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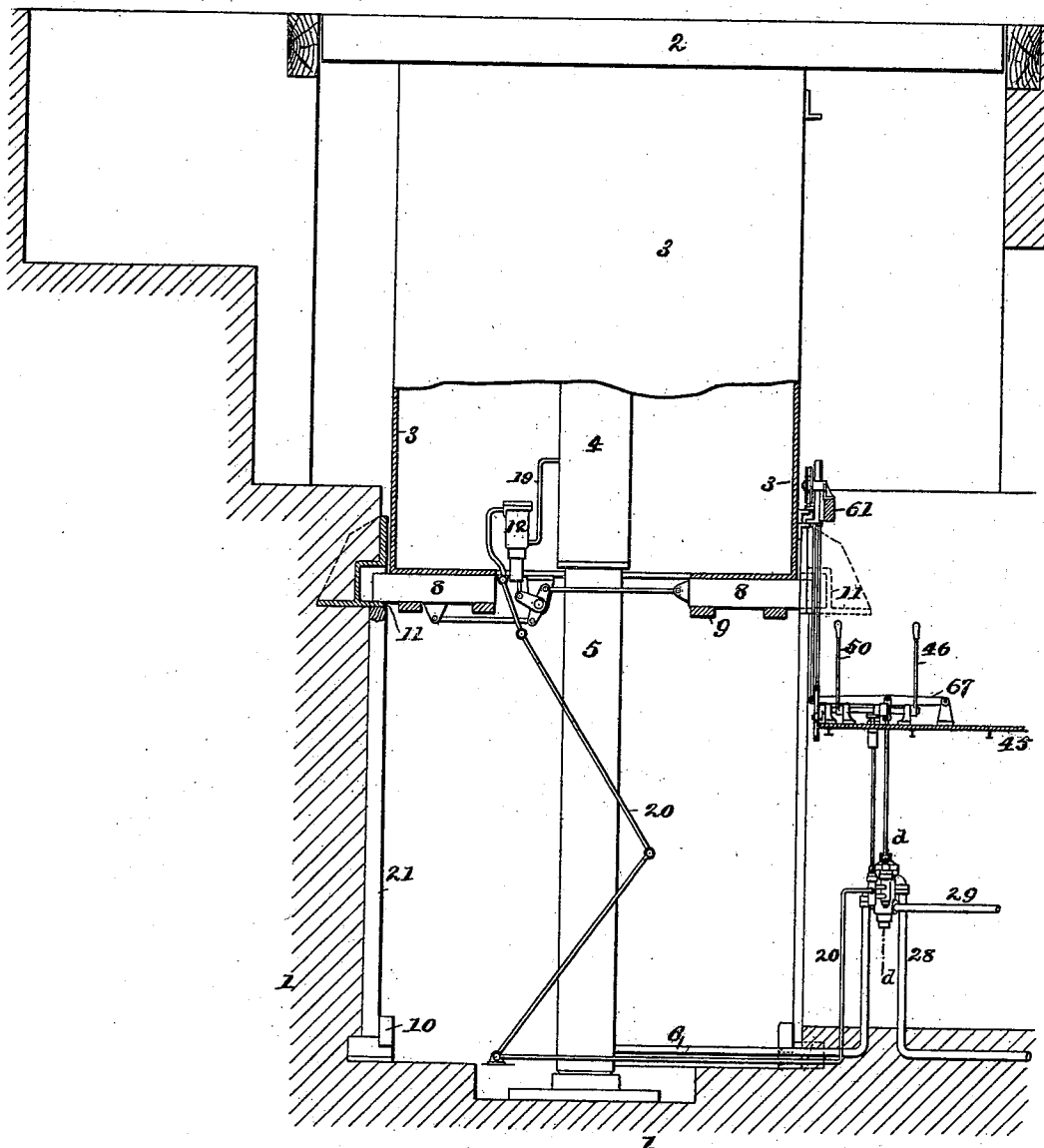
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T. F. ROWLAND.
MECHANISM FOR OPERATING ORDNANCE.

No. 488,838.

Patented Dec. 27, 1892.

Fig. 1.



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(No Model.)

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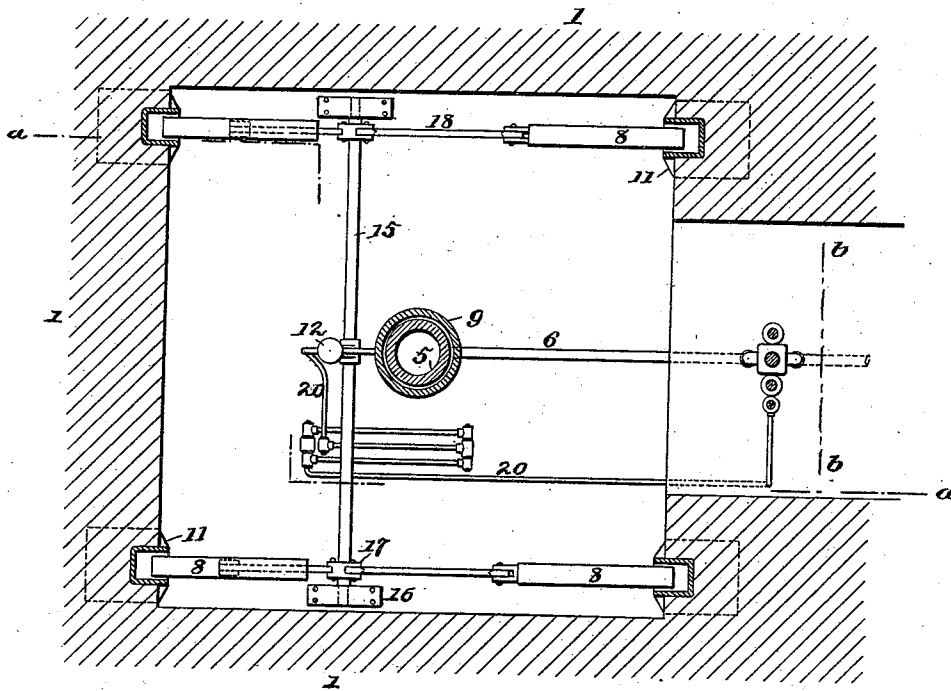
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Fig. 2.



