Aug. 29, 1939. C. I. McNEIL ET AL 2,171,005

SPEED-RESPONSIVE DEVICE

Filed May 5, 1936

Fig. 2

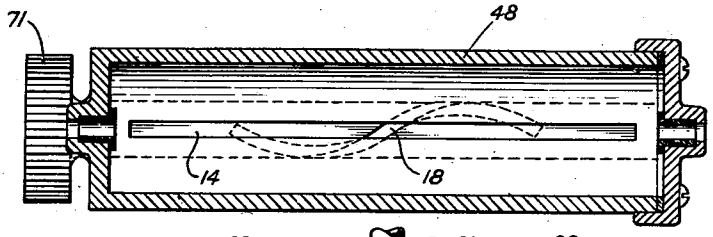


Fig. 1

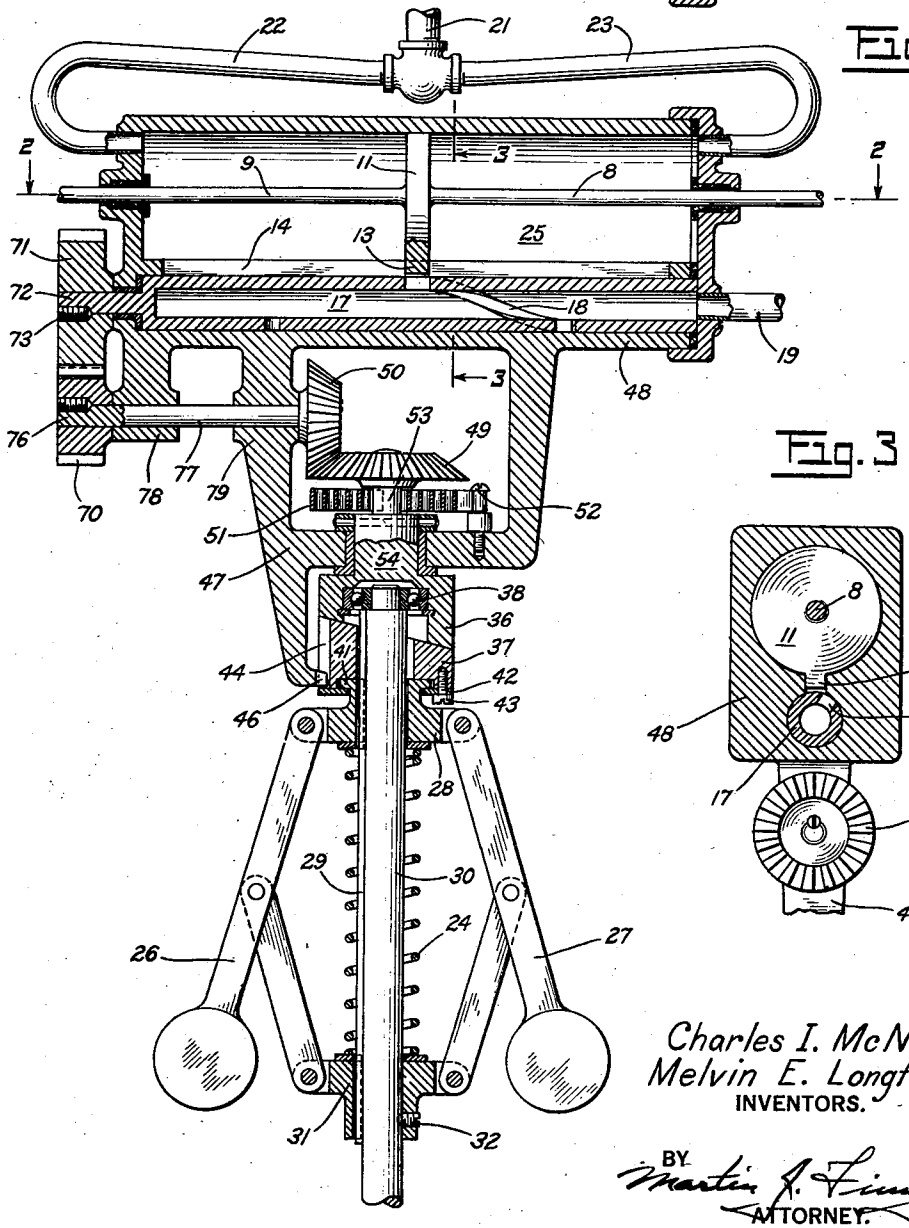


Fig. 3

Charles I. McNeil
Melvin E. Longfellow
INVENTORS.

BY Martin A. Finnegan
ATTORNEY.

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SPEED-RESPONSIVE DEVICE

Charles I. McNeil, Bloomfield, and Melvin E. Longfellow, Newark, N. J., assignors to Eclipse Aviation Corporation, East Orange, N. J., a corporation of New Jersey

Application May 5, 1936, Serial No. 78,024

1 Claim. (Cl. 121—42)

This invention relates to control apparatus, and particularly to the control of fluid actuated apparatus in accordance with the rate of movement of a rotary part associated with the device to be controlled.

It is an object of this invention to provide control means for speed regulation and more particularly for internal combustion engines that is responsive to changes in speed of the engine so as to maintain the desired predetermined mixture strengths.

In practicing the invention herein disclosed the essential factors include a servo-motor having piston and valve elements, or their equivalents, in combination with a speed responsive element adapted to control operation of the servo-motor, but in such manner that all elements of the speed responsive mechanism remain mechanically separate from the piston or equivalent element of the servo-motor at all times, so that there is no possibility of movements of the said piston being transmitted back to the speed responsive mechanism. It is accordingly an object of the invention to provide novel means for inter-relating a speed responsive mechanism with a servo-motor whereby the former may control the amount of movement—that is, length of stroke—of the latter while at the same time being free from the servo-motor to such an extent that the piston movements of the latter do not produce corresponding movements of the speed responsive or governing mechanism.

A further object of the invention is to provide a servo-motor of the type in which the valve mechanism cooperates with the piston-containing cylinder of the servo-motor in such manner as to adjustably locate the outlet for the fluid which acts upon the piston of the unit, the relationship between the two being such as to permit flow of fluid through said outlet only until the piston has reached a position of equilibrium in which the pressures on the opposing sides thereof are equal.

