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(71) Applicant: **CANDY S.p.A.**
I-20052 Monza (Milano) (IT)

(72) Inventor: **Fumagalli, Silvano**
20052 Monza, Milano (IT)

(74) Representative: **Falcetti, Carlo et al**
c/o JACOBACCI & PERANI S.p.A.
Via Visconti di Modrone, 7
20122 Milano (IT)

(54) Device for diverting and shutting-off the spraying flow in a dishwashing machine, a washing machine in general and associated machine which uses this device

(57) Device for diverting and shutting off the flow of liquid in particular in a dishwashing machine, in which the flow of liquid initiated by a pump into a chamber (8, 41) provided with a number of outlets (9, 10, 24, 35, 36) is selectively shut off by plugs (11, 12, 26, 38, 39) for sealing the outlets, which plugs are closed by the hydrodynamic thrust exerted by the flow on the plugs and are each held in the open position, even in the presence of flow, by the mutual force of attraction exerted between a magnetic element (17, 18, 28, 50, 51) of the plug and the core (19, 23, 29, 45) of an electromagnet (20, 22, 30, 43, 44) which is associated with each plug and the temporary excitation of which reduces or cancels the mutual force of attraction, allowing the associated plug to be closed, which plug is advantageously in the form of a blade-type lever hinged on the device body and returns to the open position, when the pump is deactivated, by the effect of gravity.

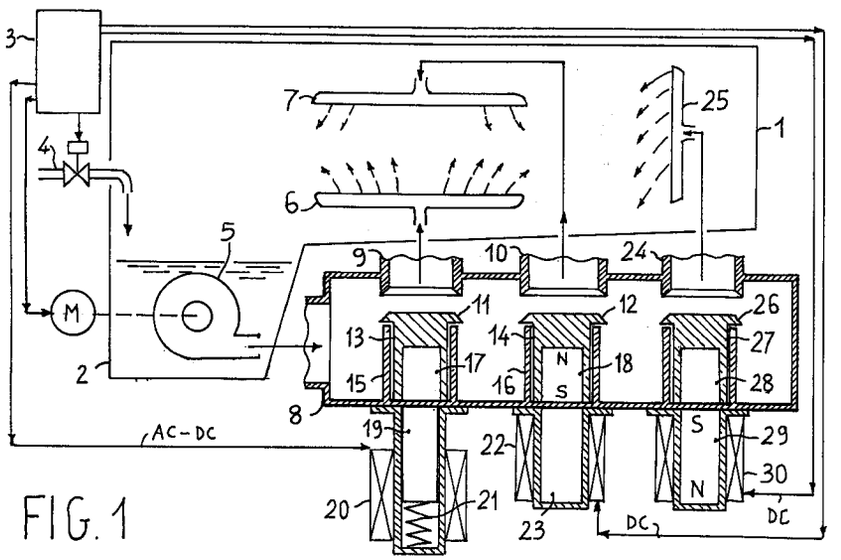

FIG. 1

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Description

The present invention relates to a device for diverting and shutting off the spraying flow, and more generally the flow, in a dishwashing machine, a washing machine in general, and to an associated machine which uses this device.

It is known that in dishwashing machines the washing water which has been introduced into a collecting tank in a limited quantity, suitably heated and with detergent added, is made to recirculate continuously, by means of at least one centrifugal pump, in spraying devices provided with spraying nozzles through which the washing water is sprayed onto the dishes, whereupon it then falls back into the collecting tank.

The spraying devices may consist of a number of fixed manifolds, of oscillating arms or of rotary whiners or combinations of these.

In dishwashing machines, the efficiency of the washing operation is determined essentially by the speed of the spraying jets leaving the nozzles and by their distribution in the washing chamber: ideally, the jets should be capable of scanning all the points of the various surfaces to be washed, a requirement which, to be satisfied, would require the use of a high number of nozzles and of a considerable liquid flow with a high feed pressure.

To satisfy this requirement, it would be necessary to use a pump of considerable power and recirculation pipes of considerable volumetric capacity, in contrast to the requirements for economy of operation which on the contrary dictate the use of minimum volumes of liquid and of pumps of limited power which are capable of delivering low flows with modest head.

