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(54) A carburettor for an internal combustion engine.

(57) The carburettor comprises at least one butterfly valve operable to put a duct in which the petrol and air mixture is formed into communication with the outlet from the carburettor, and a starting up valve operable to put this duct into communication with the atmosphere; the carburettor further includes first means operable to carry the butterfly valve into a first opening position when the motor on which the carburettor is mounted is not running, second means operable to control the gradual closure of the butterfly valve starting from the moment when the engine is started, and third means operable to control the gradual opening of the starter valve starting from the said instant; the second means include at least one heat sensitive element provided with a movable rod the displacement of which is controlled by the thermal energy of the liquid in the engine cooling circuit, a first lever fixed to the butterfly valve and a second, rocker lever, provided with a contact pad which engages against the free end of the movable rod, the second lever being provided with a cam and the first lever being provided with a contact pad engageable against this cam in such a way that, following a displacement of the said movable rod produced by an increase in the temperature of the coolant liquid rotatation of the second lever is controlled to effect gradual closure of the butterfly valve.

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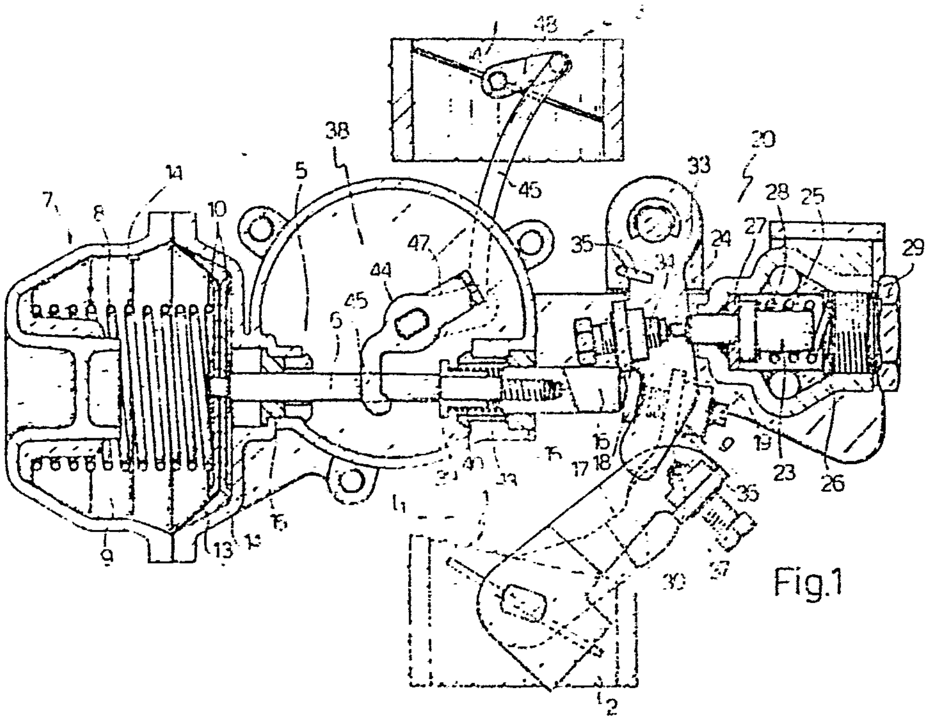
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Fig.1

A Carburettor for an Internal Combustion Engine

The present invention relates to a carburettor for an internal combustion engine and, in particular, to a carburettor for performing the cold-starting cycle of the engine on which it is mounted in an entirely automatic manner.

