(No Model.)

E. S. MATTHEWS.

HYDRAULIC VALVE GEAR.

No. 453,980. Patented June 9, 1891.

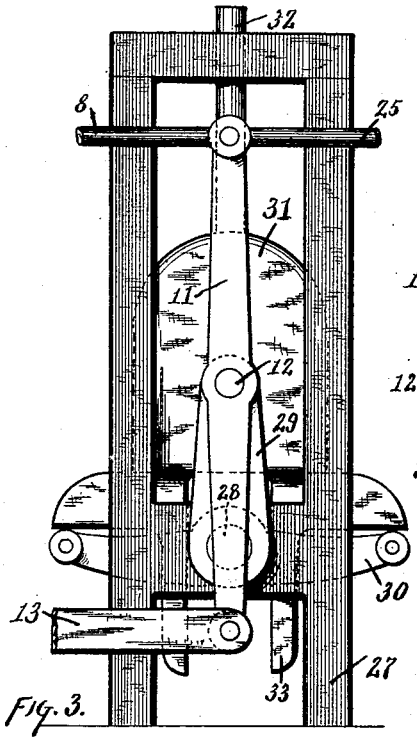

Fig. 3.

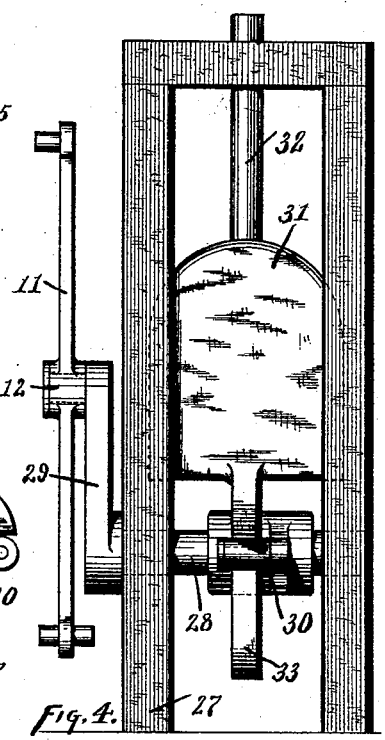

Fig. 4.

Fig. 1.

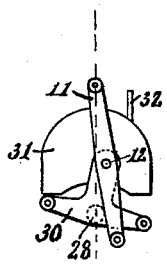

Fig. 2.

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HYDRAULIC VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 453,980, dated June 9, 1891.

Application filed February 13, 1891. Serial No. 382,114. (No model.)

To all whom it may concern:

Be it known that I, EDWIN S. MATTHEWS, of Cincinnati, Hamilton county, Ohio, have invented certain new and useful Improvements in Hydraulic Valve-Gear, (Case B,) of which the following is a specification.

This invention pertains to improvements in hydraulic valve-gear to be employed in connection with that class of reciprocating hydraulic motors in which the strokes are variable in length under the control of the operator, and in which it is desirable that the maximum limits of stroke should not be exceeded even in case of negligence on the part of the operator or in case of derangement of the hand-operating valve-gear. Hydraulic motors of this class find examples in hydraulic elevators and in hydraulic steering-gear.

Assume, for instance, a hydraulic elevator whose valve-gear is operated by the attendant in the car, his valve-handle enabling him simply to open or close the valve at will and to any extent desired, so as to regulate the motion of the car. In such a simple arrangement as this the car may easily be arranged to automatically move the valve-operating handle when the car reaches either extremity of maximum stroke, thereby insuring against attendant's neglect; but in modern construction of hydraulic elevators it is customary to relieve the attendant of the duty of forcibly opening and closing the main valve. A separate valve-operating hydraulic motor opens and closes the main valve, and the attendant from his station in the car simply operates the valve pertaining to this valve-operating motor, which valve is termed the "pilot-valve." The attendant, therefore, instead of operating the main valve, simply starts into operation a hydraulic machine to accomplish the work. This hydraulic machine depends on water-pressure to operate it, and it takes a certain time for it to move in response to the suggestions of the pilot-valve and for it to transmit the proper effects to the main valve. When the car reaches an extreme end of stroke it may of course be caused to automatically operate the pilot-valve with a view to causing the valve-operating motor to close the main valve and thus prevent overtravel of car; but assume that the elevator receives its supply of water from an elevated tank, as is quite common, and assume that the elevator in making an up trip has exhausted the water-supply. We open the main valve to make the down trip and the trip is made by permitting the outflow of water from the elevator-cylinder. At the extreme lower end of the stroke the car may operate the pilot-valve; but this will have no effect in closing the main valve, for the simple reason that there is no water-pressure to operate the valve-operating motor. This is simply one of the undesired conditions liable to arise in connection with the modern pilot-valve system of hydraulic motors to render nugatory the automatic control of the valve-gear at the stroke end.

