June 23, 1942. J. E. CONACHER 2,287,470

VALVE OPERATING MECHANISM FOR CONCRETE PUMPS

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FIG. 1.

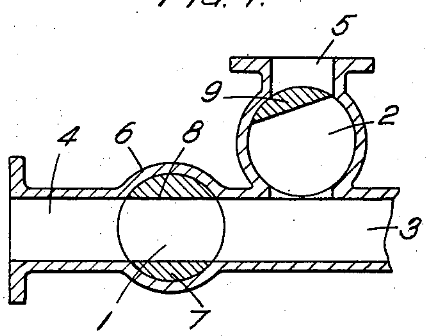



FIG. 2.

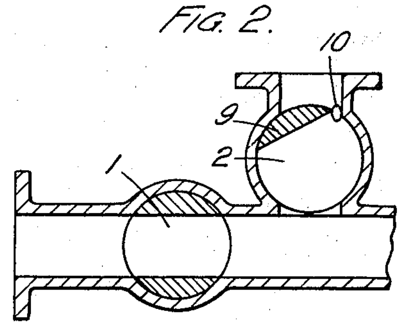



FIG. 3.

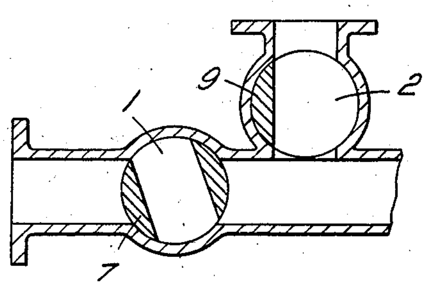



FIG. 4.

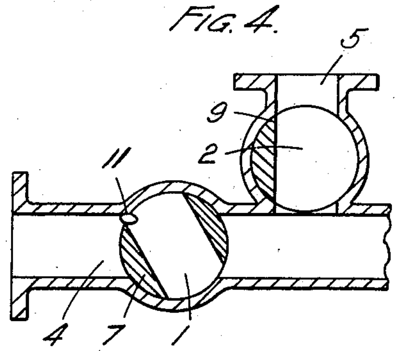



FIG. 7.

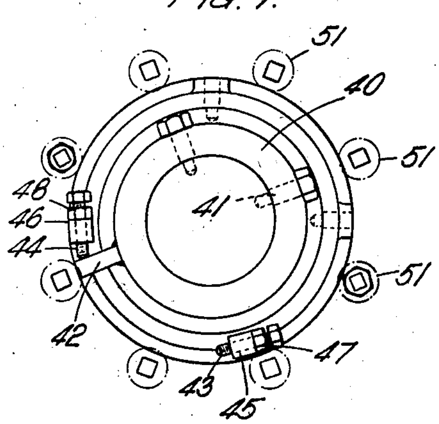
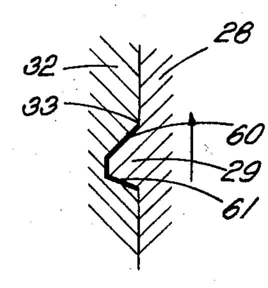



FIG. 8.

