No. 760,244. PATENTED MAY 17, 1904.

H. M. PIERCE.

SHELL FILLING MACHINE.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 6 SHEETS—SHEET 1.

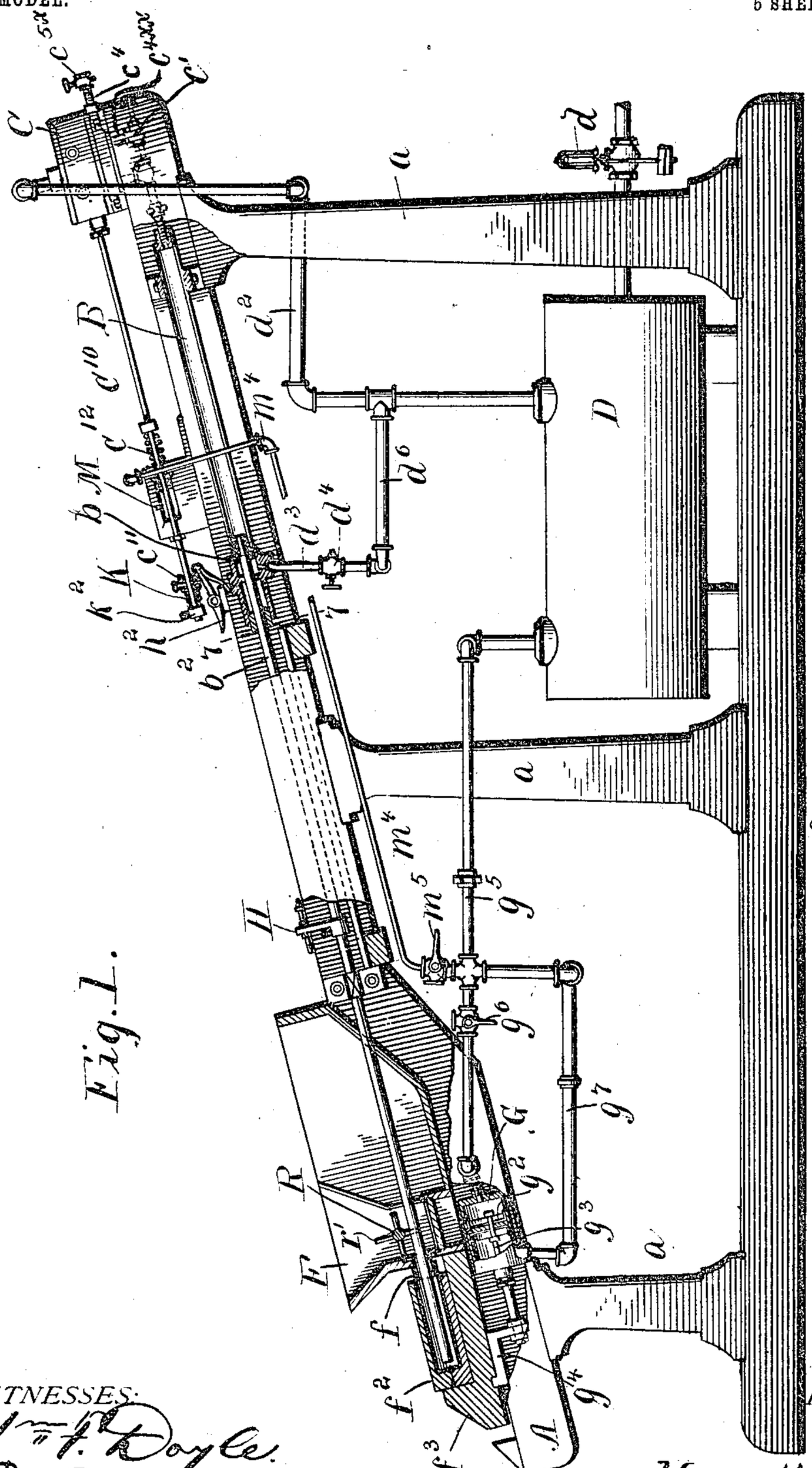


Fig. 1.

WITNESSES:

W. F. Doyle.

E. F. Brandenburg.

INVENTOR,

Harry M. Pierce.

by Alex. Dyrenforth,

his attorney.

No. 760,244. PATENTED MAY 17, 1904.

H. M. PIERCE.

SHELL FILLING MACHINE.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 5 SHEETS—SHEET 2.

