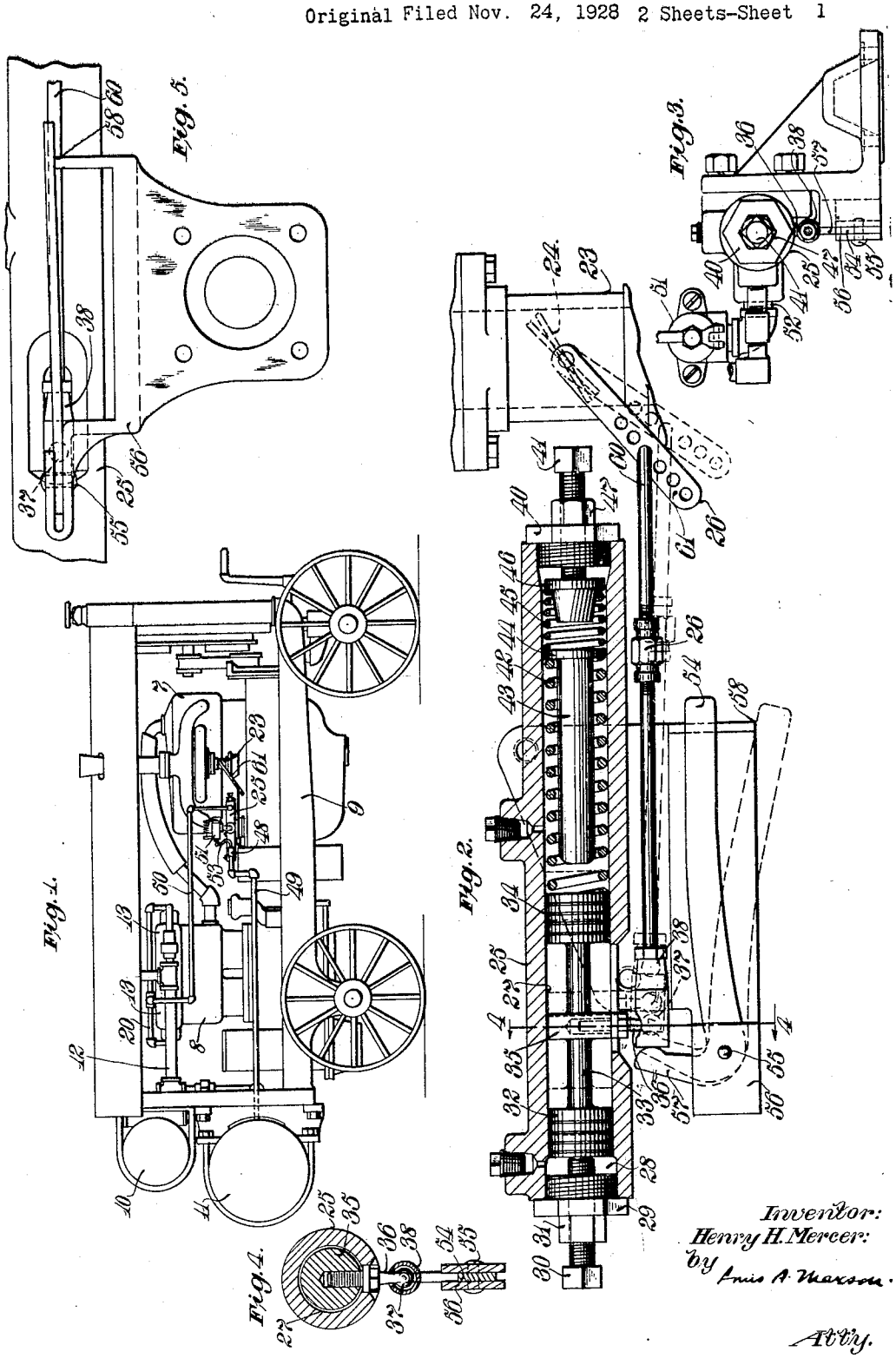
Dec. 1, 1931. H. H. MERCER 1,834,595

CONTROLLING MECHANISM

Original Filed Nov. 24, 1928 2 Sheets-Sheet 1

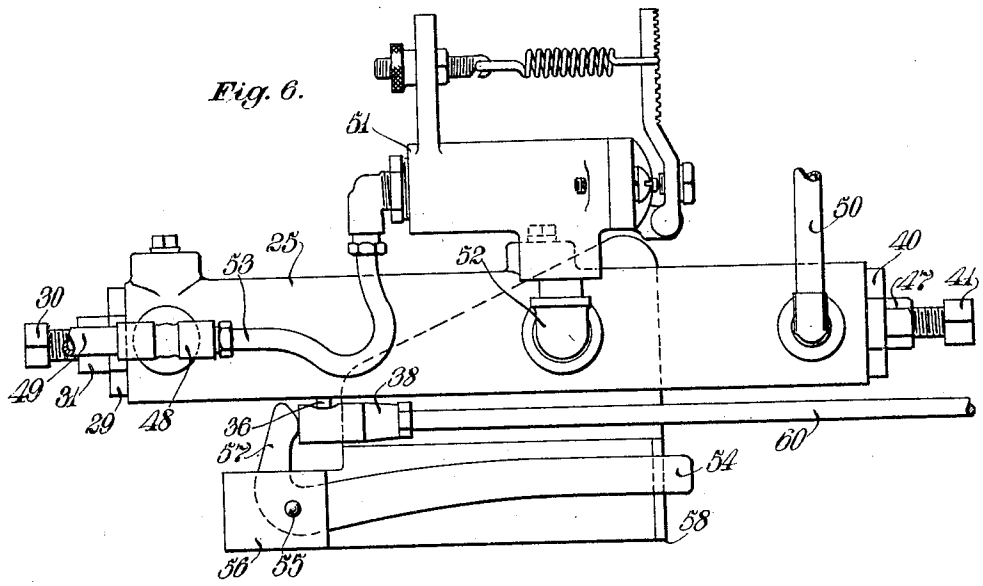


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Fig. 6.



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UNITED STATES PATENT OFFICE

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CONTROLLING MECHANISM

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This invention relates to a mechanism for controlling a prime mover as the load carried by the same varies. More particularly my invention relates to controlling mechanisms for internal combustion engines employed in the driving of air compressors and other pumping devices.

The power delivered by the common type of internal combustion engine is controlled by a valve in the supply line for the combustible mixture which is supplied to the engine. Accordingly, one object of my invention is to provide improved means for controlling the supply of such mixture as the demand made upon the engine varies. A further object of my invention is to provide improved means for varying the supply of fuel to the engine which drives an air compressor in accordance with the loading and unloading of the compressor. A still further object is to provide improved controlling means comprising means for facilitating starting. Other objects and advantages of the invention will be apparent from the following description and more particularly pointed out in the claims.

In the accompanying drawings, in which for purposes of illustration one embodiment of my invention is shown,

Fig. 1 is a side elevation of a compressor and controlling mechanism therefor, the latter being constructed in accordance with the illustrative embodiment of this invention.