In order to reconcile these contrasting requirements, it has therefore been proposed to feed selectively, in a mutually exclusive manner and for different periods of time, each of the various spraying manifolds, oscillating arms or rotary whirlers with a limited flow of liquid which can be delivered at the necessary pressure by one or more pumps of reduced power and size.

Preferably, to allow the various spraying circuits to be fed by a single pump, use is made of flow-diverting devices.

Various types of flow diverters have been proposed which only partly satisfy the requirements of reliability, simplicity of construction, operating economy and low cost which are necessary for use in dishwashing machines.

Electromagnetic shut-off and diversion valves consume considerable power, require constant maintenance and involve a high risk of loss of liquid or of ageing and breaking of the elastic diaphragm separating the electrical parts from the hydraulic circuit, if of the diaphragm type.

Thermoelectric actuators, in which the mechanical actuation is brought about by the expansion of appropriate substances which are appropriately heated electrically, are more economical and require a lower feed power, but have considerable thermal inertia which is irreconcilable with the requirement for rapid control of flow diversion.

Shut-off and diversion valves which are actuated by an electric motor have reduced consumption, concentrated solely in those periods of closing/opening action or flow change-overs, but are extremely expensive and do not reliably solve the problem of separating external actuating members and moving shut-off members inside the hydraulic circuits.

Flow-diverting devices of automatic type have also been proposed, which use the flow of liquid induced by the pump to actuate a hydraulic wheel which, directly or via a suitable reduction in the number of revolutions, moves a diaphragm for diverting the flow.

In this case, no external control device is needed, but the flow-diverting action of the diverters is uncontrollable, and to a great extent, random, in addition to being slow and gradual instead of the "ON-OFF" type.

The present invention overcomes these disadvantages and provides a device for diverting and shuting-off the spraying flow in dishwashing machines, which is simple and reliable, of very low consumption and of low cost, of maximum safety and of particularly rapid action, and which imperviously separates the external control members from the moving shut-off members inside the hydraulic circuit.

These results are achieved by a diverting device in which a plurality of shut-off diaphragms or plugs, each for a different flow path, are held in an open position by the action of magnetic attraction exerted between a magnetic element integral with the diaphragm and the core of an electromagnet outside the hydraulic circuit and separated from the magnet by a hydraulic separating wall constituting a gap for the magnetic circuit.

The temporary excitation of the electromagnet, which may be of the moving core type or the repulsion type, or the flux-cancellation type, by reducing the mutual attraction force or replacing it with a repulsive force, between magnetic element and core, allows the associated diaphragm to move from a position in which it opens, to a position in which it closes a flow path through the effect of a hydrodynamic thrust exerted on the diaphragm by a flow of liquid initiated by a circulation pump.

In this manner, a plurality of flow paths, all fed by one and the same delivery pipe, can be closed individually, with minimum consumption of power.

The characteristics and the advantages of the invention will emerge more clearly from the description which follows of a preferred embodiment and its variants which is given with reference to the attached drawings, in which:

- Fig. 1 shows diagrammatically a dishwashing machine incorporating the device for diverting and shutting off the flow according to the invention, which is also shown in diagrammatic form;
- Fig. 2 shows in vertical section on a number of

planes, along the section I-I in Figure 3, a preferred embodiment of the device for diverting and shutting off the flow according to the present invention;

- Fig. 3 shows in section, according to the view II-II in Figure 2, the diverting device in Fig. 2;
- Fig. 4 shows in a top view a control sub-assembly of the device in Figures 2 and 3.

For better comprehension of the invention, Figure 1 shows in diagrammatic form a dishwashing machine incorporating the device for changing over and shutting off the flow according to the invention, which is also shown in diagrammatic form.

The dishwashing machine comprises a washing chamber 1 provided at the bottom with a tank 2 for collecting liquid, into which, on the command of a programming device 3, washing water taken from the mains 4 is admitted.

The machine also includes a recirculation pump 5 which sucks up liquid from the collecting tank 2 in order to convey it into pipes for feeding spraying devices, which are typically but not necessarily two rotors, a lower 6 and an upper 7 rotor respectively, provided with spraying nozzles which spray with water the dishes accommodated in appropriate baskets (not shown) in the washing chamber.

