Dec. 9, 1952 A. J. WHITCOMB 2,620,673

VALVE OPERATOR

Filed Aug. 24, 1945 2 SHEETS—SHEET 1

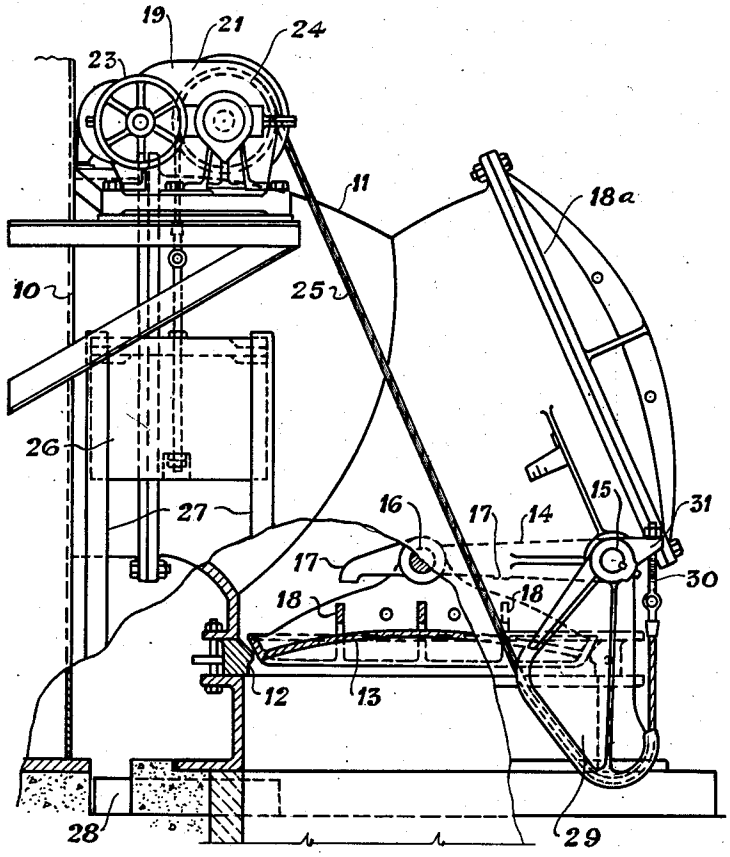


Fig. 1

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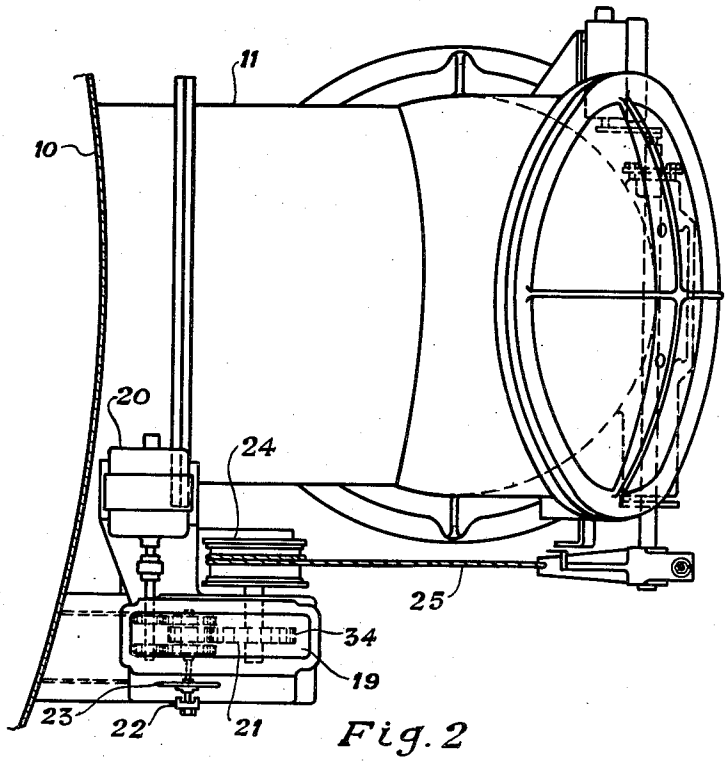


Fig. 2

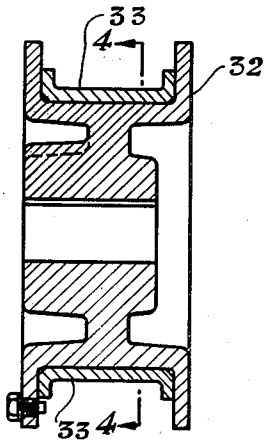


Fig. 3

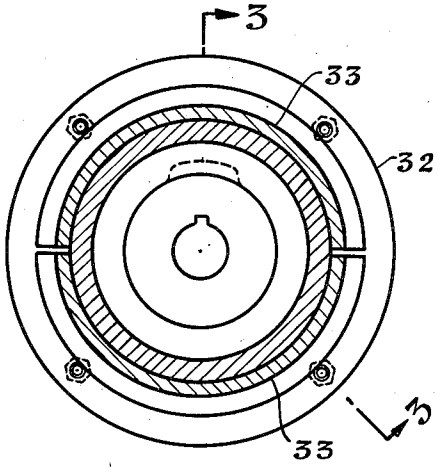


Fig. 4

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UNITED STATES PATENT OFFICE

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VALVE OPERATOR

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13 Claims. (Cl. 74—95)

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The present invention relates to improvements in valve operators.