Fig. 2 is a view partially in section through the device for controlling the fuel supply valve.

Fig. 3 is an end view of the same looking from the right of Fig. 2.

Fig. 4 is a transverse section on the line 4—4 of Fig. 2.

Fig. 5 is a bottom view of a portion of the device shown in Fig. 2.

Fig. 6 is a side elevation of the device shown in Fig. 2.

In Fig. 1 of the drawings a portable compressor outfit is illustrated, the same comprising a motor 7 and a compressor 8 both mounted on the frame 9 of a wheeled truck. The outfit is provided with a fuel tank 10 and a receiver 11 to which the air or other fluid being compressed is delivered by way of a connection 12.

It is desirable that, once the compressor has been set in operation by starting the motor 7, there be no stopping of the motor, unless the demand for air is to be discontinued for a considerable period. The pressure in the receiver 11 should, however, be maintained between certain predetermined limits; and one function of my improved controlling mechanism is to interrupt the delivery of compressed fluid to the receiver 11 when a predetermined pressure is attained therein; and to recommence the delivery of compressed fluid when the pressure in the receiver 11 drops below a predetermined point. Various mechanisms for unloading the compressor 8 could be employed in connection with my improved controlling mechanism; and as an example of one such mechanism, pistons (not shown) may be provided in the cylinders 13, means being actuated by the pistons for lifting and holding off their seats the inlet valves of the compressor 8. This mechanism will function to unload the compressor in a well known manner and will interrupt the delivery of compressed fluid to the receiver 11.

To the unloading mechanism, whether it be of this or another type, air or other fluid under pressure is supplied by way of a pipe connection 20.