Heating elements and devices for adding detergent to the washing liquid, together with filtering systems, although normally provided and known per se, are not shown since they are irrelevant to the aims of the invention.

Typically but not necessarily, the rotors 6 and 7 are of the hydraulic whirler type, and are set in rotation by the thrust exerted by the spraying jets, without the need for motive members devoted to this purpose.

For improved washing efficiency, which is compatible with the use of a reduced-consumption pump 5, it is necessary, as already stated, to feed the two rotors selectively in different time periods.

To this end, according to the invention, the pump 5 feeds a distribution chamber 8, above which two pipes 9, 10 open for delivering liquid to the rotors 6, 7 respectively.

Facing the ends of the pipes 9, 10 and below these, two plugs 11, 12 are accommodated in the chamber 8, and are provided with a cylindrical tang 13, 14 which can slide axially vertically inside a sleeve 15, 16 formed inside the chamber 8.

At the opposite end of the tangs 13, 14 to the plugs 11, 12, a core of permanent magnetic material 17, 18 respectively is fixed, preferably in a recess of the tang.

The chamber 8, the plugs 11, 12 and the tangs 13, 14 and the sleeves 15, 16 are made of non-magnetic material, preferably of plastic.

In the rest state, the tangs 13, 14 bear by the effect of gravity on the lower wall of the chamber 8 and the plugs 11, 12 are suitably distanced from the ends of the pipes so as to ensure a flow section which is smaller than the flow section of the chamber 8.

It is known that if a fluid jet is subjected to a reduction in section, its speed must necessarily increase, by virtue of the principle of continuity of flow.

Consequently, by virtue of Bernoulli's theorem, the pressure of the fluid jet in the narrowed section must be lower than the pressure of the fluid jet in the wider section.

Therefore, on activation of the pump 5, a flow is initiated into the chamber 8 which flows into the pipes 9 and 10 or even into only one of these, and the depression which is created in the passage port between the plugs 11 and 12 and the respective flow pipes 9, 10 draws the plugs 11 and 12 towards the end of the pipes bringing about their closure.

Since the pressure downstream of the end of the pipes 9, 10, even in the presence of a static load column, is lower than the pressure imposed on the chamber 8 by the head of the pump 5, the plugs 11 and 12 maintain the closed position for the entire time that the pump is active and return, by the effect of gravity and by virtue of any thrust exerted by the fluid present in the pipes 9, 10, to the rest position when the pump is deactivated.

To prevent the plug 11 being drawn towards the end of the pipe 9 when the pump is activated, and to enable it selectively, outside the chamber 8, a ferromagnetic core 19 of a suction-type electromagnet 20 is juxtaposed to the magnet 17.

The core 19 is pressed by a spring 21 against the wall of the chamber 8 and separated from the magnet 17 by a gap of a thickness equal to the thickness of the wall of the chamber.

Under these conditions, the magnetic attraction force which is exerted between magnet 17 and core 19 prevents the plug 11 from being drawn back towards the pipe 9, under all pressure and flow conditions which the pump may establish in the chamber 8.

The excitation of the electromagnet 20 causes the core 19 to be drawn inside the electromagnet and to move away from the magnet 17 with the formation of a much larger gap between the two elements.

Under these conditions, the force of attraction which is exerted between magnet 17 and core 19 is weakened considerably and is no longer sufficient to prevent the plug 11 from being drawn back hydrodynamically when the pump is activated.

The excitation of the electromagnet can be effected using a.c. voltage, for example mains voltage, or using d.c. voltage, without distinction, and is to be maintained for a very short time, of the order of a second.

The electric power required is minimal: this is because the work needed to move the plug 11 is performed by the hydraulic flow and the electromagnet 20 has solely the function of controlling temporary release.

This can be effected in a synchronized manner with the starting of the pump 5 or even once the pump has already been started.

The plug 12 can be actuated by an electromagnetic device identical to that described.

To reduce the number of moving parts to a minimum and to simplify as far as possible the release device, in Fig. 1, to provide another exemplary embodiment, the plug 12 is controlled by a repulsion-type electromagnet 22 with a fixed core 23.

The magnetic core 18 is in this case constituted by a magnetic dipole with predetermined orientation, for example with the SOUTH pole facing the wall of the chamber 8.