The invention will be described in connection with means for operating valves such as chimney valves, useful, for example, in connection with hot blast stoves associated with blast furnaces.

It has been common practice to provide a mushroom type chimney valve in which the mushroom disk is hung from an arm carried on a shaft at one side of the valve. This device has been operated manually, levers and counterweight means being provided for assisting operation of the valve. Such valves are commonly large and heavy and cumbersome for hand operation. The present invention contemplates an improved construction suitable for motor operation.

An object of the present invention is to provide an improved operator for a valve which will bias said valve to closed position when said valve is adjacent to its closed position and will bias said valve to open position when said valve is adjacent to open position.

As a corollary to the above mentioned object, it is a further object of the present invention to provide an operator for a valve which may be held in either open or closed position without a brake.

A further object is to provide an improved valve operator which may be motor powered but which will avoid damage in the event of attempt to open under excessively heavy air pressure.

A further object is to provide an improved valve operator involving power transmitting mechanism including leverage means of variable arm to afford variable counterweighting and desired bias at both the open and closed positions of the valve.

A further object is to provide an improved valve operator well adapted to meet the needs of commercial service.

Further objects will appear as the description proceeds.

Referring to the drawings—

Figure 1 is an elevational view, partly in section, illustrating one embodiment of the present invention;

Figure 2 is a top plan view of the structure shown in Figure 1;

Figure 3 is a sectional view of a slipper drum which may be used in the practice of the present invention, said Figure 3 being taken along the planes indicated by the arrows 3—3 of Figure 4; and

Figure 4 is a sectional view taken along the plane indicated by the arrows 4—4 of Figure 3.

The numeral 10 indicates the shell of a stove, said shell having in communication therewith the valve housing 11 provided with the annular

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valve seat 12. Adapted to cooperate with the valve seat 12 is the mushroom valve 13 pivotally supported by the lever or operating member 14 swung about the axis of the shaft 15 located adjacent to one side of the valve. The pivotal connection between the valve 13 and the lever 14 is provided by the shaft 16, which permits a slight amount of swinging movement of the valve 13 relative to the lever 14. Said lever 14 is provided with stops 17—17 which cooperate with corresponding abutments 18—18 on the valve 13 to limit the extent of swinging movement of valve 13 relative to the lever 14. A cover plate 18a permits access to the valve 13.

Disposed adjacent to the top of the valve housing 11 is the drive mechanism, indicated as a whole by the numeral 19. Said drive mechanism includes the electric motor 20, the gear box 21, the clutch 22, the hand wheel 23 and the slipper drum 24. Wound around the slipper drum 24 is the cable 25, one end of which is connected to the counterweight 26 adapted to travel vertically between the counterweight guides 27—27. As illustrated, the cable passes around the slipper drum 24 about one and one-half turns. A stop 28 defines the lower limit of travel of the counterweight 26.

The cable 25 passes over the grooved periphery of the segment 29, which is keyed to the shaft 15. The adjacent extremity of the cable 25 is fastened through a variable connector 30 to the bracket 31 keyed to the shaft 15. The segment 29 has a varying lever arm for purposes which will appear presently.

Upon inspection of Figure 1 it will be clear that the closed position of the valve 13 is horizontal. Said valve has a varying biasing effect as it is moved from its horizontal closed position to a position adjacent to the top limit of its swing. In other words, the effective lever arm of the weight of the valve about the axis of swing, that is—about the axis of the shaft 15, is greater when the valve is adjacent to closed position than when it is in other positions. The grooved periphery of the segment 29 has a varying lever arm with respect to the axis of the shaft 15. In other words, the effective lever arm of said segment 29 measured perpendicularly to the cable 25 from the axis of the shaft 15 varies with different positions of the mushroom valve 13. The counterweight 26, which tends to swing the mushroom valve 13 to open position, is of fixed amount.

The net result of the construction illustrated and described is that when the mushroom valve 13 is in its closed position, or is adjacent thereto, the valve-opening effect of the counterweight 26 is a minimum, whereas the valve-closing effect of the mushroom valve 13 is a maximum,

and the combination retains its bias toward closure of the valve 13. When the valve 13 is in or is approaching its full open position the bias of the valve toward closure is a minimum, but the valve-opening effect of the counterweight is a maximum, because of the increased lever arm of the segment 29. The counterweight 26 is more effective than the valve 13 at this time, and the net effect is a bias toward opening of the valve.

