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(54) Device for the cut-off of combustion air in pellet stoves

(57) Automatic device for the cut-off of combustion air in pellet stoves which can be inserted in the duct (5) for the supply of the combustion air, to prevent the back-flow of hazardous gases into the room. This device (D) is composed of a parallelepiped box-shaped body (10) whose main sides (11a-11b) are connected to suitable openings and respective sections (51-52) of the supply duct (5). A plate (13) which is connected to a relative electromagnet (15) slides through a slot (121) on a lateral side (12a) of the box-shaped body (10). When the electromagnet is not energized, it releases the plate so that a spring (16) pushes it into the body of the box-shaped body (10) until it impacts the opposing perimeter side (12b) where it sill be positioned in a manner that prevents the passage of air or smoke. When instead the electromagnet (15) is energized, it extracts the plate (131) from the box-shaped body (10) so that inside it (10) there will be an opening that allows passage of combustion air.

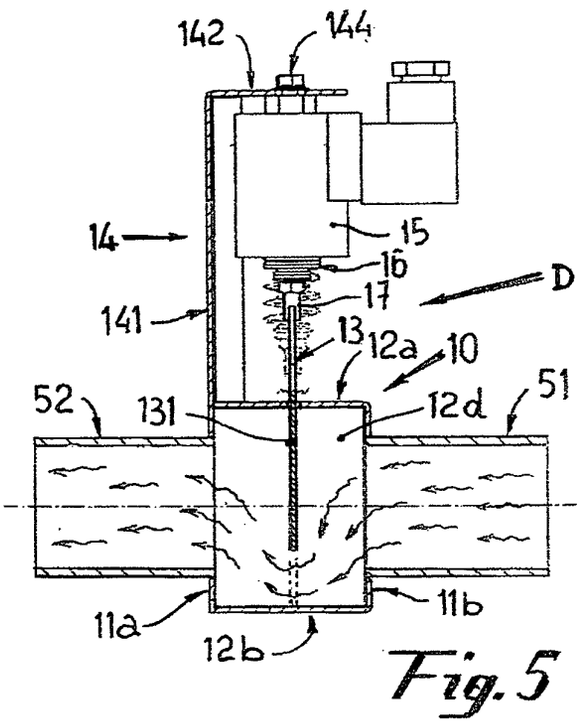

Fig. 5

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Description

[0001] The invention consists of an automatic safety device which is especially applicable to pellet stoves to cut off the flow of combustion air in the event of irregular and/or dangerous operating conditions.

[0002] This device is basically comprised of a box-shaped element in which a "guillotine" slides when activated by a special electromagnetic actuator attached by a suitable solid support to the box-shaped element itself. This entire assembly is then placed between the combustion air inlet opening and its supply duct to the relative combustion chamber.

[0003] Pellet stoves and their operation are commonly known. Therefore, for further clarity, a brief description will be provided hereunder of the basic composition of a pellet stove in order to better understand the application of the invention.

[0004] A pellet stove is normally composed of an outer cabinet which contains the basic operating parts. Furthermore, in its upper part, there is a hopper tank where the pellets are loaded. This tank opens onto a screw feeder for the pellets, which causes the pellets to drop through a duct into a suitable grate. Here, by means of yet another duct, the air required for combustion is normally aspirated from the surroundings where the stove is located. Aspiration in basic types of stoves takes place by means of natural draught produced by the flue pipe for the removal of gases produced by combustion. In more recent types which are now normally used, aspiration is produced by a forced draught produced by a special aspirator provided for this purpose. Usually, in more modem stoves of an advanced design, there is also an internal heat exchanger which, when the hot gases produced by combustion pass through it, gives off heat to the air in the room which also passes through it both by convection and in a forced manner by means of a special fan. The pellet stove will therefore be equipped with a special fan to move the air and to place it back into the room, and a fan to create forced draught, as well as all the parts and accessories required for its operation such as sensors, grills, doors, trays to collect ashes, and so on. But above all it will be equipped with electronic control and adjustment devices for all operating parameters. These electronic devices for control, adjustment, etc. are installed not only to improve operation, but also so that operation will be compliant with those regulations which govern its realization. All pellet stoves are hence normally produced in such a manner as to comply completely with all current safety standards. Furthermore, in some cases they are manufactured with means and devices which even make it possible to be ahead of and in excess of that which is set forth by said regulations. In fact, at times it happens that an expert and alert designer realizes that those regulations are not sufficient to ensure safe and regular operation of the pellet stoves. The designer therefore takes actions to improve their features, above and beyond what is set forth in current regulations, often developing solutions which become the reference point for future manufacturing regulations and directives.