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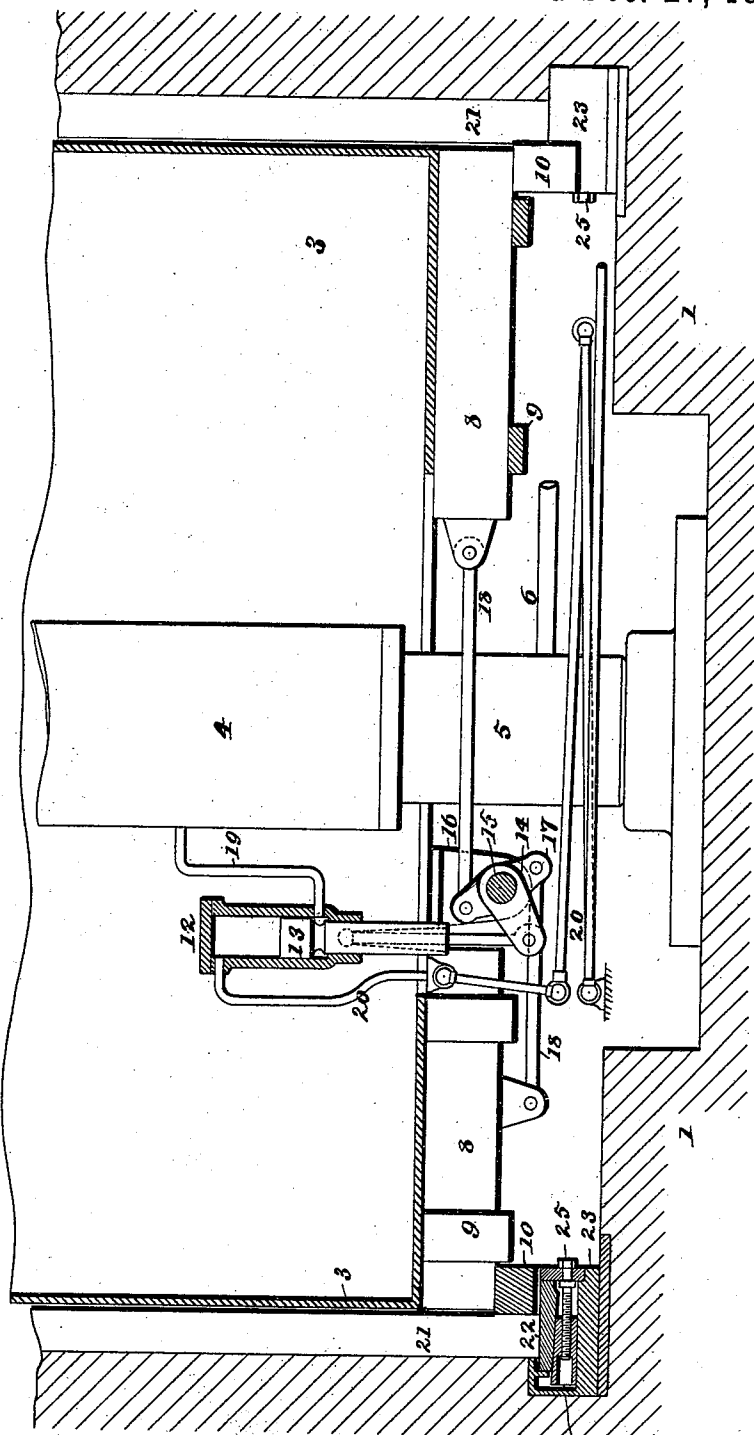
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Fig. 3.



