S. W. WARMAN.

AUTOMATICALLY OPERATED MINE GATE.

APPLICATION FILED AUG. 31, 1917.

1,299,074.

Patented Apr. 1, 1919.

3 SHEETS—SHEET 1.

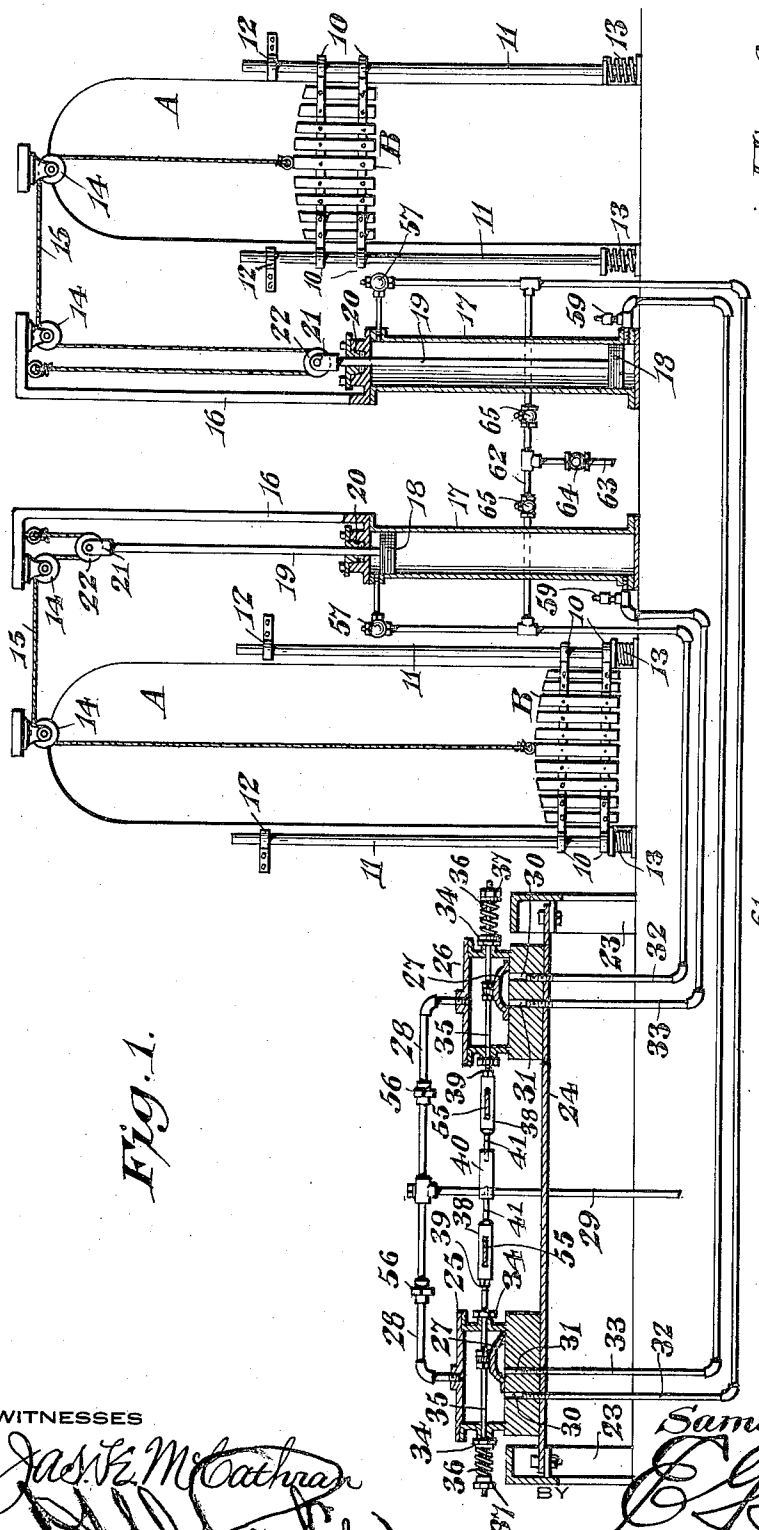

Fig. 1.

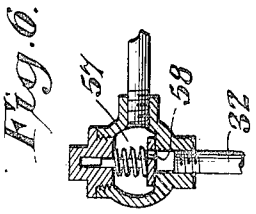

Fig. 6.

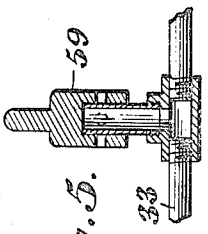

Fig. 5.