[0005] As previously stated, existing pellet stoves are equipped with electronic devices to constantly control and adjust various operating values such as room temperature, recycled air temperature in the room, released smoke temperature, and so on, and especially the amount of fuel and combustion air based on preset operating parameters and to halt combustion automatically in any of a number of possible cases of malfunction, thus placing the stove in safe operating conditions at all times.

[0006] As is known, manufacturers place special attention on certain types of features which are governed by what are known as malfunction conditions. Malfunction conditions are often the cause of potential contamination in the environment where the user lives, and when they occur, they may not only cause unpleasant odours to be emitted into the living area, such as the smell of smoke or burning, but in some cases they may lead to poisoning of the user. In worst-case scenarios, this poisoning may lead to death by asphyxiation from carbon monoxide or carbon dioxide.

[0007] For this reason, when manufacturing pellet stoves, efforts are always made evaluate and prevent a series of failures and malfunctions which may be caused by the following:

- failure of the ignition heating element (prevents combustion from starting);
- mechanical or electrical failure of the motors of the feeder screw, of the smoke aspirator, of the pump for the hydraulic circuit, should there be one;
- failures in the electrical and electronic circuits;
- electrical outages caused by power failures or by home safety switches or safety fuses;
- opening of the stove door;
- obstructions in the flue pipe.

[0008] Almost all of the aforementioned failures or malfunctions may cause automatic and complete shutdown of the stove.

[0009] In relation to this, an essential fact should be noted here, and specifically that from the moment that the stove is extinguished for one of the aforementioned reasons until combustion of the pellets in the stove halts completely, a substantial period of time will have elapsed. Also, for a variety of possible reasons, such as thin cracks, very small openings and/or other, even if the release of combustion gases (smoke) is interrupted due to one of the aforementioned causes (obstructed flue pipe, electrical power outage, etc.) combustion may continue but in conditions of insufficient oxygen. The result is that the combustion gases will be excessively contaminated with carbon monoxide and carbon dioxide. Therefore, they may, in very special yet possible conditions, flow through the combustion air intake duct

or through very thin cracks or very small openings into the room where the user is, with the previously mentioned and well-known results.

[0010] Also and not less important, in case of malfunction of even one of the electronic control parts of the stove, the stove may, in a remotely possible and highly unfortunate event, operate improperly, causing not only an irregular flow of combustion gases but also damaging the stove itself due to overheating.

[0011] Referring to what has been illustrated thus far, it is noted that no pellet stoves manufactured as of today have or are equipped with safety devices to cut off the flow off combustion air which would eliminate the aforementioned possible and highly dangerous problems.

[0012] In order to overcome said problems, the device referred to herein has been realized. In order to better understand the features and the advantages which can be obtained with it, merely for explanation and not limited to this, a special possible and preferred manufacturing form is described hereunder with reference to the attached drawings in which:

- figure 1 is a schematic lateral section view of a generic pellet stove with the object referred to herein inserted into its combustion air supply duct;
- figure 2 provides detailed illustration with an exploded prospect view of the composition of the aforementioned device;
- figures 3, 4, and 5 are right-angle projection views of the same device. In particular, figure 3 is a front view, figure 4 is a plan view, and figure 5 is a partial breakaway lateral view in accordance with line I-I in figure 3 and
- figure 6 is a prospect view that shows the entire device referred to herein.

[0013] It should be noted that in the aforementioned figures, all common elements are mentioned with the same references.