By exciting the winding of the electromagnet 22 with direct current of predetermined direction, it is possible to magnetize the core 23 in such a manner that its end facing the wall of the chamber 8 also takes on SOUTH polarity.

In this way, while the core 18 is normally attracted towards the core 23, when the electromagnet 22 is excited a repulsive force is exerted between the two cores 18 and 23 which encourages the plug 12 to be drawn back towards the end of the pipe 10.

This embodiment can advantageously be used in dishwashing machines in which the programmer 3 is of electronic type with a microprocessor instead of electromechanical type.

In this case, a d.c. voltage source (5/15V) must be provided for feeding the programmer. The same voltage can be used for feeding the electromagnet without any additional cost.

According to another variant, the function of releasing the plugs can be obtained using a flux-cancellation electromagnet.

For example, Figure 1 shows a third pipe 24, the end of which opens into the chamber 8 to convey a flow of liquid towards a third spraying device 25 (alternatively, this could also be a waste pipe).

A plug 26 identical to the previous plugs is juxtaposed at the bottom to the end of the pipe 24 and provided with a tang 27 in which a core 28 made of unmagnetized ferromagnetic material is accommodated.

The tang 27 is accommodated in a guide sleeve 29.

Arranged outside the chamber 8 and juxtaposed to the core 28 is a magnetic dipole 29, with one pole, for example the SOUTH pole, orientated towards the core 28 so as to exert a force of attraction on the core 28.

A winding 30, wound around the dipole 29, when excited by a direct current of suitable direction, neutralizes or cancels the magnetic flux generated by the dipole and cancels the force of attraction exerted on the core 28, in such a manner that the hydrodynamic action exerted by a flow of liquid in the chamber 8 can draw the plug 26 towards the end of the pipe 24.

It is therefore clear that the selective activation of the various electromagnets makes it possible to feed only one of the pipes 9, 10, 24, a plurality thereof (a pair in the example) or none of them and offers great flexibility of operating methods.

Even when the pump has been started, without deactivating it, it is possible to close any one of the pipes which were previously open.

The only operation which requires the deactivation of the pump is the opening of any one of the pipes if closed.

In Figure 3, the release electromagnets have, for the sake of simplicity, been shown as being constituted by cylindrical cores accommodated in a winding coil.

In practice, for greater efficiency, they can include yokes for closing up the magnetic circuit.

Even the arrangement of the plugs so as to ensure the rest position by the effect of gravity alone is not essential: it is possible to provide elastic means for returning to the rest position with the sole condition that the hydraulic thrust exerted on the plugs by the pump when operating and by the consequent flow prevails over the elastic return force.

Even the use of tangs which can slide axially in sleeves to ensure the mobility of the plugs is purely exemplary. Other forms of restraint can be adopted to reduce possible friction to a minimum.

Figures 2 and 3 respectively show a preferred embodiment in a composite vertical section and in a top view along section II-II in Figure 2 of a change-over device.

The device consists of a body 31 made of moulded plastic material provided at the top with a cylindrical union 32 divided into two semi-cylindrical sectors by a diametral baffle 33.

The union ends at the bottom in a transverse diaphragm 34, in which two apertures 35, 36 open, which are symmetrical relative to the axis of the union, in the shape of circular sectors with a size of 90° and respectively facing the two semi-cylindrical sectors of the union.

It is also possible to provide in the diaphragm 34 a third aperture 37 for choking the flow, as will be seen below.

Underneath the diaphragm 34, the body 31 extends to form a housing chamber 41 for two blade-type shut-off levers or clappers 37, 39 which close the apertures 35 (and 37 if present) and 36 respectively.

The chamber 41 is extended at the bottom in a union 40 which is suitably angled (for example with the axis of the union 40 forming an angle of 45° with the vertical axis of the union 32), for connection to a liquid delivery pipe 42.

The levers 38, 39 are hinged on a pin 49 parallel to the plane of the diaphragm 34 and outside its extension in such a manner that, by rotation of the levers about the pin 49, these can adopt a position for closing and for opening the ports 35, 36 respectively.