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VALVE OPERATING MECHANISM FOR CONCRETE PUMPS

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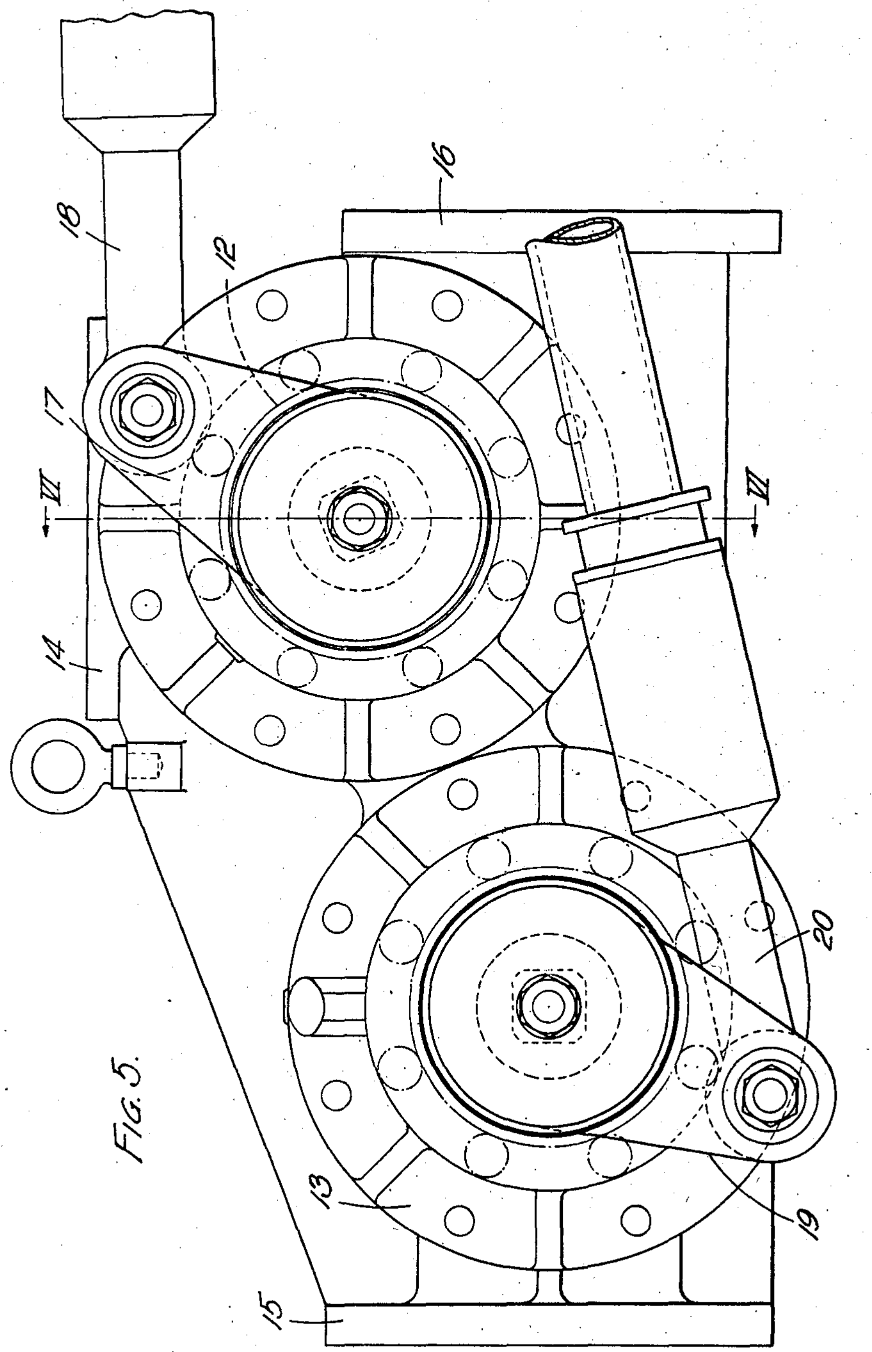


FIG. 5.