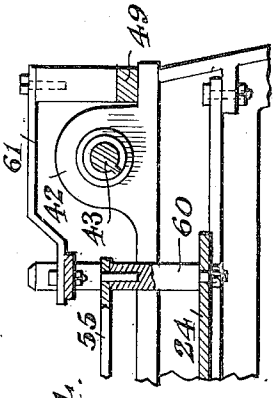

Fig. 4.

WITNESSES

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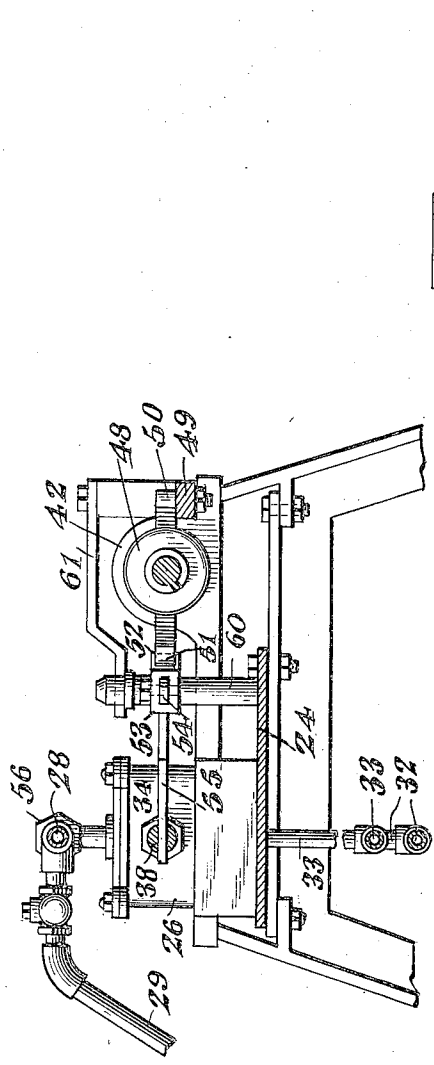

Fig. 3.

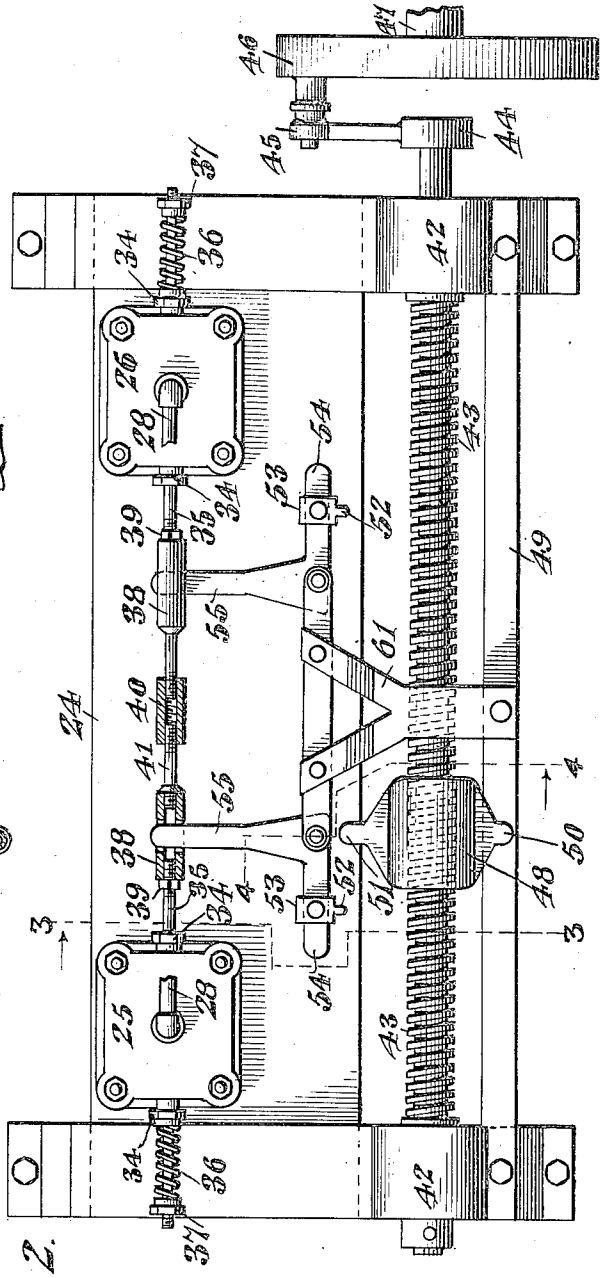

Fig. 2.

