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(54) Heat recovering system.

(57) A heat recovering system comprising at least one heat accumulator in the shape of a comparatively elongated pack of heat absorbing plates between which there are formed flow channels for the inlet and exhaust air and wherein the air flow direction through the heat absorbing pack is periodically reversed.

The inlet air channels and the exhaust air channels are hermetically sealed off from each other, whereby the inlet air and exhaust air are caused to flow in different channels and the heat is transferred from one side of the partition between the channels. is stored in the partition and is finally emitted from the other side of the partition.

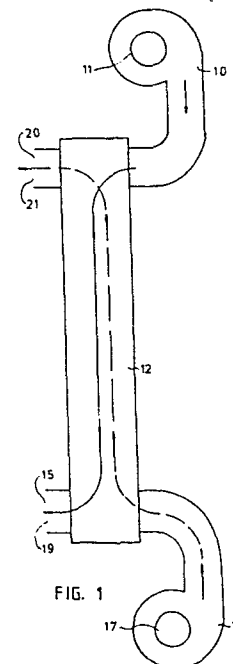


FIG. 1

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Heat recovering system

The present invention relates to a heat recovering system of the kind which comprises at least one comparatively elongated pack of heat absorbing plates between
5 which there are formed flow channels for the inlet and exhaust air and wherein the air flow direction through the heat absorbing pack is periodically reversed.

The commercially available regenerative heat recovering systems are distinguished by a high efficiency
10 as compared to the recuperative heat recovering systems. However, in certain of the known regenerative systems there is always obtained a certain percentage of return air which is a great drawback if the air is polluted by evilsmelling gases or is infected, such as at hospitals
15 or operating-rooms. Such return air is entirely unacceptable if poisonous gases are concerned.

Another type of regenerative recovering systems operates with a flushing cycle whereby the return air amount may be kept practically close to zero. However,
20 also in that case the fact remains that the surfaces which are sequentially swept by inlet and exhaust air are gradually contaminated by deposits, such as fats, drips from spray painting, oil residues and other types of contamination that may be present in the exhaust air.

25 As normal room air is cooled at heating of the heat accumulating parts there occurs, in most cases, a thin deposition of moisture at the heat absorbing surfaces. When the air flow reverses this moisture deposition is evaporated and is returned with the inlet air to the ventilated space. Then, if the gases which contaminate the
30 exhaust air are sufficiently soluble in water, there may occur a return of these gases to the inlet air as the returning air flow evaporates the moisture deposition at the heat absorbing and heat emitting surfaces.

35 In a similar manner bacteria and virus may be transferred from the exhaust air to the inlet air, and there also exists a risk for enrichment of bacteria, virus and beyond all spores from such organisms at the heat absorbing surfaces.

In homes and other localities where people keep ventilation is recommended to reduce the risk for radiation from radon gas amongst others. It has been suggested although not proven as yet that also radon gas should dissolve in the above mentioned moisture films and thus at least partially be returned with the inlet air. This problem is now examined very seriously.

Another problem of the regenerative systems is that they have to be installed high up in cool attic spaces to ensure a sufficiently small air volume that returns as the air flow in the system is reversed, and thus a lowest possible percentage of returning air. To preserve their high efficiency both the aggregates and the ducting have to be provided with an expensive insulation which, furthermore, makes the aggregates less accessible for maintenance, cleaning and repair. In many cases this insulation may cost almost just as much as the aggregate itself. Further, even with a reasonable good insulation, the disposition of the aggregate and the required air ducts in the cool attic spaces results in unnecessary losses which cause both an increased energy consumption and discomfort because the inlet air is felt as a draught if it has too a low temperature due to the just mentioned losses.

A consequence of what has been mentioned above is also that it is normally not desirable to connect the stove hood to a regenerative aggregate because of the risk of transferring smells of cooking to other parts of the home. This problem is even more pronounced in houses for several families and official spaces. Therefore, two different ventilation systems are required, viz. one for general ventilation and one for kitchen exhaust.

One object of the present invention has been to provide a heat recovering system which combines the advantages and eliminates the drawbacks of the recuperative and regenerative recovering systems.

To the just mentioned end, according to the invention the inlet air channels and the exhaust air channels are hermetically sealed off from each other.

Thus, the exhaust air and the inlet air are caused to flow in different channels and the heat is transferred from one side of the partition between the channels, is stored in the partition and is finally emitted from the other side of the partition.

The partitions between the flows, which are air or gastight sealed from each other, are used as heat absorbing elements in one or more heat accumulators at the same time as similar partitions of one or more other heat accumulators are used as heat emitting elements. The function of the heat absorbing and heat emitting accumulators is shifted after a suitable period of time. Of course, the actual length of that period is chosen in such a manner that optimum efficiency and economy are obtained.

With a construction of the above mentioned class it should be possible to achieve almost the same high efficiency as with the previously known regenerative heat exchangers at the same time as the above mentioned drawbacks are eliminated, which drawbacks are caused by the use of common channels and swept surfaces for the inlet and exhaust air and gas flows and in that a part of the exhaust gas is returned with the reversed volume.

Thus, an aggregate according to the present invention may be placed at any location within a building. The volume and length of the inlet and exhaust ducts have no influence on the function. The ducts as well as the aggregate are preferably installed in heated readily accessible spaces whereby the duct losses are reduced down to a minimum.

The kitchen air from homes may be taken care of in the aggregate, provided it is reasonably filtered from fats that would otherwise contaminate the ducts and the aggregate and reduce the efficiency. Air from toilets and other sanitary spaces may similarly be taken care of without risk for transfer of evil smell.