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VALVE OPERATING MECHANISM FOR CONCRETE PUMPS

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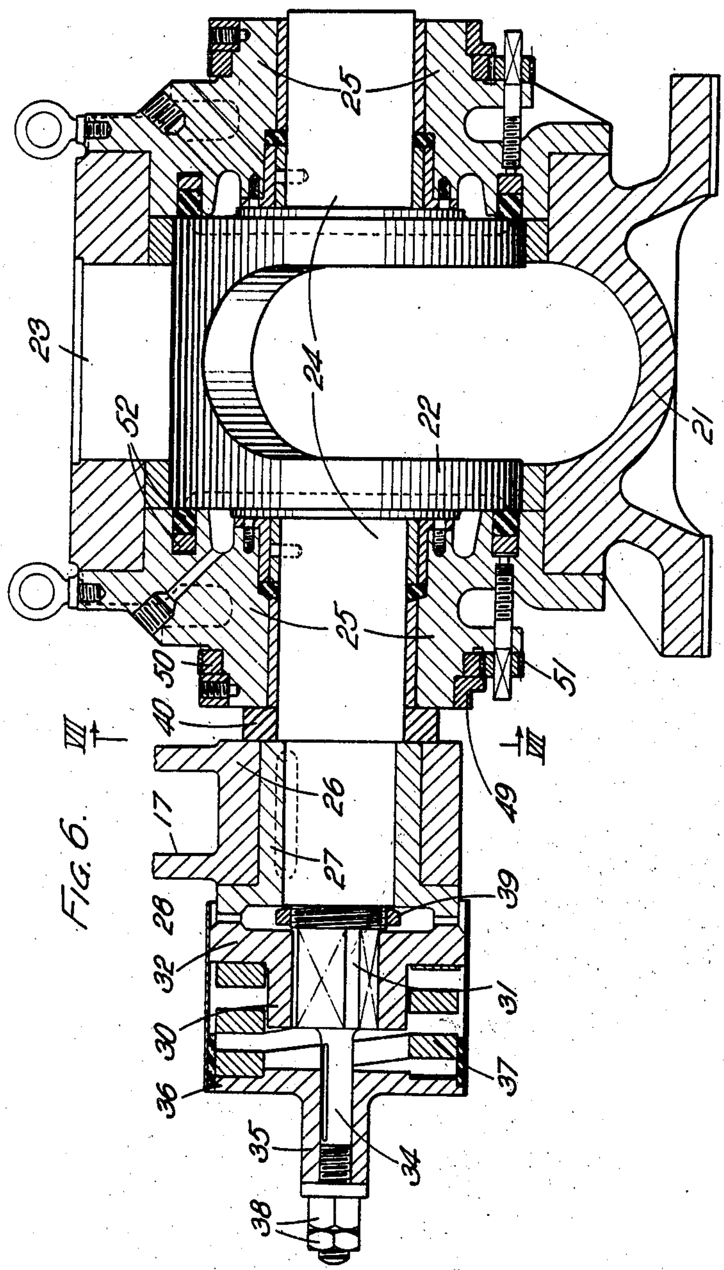


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# UNITED STATES PATENT OFFICE

2,287,470

## VALVE OPERATING MECHANISM FOR CONCRETE PUMPS

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Application March 23, 1940, Serial No. 325,520
In Great Britain April 3, 1939

2 Claims. (Cl. 137—146)

This invention relates to valve operating mechanism for concrete pumps. In the employment of the term "concrete" it will be understood that no limitation is to be implied therefrom and that the invention is generally applicable to the valve operating mechanism for pumps dealing with materials which include solid bodies. Hereinafter, and in the claims that follow, the term "concrete" will be used to apply to such material, and the solid objects in the material will be referred to as stones.

In concrete pumps as constructed and used up to the present, there is an inlet valve and an outlet valve arranged, with the aid of suitable cam mechanism, in such manner that on the suction stroke of the pump the inlet valve opens whilst the outlet valve is closed, and on the pressure stroke of the pump the inlet valve closes whilst the outlet valve opens. Rotary valve bodies have been employed and it has, of course, presented a problem to obtain satisfactory valve operating mechanism having regard to the conditions under which the valves must work and, more especially, close. Such conditions are unusual for the reason that a smooth liquid or fluid is, in this instance, not being dealt with, but on the contrary, a semi-liquid material containing solid bodies which may easily jam the valves when the latter are performing their closing movements. In known valve controlling mechanism two main principles have been adopted. There is first of all the principle of designing the valves so that they do not close completely, thereby reducing the jamming action to some extent and secondly, the principle of designing the valves in such manner as to crush any stone that may tend to cause an obstruction.

In addition to the use of the two main principles just referred to, it has been proposed to resort to a third principle, namely, to provide in the driving connection for each valve, what may be termed an overload-release which, in the event of the valve meeting with excessive obstruction during its closing movement, provides for lost-motion whereby the driving mechanism can complete its movement without imparting corresponding movement to the valve. In some cases the overload-release has included springs so arranged that there is imparted to the valve a greater torque for the opening movement than for the closing movement, the object being to ensure that the valve shall return to its open position in the event of it becoming jammed, or tending to become jammed, by contact with a hard body during its closing movement.

The present invention may be regarded as relating generally to this third principle of operation, and the invention has for one of its objects to provide valve-operating mechanism which, while permitting the application of a differential torque to the valve when the necessity arises, ensures a positive driving of the valve in both directions under normal conditions.

A further object of the invention is to provide valve-operating mechanism which is of simple construction and therefore easy and cheap to produce, but which will be capable of giving the desired operative effect in an efficient and reliable manner.