My invention relates to a system of hydraulic valve-gear adapted to permit of the attendant having control of the valve-gear at all times through the pilot-valve system and at the same time have the main valve subject to direct automatic control at the ends of the strokes, the assumption of automatic control by the machine not so modifying the conditions as to interfere in any manner with the proper control exercised by the attendant.

In exemplifying my invention I have illustrated it in connection with the simplest form of hydraulic elevator provided with ordinary construction of pilot-valve gear.

My invention will be readily understood from the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of an ordinary direct-lift hydraulic elevator fitted with pilot-valve gear and embodying a construction exemplifying my invention, various valve parts appearing in vertical section, some of the details being somewhat diagraphic in showing in order that they may be more readily understood; Fig. 2, a side elevation, somewhat diagraphic, of the lever connecting the valve-operating motor with the main valve and showing the position given to this lever by the automatic action of the elevator at the end of its upstroke; Fig. 3, a side elevation, upon an enlarged scale, of the same lever in connection with its supporting mechanism, this view illustrating a practical construction

of parts shown somewhat diagraphically in the previous figures; and Fig. 4, a front elevation of the same, it being understood, however, that while Figs. 3 and 4 illustrate practical constructions, such as I employ in actual practice, the construction thus shown is to be viewed merely as a single exemplification of the manner of carrying out my invention.

In the drawings, (ignoring Figs. 2, 3, and 4 and confining attention exclusively to Fig. 1,) 1 indicates the cylinder of a hydraulic elevator; 2, the platform thereof, which will be hereinafter termed the "car;" 3, the extreme up position of the car; 4, the extreme down position of the car; 5, supply-pipe for water under pressure from water main or elevated tank, this pipe being hereinafter called the "main;" 6, discharge-pipe to sewer or other point of discharge, this pipe being hereinafter termed the "waste-pipe;" 7, a valve of usual construction, whose office it is alternatively to place the elevator-cylinder in communication with the main, so pressure can go to the cylinder, or with the waste-pipe, so water can flow from the cylinder, or with neither, so that the water in the cylinder will be confined therein and the car held stationary, this valve being hereinafter termed the "main valve;" 9, pipe from main valve to elevator-cylinder; 10, the usual valve-operating motor, the piston of this motor being suitably connected to the stem of the main valve, the motor being shown as of that ordinary class in which pressure from the main is always on that side of the piston having the lesser area, the piston moving one way or the other, according to whether that side of the piston having the greater area is subjected to pressure from the main or is relieved of pressure; 11, the ordinary lever connecting this motor-piston with the main valve, this lever rocking on a properly-supported pivot intermediate of its length, this lever being hereinafter termed the "main lever;" 12, the pivot just referred to, on which the main lever rocks, which pivot, until later referred to otherwise, is to be assumed as having a fixed position, so as to form a simple fulcrum for the main lever; 13, usual link connecting main lever with piston of motor; 14, pipe from main to that side of motor-piston having the lesser area, this pipe being always open, so that the lesser area of the motor-piston is always under pressure from the main; 15, pipe from motor to waste-pipe, subject to the control of pilot-valve; 16, pipe from motor to main, subject to control of pilot-valve; 17, controlling-valve of the motor, usually spoken of and hereinafter termed as the "pilot-valve," the office of this valve being to place the greater area of the motor-piston in communication alternatively with the main, or with the waste-pipe, or with neither, so that the water acting on the greater area of the motor-piston will be confined and prevent the motor-piston moving either way; 18, stem of the pilot-valve; 19, connection from stem of pilot-valve to moving car, so that attendant in car may move pilot-valve, this connection being illustrated as a simple rotatory rod, and hereinafter termed the "hand-rod;" 20, handle at car, by which attendant may turn the rod and move the pilot-valve; 21, rack and pinion, illustrating converting and transmitting connection between the rod and the stem of the pilot-valve; 22, a second rod, exemplifying a second additional means of communication between the car and the valve system, this means, however, being needed for use only at the extremities of travel of the car, this rod being hereinafter termed the "automatic" rod; 23, tappet on the automatic rod at top, so car will lift automatic rod at extremity of upstroke; 24, tappet at bottom, so car will depress automatic rod at bottom of downstroke; 25, connection from automatic rod to main valve-stem, so that moving automatic rod will move main valve, and 26, bell-crank lever connecting automatic rod with connection 25.

Thus far literal reference has been made to no features of novelty, and it will be well to investigate the action of these ordinary parts as a preliminary to the description of my improved system.