Another object of the invention is to substitute for the single oil pressure chamber type of servo-motor, a double chamber concept, involving the development of balanced oil pressures in chambers on opposite sides of the piston; such substitution resulting in the following advantages:

1. The force available for doing work becomes uniform for all positions of the piston, and for both directions of movement.

2. A saving in quantity of oil passing through the unit.

3. The time factor becomes uniform for both forward and return movements, regardless of length of movement.

4. The static setting may be held constant notwithstanding changes in oil pressure.

5. An increase in operating range, rendering the unit effective for any oil pressure value, however low.

Other advantages, as well as other objects of the invention, will be apparent on examination of the following description, when read with reference to the accompanying drawing wherein:

Fig. 1 is a view in section of a device embodying the invention;

Fig. 2 is a view in section along the line 2—2 of Fig. 1 with the piston and rod omitted; and

Fig. 3 is a view in section along the line 3—3 of Fig. 1.

The parts (not shown) to be associated with and driven by, the piston rod 8 may be operatively connected with a device for changing the amount of air or fuel admitted to the combustion chambers of an engine, or to a device for changing the percentage of fuel in the combustible mixture, or any equivalent device for governing the energy input of a power plant whose drive shaft or equivalent power element rotates at variable speeds adapted to be reflected in the variations in the speed of rotation of a governing mechanism driven thereby—such as the governing mechanism hereinafter described, or equivalents thereof. At its inner end, rod 8 terminates in a piston 11, but on the opposite side of the piston there is a second piston rod 9 which does no work but serves to reduce the exposed surface of the piston, thus creating equal effective areas on both sides of the piston. The oil supply line 21 has taps 22 and 23 to the opposing chambers 24 and 25, of which the piston 11 forms the dividing wall, together with its apron 13 slidable in slot 14 to permit, when moved from the position indicated in Fig. 1, flow of oil through the hollow metering valve 17 with its spiral slot 18, the outlet being indicated at 19.