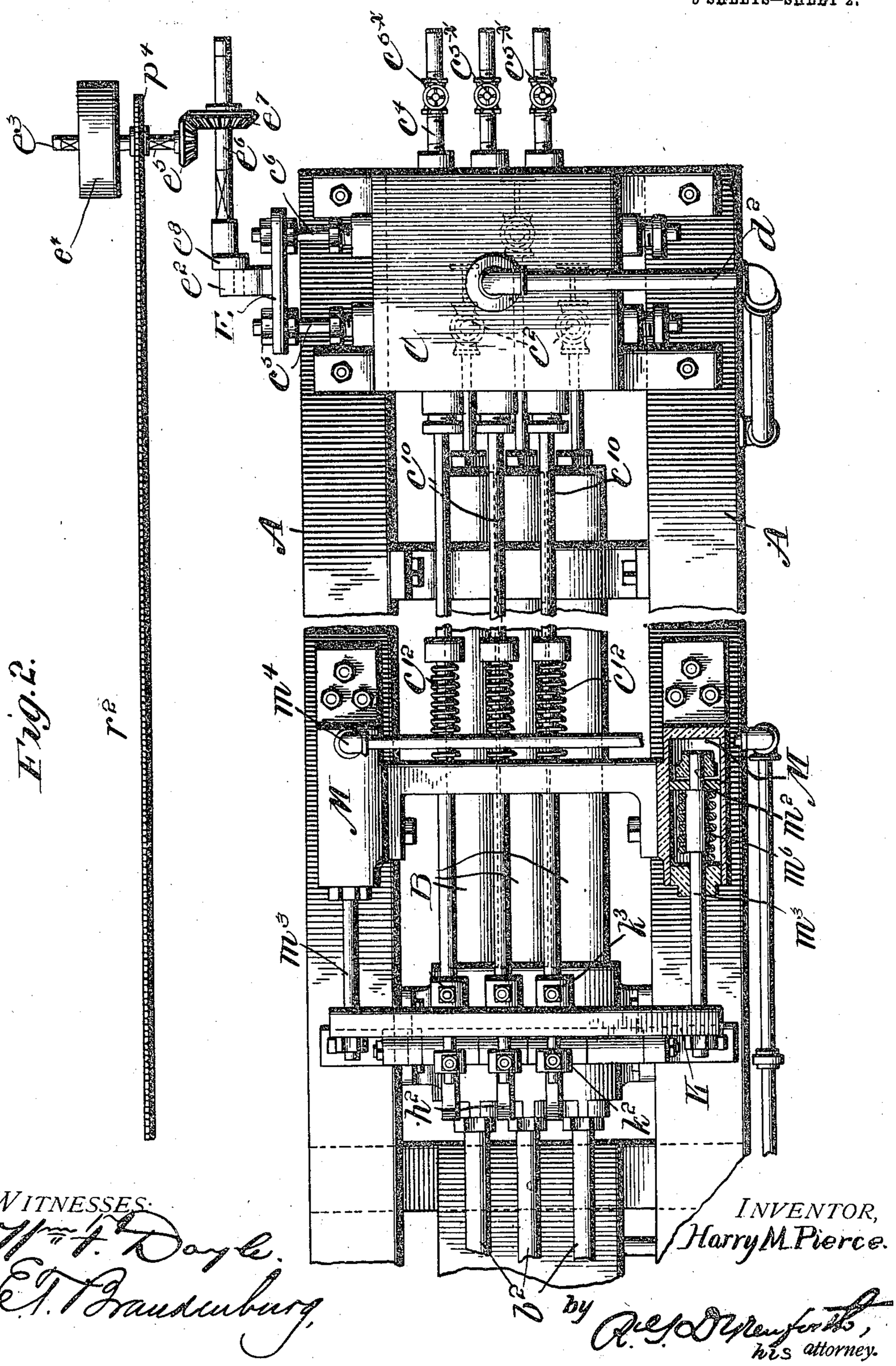


Fig. 2.

WITNESSES:

Wm. F. Doyle.

E. T. Brandenburg.

INVENTOR,

Harry M. Pierce.

by A. J. Dyrenforth,

his attorney.

No. 760,244. PATENTED MAY 17, 1904.

H. M. PIERCE.

SHELL FILLING MACHINE.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 5 SHEETS—SHEET 3.

Fig. 4.