As is known, carburettors of this type include at least one pivoted butterfly valve normally held closed by the action of a spring and operable to put a duct in which the petrol and air mixture is formed into communication with the outlet from the carburettor itself, and a pivoted starter valve operable to put this duct into communication with the atmosphere. To perform the cold-starting cycle of the engine the carburettor, starting from the instant when the engine is started, must be able to vary both the flow rate of the mixture to the outlet and the strength of the mixture itself in dependence on predetermined rules; to obtain the first object, starting from the said instant, the flow cross section controlled by the butterfly valve must be gradually reduced from a condition of maximum opening to a condition of minimum opening corresponding to the achievement of slow-running conditions; to obtain the second object the starter valve, which is found in a completely closed position at the instant in which the engine is started, must gradually open starting from this instant in such a way as to increase the quantity of air which is mixed with the petrol for the purpose of reducing the concentration of this in the mixture until a predetermined mixture strength is reached upon achieving the said slow running conditions.

Known carburettors of this type normally comprise first means operable to carry the butterfly valve into a first opening position when the engine on which the carburettor is mounted is not running, and second means operable to control the gradual closure of the butterfly valve starting from the instant when the engine is

started, as well as third means operable to control the gradual opening of the cold-starting valve starting from the said instant.

The said first means normally include a movable rod controlled by an actuator which displaces the rod itself in a first directional sense by the action of a spring and in a second directional sense by the action of the depression which is created in the engine induction manifold.

The said second means normally include a heat sensitive element provided with a movable rod the displacement of which is controlled by the thermal energy of the liquid in the engine cooling circuit; between this rod and the starter valve there is disposed a mechanical transmission comprising a plurality of members operable to transmit the movement from the rod to the butterfly valve to control its closure.

The said third means, operable to control the gradual closure of the starting valve, normally include another movable rod which is controlled by a second actuator operable to displace the rod itself in a first directional sense by the action of a spring and in a second directional sense by the action of the depression which is created in the engine induction manifold; the movement is transmitted from the first mentioned movable rod to the starting valve by means of a mechanical transmission.

Carburettors of the type briefly described have several disadvantages.

First of all they do not allow the flow cross section through the butterfly valve to be regulated in accordance with the desired variation in dependence on time, starting from the moment when the engine is started; in fact, closure of the butterfly is controlled

by the first mentioned heat sensitive element provided with a movable rod, the displacement of which depends solely on the temperature which the heat sensitive element experiences at any instant; moreover, between this and the butterfly valve is interposed a kinematic chain the members of which, at any instant, assume a predetermined configuration which depends only on the position of the said movable rod. Consequently, carburettors of the type described do not lend themselves to being used equally well on engines of various types for which there may be required a different variation with time of the flow cross section of the butterfly valve.

Moreover, carburettors of the type indicated are constructionally very complex, of rather large dimensions, and do not function reliably because of the complexity of their structure. In fact, the first mentioned means include a large number of movable members and at least two pneumatic actuators.

The object of the present invention is that of providing a carburettor of the type indicated with which it is possible to perform the cold-starting cycle of the engine in an entirely automatic manner, and with which it is possible, in a simple and rapid manner, to adapt the carburettor to be used efficiently on engines of different type which require different variations with time of the flow cross section controlled by the butterfly. Another object of the invention is that of providing a carburettor of this type having a very simple structure, which will have small dimensions and be reliable in operation.

This object is achieved by a carburettor for an internal combustion engine including at least one pivoted butterfly valve normally held closed by the action of a spring and operable to put a duct in which the mixture of air and petrol is formed into communication with the

outlet from the carburettor itself, and a pivoted starter valve operable to put the said duct into communication with the atmosphere, first means operable to carry the said butterfly valve to a first opening position when the engine on which the carburettor is mounted is not running, second means operable to control the gradual closure of the said butterfly valve starting from the instant when the engine is started and including at least one heat sensitive element provided with a movable rod the displacement of which is controlled by the thermal energy of the liquid in the cooling circuit of the engine, characterised by the fact that the said second means include a first lever fixed to the said butterfly valve and a second lever pivoting about an axis parallel to that of the said butterfly valve and provided with a contact pad able to engage against the free end of the said movable rod and thrust against this end by the action of a spring, the said second lever being provided with a cam and the said first lever being provided with a contact pad engageable against the said cam in such a way that after a displacement of the said movable rod produced by an increase in temperature of the said cooling liquid rotation of the said second lever is controlled to allow closure of the said butterfly valve.