[0014] Referring only to figure 1, it can be seen how the generic pellet stove, here synthetically represented, is composed of an outer cabinet indicated by the perimeter line 21 in the upper part of which a hopper tank 22 is located which contains the fuel consisting of pellets. At the lower part of the hopper 22, the pellets enter the feeder screw 23 which is activated by a reduction gear 24 which places the pellets, by means of a special duct 25, into the grate 26. This grate 26 is located on the lower part of a combustion chamber 27 and above a supply chamber 28 for secondary combustion air. The combustion chamber 27 in its upper part opens into the vertical duct 29 which at its lower end opens into the aspiration chamber 30 where a special aspirator composed of a suitable fan 31 activated by the relative electric motor 32 aspirates the gases which develop during combustion of the pellets, causing them to flow out the discharge duct 6 in the flue pipe (not shown). The aforementioned fan 31, along with removing the combustion gases, generates negative pressure in the combustion chamber which in turn causes aspiration, through supply duct 5, of the air required for combustion which will be divided into two parts, specifically, one part referred to as primary which directly feeds the grate 26, and another part referred to as secondary which surrounds it externally. All of this may be completed with an assembly for forced ventilation composed of an electric fan 40 which takes low-temperature air from the room, places it in a special heat exchanger composed of a duct 41 next to the vertical duct 27 in which, as previously stated, the gases produced by combustion pass through, so that the air that passes through duct 41 is progressively heated and then placed back in the room through a suitable grill-covered opening 42. Still observing the aforementioned figure 1, it can clearly be noted how the device referred to herein, which for the sake of clarity in figure 1 is shown completely in black and is also shown in figure 1 as well as in subsequent figures 2, 3, 4, 5, and 6 with overall reference D, is applied to the supply duct 5 for combustion air which will thus be divided into two parts, specifically a first section 51 and a second section 52.

[0015] The device referred to herein shall now be described in detail.

[0016] This device D, as can clearly be seen in figure 2 to figure 6, is composed of a box-shaped body 10 which is basically of a parallelepiped shape obtained from suitable sheet metal. This box-shaped body 10 includes two equal main rectangular sides 11a and 11b which are parallel to each other. They are mutually connected on the perimeters by relative perimeter sides 12a, 12b, 12c, 12d and specifically by an upper side 12a, a lower side 12b and two lateral sides 12c and 12d which of course are all rectangular and of the same width. Preferably this width will be roughly equal to the diameters of sections 51 and 52 of supply duct 5. The two main rectangular sides 11a and 11b have a width which is substantially greater than their height, which in turn is opportunely greater than the diameter of the combustion air supply duct which is globally referred to in figure I with reference 5. More specifically, since the cut-off device D is inserted in supply duct 5, the upstream segment, that is, the segment where combustion air enters, and the downstream segment, that is, the segment which supplies the grate 26 of the stove S, as previously mentioned, are referred to respectively as 51 and 52. The main rectangular sides 11a and 11b will also both be provided in the centres with respective circular openings with diameters that are equal to those of the relative sections 51 and 52of the supply duct 5 which, as can clearly be seen, have their respective ends connected to the circumferential edges of the aforementioned circular openings.

[0017] In the upper side 12a of the box-shaped body 10, there is a slot 121 placed parallel to its greater sides and equidistant from them, and which extend along the entire face 12a. The slot 121 has a width which is only slightly greater than the thickness of the metal plate 131

thus forming, as described hereunder, the cut-off device 13 for the flow of air passing though the device D. This is obviously to allow the metal plate 131 to slide freely in it (121). The cut-off element 13, as can clearly be seen in figures 2 to 6, is composed of a metallic plate 131 with a rectangular shape whose width is equal to the distance between the internal surfaces of the two lateral sides 12c and 12d of the box-shaped body 10, between which it must be able to slide at a height which, for the reasons that will be explained hereunder, will be greater than the distance between the opposing perimeter sides, upper 12a and lower 12b of the box-shaped element 10. From the centre part of the upper edge of the main rectangular side 11a of the box-shaped body 10, there also protrudes, at a right angle upwards, a support element 14 on the free end of which (14) there is vertically attached an electromagnet 15 from the lower end of which there protrudes a short section of its mobile nucleus equipped with a specially conformed part which comprises a suitable fastening element 17 of the cut-off device 13. Between the upper end of this fastening element 17 and the opposed lower end of the relative electromagnet 15, there is also a special spring 16 to push out the nucleus of the electromagnet 15 with the relative fastening element 17 and the metallic plate 131 which is attached to it (17).