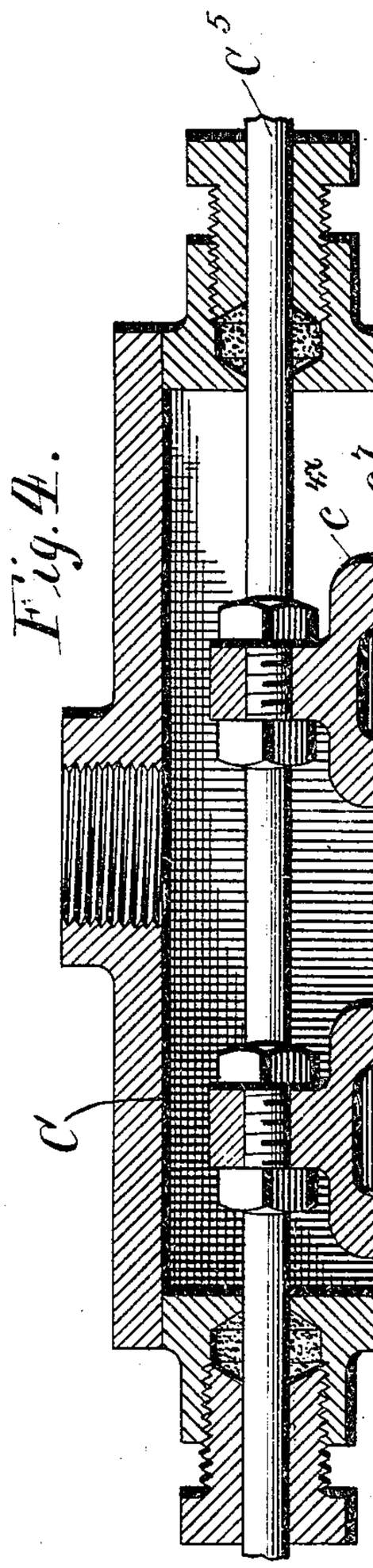
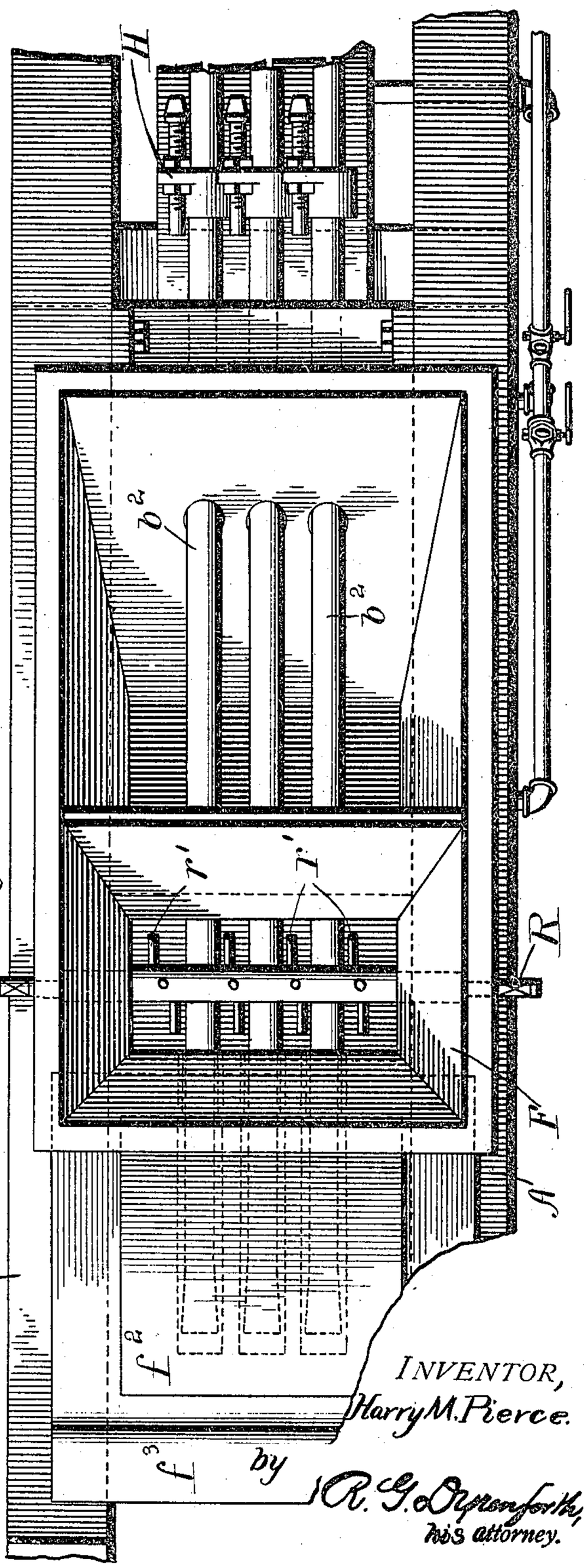


Fig. 3.



WITNESSES:

Wm. F. Doyle.

E. F. Brandenburg.

INVENTOR,

Harry M. Pierce.

by R. G. Orrmsforth,

his attorney.

No. 760,244. PATENTED MAY 17, 1904.

H. M. PIERCE.

SHELL FILLING MACHINE.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 5 SHEETS—SHEET 4.