According to the invention the valve-operating mechanism comprises a member adapted to impart an oscillatory motion to the valve body, and a coupling between such member and the valve body, the said coupling being in the form of a dog-clutch, the tooth (or each tooth if there be more than one) of which has working faces so inclined that while, on the one hand, they are capable of applying positive force to the valve to cause it to close completely under normal conditions and to open, but do not transmit mechanical power to the valve body when the resistance to movement of the latter in its closing direction is greater than a predetermined value, on the other hand they are capable of transmitting to the valve body for the opening movement of the latter greater mechanical power than that available for closing it.

According to a further feature of the invention, stops are arranged positively to limit the travel of the valve body in either direction, so that if the mechanical oscillating movement of the aforementioned oscillating member and the mechanical oscillating movement of the valve body tend to come out of phase, due to said coupling, the correct phase relation is restored by said limiting stops.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings, in which:

Figures 1 to 4 are sectional views illustrating diagrammatically several working positions of the valves of a known type concrete pump;

Figure 5 is a general outside view of the valve operating mechanism in accordance with the invention;

Figure 6 is a sectional view taken on the line VI—VI of Figure 5 in the direction indicated by the arrows thereon;

Figure 7 is a section on the line VII—VII of Figure 6; and

Figure 8 is a detail of the mechanism illustrated in the preceding Figures 5 to 7.

Referring first to Figures 1 to 4 of the drawings, there is shown in each case an outlet valve 1 and an inlet valve 2. There is an associated pump (not shown) arranged alternately to raise and lower the pressure in a pipe 3 in which there is included the valve 1. The pipe 3 has an extension 4 which serves as the outlet port for the valve mechanism. There is a lateral branch 5 in which is included the valve 2 and which serves as the inlet port for the valve mechanism. In the diagrammatic illustrations of Figures 1 to 4, the outlet valve 1 is shown as having a cylindrical casing 6 in which there is located a cylindrical valve body 7. The latter is supported for angular movement about an axis perpendicular to the plane of the paper of the drawings, so that such valve body may be brought to the position illustrated in Figure 3. A circular section passage 8 is formed in the valve body 7, such passage registering with the bore of the pipe 3.

The inlet valve 2 is similarly formed, the valve body 9 being cut away so that it may either close the inlet 5 (as in Figure 1) or, alternatively, assume a position such as shown in Figure 4 where it is substantially in continuation of the internal bore of the inlet 5.

In Figure 1, the valves 1 and 2 are in their positions corresponding to the exhaust or pressure stroke of the associated pump, the inlet 5 being closed by the valve body 9, whilst the valve body 7 occupies its position corresponding to opening of the valve 1. In Figure 3 the valves 1 and 2 are in their opposite working positions where the valve 1 is closed and the valve 2 open. This corresponds to the suction or intake stroke of the pump. In Figure 2 there is shown a position of the valves 1 and 2 corresponding to Figure 1 except that it will be noted that the valve body 9 has been unable to close completely, due to the presence of a stone 10, which has become wedged between the valve body and the adjacent edge of the casing thereof. In Figure 4 an operative position of the valve corresponding to Figure 3 is shown, but here again a stone 11 is located between the valve body 7 and the side of the outlet port 4. As already indicated hereinbefore, with known type valve mechanism for concrete pumps, difficulty of incomplete closure of the valves due to jamming by stones or the like has been dealt with either by attempting to crush the stones or, alternatively, by arranging that the valves of the pump should not close completely.

In Figures 5 to 8, there is illustrated the valve mechanism arranged in accordance with the invention. In Figure 5 the inlet valve casing is seen at 12 and the outlet valve casing at 13. There is an inlet connection 14 and an outlet connection 15 corresponding to the inlet and outlet ports 5 and 4 respectively of Figure 1. In line with the outlet connection 15 is the union 16 to which the pump (not shown) will normally be joined. The inlet valve is angularly adjusted by a yoke arm 17 (see also Figure 6) to which there is pivotally attached a connecting rod 18 that is reciprocated axially with the aid of known cam mechanism. The outlet valve is similarly operated by a yoke 19 pivotally attached to a connecting rod 20, which is also axially moved through known cam mechanism.