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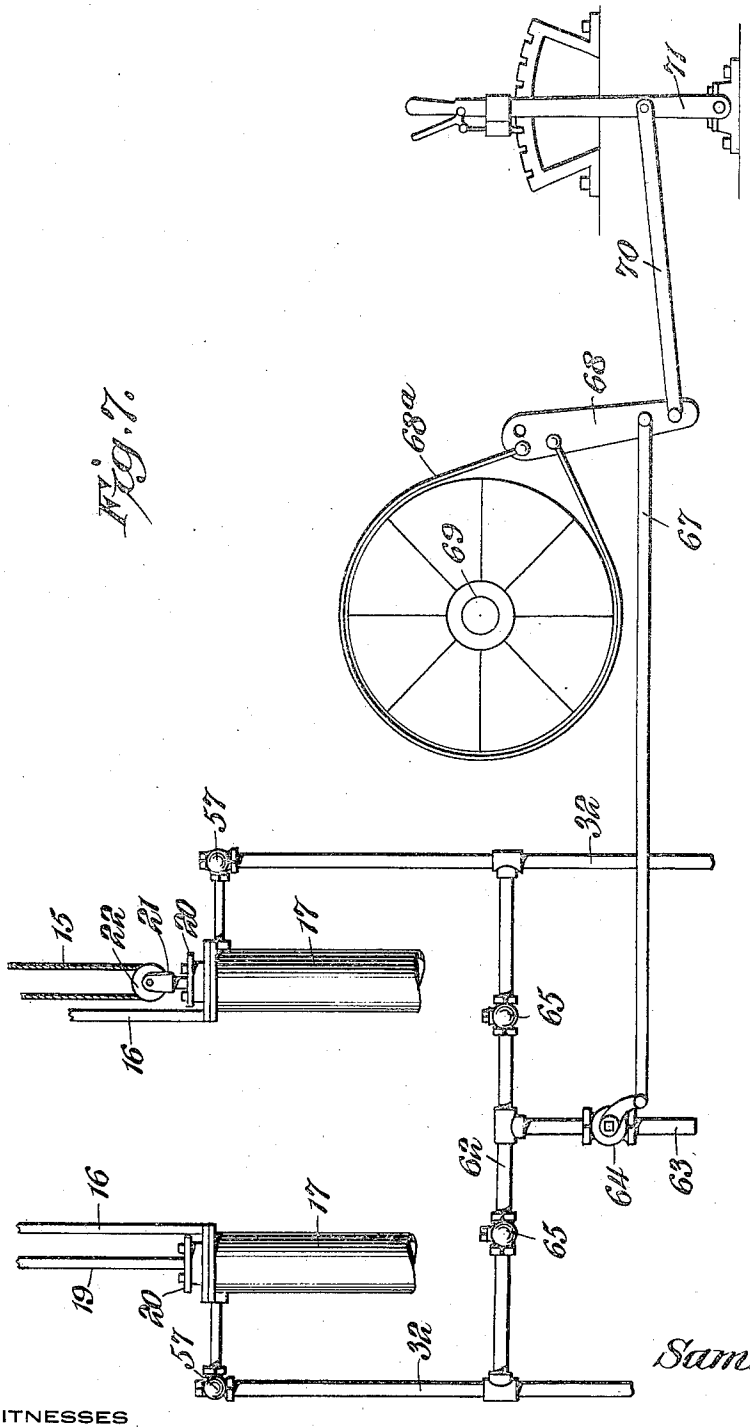
3 SHEETS—SHEET 3.

Fig. 7.



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UNITED STATES PATENT OFFICE.

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AUTOMATICALLY-OPERATED MINE-GATE.

1,299,074. Specification of Letters Patent. Patented Apr. 1, 1919.

Application filed August 31, 1917. Serial No. 189,179

To all whom it may concern:

Be it known that I, SAMUEL W. WARMAN, a citizen of the United States, residing at Brownsville, in the county of Fayette and State of Pennsylvania, have invented a new and useful Automatically-Operated Mine-Gate, of which the following is a specification.

The invention relates to automatically operated gates and more particularly to the class of automatic safety gates or barriers for mine shafts.

The primary object of the invention is the provision of a gate of this character wherein the same is operated automatically and driven from the hoisting engine for the cage or lift so that when the latter reaches a landing the gate will be raised and on the departing of the cage or lift from said landing the gate will close, thereby assuring safety to the operators in the mine shaft and affording protection to life and property.