For a better understanding of the present invention a more detailed description of it will now be given by way of example, with reference to the attached drawings, in which:

Figure 1 is a partially sectioned side view of the fundamental members of the carburettor of the invention in a first operative position; and

Figures 2 and 3 represent the same view of the carburettor of Figure 1 in two different operative positions.

The carburettor of the invention, only some of the parts of which

have been shown in the drawings, includes at least one pivoted butterfly valve 1 operable to put an upstream duct (not shown), in which a mixture of air and petrol is formed, into communication with the outlet 2 from the carburettor itself, and a starting valve 3, also pivotable, operable to put the said duct (which is located downstream thereof) into communication with the atmosphere 4. The butterfly valve 1 is normally held in the closed configuration by the action of a spring (not shown) and, in a general angular configuration thereof opens a certain flow cross section (1_1, 1_2, 1_3) to supply the mixture to the outlet 2. Conveniently, along the duct in which this valve is fitted and downstream thereof are normally formed suitable holes (not shown) to supply the mixture during the slow running operation of the engine.

The carburettor includes first means, generally indicated 5, which are operable to carry the butterfly valve into a first open position when the engine on which the carburettor is mounted is not running. These means comprise substantially a movable rod 6, a first end of which is fixed to an actuator 7 operable to control the displacement of the rod itself in a first directional sense by the action of a coil spring 8 and in a second directional sense by the action of the vacuum which is created in the induction manifold of the engine and which is transmitted, through suitable ducts not shown, to the interior of a chamber 9 of the actuator; as is clearly seen in the drawings, the end of the rod 6 is connected to a pair of discs 10 between which the central part of a deformable diaphragm 13 is disposed, the edge of which is clamped between a pair of flanges of bodies 14 which constitute the casing of the actuator 7.

The rod 6 is suitably guided during its displacement on bearings 15 carried by the body of the carburettor and conveniently comprise an end section 16 which is fixed to the remaining part of the rod itself by means of a threaded coupling.

The first means further include a pivoted lever 17 rigidly connected to the butterfly valve 1 and provided with a contact pad 18 at one end, the position of which can be adjusted with respect to the lever itself and which is able to come into contact with the end 16 of the rod 6 as is clearly seen in Figure 1. Conveniently, the contact pad 18 has a threaded stem which is screwed into a corresponding threaded hole formed in an end tongue 19 of the lever 17.

The carburettor of the invention further includes second means operable to control the gradual closure of the butterfly valve 1 commencing from the instant when the engine is started. These means, which have been generally indicated 20, include at least one heat sensitive element 23 which is provided with a movable rod 24 the displacement of which is controlled by the thermal energy of the liquid in the engine cooling circuit, which is made to circulate within a chamber 25 in which the element itself is disposed. As is clearly seen in the drawings this can be mounted within a suitable casing 26 and held against a ring 27 by the action of a spring 28 which engages on a closure plug 29 of the casing itself. The second means further includes a lever 30 fixed to the butterfly valve 1, and therefore to the first defined lever 17, and a lever 33 pivotable about an axis parallel to the butterfly valve 1 and provided with a contact pad 34 engageable against the free end of the rod 24; this lever is normally held against the rod by the action of a spring 35. The lever 33 has a cam 36 and the lever 30 is provided with a contact pad 37 engageable against the cam in such a way that, following a displacement of the movable rod 24 caused by an increase in temperature of the cooling liquid within the chamber 25, rotation of the lever 33 is controlled to allow closure of the butterfly valve 1.

