammer has been lowered to the desired position, the operating handle 56 should be moved to normal position again to open the by-pass.

The internal combustion power mechanism herein shown is very similar to that illustrated in reissue Letters Patent No. 12,957, granted to us May 18, 1909. The induction ports of the compressor 14 communicate with a chamber or passage 64 (Fig. 10) and the eduction ports of the compressor communicates with a chamber or passage 65. In the chamber 64 is an air-inlet port 66 fitted with a valve 67 which may be opened or closed by means of a thumb-nut 68 or otherwise, by the operator, when desired. Also in the chamber 64 is a port 69 communicating at 70 with a suitable carbureter, not shown. The port 69 is fitted with a valve 71 on a stem 72. The chamber 65 communicates through a check-valve 73 with the chamber of the internal combustion cylinder. The eduction chamber 65 also communicates through a valve device 74 with a reservoir 75 which in turn communicates with the interior of the cylinder 15 at 76. In the valve-device 74 is a pressure-regulating valve 77, the stem of which carries the valve 78 and is connected with a flexible diaphragm 79. The diaphragm is held normally in position of opening the valve 78 by a spring 80 tensioned by means of a screw-plug 81. The object of the reservoir 75 is to provide air-pressure for returning the piston 16 to initial position and the spring 80 may be tensioned to regulate the minimum pressure to be maintained in the tank 75. It may be stated here that before starting forging operations, and after the motor has been started, the valve 67 may be opened to cause the compressors to pump the desired amount of air-pressure into the cylinder 75, after which the valve 67 may be closed. As the intake-valve 71 from the carbureter is normally closed, the compressor pistons will draw against a vacuum and do no compressing except when the carbureter valve 71 is opened, as hereinafter explained. On the side of the internal combustion cylinder 15 is a box or casing 82 containing a piston chamber 83, in open

communication with the interior of the cylinder, and an exhaust-passage 84, for the cylinder, fitted with an exhaust-valve 85 having a stem 86. In the chamber or cylinder 83 is a plunger 87 exposed to the pressure in the main cylinder and having a stem 88.

89 is a slotted extension of the cylinder 83 containing a bifurcated sliding plug 90. Confined between the inner end of the plug 90 and the piston 87 is a regulating spring 91.

92 is a swinging contact-lever pivoted at 93 and extending through the bifurcated parts of the cylinder-extension 89 and plug 90. A spring 94 in the sliding-plug tends normally to maintain the lever 92 against the end of the stem 88. Between its ends the lever 92 has a lug-portion 95 and at its lower end it is bifurcated to receive the stem 72, being engaged by a sliding spring-pressed collar 96 on the said stem. Fulcrumed between its ends in the box 82 is a lever 97 contacting at the end of its long arm with the end of the stem 72. The end of the motor-shaft, in an extension 98 of the pump-casing 12, is geared through a worm or other gearing with a shaft 99 carrying a bevel-pinion 100.

101 is a shaft carrying a loose sleeve and clutch-member 102 provided with a bevel-gear 103 which is engaged and constantly driven by the shaft 99 through the bevel-gear 100. On the end of the shaft 101 within the box 82 is a head 104 having an annular cam-face 105 bearing against the stem 86 of the exhaust-valve, and an annular cam-face 106 engaging the short arm of the lever 97. Feathered upon the shaft 101 is a sliding clutch-member 107 equipped with a cam-head 108.

109 is an operating-handle or lever fulcrumed at 110 (Fig. 1). The lever 109 extends through a quadrant 111 and is equipped with a handle-grip 112 operating a catch to engage a notch in the quadrant. On the lever 109 near its upper end is a lug 113 contacting with a plunger 114 movable through a guide in the box 82 to engage the end of the plunger 90 therein.

121 is a bell-crank lever fulcrumed against the side of the cylinder 15 and provided at one end with a hook 115 to engage the cam 108 and a cam-lug 116 engaging the top of the handle or lever 109. The other end of the bell-crank lever carries a spring-plunger 117 to engage the clutch-member 107.