Another object of the invention is the provision of a gate structure of this character wherein the mechanism for controlling the operation of the gate is provided with check and exhaust relief valves so that an air cushion or balance is had, which eliminates all shocks or jars in the raising or lowering of the gate, and avoids the use of springs, counter-weights or other balances to close the gate after the opening thereof.

A further object of the invention is the provision of a gate of this character wherein any number of the same can be arranged at one or more landings and will be alternately operated in a positive manner under the action of fluid pressure and actuated devices provided in connection with the hoisting mechanism for the elevator, cage, car or lift.

A still further object of the invention is the provision of a gate of this character wherein the construction thereof is novel in form to assure simplicity in construction, durability, reliability and efficiency in operation and also which is inexpensive in manufacture and installation.

There are various other objects and advantages in this invention besides the above and all of which will be hereinafter more fully or particularly brought out in the following specific description of the present preferred embodiment of the invention, the same being illustrated in the accompanying drawings, wherein:—

Figure 1 is a diagrammatic view showing a pair of gates located at the entrance to the mine shaft, the hoisting mechanism therefor, and the fluid controlling mechanism for operating the same constructed in accordance with the invention, the fluid controlling mechanism being shown in sectional elevation with one gate open and the other closed.

Fig. 2 is an enlarged top plan view of a portion of the control mechanism for the gates.

Fig. 3 is a fragmentary sectional view on the line 3—3 of Fig. 2 looking in the direction of the arrow.

Fig. 4 is a sectional view on the line 4—4 of Fig. 2 looking in the direction of the arrow.

Fig. 5 is a fragmentary vertical sectional view through one of the pressure released valves.

Fig. 6 is a vertical sectional view through one of the spring check valves.

Fig. 7 is a diagrammatic view showing the connection between the supply pipes of the cylinders and the hand brake lever.

Similar reference characters indicate corresponding parts throughout the several views in the drawings.

Referring particularly to the drawings in detail, A designates the doorways or entrances to a mine shaft or shafts, which in this instance are arranged in a pair at the landing or ground level to the mine shaft; and B the gates or barriers which open and close the entrance or communication with the shaft. Each gate or barrier B is mounted for vertical sliding movement at the doorway or entrance opening, and in the mounting of the said gate the same has fixed thereto at opposite ends guides 10 which slidably embrace vertical guide rods 11 fixed at opposite sides of the doorway or entrance openings A, and are vertically supported in brackets 12 fixed to the front face of the wall of the mine shaft.

Surrounding the vertical guide rods 11 at their lower ends are coiled compression springs 13 which serve as buffers to avoid the pounding of the gate or barrier B on the closing thereof. One pair of the guides 10 are preferably in the form of interlock-

ing hinges so that the gate or barrier B can be horizontally swung to open position to facilitate the handling of long material, such as pipes, rails, long timbers, etc.

Suitably supported above the doorways or entrance openings A are guide pulleys 14 over which are trained raising or lowering cables 15, which are connected to the gates or barriers B and also connected to stationary supports 16 which are located within an engine room at a convenient point relative to the mine shaft. The supports 16 are fixed to and rise from vertically disposed piston cylinders 17 which have arranged therein floating pistons 18, the rods or stems 19 of each working through suitable stuffing boxes 20 in the upper heads of the cylinders 17. The rods or stems 19 are formed with sheave heads 21 in which are journaled sheaves 22 adapted to play upon the cables 15 which are trained through the heads 21, so that reciprocative movement of the pistons 18 within the cylinders 17 will actuate the cables 15 for the extending or the drawing of the same.

This movement of the pistons 18 will result in the raising and lowering of the gates or barriers B, as is clearly shown in Fig. 1 of the drawings, the pistons 18 being fluid actuated in a manner presently described.

Within the engine room is located a stand 23 having a table 24 on which is arranged a pair of valve chests 25 and 26 having therein slide valves 27, and leading through the tops of the chests 25 and 26 are the branches 28 of a fluid supply pipe 29 which leads from any suitable source of fluid supply, either steam or air under pressure.

Each slide valve 27 controls the ports 30 and 31 in the base of each valve chest which communicates with the pipes 32 and 33, respectively, extending to the piston cylinders 17, the pipe 32 being connected with each cylinder at the upper end thereof for communication therewith at one side of the piston, while the pipe 33 is connected with the cylinder at the lower end thereof for communication therewith at the opposite side of the piston for a purpose presently described.

