Sept. 12, 1933. C. N. FULCHER 1,926,333

MECHANISM TO CONTROL RELATIVE ROTATION

Filed Sept. 2, 1930 2 Sheets-Sheet 1

Fig. 1.

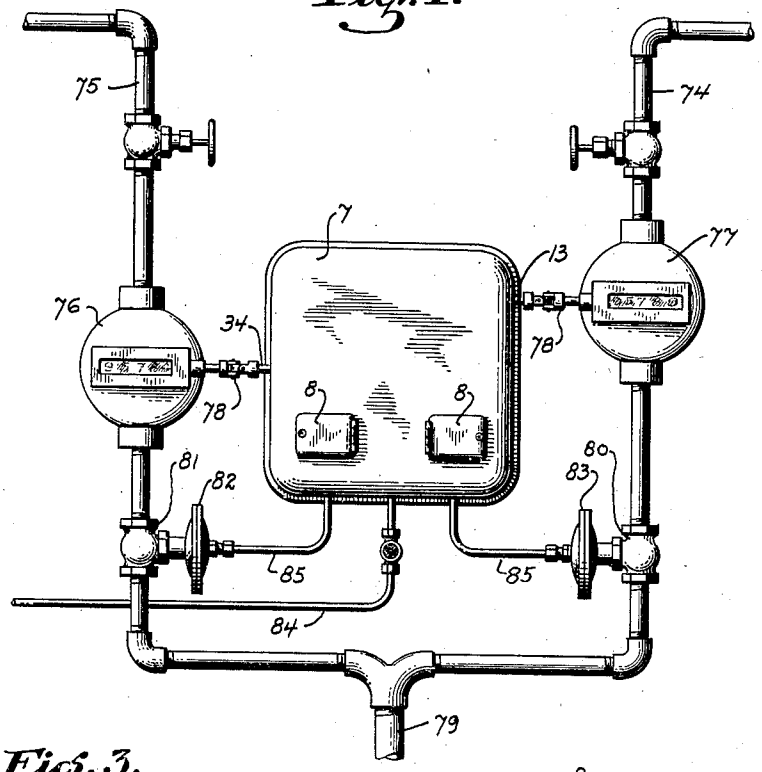

Fig. 3.

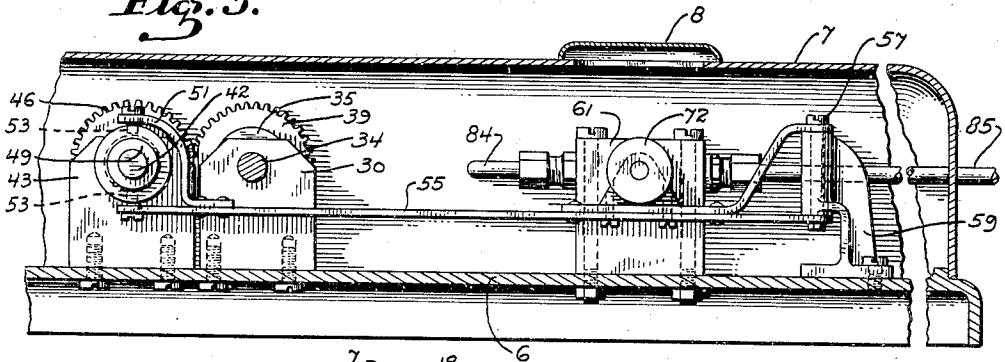

Fig. 5.

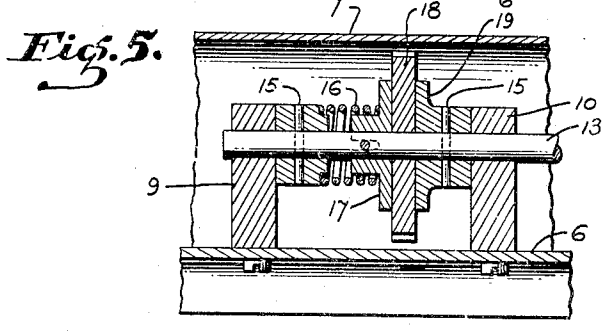

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Fig. 2.