The engine 7 is provided with an intake manifold 23 within which is disposed an element for controlling the power medium flow to the prime mover and which herein is in the form of a butterfly valve 24 (Fig. 2). A fluid pressure responsive device 25 controls the same, being connected thereto by an adjustable linkage 26. The device 25 comprises a casing within which is formed a bore 27 having at one end a chamber 28 in the form of a counterbore. This end is closed by a plug 29 through which projects a screw 30 provided with a nut 31 for locking the screw 30 in adjusted position. The screw 30 limits the travel of a piston 32 towards the corresponding end of the bore 27. The piston 32 is secured to one end of a rod 33, a second piston 34 being secured to the other end. The piston 34 and rod 33 with the cylinder 25

comprise a servo-motor while the piston 32 presents a surface subject to compressor discharge pressure. Between the two pistons the rod 33 is provided with an enlargement 35 into which a laterally projecting member 36 is screwed. The head of the member 36 is spherical, and a ball and socket joint 37 is provided between the member 36 and the end member 38 of the linkage 26. The end of the bore 27 opposite from the plug 29 is closed by a second plug 40 through which projects a screw 41 having a lock nut 47 similar to the lock nut 31. A spring 42 is provided, which presses the piston 34 toward the plug 29. Within the spring 42 is disposed an alining member 43 which terminates in a head 44. The spring 42 presses on the inner side of the head 44, and on the opposite side presses a second spring 45, this second spring being provided with an abutment member 46 which bears against the screw 41. For reasons which will hereinafter be stated, spring 45 is made materially lighter than the spring 42.

An opening extends through the casing of the device 25 into the chamber 28 and into this opening is threaded a nipple ending in a T 48. Into one branch of the T is threaded a pipe connection 49 which leads to the compressor receiver 11. From the other branch of the T 48 leads a pipe connection 53 which communicates with a pressure chamber in the pilot valve 51. A second opening extends through the casing of the device 25 into the portion of the bore 27 occupied by the springs 42 and 45; and into this opening is threaded a pipe connection 50 which is connected to the pipes 20, for delivering fluid under pressure to the unloading mechanism. The pilot valve 51, which is connected to the pipe 49 through T 48 and pipe connection 53, is adapted to control delivery of pressure fluid to the portion of the bore 27 occupied by the springs 42 and 45. For this purpose a pipe 52 connected to the pilot valve 51 is threaded into an opening in the side of the casing of the device 25.

A horizontal lever 54, pivoted at 55 to a supporting bracket 56, is provided with an upturned end 57. When the lever 54 is depressed to the broken line position shown in Fig. 2, and its end slides under a projecting shoulder 58 on the bracket 56, its opposite end 57 engages member 38 of the linkage 26, and opens the throttle valve 24 to the proper position for the same during starting of the motor 7.

The operation of the control device 25 will be given before describing the adjustable linkage 26. It will be assumed that the receiver 11 is empty, due to the escape by leakage due to a long period of idleness, or to intentional opening of a vent valve by the operator. With the receiver empty, the member comprised by the pistons 32 and 34, the rod 33 and the enlargement 35 will be in the position shown in Fig. 2, due to the pressure of the springs 42 and 45. The lever 54 is depressed to bring the throttle valve 24 to starting position. The engine is now started; and as the pressure in the receiver builds up, the pressure in the chamber 28 increases gradually and acts upon the piston 32 to gradually move the latter to the right. This results in the gradual opening of the butterfly valve 24. After the compressor is once fairly started, the end of the lever 54 is released from shoulder 58 so as not to interfere with the full travel of member 36 from end to end of its slot in the device 25. When the pressure in receiver 11 has reached the normal working pressure for which the compressor is designed, the butterfly valve 24 will be in substantially open position.

Should the demand for pressure fluid fall off, pressure in the receiver 11 may reach such a point as to actuate the pilot valve 51. When this action takes place, the pilot valve delivers fluid through the connection 52 into the bore 27 to act upon the piston 34. The pistons 34 and 32 are equal in cross section, and therefore the spring pressure will force the two pistons to the position shown in Fig. 2. This will immediately shift the butterfly valve to idling position. Since the pipe 50 is in free communication through the pipe 52, the pilot valve and the pipe 49 with the receiver, the unloading mechanism of the compressor is actuated and the compressor is unloaded.

Should the pressure in the receiver fall below the predetermined pressure at which the pilot valve 51 is set to function, a vent in the pilot valve will be opened, and the pressure in the right portion of the bore 27, as seen in Fig. 2, will immediately fall. This permits the fluid in chamber 28, which is always at receiver pressure, to force the pistons 32 and 34 to the right, so as to open the butterfly valve 24 and speed up the engine. The unloading devices for the compressor are likewise vented through pipes 20, 50, 52 and the pilot valve 51. It will therefore be noted that when the pilot valve 51 is actuated to deliver pressure fluid through pipe 52, not only does this pressure fluid pass to the pipe connections 20 to actuate the unloading mechanism, but it also presses against the piston 34 to close the throttle valve 24.