At opposite ends of each valve chest 25 and 26 are formed suitable stuffing boxes 34 through which work the valve rods 35, and on the outer ends of these rods are carried coiled resetting springs 36 which are tensioned through the medium of adjustable nuts 37 threaded on the outer ends of said rods, while the opposite ends of the rods 35 are tapped into sleeves 38 and are held engaged therein through the medium of locking nuts 39 working against sleeves 38, while between the sleeves 38 is arranged a guide sleeve or coupling 40 which has the connecting rods 41 secured in the sleeves 38 thereby connecting the guide sleeve or coupling 40 thereto. The coupling or guide sleeve 40 permits the convenient adjustment of the rods 35 so as to properly position the slide valves 27 in the chests 25 and 26 for controlling the ports 30 and 31, and also for permitting the proper timing for the operation of the mechanism controlling the slide valve, hereinafter fully described. It is to be understood that all timing of the valves is effected at the tappet on bell cranks.

On the ends of the stand 23 are bearings 42 in which is journaled a worm thread shaft 43, to one end of which is fixed a crank 44 having an eye 45 which is eccentrically connected to a driving disk 46 mounted on the shaft 47 of the engine, which is of the hoisting type for operating the lifts, cars or cages within the mine shafts. On the worm shaft 43 is a nut 48 adapted to travel back and forth and is guided in its movement on the guide bar 49, the nut being formed with a tail 50 engaging said guide bar to prevent rotation thereof.

The nut 48 is formed with a projecting lug or tappet 51 adapted to travel in the space between the bearings 42, and in the path of movement of this tappet or lug 51 are the noses 52 of tripping blocks 53 which are adjustably mounted on the short arms 54 of bell crank levers for actuating the slide valves, the long arms 55 of said levers being engaged in the sleeves 38 connecting the coupling or turn buckle with the valve rods 35 so that on the rocking of either bell crank lever, the slide valves will be operated for controlling the fluid to the cylinders 17, which fluid actuates the pistons 18 therein for the automatic raising and lowering of the gates or barrier B in a manner hereinafter fully described.

The branches 28 of the supply pipe 29 have arranged therein return check valves 56 which prevent the back flow of the fluid supply from the valve chests 25 and 26, while the pipe 32 leading to each cylinder 17 has arranged therein a spring check valve 57 which is adapted to be held wide open when the gate is being raised and closed when said gate is lowered, the valve being formed with a one-eighth inch hole 58 so that the fluid will pass slowly therethrough from the upper side of the piston 18 in the cylinder 17 when the gate is being lowered, and in this manner the upward movement of the piston 18 is cushioned. In the pipe 33 leading from each valve chest to the cylinder 17 is arranged therein a weighted release valve 59 which permits the escape of fluid to the atmosphere. The valve 59 consists of a weighted cap provided with a plurality of orifices which are normally closed by the upstanding pipe connection to the pipe 33, but, upon excessive pressure within said pipe during the downward movement of the piston 18, the said weighted cap 59 will be

elevated to raise the orifices therein above the upper open end of the said upstanding connection, when the fluid will exhaust to the atmosphere. By the action of both valves 57 and 59 the gates B on the up and down strokes thereof in the opening and closing movements will be cushioned so that said gates will be relieved of all shock or jars and the necessity for the employment of a separate cushioning cylinder is dispensed with.

The bell crank levers having the long and short arms 53 and 55 are supported for swinging movement upon pivot posts 60 which are fixed to and rise from the table 24 of the stand 23, and these posts 60 are held rigidly in vertical position by a bracket 61 supported upon the stand 23.

The relief valve 59 is weighted down to about 15 lbs. pressure so that in closing the gate when the return fluid passes back from the cylinder 17, through check valve 57, pipe 32, valve 27, pipe 33, and relief valve 59 to the underside of the piston, the gate is closed at once without shock or jar.

It takes about 45 pounds pressure to raise the gate and 15 pounds returned to the underside of the piston to close the same, as advantage is taken of the force of gravity to assist in the closing of the gate. The difference between 45 and 15 pounds pressure passes through the relief valve 59 into the atmosphere.

Referring to Figs. 1 and 7, I have shown a pipe 62 connecting the feed pipes 32 of the cylinders 17, and provided with a branch pipe 63 which discharges into the open air. Check valves 65 are provided in the pipe 62 on opposite sides of the branch pipe 63, the latter having a stop cock 64. For operating said stop cock from the hand brake of the hoisting engine, I connect the hand lever 71 by a link 70 to the brake lever 68, and connect the latter by a rod 67 to the handle of the stop cock. The brake lever has connected thereto the brake band 68^a which is passed around the drum 69 of the hoisting engine. If found desirable, a reduction valve may be installed in the fluid supply line or pipe, and the pistons and the weight release valves adjusted to operate at low pressure to assure always sufficient pressure for instant operation of the mechanism for controlling the gates.