In Figure 2, the lever 38 is shown in closed position and the lever 39 in open position which, in the absence of hydrodynamic thrusts, is advantageously adopted under the effect of gravity.

The chamber 41 is provided on one side with a flanged aperture closed by a flanged plug 46 for support of the levers 38, 39 and the release control devices.

These consist of two identical suction-type electromagnets 43, 44, one of which can be seen in section in

Figure 2 and comprises a cylindrical ferromagnetic core 45, which is axially movable in a housing formed by the plug 46 and a winding 47.

A compression spring 48 presses the core 45 against the head of its housing, towards the chamber 41, moving it away from the winding 47.

As can be seen from Figure 2, the levers 38, 39 are provided with a housing for a magnet 50, 51. When the levers are in rest or open position, the magnet is juxtaposed to the movable core of the associated release device and separated from the latter by the thickness of the flanged plug 46.

Figure 4 shows in top view the sub-assembly formed by the blade-type levers 38, 39 (shown in horizontal closed position), by the flanged plug 46 and by the pair of suction-type electromagnets 43, 44.

The levers are pivoted on the pin 49 engaged in a trio of supports 52, 53, 54 which are integral with the flanged plug, in such a manner that the sub-assembly, assembled thus, can be easily fixed, by means of screws or clamping collar, to the body 31.

An O-ring seal interposed between the flanged plug 46 and the coupling flange of the body 31 ensures perfect sealing of the joint.

The functioning of the change-over device described is completely identical to the previous one.

If the two electromagnets 43 and 44 are not excited, the two blade-type levers are held in open position and a flow admitted into the body of the device through the union 40 can flow freely into the two semi-cylindrical sections of the outlet union 32.

This can be connected to a pipe or bush 59 with two ducts 56, 57 for conveying the liquid to two spraying devices, for example a lower rotor and an upper rotor.

As the outlet union 32 is divided into two semi-cylindrical sections which have to be connected in an accurate manner to the two ducts 56, 57, the connection between the two elements is advantageously achieved using a bayonet coupling of the union 32 on the end 59 of the pipe, bush 58, which for this purpose is provided with coupling pins 60, 61.

A resilient ring or an O-ring 62, interposed between an internal shoulder of the union 32 and the end 59 of the pipe 58 ensures the imperviousness of the connection to the outside.

In this manner, the correct mutual angular positioning of the union 32 and of the pipe 58 relative to their common axis is ensured.

If the electromagnet associated with the lever 39 is excited, the lever 39, drawn by the flow of liquid, shuts off the aperture 36 and prevents the liquid from flowing out into the pipe 57.

The whole flow of liquid is therefore forced to flow out into the pipe 56.

If, as shown in Figure 3, a choking port 37 is provided, which is not shut off by the lever 39, a choked flow will continue to flow out into the pipe 57, limited by the section and by the head losses in the choking port 37.

If the electromagnet associated with the lever 38 is excited, the port 35 is shut off and the liquid can flow out into the pipe 57.

If both the electromagnets 43, 44 are excited, an initial temporary flow brings both the levers 38, 39 into closed position which is maintained for the whole time of activation of the pump and consequently of excess pressure in the chamber 41 relative to the pressure downstream of the diaphragm 34.

This example, however, is of little practical use because the same effect can be achieved by deactivating the pump, but its use cannot be ruled out altogether: for example, it can be used to shut off the flow of liquid abruptly more quickly than allowed by the inertia of the pump and the volume of liquid or for filling the tank with a greater volume of liquid by using a single steady pressure level adjustment.

The description above relates to a preferred embodiment but it is clear that it can be subjected to many variations.

For example, it is possible to produce a four-way flow-diverting device, with a delivery union arranged below and axially aligned with the outlet union, divided into four cylindrical sectors, for coupling to four separate pipes.

The body of the diverter will in this case be provided with two flanged apertures arranged symmetrically in relation to the axis of the unions and closed by two identical release devices similar to that in Figure 4, in which, however, the two blade-type levers have identical dimensions.