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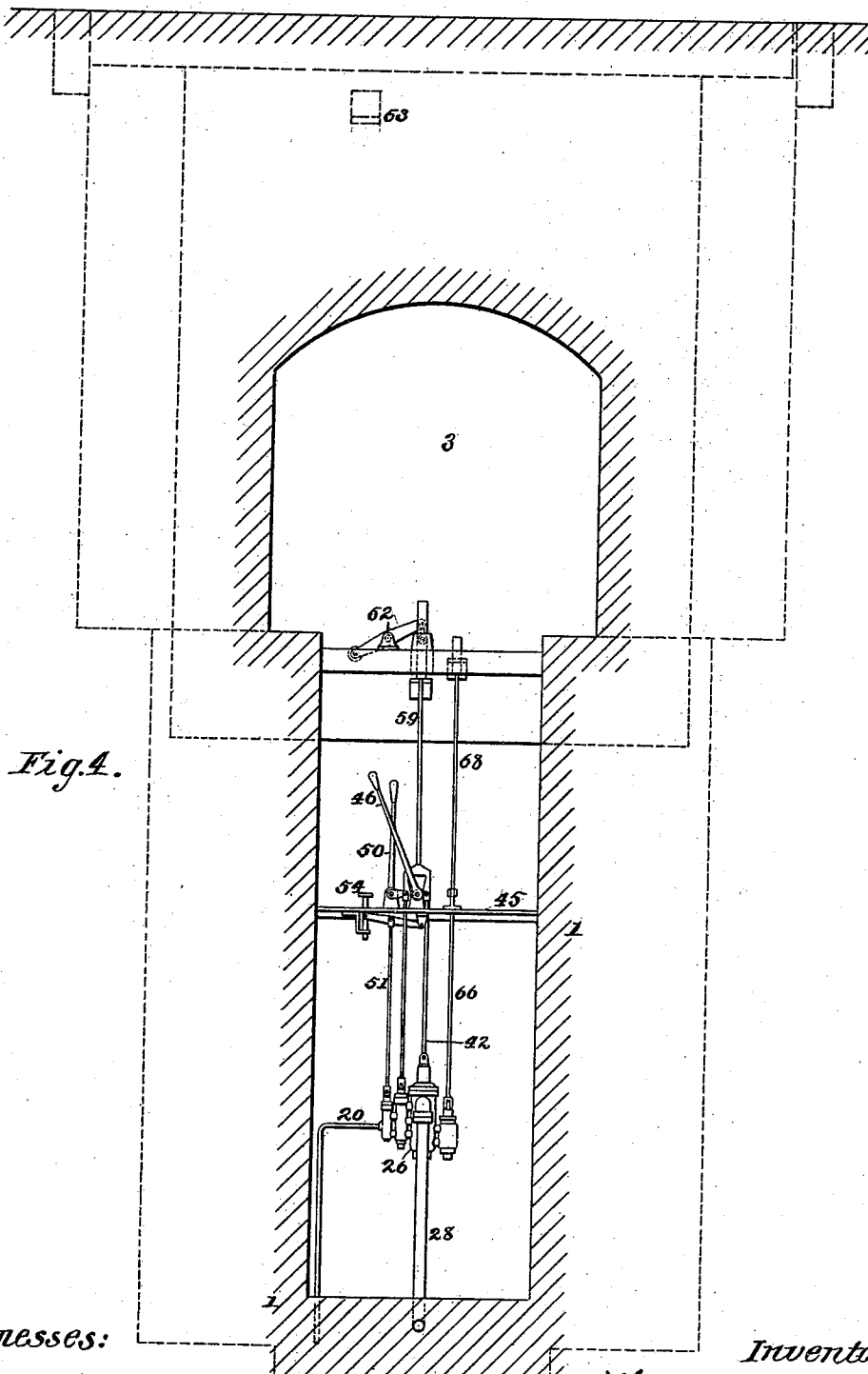
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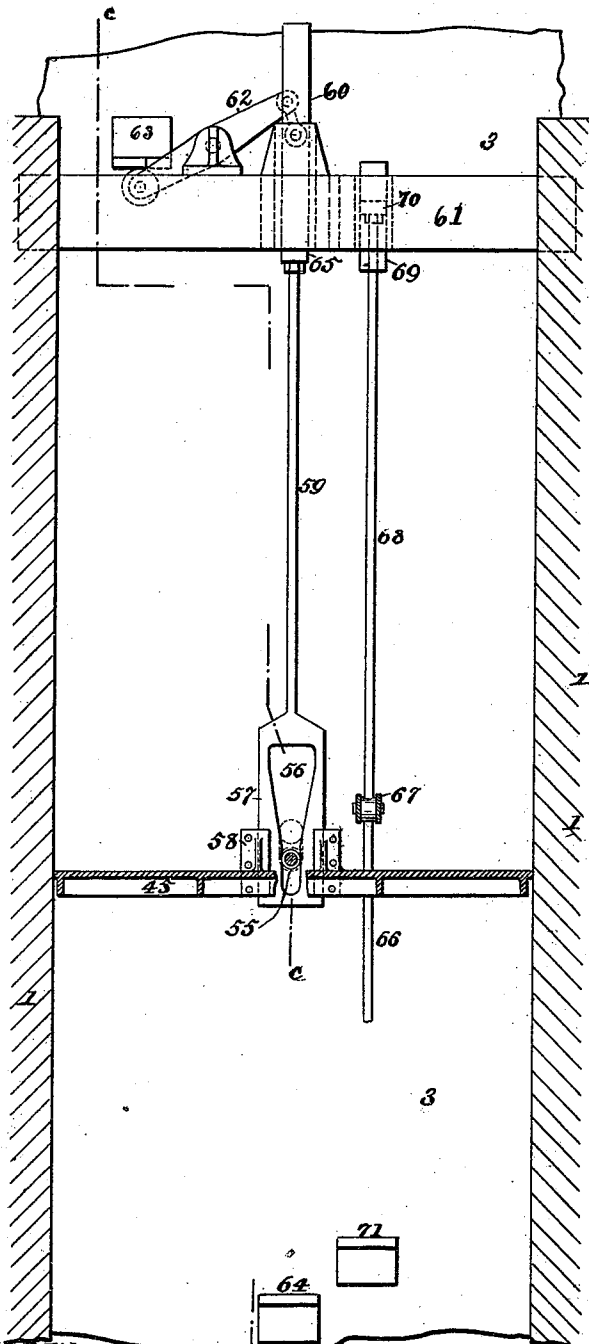
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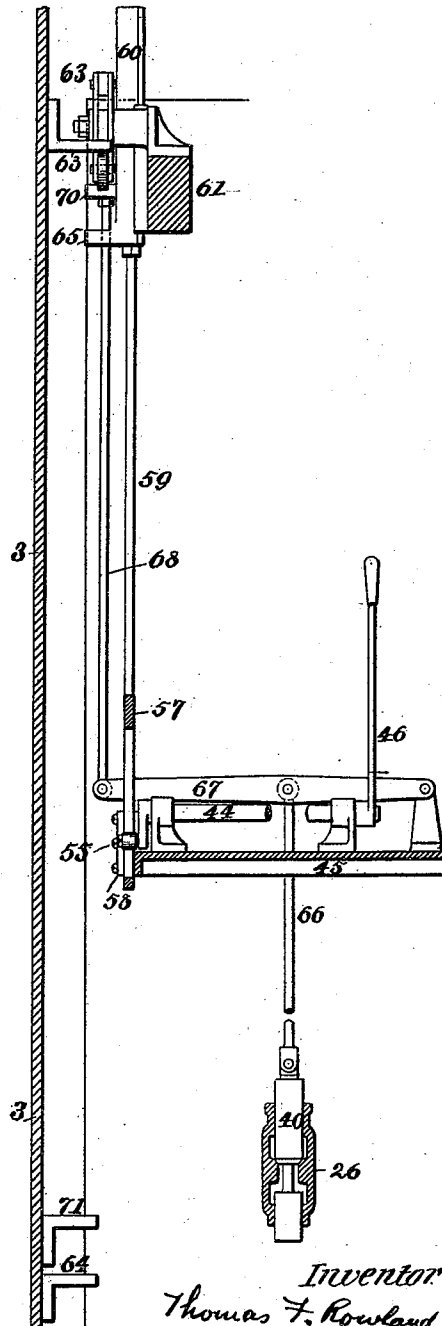
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Fig. 5



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Fig. 6.



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(No Model.)