With the valves 27 in the positions shown in Fig. 1 of the drawing, the action of the fluid within the cylinders, is as follows—

The lefthand gate B has just dropped, it is assumed, and elevated its coacting piston 18. Simultaneously therewith the right hand gate has been elevated by the actuation of its coacting piston 18. In the lefthand cylinder 17 the fluid above the piston 18 has exhausted slowly through the lefthand valve 57, backward through the pipe 32, through ports 30 and 31, housed within the valve 27, through pipe 33 and into lefthand cylinder 17, below the piston 18 thereof, the interior of the valve chest 26 being cut off from communication with the said ports 30 and 31 at this time.

On the other hand, the port 30 within the lefthand valve chest 25 being uncovered by the valve 27 therein, permits pressure to flow through its pipe 32 to the upper end of the right hand cylinder 17, thus forcing the piston 18 therein downwardly to elevate the righthand gate B. The exhaust below the said righthand piston 18 takes place directly through the adjacent weighted valve 59 to the atmosphere, for the reason that the remote end of the pipe 33 is closed by the lefthand valve 27, as shown, and thus the downward movement of the piston 18 is also cushioned.

In the operation of the mechanism, as the elevator, cage car or lift approaches the ground or surface level when lifted by the hoisting engine, the shaft 47 of said engine rotates the worm shaft 43 causing the tappet nut 48 to travel in one direction. At a predetermined point in the ascent of the elevator, cage, car or lift, the tappet nut 48 acts upon one of the tripping blocks 53, causing the rocking of the bell crank lever to effect the shifting of the slide valves 27 in unison in the valve chests 26, which control the ports 30 and 31 so that the fluid is regulated through the pipes 32 and 33 for the admission of the fluid into the cylinder 17 for operating the pistons 18 therein, which alternately control the movements of the gates or barriers B at the landing to effect the opening of one of the gates and the closing of the other. When the tappet nut 48 rides over the tripping block, the springs 36 on the valve rods 35 will become active for shifting the valves 27 to normal position so that the fluid within the cylinder 17 above the piston 18 therein will exhaust from said cylinder to the under side of the piston, it being understood, of course, that this action of the fluid takes place in one cylinder for the closing of the gate at one doorway or entrance opening A, while the fluid is being delivered to the other cylinder 17 above the piston for the opening of the second gate automatically. In the traveling of the tappet nut 48, the bell crank levers are successively operated, and in this manner the valves 27 are reversely actuated for the alternate control of the gates to effect the opening and closing action thereof.

Referring to Fig. 1 of the drawing, which represents one of the mine gates closed and the other open, it will be noted that the slide valve 27 at the right hand side has been actuated so as to bring the pipes 32 and 33 in communication through the ports 30, 31, while the slide valve at the left hand side

has the port 31 of pipe 33 closed by the valve and the port 30 of pipe 32 opening into the chest so as to receive fluid from the supply pipe 28.

When the cage is at the ground landing, the valve uncovers the port 30 of pipe 32 and the air or steam passes through pipe 32 to the cylinder on top of the piston opening the check valve 57 by the pressure, which is 45 pounds, and the gate is opened.

When the cage leaves the ground landing, the valve 27 is actuated to close communication between the chest and both ports 30, 31, and establish communication between the pipes 32 and 33 through the ports 30—31 and the valve. The air or steam amounting to 45 pounds pressure which has been required to open the gate, then passes back from the upper side of the piston through the hole in the check valve 57, through pipe 32, port 30, valve 27, port 31, pipe 33, relief valve 59 to the underside of the piston which causes the gate to close.

The check valve and relief valve 59 are important factors in this apparatus. While acting independently, they coact in the operation of the apparatus to cushion the rise and fall of the gate.

The purpose of connecting the valve 64 to the brake lever 71 is to properly control the gates, when it is found necessary to lower or raise the cage from the landing, without putting a prop under the gate. It often becomes necessary to do this when loading in long pit posts or when making an examination of the rope and cage. For instance, if the cage is lowered about 4½ feet from the landing, the valve 27 has not moved far enough to close port 30 and open port 31, so the air or steam pressure is retained in the cylinder 17 by the stop cock 64 being closed. Also when the cages are in motion, the brake lever 71 is released and the stop cock 64 is operated so as to open the pipe 63 to the atmosphere. It follows that there is then no movement of the pistons in the cylinders while hoisting, or running the cages up and down the shaft.

The gates will work without the check valves 65 and stop cock 64, but when not used the gates will jump up and down five to six inches every time the cage passes the ground landing.