The carburettor includes a third means, generally indicated 38, operable to control the gradual opening of the starting valve 3

commencing with the instant in which the engine is started; these substantially comprise a mechanical transmission operable to transmit the movement from the movable rod 6 to the starting valve 3: this transmission is formed by a shoulder 39 formed on a bush 40 carried by the rod itself and thrust against a stop of this by a coil spring 43, a pivoted rocker 44 having a first arm 45 cooperable with the shoulder 39, a link 46 having one end pivoted to a second arm 47 of the rocker and a crank 48 fixed to the starting valve 3 and pivoted to the other end of the said link. Conveniently, the starting valve 3 is normally held inthe closed position by the action of a spring, not shown.

The operation of the carburettor described, during the cold starting cycle, takes place in the following manner.

When the engine is stationary, since there is no depression within the chamber 9 of the actuator 7 the spring 8 which acts on the discs 10 holds the rod 6 in its end-of-stroke position towards the right, shown in Figure 1, in which the end 16 of the rod itself, acting on the contact pad 18, controls opening of the butterfly 1 to set it to the maximum aperture corresponding to the flow cross section indicated in the drawing by l_1.

Therefore, when the engine is started the butterfly 1 is in the open configuration whilst the starting valve 3 is in its closed configuration under the action of the spring which normally holds the valve itself in this configuration.

Conveniently, the contact pad 37 is adjusted in such a way as to leave a predetermined clearance g between its end and the cam 36 with which it must cooperate. As soon as the engine is started, because of the vacuum which is produced within the chamber 9 of the actuater 7, the force exerted by the spring 8 is overcome and

therefore the diaphragm 13 and the discs 10 fixed to it are displaced towards the left and, therefore, the rod 6 moves in the same sense in such a way as to carry the various members into the configuration of Figure 2. Consequently, the levers 17 and 30 and, therefore the butterfly valve 1, perform a small rotation which corresponds to the taking up of the clearance g between the contact pad 37 and the cam 36 in such a way as to reduce the flow cross section through the butterfly valve to carry this to a new configuration corresponding to the flow cross section l_2 smaller than the first; through this opening, of predetermined value, the desired flow rate of mixture passes towards the induction manifold. Simultaneously, following displacement of the rod 6, the shoulder 39 comes into contact with the arm 45 causing rotation of the rocker 4 in a clockwise sense in Figure 2 and, therefore, opening of the starting valve 3 is controlled through the link 46 and the crank 48: in this way, through the opening left free by this valve, a predetermined quantity of air enters which makes the mixture which is supplied to the induction manifold leaner. Subsequently, the temperature of the cooling fluid which circulates within the chamber 25 increases causing displacement, towards the left in the Figure, of the rod 24 which therefore controls rotation of the lever 33 in a clockwise sense; consequently, because of the rotation of the cam 36, rotation of the lever 30 is also allowed and, therefore, rotation of the induction valve 1 in an anti-clockwise sense takes place in such a way as to reduce the flow cross section gradually and thereby reduce the rate of flow to the induction manifold. Therefore, to each successive configuration corresponding to a predetermined position of the rod 24 there corresponds an opening of the butterfly valve 1 which is not dependent solely on the position of the rod 24, but also on the profile which has been chosen for the cam 36. In this way the variation of the flow cross section through the butterfly valve 1 as a function of time commencing with the instant in which the engine is started can vary, depending on a

predetermined law of variation which is dependent on the profile of the cam 36. At the end of the cold starting cycle, the carburettor is in the configuration represented in Figure 3 in which the end-of-stroke position of the rod 24 has been reached, corresponding to the opening l_3 of the butterfly valve necessary for correct slow running operation of the engine; simultaneously the rod 6 is located in its end of stroke position towards the left and, therefore, via the link 46 and the crank 48 the rocker 44 carries the starting valve 3 into its maximum aperture configuration.