[0018] In the preferred realized form to which reference is made, as is clearly visible in figures 2 to 6 and especially in figure 2, the support element 14, which can also be made from common sheet metal, is composed of a vertical section 141 with a "C" shape. From the upper end of this protrudes at a right angle an opportune rectangular section 142 which in its centre has a hole though it 143 to allow passage of a screw 144 which is screwed into the upper end of the electromagnet 15 thus securing it.

[0019] To better clarify the operation of device D which is being described herein, in figures 3 and 5, all of the moving parts of it (D) consisting of the metal plate 131, the fastening element 17 and the spring 16, when placed in a position that allows for the passage of air, that is, when placed in the OPEN position, is indicated by a solid line. When instead it is placed in the position that cuts off the air flow, that is, in the CLOSED position, it is indicated by a thin dotted line. It is hence clear why the height of the metal plate 131 must be greater than the height of the box-shaped body 10. In fact, it (131) must protrude from slot 121 in the upper side 12a of the body (10) for a short section to allow that in the CLOSED position the relative fastening element 17 is slightly detached from the external surface of the upper side 12a.

[0020] Also note that in figure 5, the passage of air in device D, when it is in the OPEN position, is indicate with arrows.

[0021] It is at this point clear why it was decided to develop the box-shaped body 10 with a width which is slightly larger than the diameter of duct 5 as well as with substantial size in the flow direction. Basically, this makes it possible to develop, when the cut-off element is placed in the open position, a section for air passage which is sufficient and at least equal to the cross section of duct 5, even if the size in a vertical direction of the opening is limited due to the reduced travel of the nucleus of the electromagnet.

[0022] Having concluded the description of the conformation of the device D, its operation will now be described.

[0023] As previously stated, the pellet stove S is normally equipped with a special electronic device commonly referred to as a card, which constantly monitors the various operating parameters of the stove S so as to compare them with the set parameters and thus control the various operational parts (pellet feed screw, smoke aspirator, air recycling fan, etc.) as well as checking the operating conditions, detecting any defects and above all any malfunctions.

[0024] The events which may create problems that can be avoided through the application of the device referred to herein are basically a complete interruption of electrical power, which may be caused by a power outage, by activation of home safety switches, by safety fuses, by interruption in wiring, the mechanical or electrical failure of the electric motor of the smoke aspirator and finally any obstructions in the flue pipe or smoke discharge duct. In all of these cases, if combustion in the stove is in progress, as previously illustrated it may continue for a significant amount of time, and in some cases it may even continue in extremely hazardous conditions because, as also was previously stated, combustion which takes place with a reduced flow of oxygen as in this case generates combustion gases with a high content of carbon monoxide and carbon dioxide. These gases, for a variety of reasons, may flow from the combustion air aspiration duct as well as from cracks and/or very small openings, thus penetrating into the living area where obviously they may create grave and in any case substantial hazards.

[0025] If there are none of the aforementioned problems and the stove S is operating properly, the card provides for power to the electromagnet 15 which is therefore energized and causes the cut-off element 13 to be opened. If on the other hand for one of the various aforementioned causes electrical power is interrupted to stove S and hence to the electromagnet 15, or if the card detects an operating malfunction (shutdown due to mechanical and/or electrical reasons of the smoke aspirator, even partial stoppage of smoke release, etc.) thus cutting off the power supply to the electromagnet 15, it (15) will no longer be energized and hence the spring 16 will push the cut-off element to the bottom of the box-shaped body 10 thus causing the flow of combustion air to be cut off.

[0026] Obviously, along with cutting off the flow of combustion air, there will also be a cut-off of even the smallest flow of combustion gases which will hence not be able to flow back in to the room, leading to hazardous

situations.