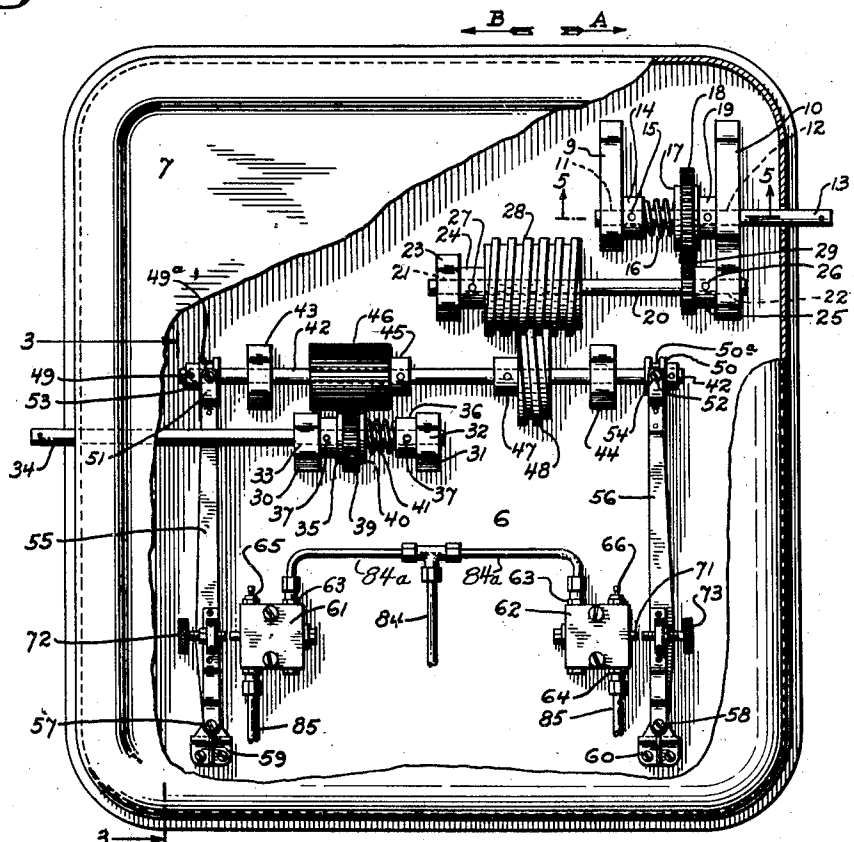
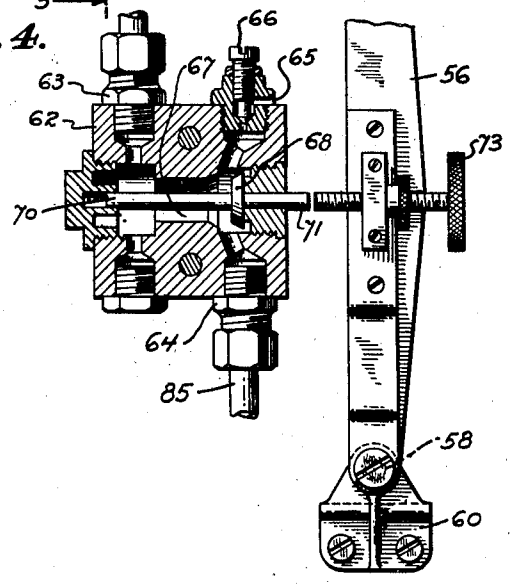


Fig. 4.



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MECHANISM TO CONTROL RELATIVE ROTATION

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7 Claims. (Cl. 137—164)

This invention relates to mechanisms to control relative rotations in any mechanism where a rotary motion is produced or where other forms of motion can be transformed into rotary motion. For purposes of exemplification the invention is herein illustrated as applied to meters for coordinating the relative flows of gas from two sources of supply, but the invention would be equally effective to control relative flow of liquid or electricity in any other like purposes where automatic throttling and accelerating control is desired.

The object of the invention is to provide a device which when once adjusted to the predetermined rotation ratio from the respective sources will automatically maintain that predetermined relationship without attention of an inspector; another object is to provide a simple and economical mechanism for the aforesaid purpose which may be constructed as a standard unit and transported from place to place and attached to varying types of apparatus where it is desired to control relative rotary motion actuated from different sources.