As will be seen from Figure 6, the inlet valve has a fixed casing 21 and a valve body 26 that may close the inlet port 23, as is actually the case illustrated in Figure 6. The valve body 22 is carried by a valve spindle 24 which is supported in bearings 25 secured to the fixed casing 21. The yoke 17 has a boss 26 which is provided with a fixed internal bushing mounted loosely upon the valve spindle 24. The bushing is formed as a sleeve 27 with a flange 28, which possesses one or more teeth as indicated at 29 in Figure 8. A sleeve 30 is carried upon a non-round part 31 of the valve spindle 24 in such manner that the sleeve 30 must at all times rotate with the valve spindle but may move axially along the same. The sleeve 30 is formed with a flange 32 and has an indentation, or indentations, such as indicated at 33 in Figure 8. Beyond the non-round portion 31 of the spindle 24 the latter is reduced in diameter so as to afford a support 34 for a flanged sleeve 35. The flange 36 of the sleeve 35 forms a bearing surface for a helical spring 37 which also bears against the flange 32. The flanged sleeve 35 is adjustable along its support 34 under the action of locking nuts 38 which co-operate with screw-threading upon the support 34.

To locate the sleeve 27, and therefore the yoke 17 of which it forms the bushing, a locking nut 39 is secured upon the spindle 24. For the purpose of defining the limiting positions of angular adjustment of the spindle 24, the latter also carries fixedly a collar 40. The fixing screws 41 for the collar 40 may be seen in Figure 7. The collar serves to carry a radially projecting abutment 42 (see Figure 7) which is adapted to coact with stops 43 and 44, consisting of set-screws which enter bosses 45 and 46 and which are locked by means of locking nuts 47 and 48. The bosses 45 and 46 are formed upon, or secured to, a ring 49 which is locked to a stationary part of the bearing 25. The ring 49 incidentally serves to hold a rack ring 50 in position, the latter co-operating with a plurality of pinions 51 which are carried upon screw-threaded shafts arranged to adjust by their axial movement the tightness of packing rings 52, the actual detail of which forms no part of the present invention.

From the description above, it will now be understood how the inlet valve operates. From the known cam control mechanism the connecting rod 18 receives a reciprocating motion of such amplitude as normally to open and close the valve body 22, completely. The reciprocating motion of the connecting rod 18 is communicated to the yoke arm 17 which causes angular movement of the sleeve 27 which, in turn, communicates such angular movement to the sleeve 30 via the tooth-and-indentation connection 29 and 33. It will be recalled that the sleeve 30 may move axially along its non-round supporting shaft 31, although this movement will be against the action of the spring 37. Any angular movement, however, of the sleeve 30 is communicated to the shaft 31, which produces corresponding angular movement of the valve body 22, since the shaft portion 31 is integral with the valve spindle 24. Assuming that the valve is working normally and no stones are trapped between the valve body edge and the enclosing casing thereof, then the tooth 29 (or each such tooth) remains seated in its complemental indentation 33 as shown in Figure 8, and the sleeves 27 and 30 move truly in unison. The abutment 42 moves precisely according to the angular movements of the valve body 22, and the stops 43 and 44 are so adjusted that they define the limit positions of the valve body 22. In normal operation without stoppages, the limiting action of the stops 43 and 44 would not be called into play since the amplitude of the reciprocation of the connecting rod 18 will be adjusted so as to afford the correct degree of angular operating movement to be applied to the yoke arm 17 to achieve the necessary complete valve opening and closing movements. If now a stone becomes lodged between the valve body and the adjacent edge of the enclosing casing thereof, as for example illustrated in Figure 2, then the tooth 29 will tend to continue its motion in the direction illustrated by the arrow in Figure 8, but the flange 32 having the indentation 33 will remain stationary owing to the wedging action of the stone or the like which prevents further movement of the valve body 22 and, therefore, the valve spindle 24 and the portion 31 of the shaft. The tooth 29, under these conditions, will ride out of the indentation 33 and will cause the sleeve 30 to be displaced axially away from the sleeve 27. Upon a return movement of the yoke 17 and, therefore, a return movement of the flange 28 having the tooth 29, the tooth 29 will pick up in the indentation 33 and will carry the sleeve 32 in a return angular movement. It may happen that if the stone or the like is not tightly jammed between the valve body and the casing, there may be a tendency for the sleeve 30 to perform a return movement in company with the sleeve 27 without engagement of the tooth 29 in its indentation 33. In this case, it will be understood that the stop 43 or 44 as the case may be, will serve to limit the position of the inlet valve body, and will thus allow the tooth-and-indentation to be brought once more correctly into register, without any tendency for the valve body to over-run its correct limit of setting. In order that the tooth 29 and the indentation 33 shall release comparatively easily in the direction of movement of the flange 28 corresponding to valve closing, the leading face 60 of the tooth 29 is inclined more than the rear face 61 (compared with the normal to the driving direction). As will be clear from Figure 8, the increased inclination of the face 60 will result in an easy disengagement of the co-operating flanges 28 and 32 when the flange 32 is moving in a direction corresponding to valve closing, whilst when the return movement corresponding to valve opening is taking place, if the tooth 29 is in engagement with its indentation 33, the face 61 will not so easily disengage with the indentation.