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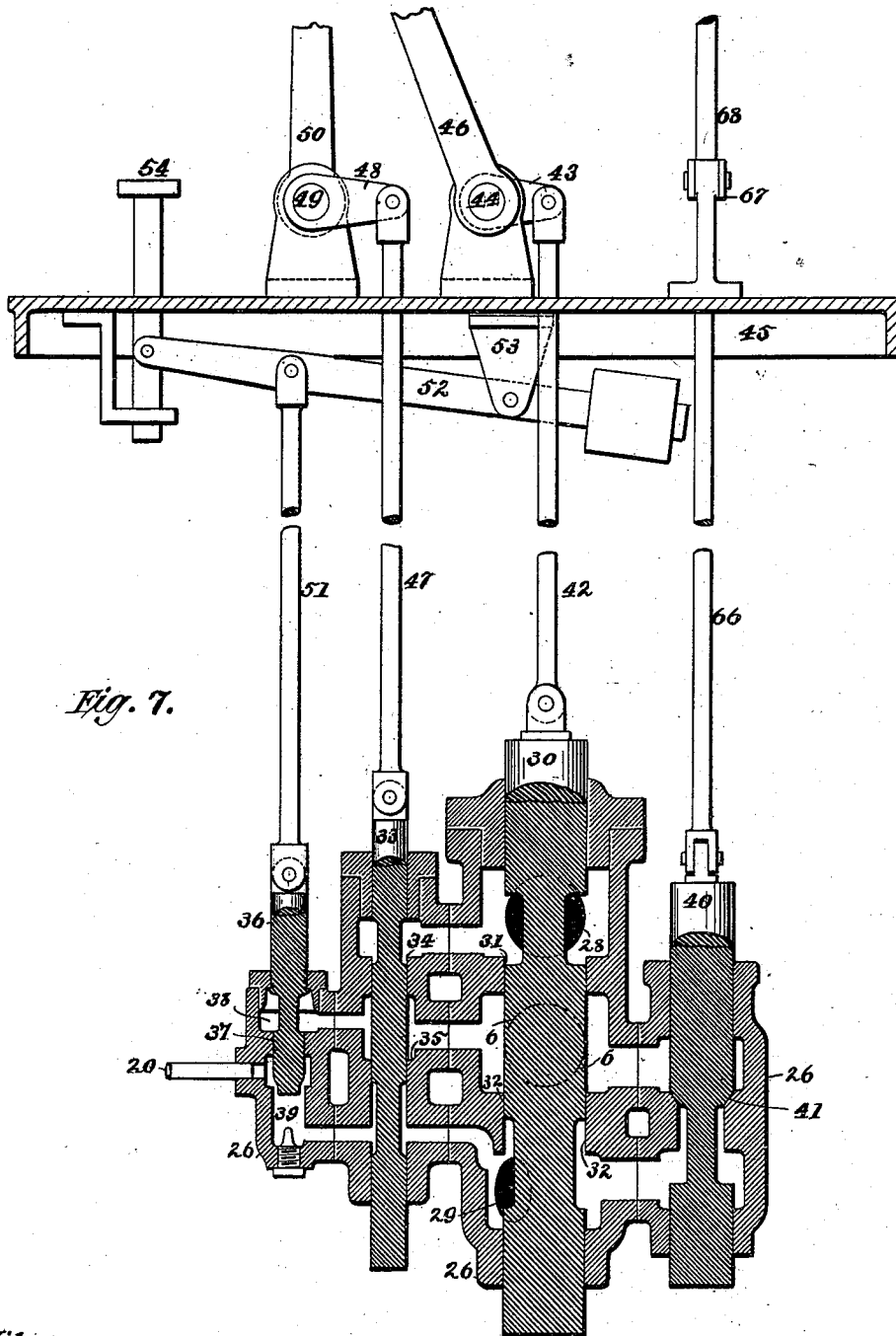


Fig. 7.

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UNITED STATES PATENT OFFICE.

THOMAS F. ROWLAND, OF NEW YORK, N. Y.

MECHANISM FOR OPERATING ORDNANCE.

SPECIFICATION forming part of Letters Patent No. 488,838, dated December 27, 1892.

Application filed August 9, 1892. Serial No. 442,600. (No model.)

To all whom it may concern:

Be it known that I, THOMAS F. ROWLAND, of the city, county, and State of New York, have invented certain new and useful Improvements in Mechanism for Operating Ordnance, of which the following is a description and specification, reference being had to the accompanying drawings.

The present improvements relate to that class of ordnance operating mechanism in which the gun or cannon is mounted on a vertically movable platform, lift or elevator, arranged within a fortification, or in a gun-pit, and which is adapted to elevate the gun from the loading position to the firing position and lower the same therefrom. Usually such a lift is arranged in a fortification, and the gun is elevated to fire over the crest of the parapet, and the following described improvements will be considered as applied to such use and working of ordnance.

Heretofore, gun lifts have been constructed and arranged so that, when the gun-carrying platform or lift was elevated to the firing position, the weight of the elevated parts was wholly sustained by the elevating mechanism and therefore the elevating mechanism had to sustain to a greater or less degree the effects of the recoil upon discharging the gun. A source of no small danger is present in these conditions, in that the elevating mechanism is relatively fragile, and by its construction and necessities of operation is susceptible, particularly when under the strain of hydraulic or other high internal pressure, to injury from the shock of recoil. It will therefore be readily understood that it is desirable to relieve the elevating mechanism from internal pressure, as well as to free it from the weight of the lift, during the discharge and recoil of the gun. Gun-elevating lifts have also been variously counterbalanced or partially supported by the action of weights, fluid buoyancy, and springs, but even in such cases the power mechanism had to sustain to an undesirable degree the effects of the discharge of the gun. More particularly, however, the inertia of the counterbalancing or like mechanism materially interfered with the speed of working the lift. It is of the greatest importance, however, to elevate or lower the gun at the highest practi-

cable speed, since the slower the vertical motion the less frequently can shots be fired, and the longer the gun has to be exposed the greater the danger of it being disabled by the enemy's fire. It is also important that the gun lift mechanism be automatically controlled and operated as far as possible, particularly in the case of large fortification-guns operated by hydraulic pressure, in order to guard against accident of any kind, because of the operator failing to properly manipulate the mechanism that controls the motive power.

The various features of my invention are illustrated as applied to, and for operating, a form of lift known as the "Abbot gun lift," which has been proposed by General Henry L. Abbot of the Corps of Engineers, United States Army.

General Abbot's proposed gun lift was designed to include a platform adapted to receive and support a gun and its operating mechanism, a lifting structure arranged below and integral with the gun platform, and a series of shores or dogs vertically arranged adjacent the lift in the walls of the pit or substructure and pivotally supported at their lower ends. When the lift should be raised, the upper ends of these shores were to be swung horizontally under the lift and were to so engage and support the lift that the elevating mechanism would be freed of the weight of the same and might be relieved of the internal pressure of the hydraulic or motive fluid.