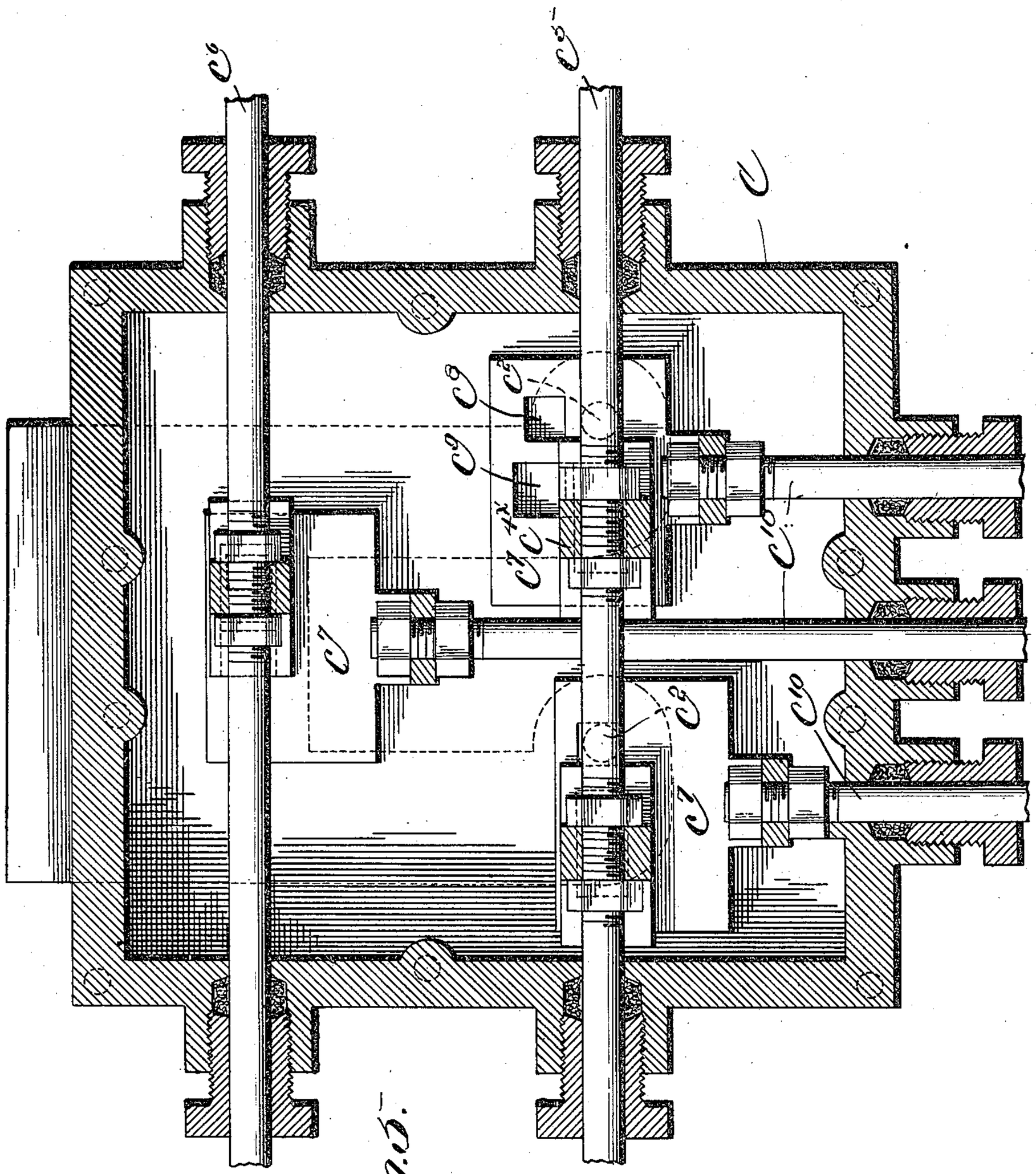


Fig. 5.

WITNESSES:
W. F. Doyle.
E. T. Brandenburg.

INVENTOR,
Harry M. Pierce.
by A. J. Dyer Smith,
his Attorney.

No. 760,244. PATENTED MAY 17, 1904.

H. M. PIERCE.

SHELL FILLING MACHINE.

APPLICATION FILED MAY 9, 1903.

NO MODEL. 5 SHEETS—SHEET 5.

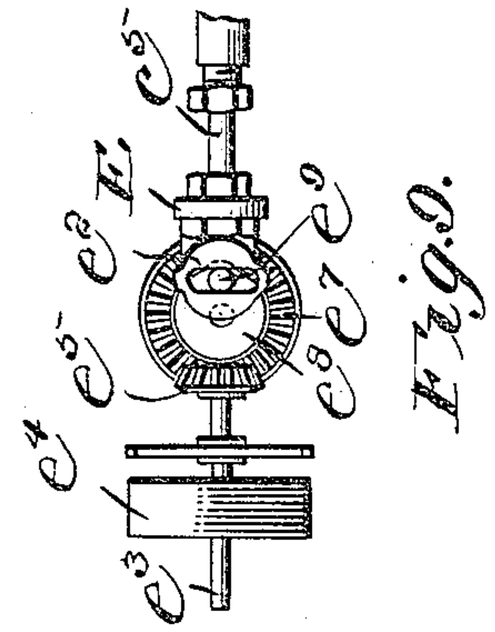


Fig. 9.

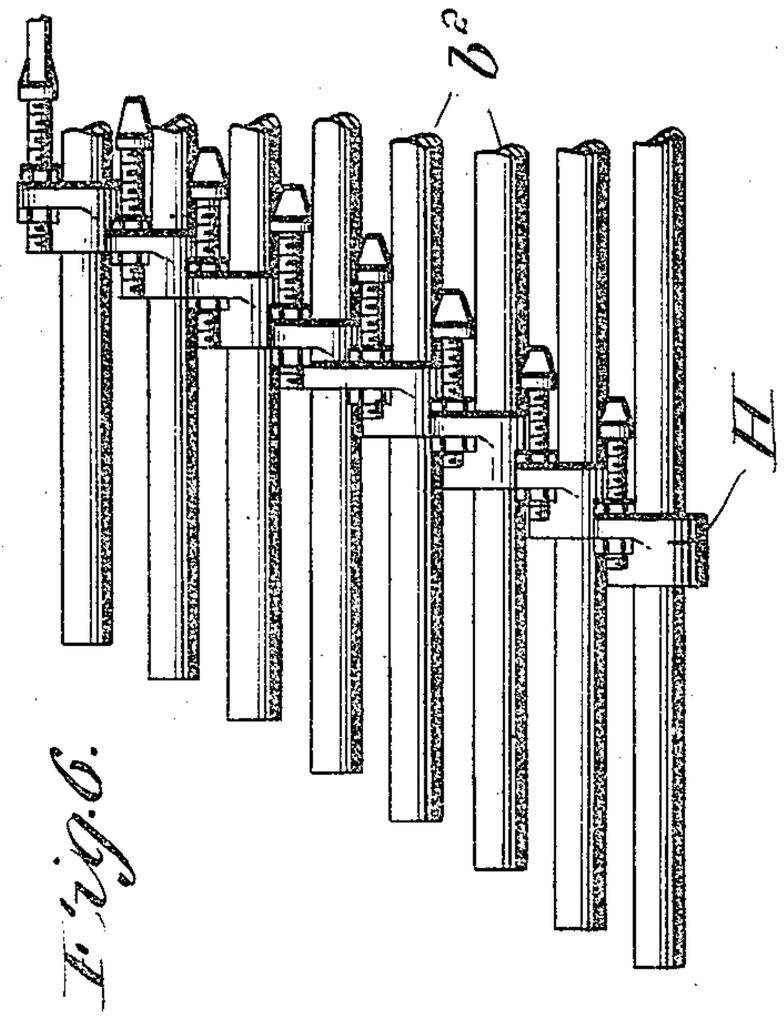


Fig. 6.