Claims

1. Device for diverting and shutting off the flow of liquid in particular for a dishwashing machine, and a washing machine in general, comprising:

   - a non-magnetic body (8, 31) forming an internal chamber (41) separated from the outside by a wall of said body and having a liquid inlet (40) and a plurality of liquid outlets (9, 10, 24, 35, 36), each provided with a sealing plug (11, 12, 26, 38, 39) which is accommodated in said chamber (8, 41) and is movable between a position for closing and a position for opening the associated outlet,
   - each of said plugs being provided with a ferromagnetic element (17, 18, 28, 50, 51) arranged adjacent to said wall for said opening position of the associated plug, and moved away from said wall for said closing position, and
   - a plurality of electromagnets (19, 20, 22, 23, 29, 30, 43, 44) arranged outside said body and each associated with one of said plugs for exerting, if unexcited, a force of magnetic attraction on said ferromagnetic element of the associated plug, if said associated plug is in the open position, said force of attraction holding

the associated plug in open position even in the presence of a flow of liquid in said chamber, the excitation of each of said electromagnets reducing the force of attraction exerted on the ferromagnetic element of the associated plug and allowing said plug to adopt the closed position through the effect of the hydrodynamic thrust exerted by a flow of liquid in said chamber.

2. Device for diverting and shutting off flow according to Claim 1, in which said ferromagnetic element (17, 50, 51) of said plugs is a permanent magnet and said electromagnets (20, 43, 44) are moving-core suction-type electromagnets (19, 45).

3. Device for diverting and shutting off flow according to Claim 1, in which said ferromagnetic element of said plugs is a permanent magnet (18) and said electromagnets are fixed-core (23) electromagnets (22) excited by direct current, which polarizes said fixed core (23) so as to exert a repulsive force on the permanent magnet (18) of the associated plug.

4. Device for diverting and shutting off flow according to Claim 1, in which said ferromagnetic element (28) of said plugs is not permanently megnetizable, and said electromagnets are flux-cancellation electromagnets (30) which are excited by direct current and have a fixed core (29) comprising a permanent magnet.

5. Device for diverting and shutting off flow according to the preceding claims, in which said plugs are blade-type levers or clappers (38, 39) hinged on a pin (52).

6. Device for diverting and shutting off flow according to Claim 5, in which said fluid outlets are cylindrical sectors (35, 36) of a cylindrical outlet union (32) divided into a number of outlet ducts by at least one internal baffle (33).

7. Device for diverting and shutting off flow according to Claim 6, in which said body (31) is provided with a flanged aperture for coupling to a flanged plug (46) for closing said aperture and for support for said plurality of blade-type levers (38, 39) and electromagnets (43, 44).

8. Device for diverting and shutting off flow according to Claim 7, in which said body (31) is provided with a cylindrical inlet union (40) with an axis forming an angle relative to the axis of said outlet union (32).

9. Device for diverting and shutting off flow according to Claim 6, 7 or 8, in which said cylindrical outlet union (32) comprises means for bayonet coupling to a pipe, or outlet bush (58).

10. Washing machine, dishwashing machine or clothes-washing machine, of the type in which the liquid admitted into a tank (2) of said machine is conveyed by a pump (5) into one or more pipes which are opened selectively by a flow-diverting device, characterized in that said flow-diverting device is a device according to one of the preceding claims.