It has been found desirable to procure a graduated opening of the throttle, so that the engine will run slightly above normal running speed at certain intermediate pressures in the receiver 11, and taper off to its customary running speed as higher pressures in the receiver 11 are attained. As a reason for doing this, it should be noted that with an extra large demand for air for a short time only, the engine can drive the

compressor faster and so supply air perhaps in great enough quantity to meet the demand.

As is takes more power to compress from zero to ten pounds gauge than to compress through a ten pound range at higher pressures, it is evident that to enable the compressor to bring up the receiver pressure from zero to line pressure, the throttle valve should be opened quite substantially during the initial running period and as will be seen this is provided for.

It has been found that if the linkage 26 is constituted by a link 60 pivotally connected to a lever 61 with the two so arranged as to make a right angle, the opening of the throttle which results from an increase in receiver pressure from atmosphere to an initial low pressure is insufficient, whereas the change in size of the throttle opening resulting from an increase from three-quarters working pressure to full working pressure in the receiver is too great. The lever 61 is therefore arranged so as to meet the link 60 at an obtuse angle. It will therefore be seen that as the pressure starts to build up behind the piston 32 and this piston starts to move to the right, the first portion of its travel results in a large arc of movement for the throttle valve 24, whereas the latter movements of the piston 32 in response to greater pressure in the receiver 11 cause gradually decreasing arcs of movement of the throttle valve 24.

Taking as an example a compressor which supplies air to an apparatus which normally requires a pressure of one hundred pounds, and assuming the pressure in the receiver 11 to be at atmosphere, if there were but a single spring present, the first ten pounds of pressure pumped into the receiver 11 would force the piston 32 approximately one-tenth of its normal travel to the right. This. however, would swing the throttle valve through more than one tenth of the full arc of normal opening movement. The next ten pounds would cause a slightly less degree of arcuate swing of the throttle valve. The same would be true of each succeeding ten pounds of increase in receiver pressure; and it would therefore be true that for the increase from ninety pounds to one hundred pounds pressure in the receiver, the corresponding arc through which the throttle moves will be materially less than the arc corresponding to the increase from atmosphere to ten pounds pressure. Now, there is also another factor which affects the running of the engine, namely that like arcuate changes in the throttle position do not effect like changes in power. As a result of the combination of these two factors and the factor that power requirements are less for compression in the higher ranges, the compressor speed would build up to a maximum at about 60 pounls receiver pressure and then fall off to the desired speed at 100 pounds a full load speed. This would be very desirable, in having increased air demand cause speeding up, but the compressor would not come up to speed very quickly after the receiver got empty, though much better than with an arrangement in which the throttle opening is not accelerated at first.

It has been noted that the spring 42 is a heavier spring than the spring 45. This feature makes it possible for the slight initial increases in the pressure in chamber 28 to cause substantial movements of the pistons 32 and 34. This is of advantage, as noted, when the compressor is first being started and the receiver 11 is practically empty. Due to friction within the engine and compressor, and the inertia of the moving parts, it is desirable to cause the butterfly valve 24 to open a substantial amount in response to a very small increase in the receiver pressure. The light spring 45 has been provided for this purpose and when the head 44 comes in contact with the abutment 46, the heavier spring 42 comes into play. From this time on, until the pressure in receiver 11 is again substantially reduced, the spring 42 resists the pressure in the chamber 28, permitting the pistons to move to the right as this pressure increases or forcing the pistons back to the left again as the pressure drops.

It will be obvious from the above description that, in accordance with my invention, the control mechanism supplies fuel to the engine in accordance with demands made upon the engine. As the pressure in the receiver 11 increases from atmospheric pressure, the butterfly valve of the fuel intake for the motor is first opened rapidly as the light spring is compressed. Thereafter the butterfly valve is gradually opened wider and wider as the pressure in the receiver tank becomes greater and the load on the compressor accordingly increases. It should further be noted that as soon as the compressor is unloaded, the supply of fuel to the motor is immediately cut down, and that when the pilot valve acts to reload the compressor, the butterfly valve is again moved to open position.

While I have in this application specifically described one form which my invention may assume in practice, it will be understood that this form has been shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a controlling mechanism for a compressor system comprising a compressor, a driving motor therefor and mechanism for

unloading the compressor, in combination, controlling means for the motor including a lever, a cylinder and piston for moving said lever in one direction, a plurality of springs tending to move said piston in the same direction, said springs differing in resiliency, means for moving said piston in the opposite direction including an element having a surface subject to compressor discharge pressure, said element being secured to said piston, and a pilot valve for supplying pressure fluid to both said cylinder and said unloading mechanism.