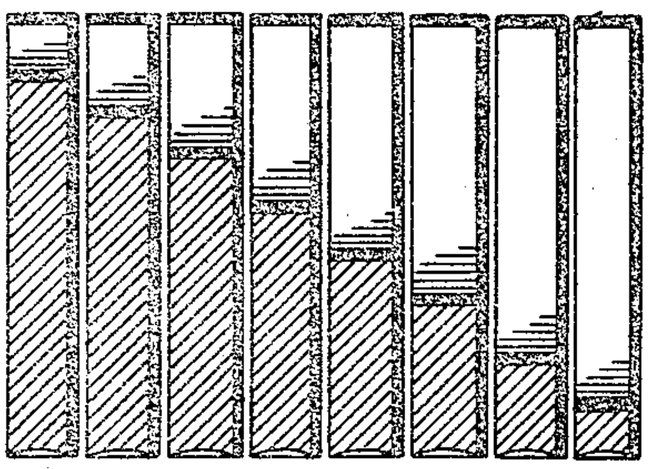


Fig. 10.

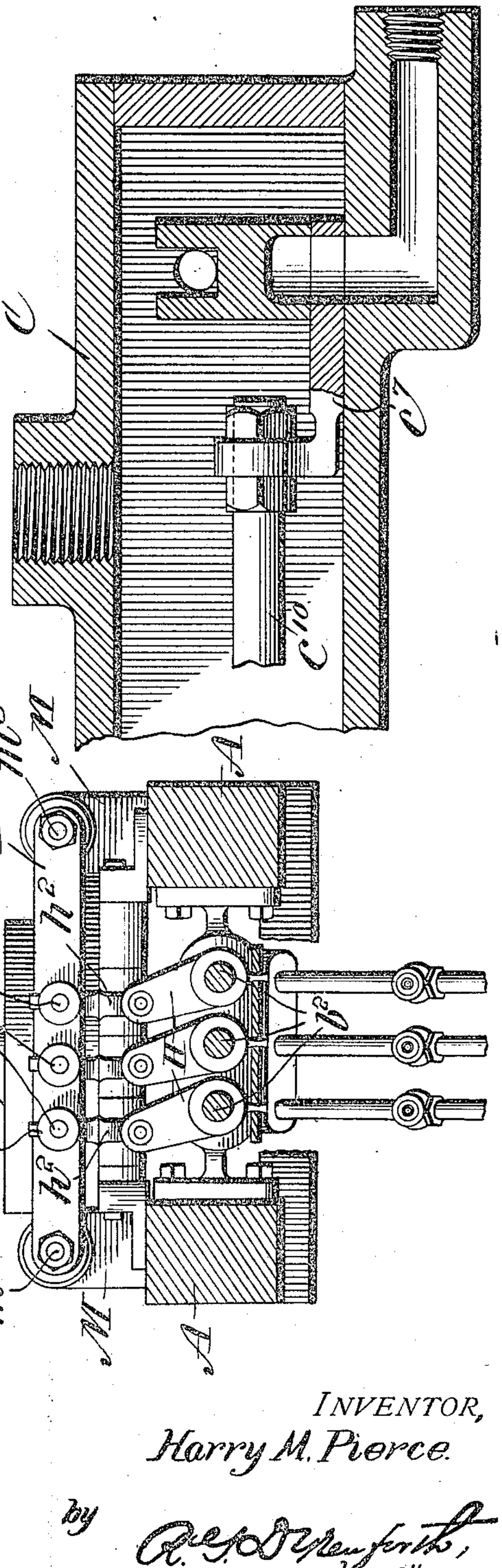


Fig. 8.

Fig. 7.

WITNESSES:

Wm. F. Doyle.

E. F. Brandenburg.

INVENTOR,

Harry M. Pierce.

by A. G. Dyrenforth,

his attorney.

No. 760,244. Patented May 17, 1904.

UNITED STATES PATENT OFFICE.

HARRY M. PIERCE, OF WILMINGTON, DELAWARE.

SHELL-FILLING MACHINE.

SPECIFICATION forming part of Letters Patent No. 760,244, dated May 17, 1904.

Application filed May 9, 1903. Serial No. 156,472. (No model.)

To all whom it may concern:

Be it known that I, HARRY M. PIERCE, a citizen of the United States, residing at Wilmington, in the county of Newcastle and State of Delaware, have invented certain new and useful Improvements in Shell-Filling Machines; 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.

The object of this invention is to provide an improved machine for filling shells and similar vessels with dynamite or other explosive material in the form of powder.

Another object of the invention is to provide a shell-filling machine operated by compressed air which will automatically stop working when the shell becomes filled or if a foreign substance gets into the path of the powder being fed.

A further object of the invention is to provide a machine for filling a plurality of shells with dynamite and operated by compressed air, in which each of the filling means will automatically cease operation as the shells are filled.

Another object of the invention is to provide, in connection with a shell-filling machine operated by compressed air, a pressure device that will serve to remove the shell from its filling position on the machine and which will also when the shell has been removed and an empty shell inserted return the shell-holder to the position for filling.