As illustrated, the cable 25 passes approximately one and one-half turns around the slipper drum 24. Said slipper drum is illustrated in Figures 3 and 4 and includes a sheave 32 keyed to a shaft extending from the gear box 21. The periphery of said sheave 32 is grooved for the reception of two slipper shoes 33—33, each of which encloses slightly less than half of the periphery of the adjacent portion of the sheave 32. Said slipper shoes 33—33 are adapted to tightly engage the grooved periphery of the sheave 32 and rotate therewith so long as there is a pull on both ends of the cable 25.

The motor 20 is connected to the slipper drum 24 through the gear box 21, which contains a train of gears illustrated schematically and indicated by the numeral 34. The hand wheel 23 may be used for manual operation of the slipper drum 24 and consequently of the valve 13. It will not be practical to place the hand wheel on the shaft of the motor 20, as an excessive number of revolutions would be required to operate the valve 13. By placing the hand wheel 23 on an intermediate shaft in the gear box 21, the torque values are kept within limits of manual practicability and the number of turns of the hand wheel 11 is restricted within satisfactory limits. By means of the clutch 22 the hand wheel 23 will be disengaged during normal motor operation and will be engaged only when and if manual operation is required. To provide this selectability the hand wheel 23 may be splined to its corresponding shaft and may be biased out of engagement with the clutch 22, the operator sliding it to its unbiased position to engage the clutch 22 when manual operation is desired.

The mode of operation of the above described embodiment of the present invention is substantially as follows:

Figure 1 shows the mushroom valve 13 in its closed position. To open said valve the motor 20 is operated to turn the slipper drum 24 in a counterclockwise direction as the parts are viewed in Figure 1, whereby the torque of the motor 20 is added to the force of the counterweight 26. This will be adequate to open the valve 13 provided air pressure above said valve has been reduced to a small value. It is not necessary, however, that the pressure above said valve drop to substantially zero, as in the case of manual operation. Rotation of the slipper drum 24 results in the lowering of the counterweight 26 and the opening of the valve 13, until the counterweight 26 engages the stop 28. The result is a slacking of the cable 25. This results in slippage between the sheave 32 and the slipper shoes 33—33. In view of this slack the motor 20 may continue to operate without affecting the position of the valve 13. The attendant can stop the motor 20 at this time, but no extreme degree of accuracy is required in so doing. It should be noted that if an attempt be made to open the valve 13 when there is a heavy air pressure on the upper side of said valve, the effect of the motor 20 will be to cause slippage between the sheave 32 and the slipper shoes 33—33 and will not damage the valve or the motor.

Closing movement of the valve 13 is caused by operating the slipper drum 24 in the clockwise direction as the parts are viewed in Figure 1. This action causes the motor 20 to lift the counterweight 26, thereby permitting the natural bias of the valve to cause it to close. When the valve closes fully there is a tendency for the cable 25 to cause slack between the sheave 32 and the segment 29. If the motor 20 continues to operate, slippage will occur between said sheave 32 and said slipper shoes 33—33 and no damage will result. Therefore the attendant is not required to act with accuracy in shutting off the current to the motor 20.

The segment 29 with its varying lever arm has the advantage, as above noted, that it contributes to the desired bias at both the open and closed positions of the valve 13. In other words, when the valve 13 is in or near its closed position the valve-opening effect of the counterweight 26 is a minimum, since the lever arm measured between the axis of the shaft 15 and the cable 25 is a minimum, whereas the valve-closing effect of the mushroom disk is a maximum. When the valve 13 is in or approaching its full open position the bias of the mushroom disk toward closure is a minimum, but the valve-opening effect of the counterweight is a maximum because of the increased lever arm of the segment 29, this lever arm being measured by the perpendicular distance between the axis of the shaft 15 and the cable 25.

Through the middle angular positions of the valve member 13 the cable pull exerted by the counterweight and the cable pull exerted by the valve member will be approximately balanced.

Though a preferred embodiment of the present invention has been described in detail, many modifications will occur to those skilled in the art. It is intended to cover all such modifications that fall within the scope of the appended claims.

What is claimed is:

1. In combination, a counterweight, a swingable operating member, a cable having its ends connected to said counterweight and to said operating member, a slipper drum upon which said cable is wound, lever means rotatable with said operating member, said lever means having variable radii to provide a varying lever arm, said cable being trained over said lever means, said lever arm being greater when said counterweight approaches its lowermost position and motive means for rotating said slipper drum.