The outlet valve indicated at 13 in Figure 5 has control mechanism of precisely the same kind as that shown in Figure 6 in respect of the inlet valve.

As already indicated above, there may be one or a plurality of teeth, such as shown at Figure 8. Alternatively, the cooperating surfaces of the flanges 28 and 32 may be formed as friction clutch surfaces without the inclusion of a tooth or teeth. The arrangement would otherwise be substantially identical with that shown in Figure 6 and the operation would also be the same, the stops 43 and 44 serving then definitely to assure that the mechanical phase of the valve body 22 and the controlling yoke arm 17 remains the same. The only distinction between the employment of a tooth, or teeth, such as 29 to afford the coupling, and of friction surfaces, lies in the fact that the dog-clutch action obtained with the tooth or teeth affords a semi-positive drive at least in the valve opening movement, whereas with the friction clutch type coupling, the drive is at no time semi-positive in the same sense. However, both kinds of coupling will afford the same general desired result, i. e. the couplings will both cease to transmit torque or power above a predetermined maximum value.

What I claim and desire to secure by Letters Patent of the United States is:

1. In a concrete pump having a valve for controlling the flow of the concrete, valve-operating mechanism comprising a member adapted to impart an oscillatory motion to the valve body, and a coupling between said member and said valve body, said coupling being in the form of a dog-clutch having at least one tooth of which the working faces are so inclined that while, on the one hand, they are capable of applying positive force to the valve body to cause it to close completely under normal conditions and to open but do not transmit mechanical power to the valve body when the resistance to movement of the latter in its closing direction is greater than a predetermined value, on the other hand, they are capable of transmitting to the valve body, for the opening movement of the latter, greater mechanical power than that available for closing it, and stops arranged positively to limit the travel of the valve body in either direction so that if the mechanical oscillatory movement of said oscillatory member and the mechanical oscillating movement of the valve body tend to come out of phase, due to said coupling, the correct phase relation is restored by said limiting stops.

2. In a concrete pump having a valve for controlling the flow of the concrete, valve-operating mechanism comprising an oscillatory driving member for the valve body, said member being formed as a connecting rod which is reciprocated in such manner as to have an amplitude of movement corresponding to the complete opening and closing movements of the valve body, said connecting rod being pivotally attached to an arm mounted for free rotational movement upon a spindle extending axially from the valve body, said arm having secured to it one of two members of a coupling, the other member of the coupling being mounted on the valve spindle in such a manner that it is axially movable therealong but fixed in regard to angular movement, means for pressing the axially movable member of the coupling towards the other member thereof, one of the coupling members having at least one tooth adapted to co-operate with at least one recess in the other coupling member, the working faces of the said tooth and recess being so inclined that while, on the one hand, they are capable of applying positive force to the valve body to cause it to close completely under normal conditions and to open but do not transmit mechanical power to the valve body when the resistance to movement of the latter in its closing direction is greater than a predetermined value, on the other hand, they are capable of transmitting to the valve body for the opening movement of the latter, greater mechanical power than that available for closing it, and stops arranged positively to limit the travel of the valve body in either direction so that if the mechanical oscillatory member and the mechanical oscillating movement of the valve body tend to come out of phase, due to said coupling, the correct phase relation is restored by said limiting stops.

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