My machine is so constructed that any grade of powder may be packed, even dynamite containing from fifty to seventy-five per cent. nitroglycerin, which up to the present time has never been successfully packed by previous machines other than by hand, such previous machines successfully packing, at most, only powder containing not over fifty per cent. of nitroglycerin. This valuable and desirable result can be accomplished by my machine by regulating the pressure or degree of hardness to which the cartridges may be packed, attained by opening or closing the regulating-valves under the valve-chest, which regulates the volume or pressure of air pouring into cylinders from the valve-chest, as more fully hereinafter appearing.

With these objects in view and others my invention comprises the construction, arrangement, and combinations of parts, substantially as hereinafter described and claimed.

In the drawings, representing an apparatus embodying my invention in my preferred form of construction and arrangement, Figure 1 is a side elevation, certain parts being shown in section. Fig. 2 is a plan view of half of the machine. Fig. 3 is a continuation of the view of Fig. 2, showing the other half of the machine in plan. Fig. 4 is a vertical transverse section through the valve-chest. Fig. 5 is a horizontal section through the valve-chest. Fig. 6 shows diagrammatically a relative plan view of the shells and the corresponding tripping device in their respective relative positions. Fig. 7 is a vertical section on the line 7 7 of Fig. 1. Fig. 8 shows a section of the cut-off valve, and Fig. 9 shows the crank and connections that operate the slide-valves.

Referring now to the drawings, in which the letters of reference indicate the same parts, A represents a suitable base, preferably of wood, that is supported by columns a, rising from a subbase a^2. At one end of the machine are secured a series of cylinders B, preferably parallel, in each of which operates a piston b, secured to a piston-rod b^2. At this end of the machine is a valve-chest C, connecting with each of the cylinders B by a port c^2, there being one of these ports for each of the cylinders. In the valve-chest adjacent each of the ports c^2 is an exhaust-port c^3. Each of the exhaust-ports leads into an exhaust-pipe c^4, the outlet of which is controlled by an adjustable valve $c^{5\times}$ in each instance, so that the exhaust can be throttled as desired and by which the length of stroke of the piston-rods b^2 may be regulated. Thus if these valves c^5 are closed the reciprocation of the piston-rods is entirely stopped. If valves are opened full wide, the piston-rods make full strokes. Therefore by closing valves gradually the length of stroke of the tamps connected to the piston-rods may be adjusted as desired. On each pipe $c^{4\times\times}$.

leading from the ports c^2 of the valve-chest to the cylinders B, is a valve c', by which the volume or pressure of air pouring into the cylinders B from the valve-chest may be regulated, and consequently the pressure or degree of hardness to which the cartridges may be packed may be adjusted as desired for powder containing different degrees or percentages of nitroglycerin. Thus, for example, if the regulating-valves c' are wide open a full volume of air will pour into the ends of the cylinders, which will permit this great pressure of air to follow the cylinder the entire length of the piston's stroke, and by so doing I can pack the dynamite almost hard enough to burst the shells. On the contrary, by closing these regulating-valves c' only a certain quantity of air can escape through them while the ports c^2 in the valve-chest are open, and these ports are blanked by the slide-valve c^4 (hereinafter described) before any large degree or amount of air has passed through the ports and the regulating-valves, and consequently the pressure of air in the cylinders is comparatively small and the shells are filled very lightly. It is obvious that the pressure may be regulated anywhere between the two limits described above through the medium of the regulating-valves c'.

A supply of air is started in the reservoir D, and the pressure there is kept constant by any suitable means—for example, an adjustable valve d serves to permit air to escape when the pressure becomes too great. A pipe d^2 leads from the reservoir D into the top of the valve-chest, while another pipe d^3 leads into the other end of the cylinder beyond the piston. In this latter pipe is a suitable valve d^4 to reduce the pressure on this end of the piston, if desired.

The port leading from the valve-chest to each of the cylinders is controlled by an ordinary D slide-valve $c^{4\times}$, which is controlled by a valve-rod c^5. When the valve is in the position shown in Fig. 4, the air may pass through the ports c^2 into the cylinder connecting therewith; but when the slide-valve is moved to its other position it serves to put the port c^2 in communication with the exhaust-port c^3 and cut off the port c^2 from connecting with the valve-chamber. There will be one of these slide-valves for each of the cylinders, and they will preferably be staggered in position, as shown in Fig. 2. There are preferably two of these valve-rods c^5, serving to operate alternate slide-valves. In the drawings only three cylinders, slide-valves, &c., are shown; but in practice a much larger number can be used. For example, from fifteen to twenty can be practically operated by one attendant.

The valve-rods c^5 and c^6 are secured at one end to a bar E, to which is attached a slotted plate e^2. On a shaft e^3 is a pulley e^4, driven from any suitable motor at a constant speed, to which shaft is secured a beveled gear e^5. A shaft e^6 has a gear e^7, meshing with the gear e^5, on which latter shaft is a crank e^8, having a crank-pin e^9, that operates in the slotted plate e^2. Consequently the rotation of the pulley will cause the crank-pin to reciprocate the bar E and the valve-rods at a constant speed.

Between the faces of each slide-valve and the bottom of the valve-chest containing the ports is interposed an apertured plate c^7, containing apertures c^8 and c^9. These apertured plates c^7 are each reciprocated by the valve-rod c^{10}. When the valve-rod is at one limit of its movement, the plate will be in the position as shown to the left in Fig. 4, and the operation of the slide-valve $c^{4\times}$ will be as hereinbefore described; but when the valve-rod c^{10}, whose path of movement is perpendicular to that of the valve-rod c^5, has moved the valve-plate c^7 to the other limit of its movement the ports c^2 and c^3 will be blanked, as shown, to the right in Fig. 4. Hence the valve-chest will be cut out of communication with the corresponding cylinder. The slide-valves are reciprocated at a constant speed, as before stated, while the cut-off valves c^7 are normally in position with their apertures registering with the ports in the chest; but by automatic means, hereinafter set forth, these valve-plates c^7 are moved to blank the ports in the valve-chest.