One part of the operating handle 56 is curved to correspond with the arc of a circle drawn from the fulcrum 110 of the lever or handle 109, and the latter along its lower end describes the segment of a circle drawn from the fulcrum 57 of the lever or handle 56. The two operating levers 56, 109 are coincidentally notched, as indicated in Fig. 2, so that when one is in normal position the

other may be moved, but both cannot be out of normal position at the same time.

When the forging-hammer has been lowered against the work, as before described, and the lever 56 returned to normal position, the operator moves the operating handle 109 at its lower end in the direction to the left in Fig. 1, causing the upper end of the lever to turn the bell-crank lever 121 and slide along the under surface of the lug 116. This swinging of the bell-crank lever turns its hook-portion 115 out of engagement with the cam 108 and causes the arm at the yielding plunger 117 to slide the clutch-member 107 into engagement with the clutch-member 102. This causes the shaft 101 to be rotated at comparatively slow speed by the shaft 99. In the movement described of the lever 109 the lug, or finger, 113 carried thereby, presses the plunger 114 against the plunger 90. Initial turning of the shaft 101 causes the cam-face 106 carried by the head 104 to swing the lever 97 and thrust the stem 72, to open the inlet-valve 71 from the carbureter. The plunger 90 is pressed against the spring 91 and the degree of compression of the said spring depends upon the distance to which the lever 109 is swung in that direction by the operator. The mixture drawn in by the compressor is discharged therefrom through the chamber or passage 65 and valve 73 against the piston 16, moving the latter against the resistance of the air from the cylinder 75 along the plunger 17 until stopped thereby. The chamber 83, as aforesaid, is in open communication with the cylinder 15, and when the pressure of explosive mixture in the cylinder against the piston 16 and consequently in the chamber 83 against the piston 87 is sufficient to overcome the resistance of the spring 91, the stem 88 is moved to swing the lever 92 to cause its lug portion 95 to move the spring plunger terminal 118 of an electrical contact device. The said contact device is in circuit with a spark-plug 119 in the cylinder, the same being a shunt-circuit from the motor-circuit wires 120.

The operation, when the lug 95 moves the plunger contact 118, is to produce an electric spark in the cylinder to ignite the charge, all in a common manner. The explosion drives the piston 16 in the direction in the left in Fig. 10, thereby exerting a blow through the plunger 17 against the oil-column, which is exerted against the piston 28 and transmitted through the hammer 25. It will be noted that the springs 30, which are capable of upholding the hammer 25 and attendant parts without material compression, will yield under the blow exerted through the oil-column. Following the explosion the operator moves the handle 109 back to normal position, thereby releasing the bell-crank lever 121 and causing the

hook 115 to engage the cam 108 and stop rotation of the shaft 101 by separating the clutch-members. In the final turning movement of the shaft 101 and cam-head 104, the cam 105 opens and then permits closure of the exhaust valve 85, and while the same is open the air pressure from the cylinder 75 returns the piston 16 and attendant parts to initial position to scavenge the internal combustion cylinder. Every time the lever 109 is moved from normal position, as described, a blow will be struck, or pressure will be exerted, through the oil-column against the piston 28 and the work, and a plurality of blows may be thus exerted against the work without changing the location of the hammer, through the medium of the lever 56 and attendant parts. The hammer, however, may be raised and lowered with reference to the work at any time, while the lever 109 is in normal position, at which time, as explained, the internal combustion mechanism is out of operation. As the strength of each blow depends indirectly upon the degree of compression of the explosive mixture previous to the explosion, the operator may increase or diminish the force of the blows by the extent of movement he gives to the lever 109, and consequently the amount of tension he gives to the spring 91. When the work-performing member 25 rests against the work on the anvil, its travel, under the force of an explosion, in each instance, will, of course, be but slight; but the areas of the pistons 16 and 28 are so great with reference to that of the liquid-displacing plunger 17, that the travel of the piston 16 exceeds many times that of the piston 28, with proportionate increase in the transmitted pressure.

While we have shown and described our improvements, as we prefer to embody them in a forging machine, they may, in the same or modified form, be applied to power presses constructed for purposes other than the forging of metals, such, for example, as die-operating, punching, shearing, briquetting, and pressing machines generally. It is quite common practice, where pistons and cylinders are employed, to cause either or both to be movable one with relation to the other and constitute or carry the movable work-performing members of the machines; therefore, although in the present machine both the internal combustion and hydraulic cylinders are stationary and the pistons therein movable, we wish the claims to include, as an equivalent, a construction wherein a cylinder is movable with reference to its piston to actuate the work-performing member, should such modification be deemed desirable.