It is therefore evident that with the carburettor of the invention a cold starting cycle is obtained during which the flow cross section through the butterfly valve can vary in dependence on the time (commencing from the instant in which starting takes place) or else in dependence on the temperature of the cooling fluid according to a predetermined law of variation. This favourable result therefore allows the carburettor of the invention to be used on engines of different type in which different laws of variation of closure of the butterfly valve are required during the starting cycle: to vary this law of variation it will be sufficient to utilise levers 33 the cam 36 of which has a different profile, or else to act directly on the cam itself to modify its profile.

The structure of the carburettor described is, moreover, very simple, of small dimensions and considerable reliability. In fact, to control the various functions which have been described there are necessary only members of very simple form and a single actuator, the actuator 7, is able simultaneously to control both the setting of the butterfly 1 in the initial configuration and the gradual rotation of the starting valve 3 during the starting cycle itself.

It is clear that the form and disposition of the various parts of the carburettor which has been described can be modified and varied without by this departing from the scope of the invention itself.

CLAIMS

1. A carburettor for an internal combustion engine including at least one pivotable butterfly valve normally held closed by the action of a spring and operable to put a duct in which a mixture of air and petrol is formed into communication with the outlet of the carburettor itself, and a pivotable starting valve operable to put the said duct into communication with the atmosphere, first means operable to carry the said butterfly valve to a first position of opening when the engine on which the carburettor is mounted is not running, second means operable to control the gradual closure of the said butterfly valve commencing with the instant in which the engine is started, and including at least one heat sensitive element provided with a movable rod, the displacement of which is controlled by the thermal energy of the liquid in the cooling circuit of the said engine, characterised by the fact that the said second means include a first lever fixed to the said butterfly valve and a second lever pivotable about an axis parallel to that of the said butterfly valve and a contact pad engageable against the free end of the said movable rod and thrust against this end by the action of a spring, the said second lever being provided with a cam and the said first lever being provided with a contact pad operable to engage against the said cam in such a way that following a displacement of the said movable rod produced by an increase in the temperature of the said cooling liquid rotation of the said second lever is controlled to allow closure of the said butterfly valve.

2. A carburettor according to Claim 1, characterised by the fact that the profile of the said cam is chosen in such a way as to obtain a predetermined relation between the displacements of the said end of the said movable rod and the angles of rotation of the said butterfly valve.

3. A carburettor according to Claim 1 or Claim 2, characterised by the fact that each of the said contact pads comprises a threaded rod adjustable in a corresponding threaded hole formed in a tongue of the corresponding lever.

4. A carburettor according to any preceding Claim, characterised by the fact that the said first means comprise a rod movable substantially in the direction in which the said movable rod is movable, a first end of which is rigidly connected to an actuator operable to control the displacement of the said rod in a first directional sense by the action of a spring and in a second directional sense by the action of the depression which is created in the induction manifold of the said engine, the second end of the said rod being arranged to engage on a second contact pad of the said first lever to control the rotation of the said butterfly valve in the said first position of opening by the action of the said actuator spring.

5. A carburettor according to any preceding Claim, characterised by the fact that it includes third means operable to control the gradual opening of the said starting valve commencing with the instant when the engine is started, the said third means comprising a mechanical transmission operable to transmit motion from the said movable rod, when it moves in the said directional sense, to the said starting valve, to control the closure thereof.

6. A carburettor according to Claim 5, characterised by the fact that the said transmission includes a shoulder formed on the said movable rod, a pivotable rocker having a first arm cooperable with the said shoulder, a link having one end pivoted to a second arm of the said rocker and a crank fixed to the said starting valve and pivoted to the other end of the said link.

7. A carburettor according to Claim 6, characterised by the fact that the said shoulder is formed on a bush slidable on the said movable rod and thrust towards the said first rocker arm by a spring.

8. A carburettor according to Claim 6 and Claim 7, characterised by the fact that the pivot axis of the said rocker is parallel to the said axes of the first and second levers.