The speed responsive means for rotating the valve 17, and thereby varying the position of the spiral slot 18 with respect to the longitudinal slot 14, is shown as including a centrifugal governor including a spring 24 and weighted links 26, 27 pivotally suspended from a collar 28 movable along a spline or groove 29 on the engine driven shaft 30, whenever the speed of said shaft 30 increases or decreases, the movement being down for an increase (due to the link action under centrifugal force), and up for a decrease (due to the spring 24), the lower collar 31 being held (by

set screw 32) against any movement whatever relative to shaft 30.

The means for converting the occasional longitudinal movement of collar 28 into a corresponding occasional movement of valve 17 includes a torsion spring 51, and a pair of abutting truncated sleeves 36 and 37, the former being rotatable by said spring 51 in relation to shaft 30 (such relative rotation being facilitated by bearing 38) and the latter being held against rotation (as by restraining means 46 registering with spline 44) but movable longitudinally to the same extent as collar 28, and in response to longitudinal movement of said collar by virtue of the interlocking flanges 41 and 42 on the said parts 28 and 37—the flange 42 being held to the sleeve 37 by suitable means 43.

The above described restraining means 46 is located on a depending arm 47 of the housing 48 in which the meshing gears 49, 50 are enclosed, as well as the torsion spring 51 whose outer end is anchored to the housing by means 52, and whose inner end attaches to the neck portion 53 of a short shaft 54 integral with sleeve 36 and thereby acts to hold the latter firmly abutting the truncated surface of sleeve 37 at all times, the direction of coiling of the spring being such that the spring unwinds as sleeve 37 descends, and rewinds as sleeve 37 forcibly turns the sleeve 36 in a reverse direction as it ascends. These alternate clockwise and counterclockwise movements (occurring as the engine speed alternately rises and falls) are effective to rotate gears 49, 50, 70 and 71, the latter being secured to the stem 72 of valve 17, as indicated at 73. A similar fastening means 76 holds gear 70 to the shaft 77 drivably connecting gears 50 and 70 and journaled in the bosses 78 and 79 of housing 48.

It will be seen from the foregoing that a variation in the speed of the engine to be controlled will produce a corresponding variation in the position of the governor sleeve 37 with respect to the sleeve 36, and hence a corresponding change in the position of the spiral slot 18 with respect to the longitudinal slot 14 of the servomotor, which change in position will produce an opening for the escape of fluid from the corresponding side of the cylinder 48 and hence an unbalancing of the pressures on the opposite sides of the piston 11. This unbalancing of the pressures will in turn cause the piston 11 to move to a new position in which the flow of fluid from the cylinder will again be cut off and equilibrium reestablished—the movement of the piston being meanwhile communicated to the fuel or energy input mechanism (not shown) with which the piston rod 8 operatively connects.

What is claimed is:

In a control apparatus, in combination, a cylinder having an inlet for fluid under pressure, a piston in said cylinder adapted to be moved first in one direction and then the other by the fluid pressure in the cylinder to actuate the device to be controlled, and speed responsive means to provide and adjustably locate a fluid outlet from the cylinder, whereby the position of the piston in the cylinder is determined, said speed responsive means being operable independently of said fluid under pressure and including a valve normally in flow inhibiting relation to said piston and cylinder but rotatable to connect one side or the other of said piston with said fluid outlet, according to the direction of rotation of said valve, said speed responsive means also including a centrifugal governor, all elements of which are mechanically separate from said piston, to prevent movements of the latter from being mechanically transmitted to said governor.

CHARLES I. McNEIL,
MELVIN E. LONGFELLOW.