At the lower end of the machine is a receptacle or hopper F, at the lower part of which is a series of stems f of a size to snugly fit the shells it is desired to fill. Opposite each of the stems is arranged a shell-case f^2, that may be hinged to receive and permit removal of the shells. The shell-cases are arranged on a slide-block f^3, by means of which they may be brought to the said stems and when filled moved away therefrom.

A cylinder G is secured to the base and contains a piston g^2, attached to a piston-rod g^3, the latter being connected with the slide-block f^3 by bracket g^4. The rear end of the cylinder G connects with the reservoir D by means of the pipe g^5, in which is a cut-off valve g^6. When the valve g^6 is open, the pressure of the air from the reservoir will cause the piston g^2 to move the slide-block and remove the shell from the pipe-stem f; but when this valve g^6 is moved to another position, which valve is known as a "three-way" valve, connection between the reservoir and the cylinder through the pipe g^5 is cut off, while this rear end of the cylinder is put in communication with the atmosphere. A new series of unfilled shells are then placed in the shell-holder, whereupon the constant pressure of air on the forward end of cylinder G through the pipe g^7 will advance the sliding block and shell-holder to bring the new shells onto the stems f and will hold them there firmly until they are packed.

In the hopper F operate a number of tamps, each being secured to the piston-rod b^2 or integral therewith. Each tamp enters the hopper opposite one of the stems f, engaging the shell to be filled. Consequently when the piston in the cylinders B serve to advance the tamps the free extremity of the tamps will force the material in the hopper F into the shell and further serve to ram it tightly into the shell, according to the degree of pressure back of the cylinder. Thereupon the slide-valve will cause the piston to move in the opposite direction and the tamp will be withdrawn to engage another amount of powder in the hopper, which will be forced into the shell on the next forward stroke.

It will be observed that when the slide-valve puts one of the cylinders in communication with the reservoir D the compressed air will have access to each side of the piston b; but the piston-rod will cause a less area to be exposed to this pressure on the lower side of this piston than on the upper side. Hence the piston will be advanced, and the tamp will force the powder into the shell; but when the upper end of the cylinder is exposed to the atmosphere by the slide-valve instead of being in communication with the reservoir the pressure from the reservoir through the pipe d^6 will cause the piston and tamp to return. Now since the slide-valve is given a constant speed and, furthermore, the pressure in the reservoir D is maintained constant the return stroke of the piston will be practically constant in extent. This is graphically represented in Fig. 6.

On each of the valve-stems is arranged a trip H, that engages a trip-lever h^2. On each of the valve-stems c^{10} is a lug c^{11}, that is normally engaged by the trip-lever h^2, that is pivoted to a stationary frame. This means serves to retain the valve-plate c^7 with its ports c^8 and c^9 registering, respectively, with the ports in the bottom of the valve-chest; but as the return movement of the tamps is maintained constant when the shell becomes filled the return of the tamp will cause the tripper H to move the lever h^2, disengaging the latter from the lug c^{11}. Thereupon a spring c^{12}, that has been under tension, will move the valve-stem c^{10}, and thereby move the valve-plate c^7 until it blanks the ports adjacent thereto in the valve-chest. This will cause the tamp to stop working, as it no longer has communication with the reservoir, although its controlling slide-valve is still reciprocated by the constantly-moving valve-rod c^5. This operation applies to each of the tamps. Just as soon as a shell becomes filled the cut-off valve will be tripped to blank the ports connected therewith in the valve-chest.

When all of the cut-off valves have been tripped, the filled shells removed, and empty ones replaced, and it is desired to move the cut-off valves to permit the machine to operate, the valves are all returned to their normal position by a bar K, through which passes each of the valve-stems, the latter having collars k^2 k^3 on each side of the bar K. The bar K is operated by a pair of pressure devices, each of which comprises a cylinder M, containing a piston m^2, attached to a piston-rod m^3, the latter piston-rods each being secured to the bar K. Air from the reservoir D is admitted back of the piston m^2 through a pipe m^4, controlled by the three-way valve m^5. When this valve is turned to admit air, the pistons are advanced against the force of springs m^6, and the bar K serves to move the valve-stems c^{10} until the lugs c^{11} each engage with the appropriate trip-lever h^2, whereby they are retained in this position. Thereupon the three-way valve m^5 is turned to put the pipe m^4 in communication with the atmosphere. This latter movement will cause the springs m^6 to return the pistons and bar K to their former positions; but this latter movement of the bar K will not affect the valve-stems c^{10} by reason of the play permitted by the separation of the collars k^2 and k^3.