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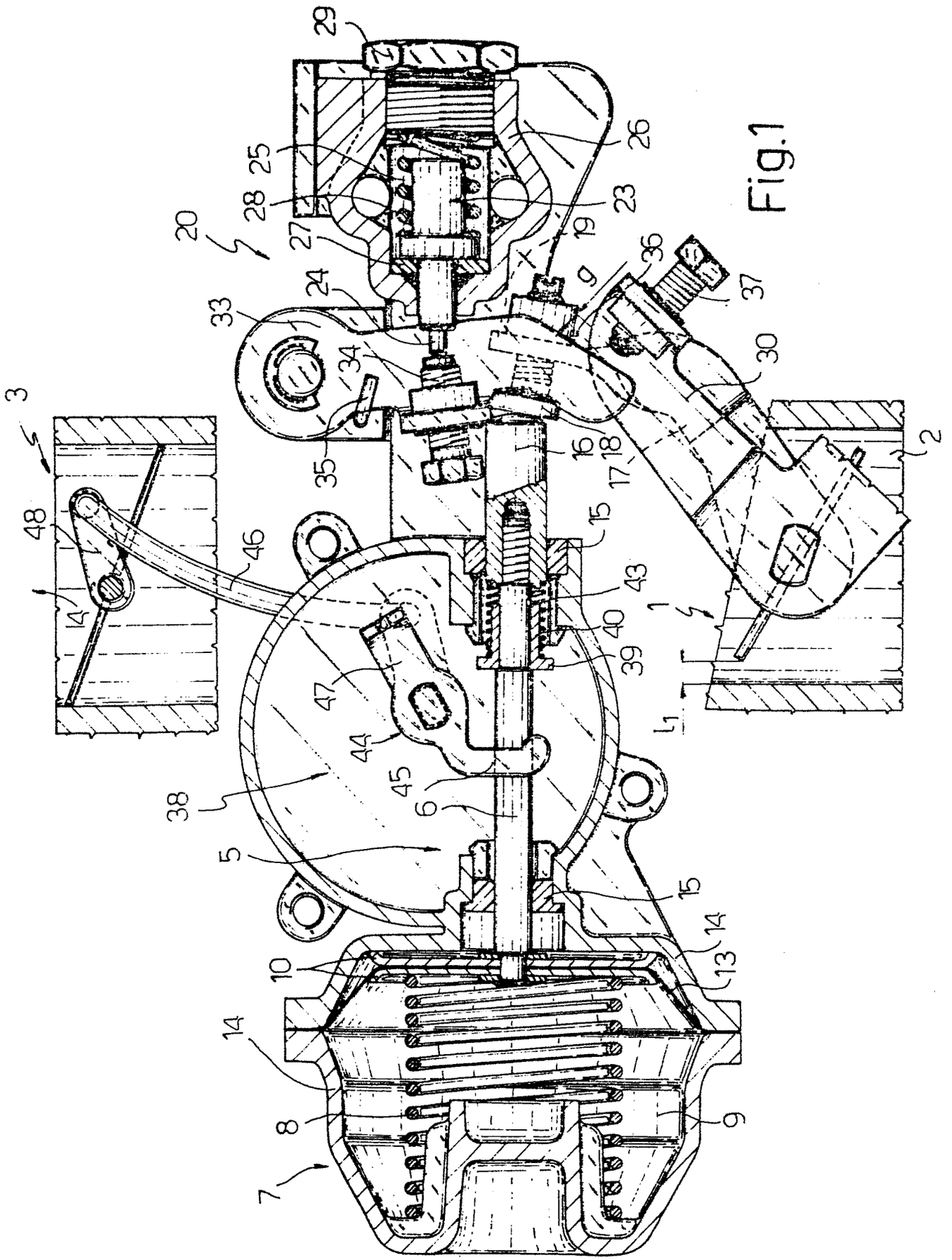