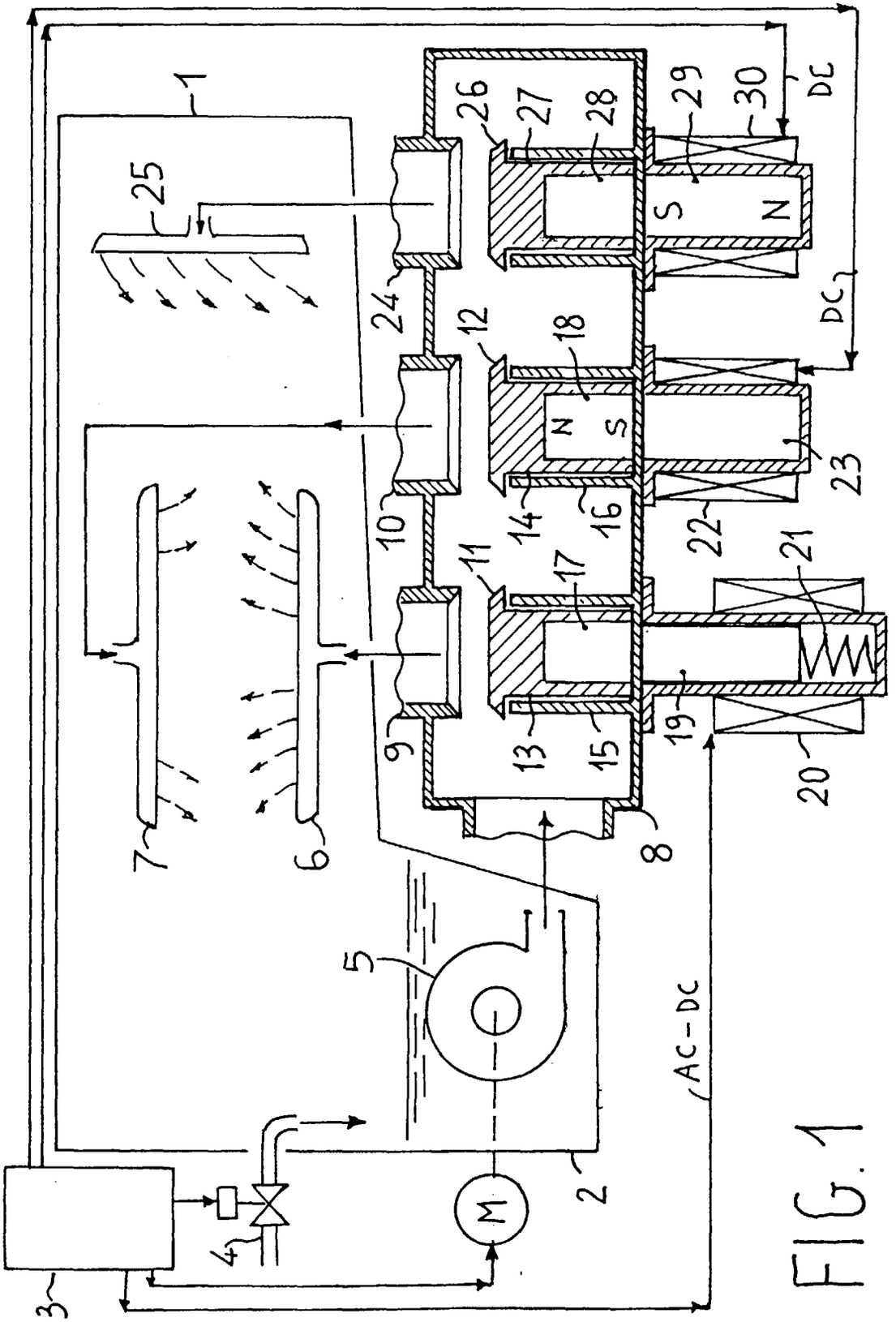
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FIG. 1