The gates or barrier B operate alternately identically with the operation of the cages, cars or lifts in the mine shaft, that is to say, when one cage, car or lift is at the landing, the companion gate therefor is raised, while when the other cage or lift is lowered within the shaft said other gate is closed, so that in this manner injury to operators and damage to property is eliminated.

While there is illustrated in the drawings only one pair of gates and the actuating mechanism therefor, it will, of course, be understood that a system or series of gates may be actuated by said mechanism, and said gates may be arranged at any number of landings, or either below or above the same, and this is contemplated within the scope of the invention.

It is to be further understood that while reference has been made to motive fluid pressure, the same may include either steam or air, or any other medium may be utilized if desired.

From the foregoing it is thought that the construction and operation of the invention will be clearly understood, and therefore, a more extended explanation has been omitted.

What is claimed is:—

1. The combination with a cylinder, a piston within the cylinder, means for connecting a gate with the piston so as to actuate the same, a pair of pipes connected with the opposite ends of the cylinder, a valve chest to which the other ends of the pipes connect and communicate, a slide valve in said valve chest, means for alternately reciprocating the slide valve so as to either bring the ends of the two pipes remote from the cylinder in communication with each other through the valve, or cut off communication with one pipe and open communication with the other, a check valve provided in one of said pipes and a relief valve located in the other.

2. The combination with a cylinder of equal bore throughout, a single piston operating within the cylinder, means connecting the piston with a gate or barrier so as to cause the opening or closing of the gate or barrier by the shifting of the piston in the cylinder, a pair of pipes connected to and communicating with the cylinder at opposite ends, and alternately actuated valve means at the other ends of the pipes, said valve means operating to first supply motive fluid to one of said pipes while cutting off such supply to the other pipe, and then to cut off the supply of motive fluid to both pipes and at the same time establish through the valve means fluid communication between said other ends of the pipes, so as to allow the motive fluid forced out from one end of the cylinder through one pipe to enter the other pipe and return to the other end of the cylinder.

3. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate to each of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends, a valve chest for each pair of pipes and with which said chest said pipes communicate, means for supplying motive fluid to said valve chests, a valve in each valve chest, means for connecting the valve rods so as to cause them to move in unison, and means to alternately shift the valves so as to establish communication between one valve

chest and one of the pipes of one pair, and at the same time also close communication with the other pipe of said pair, and then close communication between the other valve chest and both pipes of the other pair, causing said last-mentioned pair of pipes to communicate with each other through the medium of said valve so as to allow the motive fluid forced out from one end of the cylinder through one pipe to enter the other pipe and return to the other end of the cylinder.

4. In combination with a plurality of cylinders, pistons movable in the cylinders, means for connecting gates or elements individually to the pistons of said cylinders, a pair of pipes for each cylinder connected to the opposite ends thereof, a plurality of valve chests, one valve chest for each pair of pipes, a pair of ports in each valve chest with which said pipes individually connect, a valve located in each valve chest for opening and closing said ports, means for connecting the valves to cause them to move in unison, and means to cause the shifting of said valves so as to effect the raising of one piston and the lowering of the other piston alternately, whereby the gates or elements are alternately closed and opened.

5. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate to each of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends, a valve chest for each pair of pipes and with which said pipes communicate, means for supplying fluid to said valve chests, a valve in each valve chest, a rod for each valve, a spring for each rod, means for connecting the valve rods so as to cause them to move in unison, and means to alternately shift the valves so as to establish communiction between one valve chest and one of the pipes of one pair, and at the same time close communication with the other pipe of said pair, and also close communication between another valve chest and both pipes of the other pair, causing said last-mentioned pair of pipes to communicate with each other through the medium of said valve.

6. The combination with a pair of cylinders, a piston in each cylinder, means for connecting each piston individually to a gate, a pair of pipes communicating with the opposite ends of each cylinder, a pair of valve chests with which said pipes communicate, means for supplying motive fluid to said valve chests, a pair of slide valves, one for each valve chest, for controlling the passage of motive fluid through said pipes, means for connecting the slide valves so as to cause them to move in unison, and means for alternately shifting the valves in opposite directions so as to effect the raising of one gate and the lowering of the other simultaneously.

7. The combination with a cylinder, a piston within the cylinder, means for connecting a gate with the piston so as to actuate the same, a pair of pipes connected with the opposite ends of the cylinders, a valve chest to which the other ends of the pipes connect and communicate, a slide valve in said valve chest, a spring for said slide valve for reseating the same, means for alternately reciprocating the slide valve so as to either bring the ends of the two pipes remote from the cylinder in communication with each other, or cut off communication with one pipe and open communication with the other, a check valve provided in one of said pipes, and a relief valve located in the other.