2. In combination, a counterweight, a swingable operating member, a cable having its ends connected to said counterweight and to said operating member, a slipper drum upon which said cable is wound, lever means rotatable with said operating member, said lever means having variable radii to provide a varying lever arm, said cable being trained over said lever means, and motive means for rotating said slipper drum.

3. In combination, a counterweight, a swingable operating member, a cable having its ends connected to said counterweight and to said operating member, a slipper drum upon which said cable is wound, lever means rotatable with said operating member, said lever means having variable radii to provide a varying lever arm, said cable being trained over said lever means, said lever arm being greater when said counterweight

approaches its lowermost position, and motive means for rotating said slipper drum.

4. Lifting means comprising in combination a cable, a counterweight connected to one end of said cable and a swingable operating member connected to the other end of said cable, a lever member movable with said operating member, said lever member having variable radii to provide a varying lever arm, said cable being trained over said lever member, a slipper drum upon which said cable is wound, and motive means for rotating said slipper drum.

5. In combination, a counterweight, a cable connected at one end to said counterweight, a swingable operating member, a slipper drum upon which said cable is wound, said cable being connected at its other end to said operating member, a segment swingable with said operating member, said segment having a varying radii, said cable being trained over said segment whereby said segment may vary the perpendicular distance from said cable to the axis of swing of said operating member, and motive means for rotating said slipper drum.

6. In combination, a counterweight, a cable connected at one end to said counterweight, a swingable operating member, a slipper drum upon which said cable is wound, said cable being connected at its other end to said operating member, a segment swingable with said operating member, said segment having a varying radii, said cable being trained over said segment whereby said segment may vary the perpendicular distance from said cable to the axis of swing of said operating member, said operating member and said segment having the same axis of swing and motive means for rotating said slipper drum.

7. In combination, swinging means, a counterweight, a cable connecting said counterweight to said swinging means, a slipper drum over which said cable is wound, lever means connected to said swinging means and swingable therewith, said cable being trained over said lever means, said lever means having a varying lever arm for varying the perpendicular distance of said cable from the axis of said swinging means and motive means for rotating said slipper drum.

8. In combination, swinging means, a counterweight, a cable connecting said counterweight to said swinging means, a slipper drum over which said cable is wound, lever means connected to said swinging means and swingable therewith, said cable being trained over said lever means, said lever means having a varying lever arm for varying the perpendicular distance of said cable from the axis of said swinging means, said swinging means and said lever means having the same axis of swing and motive means for rotating said slipper drum.

9. Valve actuating apparatus comprising, in combination, an oscillatable valve actuating shaft having defined limits of angular movement, a lever connected to said shaft the effective moment of which varies in accordance with the angular movement of said shaft, a counterweight of constant load characteristics having a range of movement corresponding to the angular movement of said shaft, a drive mechanism including a slipper drum, and a cable wound in snubbing relation about said slipper drum, one end of the effective length of said cable being secured to said lever, the other end thereof being attached to said counterweight.

10. The invention of claim 9 further characterized by the relationship of the several parts wherein the load on said shaft overbalances the countervailing load of said counterweight adjacent one of the extremes of movement thereof, and is overbalanced by said counterweight adjacent the other extreme of such movement.

11. The invention of claim 10 wherein the shaft load and counterweight are in substantial balance at a position intermediately of said range of movement.

12. An actuating apparatus comprising in combination an oscillatable valve actuating shaft having defined limits of angular movement, a first lever, one end of which is connected to said shaft and the other end of which is connected to a member to be operated, having a range of movement correponding to the angular movement of said shaft, the effective movement of said first lever varying in accordance with the angular movement of said shaft, a second lever, one end of which is attached to said shaft and the other end of which is connected with a counterweight by means of a cable, the effective moment of said second lever varying in accordance with the angular movement of said shaft, said counterweight having constant load characteristics and having a range of movement corresponding to the angular movement of said shaft, said cable being wound intermediate of its ends in snubbing relation about a slipper drum, the rotation of said slipper drum by a rotating means being adapted to axially displace said cable to actuate said second lever to actuate the rotation of said shaft between its defined limits of angular movement, the load of the weight of said member to be operated asserted on said shaft through said first lever over-balancing the load of said counterweight asserted on said shaft through said cable and said second lever adjacent one of the extremes of movement of said shaft and being over-balanced by said counterweight adjacent the other extremity of movement thereof, the load of the weight of said member to be operated and the counterweight load being in substantial balance at a position intermediate of said range of movements.

13. The apparatus of claim 12 wherein said slipper drum comprises a sheave and two slippers located around the periphery thereof, said slippers being adapted to be in friction driven relation with said sheave at which time said slippers are in friction driving relation with said cable, when said cable is under tension due to the assertion of forces thereon by said counterweight and by the weight of said member to be operated and in non-friction driven relation with said sheave at which time said slippers are in non-friction driving relation with said cable when one of said forces is no longer asserted on said cable.

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