With the car in the position shown, the elevator-cylinder contains water confined therein by the main valve, which is shown in closed position. Say the attendant wishes to descend. He turns handle 20 and moves the pilot-valve to the right. The motor-piston, which before has pressure on both sides, is now relieved on the left side, being in communication with the waste-pipe, and the pressure on the right-hand side will cause the piston to move to the left, whereby, through lever 11, the main valve will be moved to the right. This puts the elevator-cylinder in communication with the waste-pipe, and water flows out and the car descends. As the attendant merely started the valve-operating motor into action, it follows that the motor would make its full stroke and fully open the main valve to the waste-pipe and allow the car to descend at maximum speed; but the attendant may stop the valve-operating motor when the main valve has been opened sufficiently to give the desired speed of descent, but generally the valve-gear is so constructed that the motor will be automatically stopped when a certain predetermined speed is reached. I omit consideration of such devices as having no modifying effect upon my present improvements. If the attendant wishes to ascend he moves the pilot-valve to the left, thus admitting main pressure to the greater area of the motor-piston and causing that piston to move to the right, whereby the main valve is moved to the left and pressure from the main thereby admitted to the elevator-cylinder. To stop, he restores the main valve to the closed position shown. Now assume that he is on the down trip and neglects to do those things necessary to close the main valve. He will bump at the lower

end of the stroke. The same might happen at the end of the up trip. The obvious suggestion is, therefore, to cause the car to automatically operate the handle 20 at the two extremities of car travel after the manner usual in belt-driven elevators and also after the manner of old-style hydraulic elevators, in which the attendant's handle is operated by direct connections on the main valve; but let us analyze the effect of the car acting automatically on handle 20 in a pilot-valve system. First, it will likely be found that a connection between car and handle 20 to engage that handle and perform movements thereof at the ends of the car travel will put that handle in such condition that the handle cannot be operated properly by the attendant when he wishes to return; but perhaps mechanical contrivances can overcome this objection. Second, the transmission between pilot-valve and main valve is not a positive one, the main valve simply moving in obedience to the suggestions of the pilot-valve. Therefore the automatic arrest involves to too great an extent the uncertain element of time employed in responding to a suggestion. Third, the connection between pilot-valve and main valve not being positive the arrest is to too great a degree dependent on absolute good order of non-positive mechanism. Fourth, assume that the water-supply is taken from an elevated tank and that the draft thereon by previous elevator strokes have exhausted the supply of water. Assume the parts as in Fig. 1. The descent is made by permitting outflow from the elevator-cylinder, and near the lower end of the stroke the attendant operates his handle in order to close the main valve. He has moved his pilot-valve to the left and put the main in communication with the greater area of the motor-piston; but the motor-piston does not move to the right for the simple reason that there is no water-pressure in the main to move it. Therefore his main valve will not close. He is helpless and will bump at the bottom. Usually buffers somewhere about the apparatus are depended upon to avoid this last condition of affairs. In my improved system I cause the car to act directly on the main valve at the two extreme of car travel, ignoring entirely the existence of the pilot-valve and motor, at the same time not interfering with the full utilization of the pilot-valve and motor by the attendant, though putting it out of his power to use their agency improperly at the extremes of car travel.

Continuing now with reference to the drawings, 27 indicates a fixed frame for the support of the pivot 12 of the main lever, which pivot, however, must be no longer considered as a fixed pivot; 28, a shaft journaled in this frame; 29, an arm secured to this shaft and projecting upwardly and carrying at its upper end the pivot 12 of the main lever, this pivot 12 being, therefore, carried in a rocking arm; 30, two horizontal arms secured to shaft 28 and carrying rollers at their ends, arms 29 and 30 therefore forming together a three-armed lever on the shaft 28, supported in fixed bearings in the frame; 31, a heavy weight resting on the two extremities of arms 30, and bearing equally upon them, so that the tendency of this weight is to hold the three-armed lever in a symmetrical position with arm 29 vertical, thus giving to pivot 12 a certain definite normal position, it being understood that the weight 31 is capable of rising in a vertical path only; 32, a guide-stem for the weight to insure against its tipping as it rises, this guide-stem being merely typical in this part of the drawings, and being shown to one side of the center of the weight in order that it might not be hidden behind the main lever.