The invention or inventions and parts thereof, consist of mechanism and devices combined and arranged in various ways (to be hereinafter fully described), whereby the following mechanical operations of a gun lift can be effected. The lift is first slowly started, and then increases in speed and is rapidly raised until it approaches the limit of its upward movement, when it slows in speed and gradually comes to rest upon horizontal bolts carried on the lift and automatically operated to enter bracket sockets provided therefor and attached to the side walls of the substructure. The gun can now be fired, and the elevating mechanism, having the power pressure withdrawn from within the same and not acting to support the lift, will be unaf-

5 fected by the discharge. The power pressure is now reapplied to the elevating mechanism, the lift slightly elevated, the bolts withdrawn from their sockets, and then the lift is
 10 quickly lowered, and as it approaches its lowermost position its speed is regularly lessened so that it will gradually come to rest without blow or shock. In effecting such operation the person manipulating the mechanism controlling the motive fluid is mechanically prevented applying the full elevating power until after the lift has been started; in like manner the full power is mechanically and positively reduced upon the lift approaching its
 15 upper position, and the lift is there brought gently to rest after the locking bolts have been automatically entered in the sockets provided therefor. And, further, when the lift nears its lower position, the motive fluid is
 20 similarly automatically controlled to prevent the lift landing too suddenly.

In the accompanying drawings, an "Abbot gun lift" is shown fitted with my improvements, and my improved mechanism for mechanically operating the same, Figure 1, being
 25 a vertical section of a gun pit and the surrounding masonry or wall of the pit on plane *a a* of Fig. 2, the parts being shown as when the lift is in its upper position. Fig. 2, is a
 30 horizontal section across the pit, showing in diagrammatic plan the bolt mechanism which is located at and on the bottom of the lift and which is employed to support the lift both in its upper and lower positions. In this figure
 35 this mechanism is shown in position as seen in Fig. 1. This view is shown on a slightly larger scale than that of Fig. 1. Fig. 3, is an enlarged detail view of the locking mechanism at the bottom of the lift, and as such mechanism is seen at its lower unlocked position.
 40 Fig. 4, is a vertical section on a slightly enlarged scale from that of Fig. 1, and on plane *b b*, Fig. 2, across the walls of the pit, and across the galleries leading to the bottom of the same and to the loading position of the gun, the operator's platform and the mechanism for controlling the power pressure located in such gallery being shown in elevation and in relative position to the lift. Fig. 5, is a
 45 vertical section in enlarged detail, similar to Fig. 4, showing the relation of the automatic power-controlling mechanism to the lift; Fig. 6 being a vertical section of the same parts on plane *c c* of Fig. 5. Fig. 7, is an enlarged
 50 detail view in central vertical section of the valve mechanism which controls the power fluid by which the lift is operated, this view showing this mechanism as seen on plane *d d*, and looking toward the pit or to the left, of
 55 Fig. 1.

Referring to the various views in detail, 1 represents the general ground-work, masonry or walls of the pit in which is arranged and mounted the gun lift and the machinery for
 60 operating the same, this ground-work being of any suitable material and construction.

2, is the platform upon which the gun is

70 mounted as also the turn-table, chassis and other mechanism for manipulating the gun for purposes of loading, training &c. Preferably this platform is rectangular in form and usually approximately square, but such form is not essential.

3, is the gunlift, which is a structure of hollow, or box form and of smaller size in horizontal section than the lift platform 2. The platform and lift are integral, and are structurally composed of powerful iron beams and girders united to form a frame-like structure of great strength adapted in its various features of construction, not necessary to describe here, to sustain the load and strains to which it is to be subjected.

4, represents the cylinder and 5, the plunger of a hydraulic apparatus for elevating the lift, the former moving telescopically over and on the latter. The cylinder is attached to the lift and moves with the same, while the piston rests upon a base plate at the bottom of the pit.

6, is the pipe that conducts the motive fluid, usually water, to the interior of the cylinder. It is to be understood that this pipe communicates with a proper source of water under pressure. In the case of the present plant, the water is derived from one or more hydraulic accumulators, of form and construction shown in my application filed July 8, 1891, Serial No. 398,756, and May 23, 1892, Serial No. 434,089, which accumulators are worked by any suitable power so as to maintain a constant supply of water under high and uniform pressure. Upon permitting the motive fluid to pass within the cylinder, the latter is moved vertically on the piston, and the lift is elevated, and upon permitting the motive fluid to exhaust from the piston the lift is lowered.

8 represents locking bolts, four in number, which are hung in stirrups 9 at each corner of the lower end of the body of the lift. It is by and upon these locking bolts that the lift is wholly supported both when at rest at the bottom of the substructure and when at the top of the superstructure or in the firing position, the bolts resting in the first-named position on the shelves 10 of base-blocks, and when in the upper position in and on the socketed brackets 11.

12 is a cylinder mounted on a suitable cross-support of the frame-work of the lift, the piston 13 of which is differential in form of construction and is pivotally attached by its piston rod to an arm 14 on the rock-shaft 15 which is hung in pillar-blocks 16, which shaft also carries, and rigid therewith, the rocker arms 17, these arms being connected with the locking bolts 8 by rods 18. A pipe 19 conveys water from within the lift cylinder 4 to below the piston 13, and a pivotally jointed extensible pipe 20 conveys water at proper time from the source of supply to above the piston. The area of the upper face of this piston is considerably greater than the area of its lower

face. Whenever the water pressure is exerted in the hydraulic cylinder 4 the same pressure is felt below the piston 13, and consequently, assuming no pressure or a less pressure to be exerted above the piston, the piston is forced toward the upper end of its cylinder and pressure is put upon the bolts 8 to extend or tend to extend them outwardly from the sides of the lift for the purpose of guiding said lift in its vertical travel.