What we claim as new and desire to secure by Letters Patent is—

1. In a machine of the character described, the combination of a hydraulic cyl-

inder, a confined liquid column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, and an internal combustion power-generator having a cylinder, a plunger, a piston connected with the said plunger and having limited independent motion with relation thereto, the piston operating, under the force of an explosion in the generator cylinder, to force the plunger against the said column to actuate the work-performing member, and means for returning the piston to scavenge the cylinder.

2. In a machine of the character described, the combination of a hydraulic cylinder, a confined liquid column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, an internal combustion power-generator having a cylinder and a piston operating against the said column, under the force of an explosion in the generator cylinder, to actuate the work-performing member, and means for moving said hydraulic cylinder-piston to position the work-performing member away from and toward the work, said means being independent, for its control, from said generator.

3. In a machine of the character described, the combination of a hydraulic cylinder, a confined liquid-column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, an internal combustion power-generator having a cylinder and a piston operating against the said column, under the force of an explosion in the generator-cylinder, to actuate the work-performing member, and fluid-pressure means for moving said hydraulic-cylinder-piston to position the work-performing member away from and toward the work, said means being independent, for its control, from the said generator.

4. In a machine of the character described, the combination of a hydraulic cylinder, a confined liquid-column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, an internal combustion power-generator having a cylinder and a piston operating against the said column, under the force of an explosion in the generator-cylinder, to actuate the work-performing member, and hydraulic means for moving said hydraulic-cylinder-piston to position the work-performing member away from and toward the work, said means being independent, for its control, from the said generator.

5. In a machine of the character described, the combination of an internal combustion power-generator having a cylinder and piston, a work-performing member operated by said piston, under the force of an

explosion in said cylinder, and means for positioning the work-performing member against the work prior to an explosion in the cylinder, said means being independent, 5 for its control, from said generator.

6. In a machine of the character described, the combination of an internal combustion generator having a cylinder and piston, forming parts movable one with relation to the other, a work-performing member operated from said moving part under the force of an explosion in the cylinder, a compressed-explosive-mixture supplier for the cylinder, a charge-igniter, a cylinder 15 exhaust-valve, normally inactive power-operated means governing the introduction of explosive mixture into the cylinder and the exhaust thereof, and a lever movable to bring the said power-operated means into action and operating, by the extent of its movement, to regulate the degree of compression of the mixture, in the cylinder, prior to the ignition thereof. 20

7. In a machine of the character described, the combination of a hydraulic cylinder, a confined liquid-column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, fluid-pressure means for moving said 30 hydraulic cylinder piston to position the work-performing member away from and toward the work, an operating lever movable from normal position to bring said fluid-pressure means into action, an internal combustion power-generator having a cylinder and a piston operating against the said liquid-column, normally-inactive power-

operated means on the generator controlling the introduction of explosive mixture into the internal combustion cylinder, the ignition of the mixture and the exhaust after an explosion, and a lever movable from normal position to bring said power-operated means into action. 40

8. In a machine of the character described, the combination of a hydraulic cylinder, a confined liquid-column communicating therewith, a piston in said cylinder, a work-performing member operated by said piston, fluid-pressure means for moving said 50 hydraulic-cylinder-piston to position the work-performing member away from and toward the work, an operating lever movable from normal position to bring said fluid-pressure means into action, an internal combustion power-generator having a cylinder and a piston operating against the said liquid-column, normally-inactive power-operated means on the generator controlling the introduction of explosive mixture 60 into the internal combustion cylinder, the ignition of the mixture and the exhaust after an explosion, a lever movable from normal position to bring said power-operated means into action, said levers interlocking with each other so that one can be moved only when the other is in normal position, substantially as set forth. 65

MORRIS C. WHITE.
OTHO C. DURYEA.

In the presence of—
CHAS. E. GAYLORD,
RALPH SCHAEFER.