To more fully comprehend the invention reference is directed to the accompanying drawings, wherein

Fig. 1 is front elevation showing adaptation of an applied general lay-out of the invention with relation to mixture of gases from two sources.

Fig. 2 is enlarged detail in front elevation of the control mechanism, with top of cover partially broken away.

Fig. 3 is vertical side view on line 3—3 of Fig. 2.

Fig. 4 is enlarged detail front view of regulating valve mechanism with valve structure in section showing a suitable valve structure for use with the invention.

Fig. 5 is sectional longitudinal transverse plan on line 5—5 of Fig. 2.

Referring to the drawings wherein like reference characters designate corresponding parts, 6 indicates generally a mounting board which optionally may have thereover a removable cover 7 having doors 8 therein for easy access to regulate the valves. Mounted in any suitable manner upon the board is a pair of brackets 9 and 10 having journalled thereon as at 11 and 12 a rotatable shaft 13. Axially mounted on shaft 13 are a collar 14, a coil spring 16, clutch plate 17, a floating driving gear 18, and a collar 19, the collars 14 and 19 being fixedly keyed on the shaft 13 by means of pins 15. The gear 18 is freely mounted on shaft 13 and is caused normally to rotate in unison therewith by means of the rotation of collar 19 bearing against one side of the gear and the clutch plate bearing thereagainst on the other side and maintained in frictional contact with said gear by the spring 16 which seats on the collar 14. This structure normally causes the gear to rotate with the shaft, but permits slippage on the shaft under circumstances presently to be explained.

A second shaft 20 in relative parallelism with shaft 13 has rotatable journalled bearings at 22 and 21 in an extension of bracket 12 and a bracket 23, respectively, and mounted collars 24 and 25 which are keyed to the shaft by pins 27 and 26.

Fixedly mounted on the shaft 20 in any suitable manner and rotatable therewith is a spiral 28 preferably having square-cut threads. Also fixedly mounted on shaft 20 and rotatable therewith is a spur gear 29 in mesh with gear 18 on shaft 13 and it will be apparent that on rotation of shaft 13, the shaft 20 and the spiral 28 will normally be rotated thereby, subject, however, to the slippage of gear 18 explained hereafter. Rotatably journalled in brackets 30 and 31 as at 33 and 32 is a third shaft 34 having fixedly mounted thereon a structure substantially similar to and operating in the same manner as the structure on shaft 13 and comprising collars 35 and 36 keyed to shaft 34 by pins 37. A driving gear 39 is freely mounted on the shaft and normally caused to rotate therewith by frictional contact with collar 35 on one side and clutch plate 40 on the other side actuated in its bearing against the gear by coil spring 41 which seats on the collar 36.

In relative parallelism with the other shafts, a fourth shaft 42 is rotatably mounted and axially slidable in brackets 43 and 44. Keyed to shaft 42 by means of collar 45 is rack gear 46 which is in mesh with gear 39 with relation to which the rack gear is adapted to oscillatory movement. Also keyed to the shaft 42 as by collar 47 is a second spiral 48 preferably having square-cut threads. The spirals 28 and 48 are relatively meshed and have threads of the same pitch running in opposite directions, one left hand and the other right hand.

It is obvious from the foregoing that upon rotation of the shaft 34, the shaft 42 and the spiral 48 will normally be rotated thereby, subject however to slippage of gear 39 hereafter explained. Fixedly keyed to shaft 42 and preferably adjacent its ends are collars 49 and 50 each of which has an annular groove therein, 49*a* and 50*a*, respectively, said grooves being adapted to receive therein a yoke, 51 and 52, respectively, which is

so arranged that the collar may freely rotate therein. Each yoke is provided with a tongue 53 and 54 which ride in the grooves 49*a* and 50*a*. The yokes are connected with levers 55 and 56 which may be oscillated on pivotal mountings 57 and 58 on brackets 59 and 60 mounted in any suitable manner on the mounting board 6.

While this invention is adaptable to many types of mechanisms where throttling or accelerating control is desired, the illustration of adaptability herein is in respect of control of intermixture of gases, which will be now described.