In order to prevent clogging of the dynamite or other powder in the hopper F, I provide a suitable stirrer, such as a shaft R, having a number of pins r' thereon, which shaft is revolved by a chain r^2, that connects the spur-wheel r^3 on the shaft R with the spur-wheel p^4 on the driving-shaft e^3.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a cylinder, a piston and piston-rod working therein, a hopper, a shell-holder connected with said hopper, a tamp connected with the piston-rod and arranged to force material from the hopper into the shell in the shell-holder, a source of fluid-pressure, a valve-chest having communication with the source of pressure, a port in the valve-chest having communication with one end of the cylinder, means for maintaining a constant pressure on the other side of the piston, a port in the valve-chest adjacent the latter port and connecting with the atmosphere through an exhaust-pipe, means for regulating the quantity of air admitted to the cylinder from the valve-chest, an exhaust stop-valve on said exhaust-pipe for regulating the length of stroke of the tamp, a valve-rod, a valve on the rod arranged to put the cylinder alternately in connection with the valve-chest and with the atmosphere, means for operating said valve-rod at a constant speed, an apertured plate arranged between the valve and the valve-seat of the chest, and having a pair of apertures arranged to register with the ports in the valve-chest when the plate is in one position, said plate being arranged to blank said ports when the plate is in a second position,

and means connected with the piston-rod and arranged to operate said plate when the tamp is in a predetermined position and thereby blank the ports in the valve-chest and prevent further operation of the piston in the cylinder, substantially as described.

2. The combination of a cylinder, a piston and piston-rod working in the cylinder, a hopper, a shell-holder connected with the hopper, a tamp connected with the piston-rod and arranged to force material from the hopper into shells in the shell-holder, a source of pressure, a valve-chest having communication with the source of pressure, a port in the valve-chest having communication with one end of the cylinder, means for maintaining a constant pressure on the other side of the piston, a port in the valve-chest adjacent said latter port and connecting with the atmosphere, a valve-rod, a valve on said rod arranged to put the cylinder alternately in communication with the valve-chest and with the atmosphere, means for operating said valve-rod at a constant speed, an apertured plate arranged between the valve and the valve-seat of the chest and having a pair of apertures arranged to register with the ports in the valve-chest when the plate is in one position, said plate being arranged to blank said ports when the plate is in a second position, a trip connected with the piston and arranged, through interposed mechanism, to operate said plate when the tamp is in a predetermined position and thereby blank the ports in the valve-chest and prevent further operation of the piston in the cylinder, substantially as described.

3. The combination of a cylinder, a piston and piston-rod working in the cylinder, a hopper, a shell-holder connected with said hopper, a tamp connected with the piston-rod and arranged to force material from the hopper into shells in the shell-holder, a source of fluid-pressure, a valve-chest having communication with the source of pressure, a port in the valve-chest having communication with one end of the cylinder, means for maintaining a constant pressure on the other side of the piston, a port in the valve-chest adjacent said latter port and connecting with the atmosphere, a valve-rod, a valve on the rod arranged to put the cylinder alternately in communication with the chest and with the atmosphere, means for operating said valve-rod at a constant speed, an apertured plate arranged between said valve and the valve-seat of the chest and having a pair of apertures arranged to register with the ports in the chest when the plate is in one position, said plate being arranged to blank said ports when the plate is in a second position, a valve-rod connected to the apertured plate and carrying a coiled spring, a trip connected with the piston-rod, a trip-lever arranged in the path of the trip, one end of such trip-lever engaging and holding the valve-rod of the apertured plate and the other end adapted to be engaged by the trip carried by the piston-rod when the tamp is in a predetermined position, thereby to release and reciprocate the valve-rod of the apertured plate to blank the ports in the valve-chest and prevent further operation of the piston in the cylinder, substantially as described.

4. The combination of a cylinder, a piston and piston-rod working in the cylinder, a hopper, a shell-holder connected with said hopper, a tamp connected with said piston-rod and arranged to force material from the hopper into shells in the shell-holder, a source of fluid-pressure, a valve-chest having communication with the source of pressure, a port in the valve-chest having communication with one end of the cylinder, means for maintaining a constant pressure on the other side of the piston, a port in the valve-chest adjacent said latter port and connecting with the atmosphere, a valve-rod, a valve on said rod arranged to put the cylinder alternately in communication with the valve-chest and with the atmosphere, means for operating said valve-rod at a constant speed, an apertured plate arranged between said valve and the valve-seat of the chest and having a pair of apertures arranged to register with the ports in the valve-chest when the plate is in one position, said plate being arranged to blank said ports when the plate is in a second position, means connected with the piston-rod and arranged to operate the plate when the tamp is in a predetermined position and thereby blank the ports in the valve-chest and prevent further operation of the piston in the cylinder, and means for returning the plate to normal position with its apertures registering with the ports in the valve-chest, substantially as described.

5. The combination of a cylinder, a piston and piston-rod working in the cylinder, a hopper, a shell-holder connected with said hopper, a tamp connected with the piston-rod and arranged to force material from the hopper into shells in the shell-holder, a source of fluid-pressure, a valve-chest having communication with the source of pressure, a port in the valve-chest having communication with one end of the cylinder, means for maintaining a constant pressure on the other side of the piston, a port in the valve-chest adjacent the latter port and connecting with the atmosphere, a valve-rod, a valve on said rod arranged to put the cylinder alternately in communication with the valve-chest and with the atmosphere, means for operating said valve-rod at a constant speed, an apertured plate arranged between the valve and the valve-seat of the chest and having a pair of apertures arranged to register with the ports in the valve-chest when the plate is in one position, said plate being arranged to blank said ports when

the plate is in a second position, and means connected with the piston-rod and arranged to operate the plate when the tamp is in a predetermined position and thereby blank the ports in the valve-chest and prevent further operation of the piston in the cylinder, substantially as described.

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

HARRY M. PIERCE.

Witnesses:
WM. B. FOSTER,
J. HUNT HOLT.