Fig.1

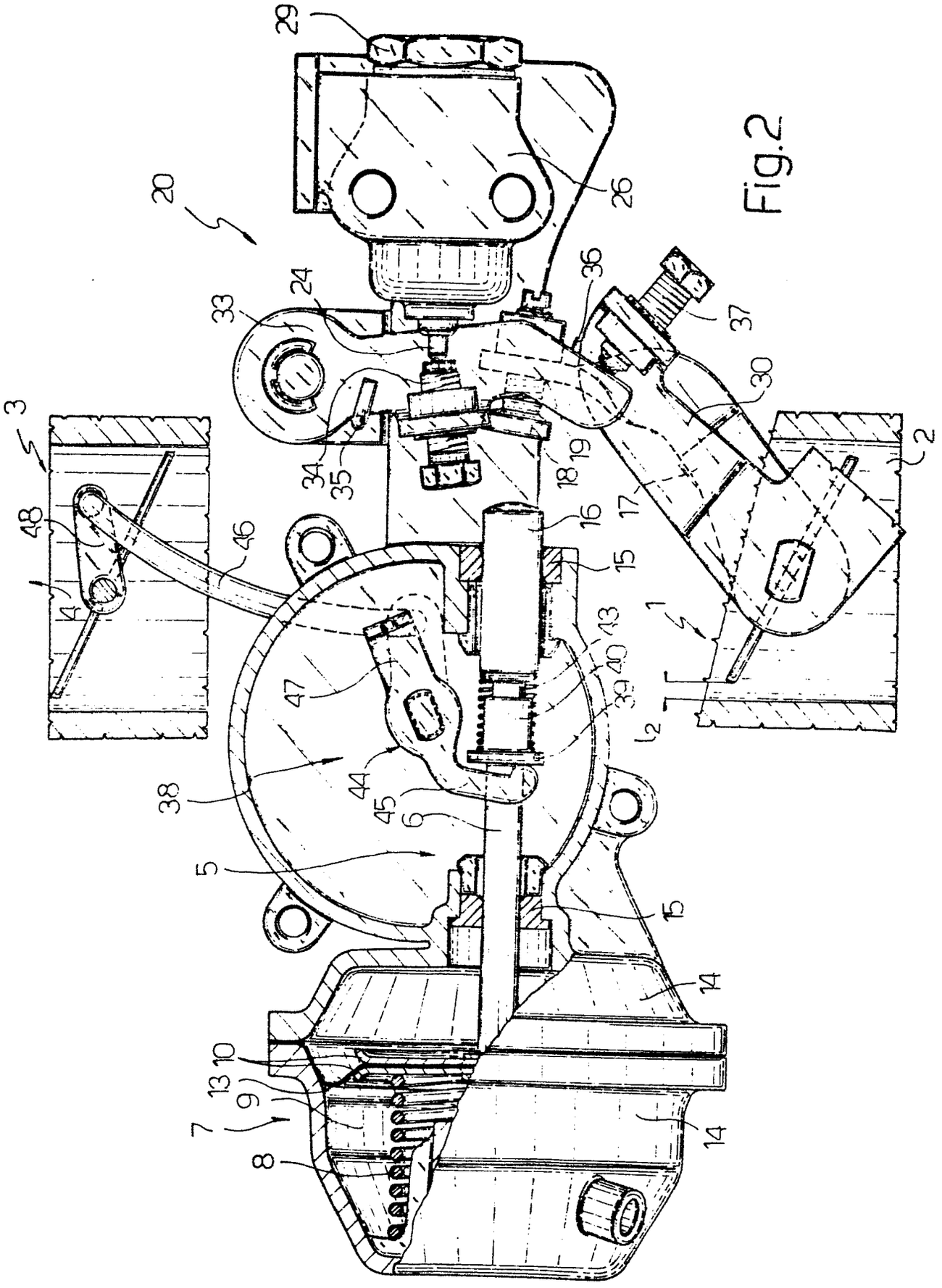

Fig.2