Now before investigating the action of these later described parts it will be well to return again to the defects of the previously-mentioned automatic system in which the car was assumed as having control of the pilot-valve at the ends of car-travel. It was found that the system possessed serious defects; but in Fig. 1 there is a separate rod 22, connected directly with the main valve, and enabling the car to close the main valve at the ends of car travel without any reference to the existence of pilot-valve and motor. Why is not this sufficient? Why may not the car at the end of its downstroke simply strike tappet 24 and close the main valve? The answer is that this would be all-sufficient if lever 11 was not connected with the main valve, which lever pertains to the pilot-valve and motor system. This lever is also connected with the motor-piston. We have assumed pivot 12 as a fixed pivot. This would mean that the main valve could not move unless the motor-piston moved, and this again would mean that tappet 24 could not close the main valve unless it could also move the motor-piston. Now the motor may be in just that condition in which it most seriously opposes any closing movement of the main valve. We may readily imagine that the pilot-valve has been set to open the main valve at the very time when tappet 24 earnestly insists on closing the main valve. Here at once is a conflict of authority. The motor is a powerful machine, and its power for evil should be counterbalanced by something better than merely superior force on the part of the automatic arrangement. I therefore arrange that tappet 24 or 23 may close the main valve without putting lever 11 through its normal oscillation on pivot 12, this being effected by causing the lower pivot of lever 11 to serve as the fulcrum for the new movement of lever 11, pivot 12 simply swinging to one side with the lever to permit of the movement.

Normally pivot 12 is a fixed pivot, and in all of the oscillations of lever 11 as effected by the motor, lever 11 moves on this fixed pivot; but it is a fixed pivot only by reason of the fact that weight 31 tends to hold the

three-armed lever in a normally fixed position. If the motor holds the lower pivot of the main lever stationary, and we attempt to move the top of the main lever to the left, we will exert a force to the left on pivot 12, and that pivot will yield to the left, and the right-hand one of arms 30 will rise and lift the weight vertically, and the left-hand one of arms 30 will descend and leave the weight. The main valve may thus be moved without moving the motor-piston. On removing pressure from the upper end of the main lever, the weight descends and restores pivot 12 and the main lever to normal position, and of course restores the main valve to its former position. Therefore it will be seen that tappets 23 and 24 may close the main valve regardless of the disposition of the pilot-valve or motor.

In Fig. 1 assume the motor-piston to the extreme right, which would mean a left position for the top of the main lever and an open position for the main valve. Water from the main now flows to the elevator-cylinder and the car goes up. The attendant neglects his handle 20, and if there is no automatic arrangement the car will bump at the top of the stroke; but the car strikes tappet 23 and pulls the main valve to the right and closes it. In doing so it has moved the top of the main lever to the position shown in Fig. 1, the weight and the three-armed lever taking the position shown in Fig. 2. The main valve is thus closed and the bumping avoided. The car holds tappet 23 up, and this means that the main valve cannot be moved to the left. Even the pilot-valve and motor cannot be employed to move the valve to the left; but it can never be wanted to the left under such circumstances, for the car is in the top position and no more water is wanted in the elevator-cylinder; but the attendant may operate his handle for a descent, and thereupon, looking at Fig. 2, the motor will first restore the main lever and weight and three-armed lever to the identical position shown in Fig. 1, and will then proceed to the left and move the main valve to the right, tappet 23 offering no obstacle to this movement. Thus it will be seen that the automatic system for the ends of travel stroke may be as certain and as positive as though the pilot-valve and motor system were not employed, and that the pilot-valve and motor system may be employed as fully and perfectly as though the automatic system were not present.

In Figs. 3 and 4 I illustrate more perfectly a practical construction for carrying out my invention by means of a vertically-moving weight and three-armed lever. The frame in which shaft 27 is journaled is carried upward to furnish a housing for the weight, and the weight, instead of being broad enough to rest on the rollers of arms 30, is provided with base-arms extending from it over the rollers, the weight being guided vertically by the stem 32 in the frame and by guide-jaws 33 straddling the rock-shaft below the weight.

I claim as my invention—

1. The combination, substantially as set forth, with a hydraulic machine, a main valve to control the flow of water to and from the same, a motor to move the main valve, and hand-operated mechanism to control the motion of the motor, of a connection to transmit motion from the motor to the main valve and adapted to yield and permit the main valve to be moved independent of the motor, and a connection from the main valve to and arranged to be actuated by said hydraulic machine to close the main valve automatically at the stroke ends.

2. The combination, substantially as set forth, with a hydraulic machine, a main valve to control the flow of water to and from the same, a motor to move the main valve, and hand-operated mechanism to control the motion of the motor, of a lever connecting the motor with the main valve, a yielding fulcrum-pivot for such lever, and mechanism connected with and actuated by the hydraulic machine to move said lever and fulcrum-pivot at the stroke ends of the machine.

3. The combination, substantially as set forth, with a hydraulic machine, a main valve to control the flow of water to and from the same, a motor to move the main valve, and hand-operated mechanism to control the motion of the motor, of a main lever connecting the motor with the main valve, a pivoted arm carrying at its free end the fulcrum-pivot for said main lever, a weight or equivalent agent holding said arm and fulcrum-pivot in a normal position, and mechanism connected with and actuated by the hydraulic machine to displace said arm and fulcrum-pivot and main lever at the stroke ends of the machine.

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