In this exemplification there are provided throttle valve 61 and 62 of any suitable and well known type, the details of one only being described herein. As herein exemplified each of said valves comprises a housing having an inlet 63 and outlet 64 and a bleeder 65 which latter may be regulated and adjusted in any well known manner, such as by set-screw 66. The valve is provided with a chamber 67 with which the inlet, outlet, and bleeder are connected. The chamber has mounted therein a one-way cone-seated valve 68 normally maintained open by a pressure medium in the conduits 84*a*, the valve having a stem 70 protruding beyond the housing as at 71. The levers 55 and 56 have mounted thereon adjustable set-screws 72 and 73 respectively which, by suitable oscillation of the levers, contact with the valve stem 70 and open the valve for passage therethrough of a control medium such as air, gas, liquid, or the like.

Assume that it is desired to mix two gases in ratio of one-to-five. The one-ratio gas has a conduit 74, and the five-ratio gas has a conduit 75, each conduit having in its line a meter as indicated 76 and 77 wherein the flow therethrough causes rotary motion to be transmitted to the respective shafts 13 and 34 by suitable means, preferably shafts provided with universal joints 78. After passing through the meters the conduits 74 and 75 have confluence into a single conduit 79 which leads to a container (not shown) for the combined mixture. Intermediate the meter and confluence each conduit is provided with a valve 80 and 81 operatively associated with diaphragms 83 and 82, said valves being maintained closed by any suitable well known means, such as a spring, and normally maintained opened by pressure on diaphragms 82 and 83 through valves 61 and 62.

The gears 39 and 46 operated by the shaft 34 would rotate at a one-to-one speed, whereas the gear 18 on shaft 13 would rotate only once to each five rotations of the spur-gear 29, the gears being of proper relative size to accomplish this result. This causes the shaft 20 and the spiral 28 thereon to rotate at the same speed as the normal speed of rotation of shaft 42 and spiral 48 thereon, when meter 77 is running with one-fifth the speed of meter 76, so that spirals 28 and 48 normally rotate in unison at the same speed. If, however, the one-ratio gas begins to pass through meter 77 at a greater ratio than one-to-five, the rotation of shaft 13 increases its speed of rotation and thereby increases the speed of rotation of spiral 28 which causes the spiral 48 to move horizontally across the face of the spiral 28 in the direction of the arrow lettered B at the top of Fig. 2. Since the spiral 48 is fixedly mounted, the shaft 42 moves horizontally therewith, the rack gear 46 having sliding mesh with gear 39, and continues to rotate. This horizontal movement of the shaft 42 in the said direction, by means of the pivoted lever 56, contacts the set-screw 73 with the protruding portion 71 of the valve stem 70 which closes the valve on its seat, thus throttling the passage through that valve. A constant pressure medium, such as compressed air, is provided through the conduit 84 and its branches 84*a* to the inlet ports 63 of the valves 61, 62, and said valves are normally maintained open, thereby allowing pressure on diaphragms which hold valves 80 and 81 open. When the valve 62 is throttled or closed, the pressure on diaphragm 83 is diminished and thus permits the valve 80 to partially close, and thereby diminishing the flow of gas therethrough and also through meter 77, thus decreasing the speed of rotation of shaft 13 which through the gears 18 and 29 decreases the speed of rotation of spiral 28, so that it is then rotating at lesser speed than spiral 48 and causing spiral 48 to move horizontally across the threads of spiral 28 in direction of arrow A at top of Fig. 2 until spiral 48 assumes its normal position relative to spiral 28 and again rotates at the same speed therewith, the shaft 42 being thereby returned to its normal position, releasing the contact between set-screw 73 and the valve stem 71, and opening the valve 62 which in turn opens valve 80. A like action as applied to valve 61 through lever 55 would occur if shaft 34 were caused to increase speed of rotation by the gas flow through meter 76 increasing above the predetermined ratio which in the example is one-to-five. Likewise, if the flow from either source is decreased below the one-to-five ratio a relatively similar movement of shaft 42 would take place and thus coordinate the flow.

As above stated, the driving gears 18 and 39 are freely mounted on the respective shafts 13 and 34 and are caused to rotate by clutch means 17 and 40 abutting said respective gears which construction is preferred so that if for any reason the shaft 42 should reach the limit of its horizontal movement, the gears 18 and 39 would have slippage on their mounting shafts and thus prevent damage to the control apparatus.