8. The combination with a cylinder, a piston within the cylinder, means for connecting a gate with the piston so as to actuate the same, a pair of pipes connected with the opposite ends of the cylinder, a valve chest to which the other ends of the pipes connect and communicate, means for supplying fluid to said valve chest, a slide valve in said valve chest, means for alternately reciprocating the slide valve so as to either bring the ends of the two pipes remote from the cylinder in fluid communication with each other, or cut off communication with one pipe and open communication with the other, a perforated check valve provided in one of said pipes, and a weighted relief valve located in the other.

9. The combination with a pair of cylinders, a piston in each cylinder, means for connecting each piston individually to one of a pair of gates, a pair of pipes communicating with the opposite ends of each cylinder, a pair of valve chests with each of which a pair of said pipes communicate, means for supplying motive fluid to said valve chests, a pair of slide valves one for each valve chest for controlling the passage of motive fluid through said pipes, means for connecting the slide valves so as to cause them to move in unison, means for alternately shifting the valves in opposite directions so as to effect the raising of one gate and the lowering of the other simultaneously, a transverse pipe connecting one of the pipes of each pair, a separate pipe connected to the transverse pipe and having a stop cock, and check valves in the transverse pipe on opposite sides of the connection of the last-mentioned pipe thereto.

10. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate to each of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends, a valve chest for each pair of pipes, and with which said pipes communicate, means for supplying fluid to said valve chests, a valve in each valve chest, a rod for each valve, means for connecting the valve rods

so as to cause them to move in unison, levers for actuating the said connecting means to the valve rods, tripping blocks on said levers, a worm screw, a traveling nut upon said screw, and having a tappet to contact with the tripping blocks, and means for rotating the screw to feed the nut along the same.

11. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate to each of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends, a valve chest for each pair of pipes and with which said pipes communicate, means for supplying motive fluid to said valve chests, a valve in each valve chest, a rod for each valve, means for connecting the valve rods so as to cause them to move in unison, a worm screw, means for rotating the same, a traveling nut on said screw having a tappet, and means between said nut and connecting means for the valve rods to alternately shift the valves so as establish communication between one valve chest and one of the pipes of one pair, and at the same time close communication with the other pipe of said pair, and also close communication between another valve chest and both pipes of the other pair, causing said last-mentioned pair of pipes to communicate with each other through the medium of the said valve.

12. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate to each one of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends, a valve chest for each pair of pipes and with which said pipes communicate, means for supplying motive fluid to said valve chests, a valve for each valve chest, a rod for each valve, a spring for each rod, means for connecting the valve rods so as to cause them to move in unison, levers connected to the last-mentioned means, a worm screw, means for rotating said screw, a traveling nut on said screw, and means provided on said nut to actuate the levers and alternately shift the valves so as to establish communication between one valve chest and one of the pipes of one pair, and at the same time close communication with the other pipe of said pair, and also close communication between another valve chest and both pipes of the other pair, causing the last-mentioned pair of pipes to communicate with each other through the medium of said valve.

13. The combination with a plurality of cylinders, a piston operating in each cylinder, means for connecting a gate or barrier to each of the pistons, a pair of pipes communicating with each of the cylinders at opposite ends for supplying motive fluid thereto, valve means between the ends of the pipes remote from the cylinder, a transverse pipe connecting one of the pipes of each pair, a pair of check valves in said transverse pipe, a branch pipe connected to the transverse pipe between the check valves, said branch pipe being open at its outer end, a stop cock in said branch pipe, and means for connecting the stop cock to the hand brake of the hoisting engine.

14. The combination with a cylinder, a piston operating therein, means for connecting a gate or barrier to the piston, a pair of pipes communicating with the cylinder at opposite ends, valve means at the ends of the pipes remote from the cylinder for controlling the operation of the gate or barrier, an exhaust pipe connected with one of the pair of pipes and opening into the atmosphere, a stop cock for the exhaust pipe, and means for connecting the stop cock to the hand brake of the hoisting engine for the elevator cage, whereby when the brake is released the stop cock is opened, and vice versa.

15. The combination with a fluid pressure motor, means for connecting a gate or barrier to said motor, valve means for controlling the operation of the gate or barrier by said motor, a brake for the elevator cage hoisting mechanism, an exhaust cock connected with said motor, and means for connecting said cock to said brake, whereby when the brake is released the stop cock is opened and vice versa.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

SAMUEL W. WARMAN.

Witnesses:
REUBEN M. FRY,
CHAS. OPPERMANN.