[0027] From what has been explained, it is clear that the installation of the aforementioned device in a pellet stove makes it possible to avoid any and all operational hazards arising from one of the aforementioned causes, thus obtaining completely safe use.

[0028] It is clear that variations to the size, conformation, manufacturing and other aspects may be made to the device referred to herein while still complying with that which is described herein and claimed hereunder with reference to the attached drawings and hence with the dominion of industrial privilege.

Claims

1. Automatic device for the cut-off of combustion air in pellet stoves. This device (D) can be inserted in the normal supply duct (5) for combustion air which feeds the grate (26) of a relative pellet stove (S) to interrupt the flow of combustion air in the event of interruption for various reasons of the electrical power supply as well as in the event of failures and/or malfunctions of the stove (S). This device is **characterized by** the fact that it includes a box-shaped body (10) which can be installed between two sections (51 and 52) of the supply duct (5) for combustion air. It is connected to these sections (51 and 52) of the supply duct (5) for combustion air by corresponding openings so that the combustion air can flow through it. In the box-shaped body (10) there is an opportune cut-off element (13) which is connected to a suitable electrical or electromagnetic device to place it in a first position in which combustion air may flow through the hollow box-shaped body (10) and in a second position in which instead it is placed in such a manner as to completely cut off said flow as well as the flow of combustion gas which , in various possible malfunctions of the stove (S) or for other causes, may flow back into the room in a dangerous manner;

2. Device according to the claim 1 **characterized by** the fact that the box-shaped body (10) is composed of an outer covering in a basically parallelepiped shape which can easily be made from suitable sheet metal. This box-shaped body (10) has two main sides (11a, 11b) which are equal and parallel to one another, and which have central openings which are suitable to connect them to the corresponding edges at the ends of the two sections (51 and 52) of the supply duct (5). Also, a perimeter side (12a) of the box-shaped body (10) is provided with a thin slot (121) parallel to and equidistant from its upper sides and which extends along the entire length of it (12a). This slot (121) is to allow the passage of a relative metallic plate (131) which constitutes the cut-off device (13);

3. Device in accordance with claim 1 **characterized by** the fact that said electric or electromagnetic device which is to activate the cut-off device (13) is composed of a suitable electromagnet (15) which, when supplied with power places the cut-off device (13) in the open position, whereas when it is not powered it releases it to the closed position;

4. Device in accordance with the previous claims **characterized by** the fact that the from the perimeter side (12a) of the box-shaped body (10), there protrudes at a right angle a support element (14) at the free end of which and parallel to it (14) there is attached an electromagnet (15). The slightly protruding moving nucleus of the electromagnet (15) has attached to it a fastening element (17) of the cut-off device (13), and a special compression-operated spring (16) which is placed between the fastening element (17) and the opposing end of the relative electromagnet (15) so that the cut-off element (13) is placed in a closed position when the electromagnet is not energized;

5. Device in accordance with the previous claims **characterized by** the fact that the metal plate (131) which constitutes the cut-off device (13) is of a rectangular shape with a width that is equal to the distance between the opposed internal surfaces of the two lateral sides (12c, 12d) of the box-shaped body. It may slide between them (12c, 12d) at a height which instead must be slightly greater than that between the other two perimeter sides, upper (12a) and lower (12b) in order to ensure that said metal plate (131), even when fully inserted into the box-shaped body (10), that is, in a closed position, protrudes from the external surfaces of the relative upper surface (12°) by a length which is suitable to allow connection to the fastening element (17).