2. In a controlling mechanism for a compressor system comprising a compressor, a driving motor therefor and mechanism for unloading the compressor, in combination, controlling means for the motor including a movable element, means for moving said element in one direction including an element having a surface subject to compressor discharge pressure, a servo-motor to which actuating fluid is supplied upon unloading of the compressor for moving said motor controlling element in the opposite direction, means for arresting movement of said motor controlling element in the said opposite direction at a position suited to idling unloaded operation of the compressor, and manually operable means for positively moving said motor controlling element in said first mentioned direction having associated therewith means for releasably retaining it in position for the starting of said motor.

3. In a controlling mechanism for a compressor system comprising a compressor, a driving motor therefor and mechanism for unloading the compressor, in combination, controlling means for the motor including a lever, a servo-motor for actuating said lever in one direction comprising a cylinder and piston to which actuating fluid is supplied upon unloading of the compressor, means for actuating said lever in the opposite direction including an element having a surface subject to compressor discharge pressure, and a manually operable lever for actuating said piston to move said motor controlling lever in the second mentioned direction.

4. In a controlling mechanism for a compressor system comprising a compressor, an internal combustion driving motor therefor, and mechanism for unloading the compressor, in combination, a throttle valve for the fuel supply to said motor, a servo-motor for closing said valve comprising a cylinder and piston to which actuating fluid is supplied upon unloading of the compressor, means for opening said throttle valve including an element having a surface subject to compressor discharge pressure, and a manually operable lever for actuating said piston to open said valve.

5. In a controlling mechanism for a compressor system comprising a compressor, an internal combustion driving motor therefor and pressure fluid actuated mechanism for unloading the compressor, in combination, a throttle valve for the fuel supply to said motor, a member operatively connected to said throttle valve for moving the same in opposite directions, means for moving said member in one direction having an element subject to compressor discharge pressure, a servo-motor for moving said member in the opposite direction comprising a cylinder and piston, a plurality of springs tending to move said member in the first mentioned direction, said springs differing in resiliency, and a pilot valve for supplying pressure fluid for actuating both said cylinder and said unloading mechanism.

6. In a controlling mechanism for a compressor system comprising a compressor and an internal combustion driving engine therefor, in combination, a valve controlling the fuel supply to said engine, means operative on fluid supply thereto to unload the compressor and operative on release of fluid so supplied to effect reloading, fluid pressure means for moving said fuel supply controlling valve, means for controlling fluid supply and exhaust to both said means for moving the supply valve and said means for unloading the compressor, and means responsive to the discharge pressure of the compressor for varying the position of said fluid supply controlling valve, said last mentioned means comprising a cylinder and piston and two springs, one of which is lighter than the other and resiliently resisting the movement of said piston within said cylinder.

7. A controlling mechanism for a prime mover which drives a given load comprising, in combination, a member for controlling the power medium flow to said prime mover, means responsive to an increase in load on said prime mover, and means for regulating the position of said power medium flow control member governed by said responsive means whereby during initial increases of load above no-load said control member is positioned to permit a given increase in the rate of flow of the power medium to the prime mover for effecting operation of the prime mover at a speed exceeding by a predetermined amount normal full load speed and during later increases of load the flow of the power medium to the prime mover is increased at a decreasing rate whereby the increased load is carried by the prime mover at a substantially normal full load speed which is less than said overspeed.

8. The combination set forth in claim 7 further characterized in that the load responsive means includes a plurality of springs of differing resiliency.

9. In a controlling mechanism for a prime mover, the combination of a power medium control member, means responsive to an in-

crease in load on said prime mover including a movable element, and means for regulating the position of said power medium control member governed by said movable element, whereby for a given initial movement of said element said power control member is moved a predetermined amount, and during a further movement of the same given amount as before, said power control element is moved less than it was moved initially, and means for quite differently opposing such movements.

10. In a control mechanism for a prime mover, the combination of a power medium control member, means responsive to an increase in load on said prime mover, and means governed by said responsive means for regulating movement of said power medium control member whereby for given increases in movement of said responsive means said power control member is moved to permit the rate of flow of power medium to the prime mover to be increased at a decreasing rate, and means for manually setting the initial starting position of said power control member.

11. In a controlling mechanism for a prime mover, the combination of a power medium control member, means responsive to an increase in load on said prime mover including a movable element, means movable by said movable element for regulating the position of said power medium control member, means for opposing a relatively slight resistance to initial movements for said movable element, and means for opposing a substantially greater resistance to subsequent movements of said movable element.

In testimony whereof I affix my signature.

HENRY H. MERCER.