21 represents four vertical stanchion guides adjustably secured by any suitable means against or in the walls of the substructure and located parallel to the lift and opposite the ends of the locking bolts 8 on the lift. These stanchions are composed of steel beams with angle bars attached and they present to the locking bolts flat and smooth faces against which the locking bolts press as the lift ascends and thereby steady and guide the latter, as well as hold the lift in proper relation to the hydraulic cylinder and its piston. These stanchions rest upon a plate 22, Fig. 3, which plates are contained in base-blocks 23 of form and construction adapting the plates to have slight vertical motion. Beneath these plates are located wedges 24, and screws 25 rotarily fixed in the fronts of the blocks enter threaded holes in the wedges. Turning the screws gives horizontal motion to the wedges and thereby effects the lowering or raising of the stanchions. Resting upon the upper ends of the stanchions and properly secured to them are socket brackets 11, which are of iron or steel. These sockets are of such construction as to loosely receive the ends of the locking bolts and to permit of a slight upward movement of the lift after the locking bolts have entered the sockets.

The main operation of elevating and lowering the lift can now be explained, it being understood that there are controlling means, to be hereinafter fully explained, for supplying water under pressure to and exhausting it from the supply pipe 6 leading to within the hydraulic cylinder 4, as also to and from the pipe 20 communicating with the cylinder 12 above the piston 13. To elevate the lift, the water will be slowly admitted to the elevating cylinder to first gradually and without shock overcome the great weight of the lift and its load. This application of lifting pressure is also felt, through pipe 19, beneath the piston that operates the locking bolts, and as the lift begins to ascend, and thereby frees the locking bolts of its weight, the piston will be slightly raised and the locking bolts will be partially shot out so that their end faces bear on the stanchions on the side walls of the pit. The area of the under-face of the locking bolt-operating piston is such as to effect the prompt and certain action of the locking-bolt mechanism in its guidance of the lift, but is not so large as to cause them to so forcibly press against the stanchions as to create any essential friction as the lift ascends; this pressure is, however, sufficient to

cause the bolts to effectively steady the lift and to prevent undesirable vibration or other irregularity in the vertical movement of the lift. Upon the lift being thus started, the flow of the motive fluid to the lifting cylinder is increased and the speed of movement of the lift is accelerated to the maximum, depending however in certain respects, to be explained, upon the will of the operator. As the lift approaches the limit of its vertical travel the feed of the motive fluid is gradually and automatically cut off until the lift is brought gently to rest, with its locking bolts projecting into the socket brackets at the top of the side stanchion guides; that is, as the locking bolts leave the upper ends of the stanchions the fluid pressure maintained on them causes them to shoot outwardly to the full extent of their movement and to enter the sockets. The water is now to be gradually exhausted from the elevating cylinder, thus permitting the lift to descend a short distance and to come to final rest or firing position, the lift being now wholly supported upon its locking bolts which are extended to within the sockets and bear upon the same. Thus the entire weight of the lift is upon the stanchion guides attached to the superstructure when in firing position, and the elevating cylinder and piston are relieved of internal pressure. It will therefore be seen that the shock of firing cannot be felt by the elevating mechanism to any material and certainly not to any dangerous extent, and also and especially, such mechanism has not to sustain any shock or strain.

To lower the lift, pressure is first gradually restored in the elevating cylinder until the lift is slightly raised, thus freeing the locking bolts from the socket bearings. The motive fluid being at the same time applied above the bolt cylinder piston, co-incidentally with the upward movement of the lift the locking bolts are also automatically withdrawn; for by reason of the upper face of the locking-bolt piston being larger than the lower face, the pressure against the latter will be overcome even though the fluid pressure be the same within the elevating and bolt-operating cylinders. After the locking-bolts have been thus withdrawn, the elevating cylinder is exhausted and the lift lowered. The pressure to withdraw the locking bolts is continued until the locking bolts pass to below their socket bearings, after which such pressure is exhausted and the locking bolts are, by the action of the pressure below the bolt piston, again automatically projected to bear against the faces of the stanchion guides and steady the lift as it descends. This function is practicable because of the pressure within the elevating cylinder during its descent, which pressure is produced by the weight of the structure. As the lift nears the landing blocks, at the base of the stanchion guides, its speed is reduced so that it is brought to rest gradually without shock.

It is to be noted that the lift, when at either

its upper or lower position of final rest, is supported upon the base-blocks of the stanchion guides and that each of the two landings of the lift (the base-blocks shelves 10 and the socket brackets 11) are positively positioned relatively by the stanchion guides and yet are capable of being adjusted at will. By these means these landings are independent of the masonry of the superstructure, and any settling, variation or disturbance of the walls will not affect the desired positive relation of the lift landings to the predetermined range of movement of the lift. At the same time, if necessary, for any reason to alter or adjust the landings relatively, this can be easily effected by the adjusting base-block devices provided therefor.

I have shown in the drawings the earth works, masonry or other ground structure surrounding the gun pit as provided with one main passage or tunnel leading to the pit, see particularly Figs. 1, 2 and 4, and such passage is divided by a gallery floor into an upper way or communication opening into the pit at or near the level of the gun platform when at its lower position, and a lower way or passage on the level of the bottom of the pit; and mechanism for controlling the movement of the lift is also located in such gallery. It is, however, to be understood that these features of the plant may be of other kinds and otherwise disposed relatively. In the lower part of the superstructure gallery and near to the same, is located the valve mechanism 26, which mechanism may be fixed in position and supported by any suitable devices, such devices being omitted from the drawings. Just above this valve mechanism, Figs. 1, 4 and 7, is located the valve-operating mechanism, the same being mounted on a platform floor 45, which is the position of the operator in charge of the lift, this position being such preferably that the operator is in view of the lift and can watch it when in operation.

The valve mechanism shown in detail in Fig. 7, the valves being in a closed position, consists of a valve casing 26, containing four plunger or piston valves which have lengthwise movement through the various valve seats and open or close the same by the registry with the seats of portions thereof varying in diameter. In this view the inlets and outlets of the casing 26 are indicated by the same numerals that represent the pipes leading to and from the same. Thus, the dotted circle 6 represents the opening through the casing where the pipe 6 which conducts the water under pressure to the lift elevating mechanism, is joined to the casing; 20 is the connection with the pipe that supplies the bolt withdrawing or unlocking pressure to the cylinder 12 on the lift; 28 is the induction passage and communicates with the pipe 28 which extends to the source of fluid pressure—the hydraulic accumulators, or other similarly-operating fluid pressure devices; and 29 is the eduction passage that communicates with the exhaust pipe 29.