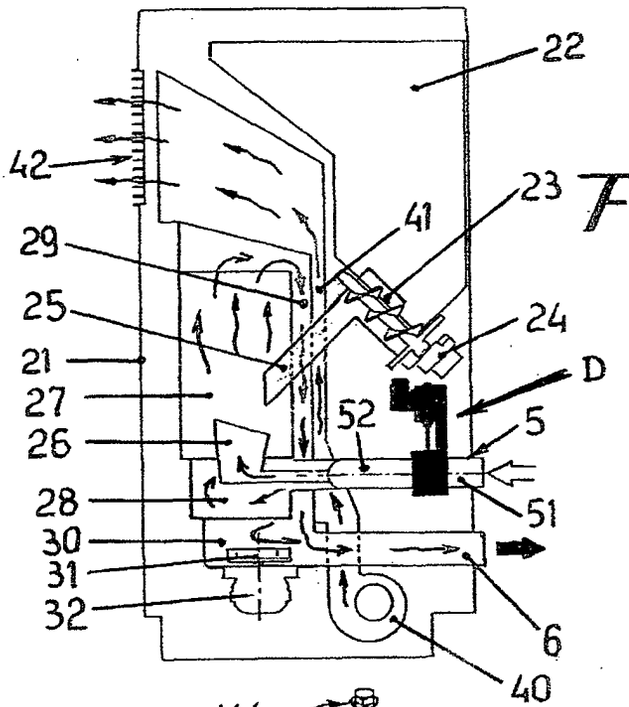
22
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Fig. 1

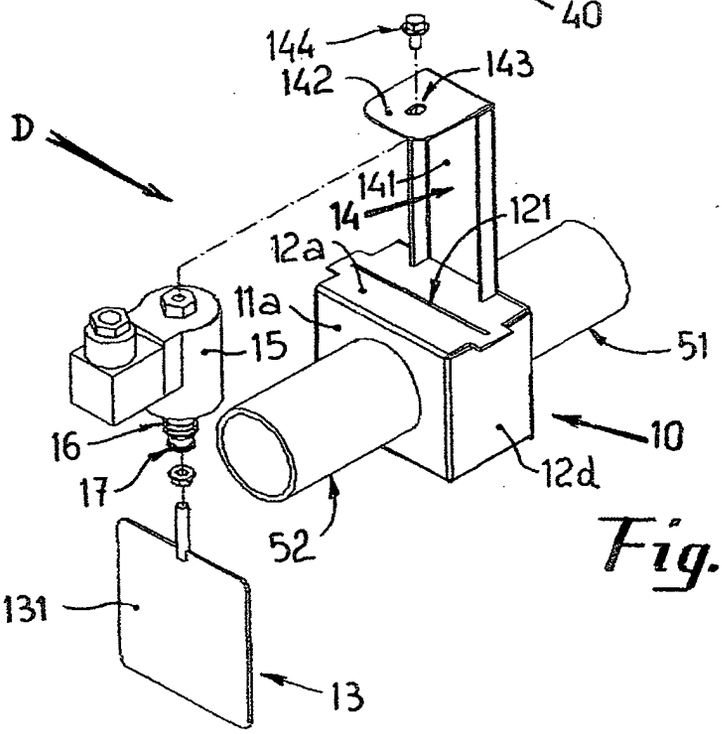
144
142
143
D
141
14
121
12a
11a
15
51
16
10
17
12d
52
131
13