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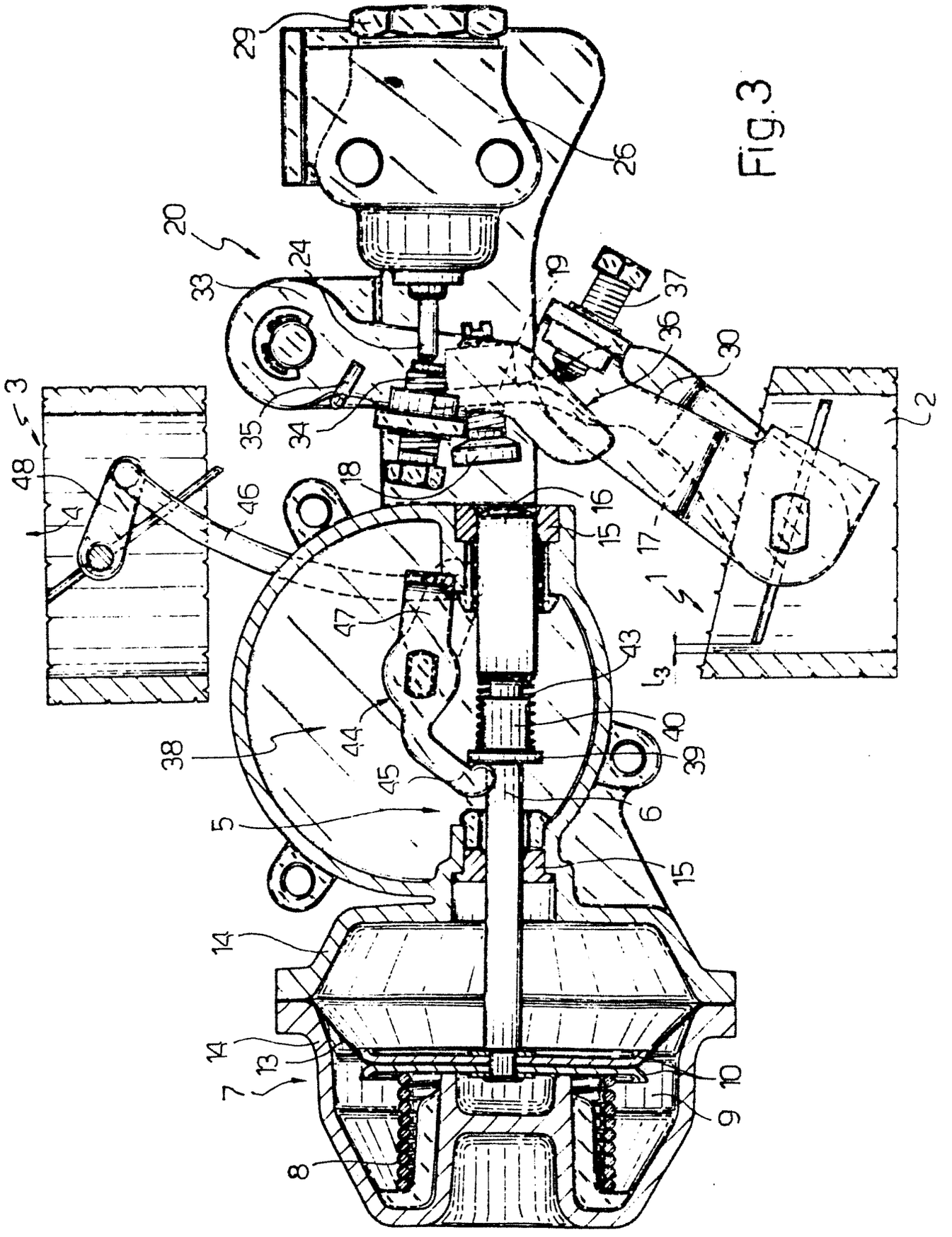

Fig.3