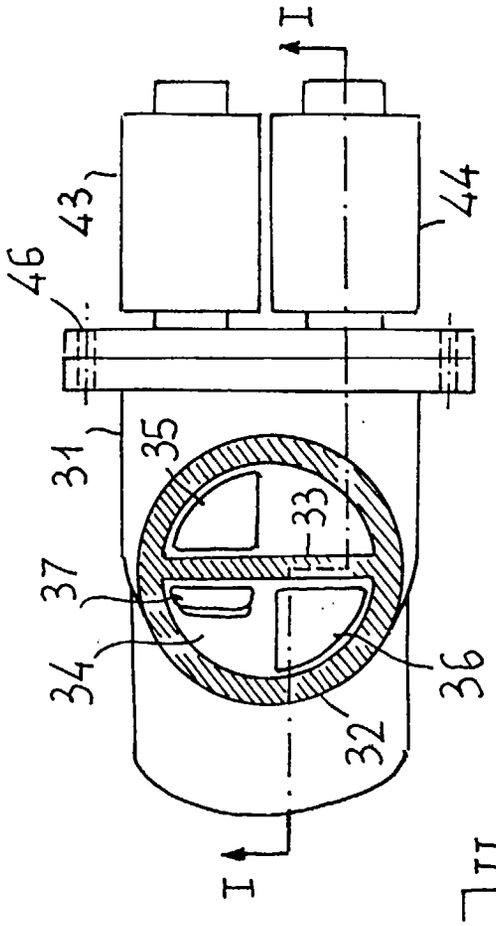

FIG. 3

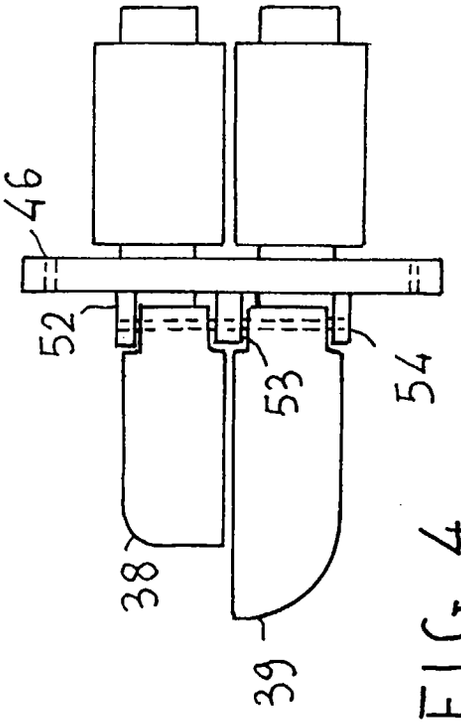

FIG. 4

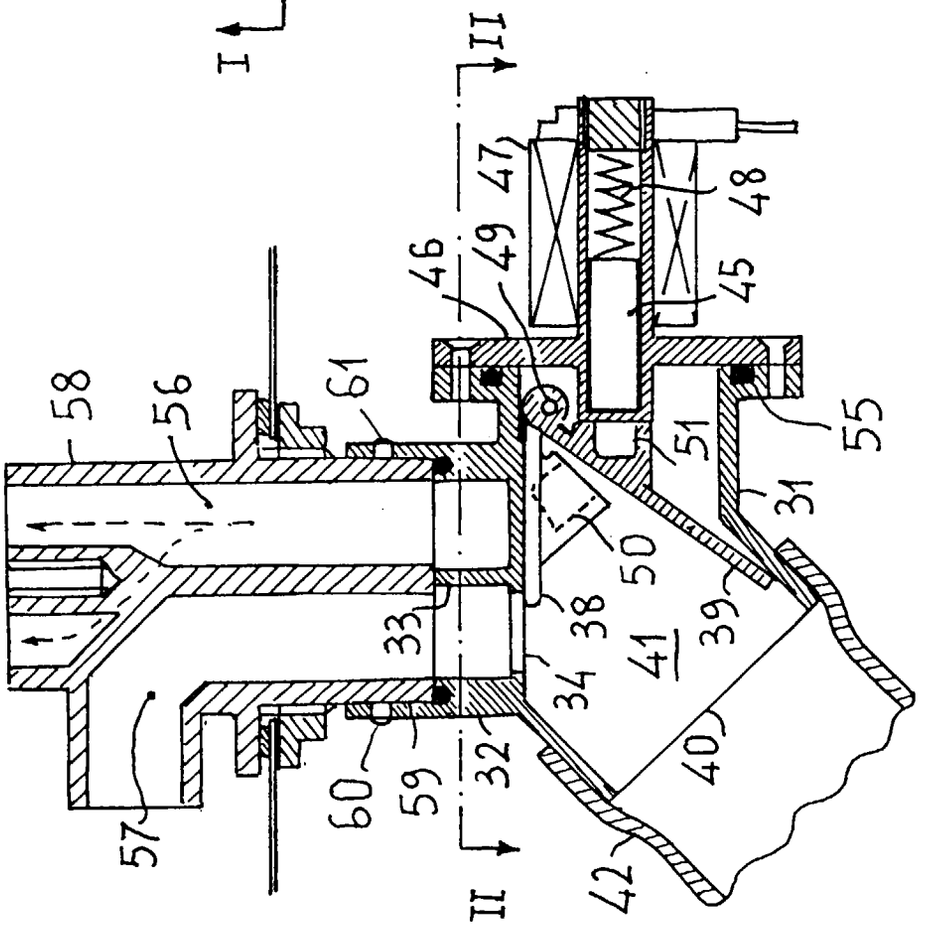

FIG. 2