To change the speed ratio of rotation, the relative size of gears may be altered. In the exemplification herein described minor adjustments for sensitivity in the controller may be accomplished by adjusting set-screws 72 and 73 whereby said set-screws are effective to momentarily advance or delay the opening of the respective co-operating valves.

Having thus described my invention, what I claim and desire to secure through Letters Patent is:

1. A device to coordinate flow of fluid, comprising independent fluid supply conduits, each having valve means therein to regulate fluid flow, a rotatable member connected with each supply conduit and adapted for rotation responsive to the flow of fluid through the conduit, a helically threaded spiral gear adapted for rotation by each of the said rotatable members, said spiral gears being intermeshed, and one of said gears being adapted for axial movement relative to the other gear, and means operatively responsive to the axial movement of said one gear whereby the valves in the fluid supply conduits may be actuated.

2. A device to coordinate predetermined ratio of flow of fluid, comprising independent fluid supply conduits each having a valve means therein to regulate fluid flow, a rotatable member connected with each supply conduit and adapted for

rotation responsive to the flow of fluid through a conduit, intermeshing gears adapted for rotation responsive to rotation of the said rotatable members, one of said gears being mounted so as to be movable longitudinally of its axis, and means operatively responsive to the axial movement of said one gear whereby the valves in the fluid conduits may be actuated.

3. A device to coordinate predetermined ratio of flow of fluid, comprising independent fluid supply conduits, a valve in each conduit adapted for regulating flow in a conduit, a rotatable member connected with each supply conduit and adapted for rotation responsive to flow of fluid through the conduit, intermeshing gears adapted for rotation responsive to rotation of the said rotatable members, one of said gears being mounted so as to be movable longitudinal of its axis, means operatively responsive to the axial movement of said one gear whereby the valves in the fluid conduits may be actuated, and clutch means interposed between the said rotatable members whereby one of said rotatable members may rotate independently while the other rotatable member is at rest.

4. A device to coordinate predetermined ratio of flow of fluid, comprising independent fluid supply conduits, a valve in each conduit adapted for regulating flow in a conduit, a rotatable member connected with each supply conduit and adapted for rotation responsive to flow of fluid through a conduit, intermeshing oppositely threaded helical gears adapted for rotation responsive to rotation of said rotatable members, one of said gears being mounted so as to be movable longitudinally of its axis, means operatively responsive to the axial movement of said one gear whereby the valves in the fluid conduits may be actuated, and means associated with the last mentioned means whereby the differential in the opening and closing of the respective valves may be adjusted.

5. A device to coordinate flow of fluids and the like, comprising a pair of independent conduits, each having therein means adapted for adjusting flow in that conduit, a rotatable member associated with each conduit and adapted for rotary movent responsive to the flow in its associated conduit, other rotatable members cooperatively interposed between the respective first mentioned rotatable members whereby the respective means to adjust flow in the respective conduits may be actuated responsive to a variance from a predetermined speed of rotation of the respective first mentioned rotatable members associated with the conduits.

6. A device to coordinate predetermined ratio of flows of fluids and the like, comprising a pair of conduits each having means therein to translate a force of flow therethrough into rotary motion, a train of rotatable members cooperatively arranged for interrelated simultaneous rotation, said train being connected with the said respective means to translate force of flow into rotary motion, means in each conduit for adjusting the flow in that conduit, and means automatically and intermittently operative between the last mentioned adjusting means and the train of rotatable members, two of the rotatable members in said train having differential relationship for actuating said automatically and intermittently operative means responsive to a variable in the relative predetermined flow through the respective conduits.

7. A device adapted to maintain a desired ratio of flow in two separate fluid conduits, comprising two separate fluid conduits; apparatus, including a rotataive member, in one conduit adapted to give rise to a rotary motion of such member, said rotary motion being variable in accordance with rate at which fluid flows through said conduit; a separate apparatus in the other conduit and including a rotataive member, adapted to give rise to a rotary motion of such member, said rotary motion being variable in accordance with the rate at which fluid flows through said conduit; a longitudinally fixed spiral gear driven by one of said rotary members, a longitudinally movable gear driven by another of said members, said gears being in mesh with one another, and means actuated by the longitudinal motion of said longitudinally movable gear for regulating the flow of fluid through one of said conduits.

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