30 is the main valve. It works through and to open and close the valve seats 31 and 32, to put the chamber of the feed pipe 28 into communication with the chamber of the supply pipe 6, as also to put the feed chamber into communication with the chamber of the exhaust pipe 29, the contracted or passage portion of the valve serving to open these valve seats when the valve is adjusted so as to bring either of such contracted portions into or adjacent the valve seat it controls.

33 is the auxiliary valve, it being constructed similarly to the main valve, and is arranged to open or close the valve seat 34 arranged between the feed and supply chambers 28 and 6 around the main valve, and also to open and close the valve seat 35 between the supply and exhaust chambers 6 and 29.

36 is the valve that controls the admission and exhaust of water to and from the locking bolt cylinder 12 on the lift and through the pipe 20. This valve opens and closes the valve seat 37, and it is to be noted that the seat of this valve is of smaller cross-section than the spindle part, whereby pressure in the chamber 38 will tend to cause the valve to return to the closed or normal position. Chamber 38 communicates with the chamber 6 around the main valve. This valve also serves to close the passage 39 which passage leads around the auxiliary valve to the exhaust chamber 29.

40 is the relief valve, which opens and closes the valve seat 41 arranged in a passage leading from the supply chamber 6 and to the exhaust chamber 29.

Referring now particularly to Figs. 5, 6 and 7, the main valve 30 is pivotally attached by the connecting rod 42 to the arm 43 on the rock shaft 44, which shaft is mounted in suitable journals resting on the platform 45 just over the valve mechanism 26, and is also provided with an operating hand lever 46. In like manner the auxiliary valve 33 is connected by rod 47 to the arm 48 of rock shaft 49 which carries the hand lever 50. The bolt-unlocking valve 36 is connected by rod 51 to the counter-weighted lever 52, which is pivotally supported in block 53 and is provided with the foot depression plate 54 located near the operator's position between the hand levers 46 and 50. It will now be plain that the various movements of the valves, to effect the elevating and lowering of the lift, are under the control of the operator, who has but to move his hand levers and his foot lever at the proper times and in proper directions. It is essential, however, to provide against accidental operation of the valves as well as to insure as far as practicable their automatic operation, in the respects that the whole fluid pressure should not be thrown too suddenly on the elevating mechanism of the lift, and only after a predetermined time or when it has been properly started, and that such pressure should be gradually and not suddenly reduced when the lift is being brought to rest upon either

its upper or lower landing; next, it is essential that the fluid pressure should be suitably exhausted from the elevating mechanism when the lift has reached a predetermined height, as in event of the operator failing to operate the valve mechanism to effect the arrest of the lift. Accordingly I will now describe the means employed to accomplish these ends.

10 The main valve-operating shaft 44 carries at its end next the lift a crank arm 55, which arm is positioned within the V-shaped opening 56 of the cam slide 57 mounted and having vertical movement in ways 58 on the platform 45. The vertical movement of this cam slide causes the same to engage the crank arm and bring it to the position shown, thus rotating the shaft 44 and closing the main valve, or to free the crank arm to permit the main valve to be opened. The cam slide is attached to the rod 59, which joins the slide-bar 60 passing through slide supports on cross beam 61 and pivotally attached to one end of the rocking lever 62 also pivotally mounted on said beam.

63 is a bracket stop fixed at the top of the lift (the lift in these figures is shown at its lower position), and this stop is so positioned that, as the lift descends and just before it reaches its lower position, this stop comes in contact with the free end of the rocking lever 62 and causes the cam slide 60 to be drawn upwardly to the position illustrated.

64 is a similar bracket stop mounted on the side of the lift and at the bottom thereof, and 65 is a like bracket carried at the top of the rod 59, these bracket stops being in vertical line. As the lift ascends and approaches its uppermost position, stops 64 and 65 come into contact and the cam slide is brought to the position shown as before. Immediately after starting the lift to ascend or descend, the cam slide is freed and drops down so that the rock shaft arm governed by it is freed and the rock shaft can be rotated by the operator to open the main valve.

66 is a rod extending from the relief valve 40 to the lever arm 67 pivotally supported at one end on the platform 45 and pivoted at its other end to the rod 68 which ends in the slide bar 69 vertically movable in ways on the beam 61. The slide 69 bears a shoulder or stop 70 which is arranged in the path of the bracket stop 71 at the bottom of the lift. Should the operator after the main valve has been closed, not duly close his auxiliary valve (as herein-after explained) and the supply of water continue to the elevating mechanism, then when the stop 71 comes in contact with the shoulder 70, the relief valve will be lifted and the pressure on the elevating mechanism will be relieved.

To operate the lift, assuming the water pressure to be on the main valve mechanism and the lift to be at its lower position, the operator will first lower the auxiliary valve, so as to gradually put the feed and supply cham-

bers 28 and 6 into communication, thus causing the motive fluid to enter the elevating cylinder of the lift as also to below the piston of the locking-bolt actuating cylinder. This effects the gradual start of the lift without shock or unnecessary strain, the bolts being at the same time pushed outwardly against the stanchion guides and brought to position to steady and help guide the lift. When the inertia of the lift has thus been overcome and the lift has ascended a short distance, the slide cam controlling the main valve is freed and the main valve can be gradually opened by pushing it down, or the operator can wait the full freeing of the main valve and throw it wide open. This permits the motive fluid full access to the elevating cylinder, and the lift is moved at its greatest speed. As the lift approaches the upper landings, the cam slide gradually closes the main valve, the bolts are shot out over the landings, and the operator lifts and closes the auxiliary valve; or if he fails so to do, the lift will open the relief valve, the motive fluid will pass from the supply chamber to the exhaust chamber, and the elevating pressure upon the lift be relieved. Assuming, however, that the auxiliary valve be duly closed and the lift be arrested, the operator then raises this valve to such extent that the supply and exhaust chambers are put in communication, and the water begins to exhaust from the elevating mechanism into the supply chamber and out through the exhaust chamber, and thereby the lift is slightly lowered and brought to rest upon its locking bolts which bear upon the upper lift landings. Immediately after the discharge of the gun, the operator again depresses the auxiliary valve and communicates the feed and supply chambers to the valve long enough to elevate the lift slightly; then he depresses the locking bolt withdrawing valve 36, opening valve seat 37 and closing passage 39, and causes the water to flow from the feed chamber to above piston 13, which piston is thereby depressed, producing the full withdrawal of the bolts. Now the auxiliary valve is moved to exhaust position and the lift is gradually lowered until the bolts are opposite the stanchion guides; then the locking-bolt withdrawing valve is permitted to rise, which cuts off fluid flow to the locking-bolt cylinder and opens the exhaust passage 39 therefrom, and at the same time the pressure maintained below the locking-bolt piston causes it to again rise and the locking-bolt to be pressed outwardly against the stanchion guides. This partial descent of the lift has caused the cam slide to free the main valve, which may then be thrown wide open to exhaust after the full withdrawal of the locking-bolts, and the lift permitted to take its greatest speed of descent. As the lift approaches the bottom of the superstructure, the main valve is automatically closed by the slide cam, observing which the operator will again raise the auxiliary valve and so cut off the exhaust from the elevating