Fig. 2

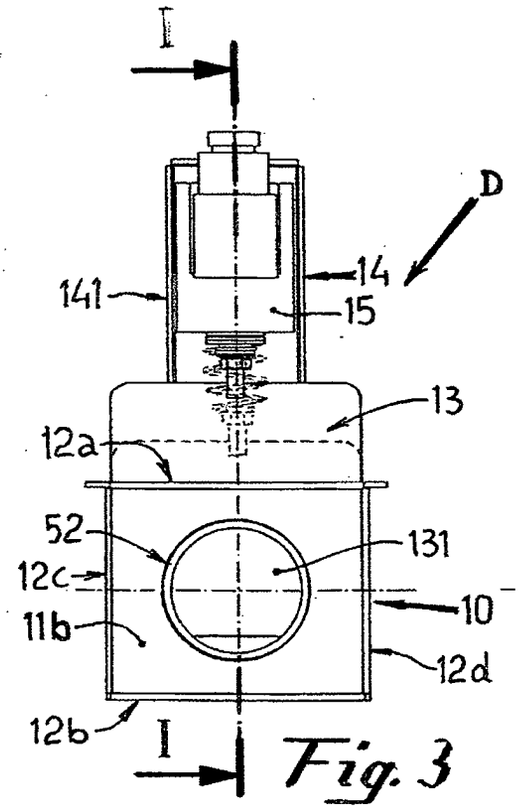

Fig. 3

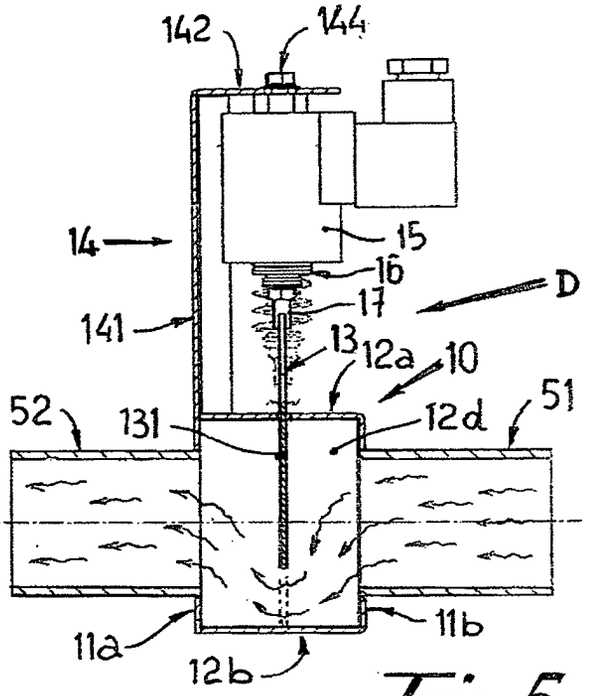

Fig. 5

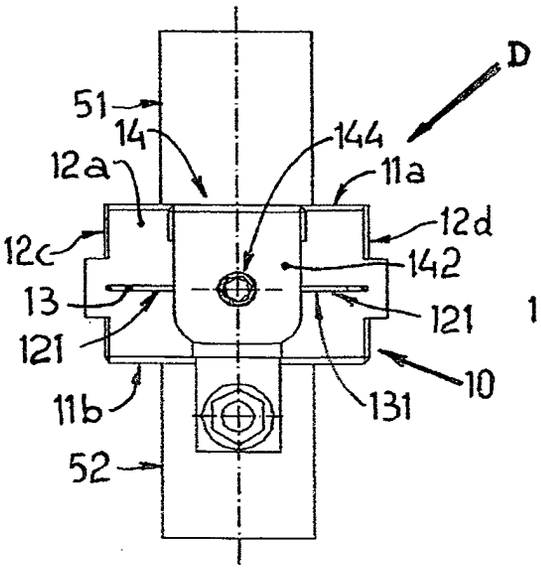

Fig. 4

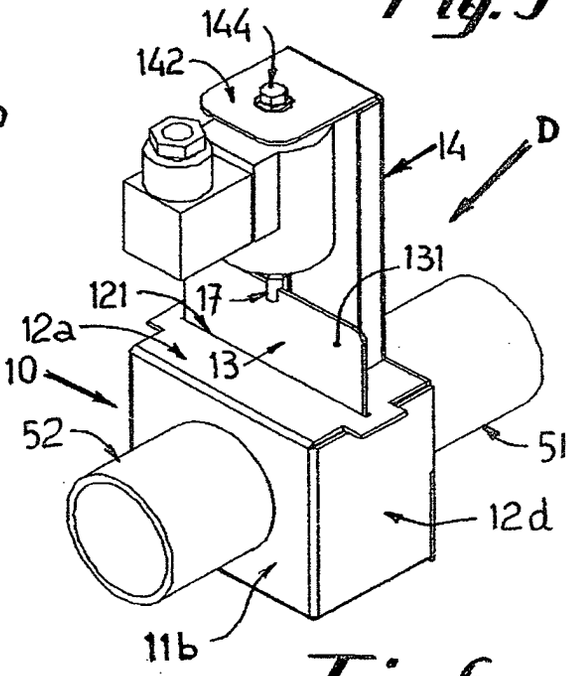

Fig. 6