cylinder as to cause the lift to gradually come to rest on the stanchion base blocks. Of course the bolts may be held withdrawn during the entire descent of the lift, but it is preferred after having withdrawn them from the landings and after the lift has been lowered below the landings, to project them against the stanchions that the lift may be held steady during its descent and any tendency to swinging or vibrating is thereby obviated. Similarly, also, the bolts can be held withdrawn from the stanchions when the lift is ascending, by the application of pressure upon the larger face of the bolt operating piston, the bolt mechanism being capable of operation at the will of the operator, and whenever the bolts do not support the lift. By these means a gun lift and load of great weight can be rapidly and safely handled. These arrangements and combinations of parts, result in higher efficiency than is true of other forms of lifts, and at the minimum of cost, and with the least liability of failure of the mechanism or injury thereto. I am aware that the mechanisms shown and described are susceptible of many modifications, and, therefore, I do not limit myself to the particular forms shown.

What is claimed as new is:

1. A gun lift and mechanism for elevating the same, in combination with locking-bolt mechanism adapted to engage the walls to support the lift, and hydraulic bolt retracting mechanism independent of the operation of the elevating mechanism.

2. In combination, with a gun-elevating lift, a stationary structure adjacent the lift, mechanism for elevating and lowering the lift, sliding locking-bolts carried on the lift and adapted to engage said stationary structure and support the lift thereon, and a hydraulic cylinder and piston mechanism also carried on the lift, and adapted to project and withdraw the said locking bolts.

3. In combination with a vertically movable gun-lift and the superstructure thereof, a locking-bolt mechanism adapted to engage the side walls and support the lift thereon, and a hydraulic mechanism connected with and operating to project and withdraw the locking bolts.

4. In combination with a gun-lift, hydraulic mechanism for elevating the same, a bolt-locking mechanism carried on the lift and adapted to engage the pit walls and support the lift thereon, and hydraulic mechanism carried on the lift and for operating the bolts and adapted to operate to project the bolts by the lift-elevating pressure.

5. In combination with a vertically movable gun-lift and the side walls or pit structure thereof provided with landings for the lift, a locking-bolt mechanism carried on the lift and adapted to engage the landings of said walls and support the lift thereon, and a hydraulic mechanism connected with and operating to hold said bolts against the side walls as the

lift moves vertically and to project them to engagement with said landings.

6. In combination with a vertically operated gun-lift and the mechanism for elevating and lowering the same, vertically adjustable landings for the lift to rest upon when in the elevated position, and bolt mechanism carried on the lift and operated to engage said landings and support the lift thereon.

7. In combination with a vertically moving gun-lift and the mechanism for elevating and lowering the same, bracket landings for the lift to rest upon when elevated, stanchions supporting said brackets, mechanism supporting said stanchions and adapted to vertically adjust the same and the landings, and bolt mechanism carried on the lift and operating to engage said landings and support the lift thereon.

8. In combination in a structure comprising the upper and lower landings of a gun-lift, stanchions or similar vertically arranged supports located between the upper and lower landings, and means for adjusting the landings relatively.

9. In combination with a vertically movable gun-lift, operated by hydraulic mechanism to elevate and lower the lift, hydraulic bolt mechanism carried on the lift, landing supports arranged adjacent the lift and in the paths of the locking bolts of the locking bolt mechanism thereon, and a valve mechanism arranged between said hydraulic mechanisms and their source or sources of fluid pressure and adapted to effect and control the operation of the hydraulic mechanisms.

10. In combination with a gun-lift, hydraulic mechanism for elevating and lowering the same, connections from the hydraulic mechanism to a source of fluid pressure, a main valve in said connections for opening and closing the same, and a passage around the main valve provided with a valve auxiliary to the main valve and adapted to open and close a passage between the feed and exhaust ports of the main valve whereby to graduate the application of pressure to and withdrawal of the same from the elevating mechanism.

11. In combination with a gun lift and hydraulic mechanism for elevating and lowering the same, a main valve acting to control the application of fluid pressure to and the withdrawal of the same from the elevating mechanism, and mechanism for closing and locking the valve and operated by the lift as it approaches a predetermined position, and a valve and passage connecting the feed and exhaust ports of the main valve and adapted to supply and exhaust the fluid pressure while the main valve is closed.

12. In combination with a gun-lift and hydraulic mechanism for operating the same, a main valve operated to control the supply and exhaust of fluid pressure to and from the elevating mechanism, a relief valve connecting the feed and exhaust ports of the main valve,

and a mechanism operated by and upon a predetermined movement of the lift to open the relief valve and thereby exhaust the fluid pressure from the elevating mechanism.

5 13. In combination with a gun-lift and hydraulic mechanism for elevating the same, a valve mechanism composed of two valves of different size, arranged to control the application and exhaust of fluid pressure to and
10 from the elevating mechanism, the smaller valve connecting around the larger valve and serving to graduate the feed and exhaust of the fluid pressure, mechanism operated by the lift and adapted to close and lock the larger
15 valve, and a relief valve mechanism operated by the lift and adapted to exhaust the fluid pressure from the elevating mechanism.

14. In combination with a gun-lift and hydraulic mechanism for elevating the same, bolt mechanism for supporting the lift, a differential hydraulic piston connected to and
20 for operating the bolt mechanism, connections between the elevating and bolt-operating mechanisms, whereby they are simultaneously operated by the same fluid pressure,
25 and a valve mechanism controlling the fluid pressure upon both sides of said piston.

THOMAS F. ROWLAND.

Witnesses:

WILLIAM O. BROWNELL,
LUCIUS A. SMITH.