The aggregate may advantageously be used in hospitals and operation rooms in as much as the inlet and exhaust flows pass hermetically sealed off from each other. Further, the aggregate may be used for instance in connection with spray painting provided that one also here works with a reasonable cleaning of the gas to prevent clogging. The aggregate is also useful in

the chemical industry where one often works with exhaustion of air which is contaminated by poisonous gases. Still further, the aggregate eliminates all risks for return of radon gas with returned air.

5 The invention will be disclosed in more details below with reference to the accompanying drawings wherein preferred embodiments are shown.

FIG. 1 illustrates one embodiment of an aggregate according to the invention in side view;

10 FIG. 2 is a front view of the aggregate of FIG. 1;

FIG. 3 and 4 are a side view and a front view, respectively of a second embodiment of the aggregate according to the invention

15 FIGS. 5, 6, 7, and 8, respectively, illustrate diagrammatically a third embodiment of the aggregate according to the invention in four different operational stages.

The aggregate as shown in FIGS. 1 and 2 comprises an exhaust fan 10 and an inlet fan 11 and two heat accumulators 12 and 13. Each one of these accumulators comprises a pack of plates which are disposed in such a manner that flow channels are formed between adjacent plates, and sealing strips are interposed between the plates in such a manner that individual flow channels for inlet air and exhaust air are formed which channels are hermetically sealed off from each other. The exhaust air is sucked in through the opening and is blown by the fan 10 through the accumulator 13 and out in the ambient air through the opening 15. The exhaust air flows through the accumulator 13 as long as the flap valve 16 is in its left hand position as shown in FIG. 2. After a suitable period of time, e.g. one minute, the valve 16 is shifted to its right hand position (shown in dashed lines in FIG. 2), and the exhaust air is then passed through the accumulator 12.

Inlet air from outside is sucked in through the opening 17 by means of the fan 11 and is blown through the accumulator 12 (in the cycle where the exhaust air is blown through the accumulator 13). By the end of the cycle the valve flap 18 is shifted from its right hand position in FIG. 2 to its left hand position (shown in dashed lines in FIG. 2) synchronously with the shifting of the valve flap 16 from its left hand po-

sition into its right hand position as mentioned above. Then, for one cycle, the inlet air flows through the accumulator 13 whereas the exhaust air flows through the accumulator 12. The exhaust air leaves through the opening 15 when flowing through the accumulator 13 and through the opening 19 when flowing through the accumulator 12. The inlet air flows into an inlet duct (not shown) through an opening 20 as it has passed the accumulator 13 and through an opening 21 as the inlet air has passed the accumulator 12. The openings 15 and 19 (one hidden behind the other in FIG. 1) lead to one and the same exhaust air duct (not shown in FIG. 1) and the openings 20 and 21 (similarly one hidden behind the other in FIG. 1) lead to one and the same inlet air duct (not shown).

The second embodiment as shown in FIGS. 3 and 4 has an inlet air fan 22 which sucks the inlet air through the accumulators 12 and 13, respectively, rather than blowing the inlet air through the accumulators as was the case with the embodiment of FIGS. 1 and 2. In this embodiment the valves (not shown) have been synchronized in that they are disposed on one and the same shaft 2

The moisture conditions are always important with all heat exchangers. According to the present invention there is achieved a direct transport out of the humidity of the room air. The inlet air will contain only the humidity which is contained in the outer cool air. This may be a drawback, such as in homes, where the humidity may become too low in wintertime. On the contrary, in stables and green houses, for instance, where it is desirable to have as big a transport out of the moisture as ever possible the properties of the aggregate according to the invention are very valuable. During the cycle when the exhaust air heats the cooled accumulator it will pass the dew point with an attendant deposition of condensate which flows downwardly. Therefore, the accumulator should be designed in such manner that a proper outflow of the condensate is achieved.

At outer temperatures far below the freezing point it is necessary to heat the accumulators over the entire length during the heating cycle. Otherwise the downflowing condensate will block the exhaust air channels in the lowermost portion by freezing.

In certain cases it may become necessary to preheat the inlet air ahead of the heat recovering aggregate to such an extent that the lowermost portion of the accumulator taws up by the end of each heating cycle, so that the condensate may flow off. This preheating is utilized in the system and does not involve a loss. The preheating may be controlled by means of a thermostate from a suitable point and is preferably carried out by means of a heating battery in the inlet air duct.

The third embodiment of the heat recovering system according to the invention may be said to constitute a regenerative heat recovering system with eliminated valve leaking, rectifying of the air flows and cleanblowing.

This system comprises two heat accumulators 30, 31, each one comprising elongated packs of heat absorbing and emitting plates disposed close to each other so that air flow channels are formed between them. The ends of the accumulators 30, 31 are interconnected by means of distribution boxes 32 and 33, respectively, FIGS. 5 - 8. Each box has a central, longitudinal partition (not shown) which forms two chambers, such as chambers 34, 34 in FIG. 5. The ends of these chambers are connected to the accumulators 30, 31 through valves 36, 37 and 38, 39, respectively, and centrally the chambers 32, 33 are connected to inlet and exhaust ducts such as the ducts 40A and 41A in direct communication with the ventilated space and inlet duct 40B and exhaust duct 41B in direct communication with the atmosphere outside the ventilated space, as shown diagrammatically in FIGS. 5-8.

The valves 36-39 are of the type that closes one of the valve flaps of each set prior to the opening of the corresponding other flap of the set in question to avoid any leakage of e.g. contaminated air from one chamber into the other as the air flow directions are changed as will be set forth below.

In the stage as shown in FIG. 5 the left hand accumulator 30 absorbs heat from the exhaust air, coming from duct 41A and leaving through duct 41B whereas the inlet air from duct 40B is heated in accumulator 31 and enters the ventilated space through duct 40A.

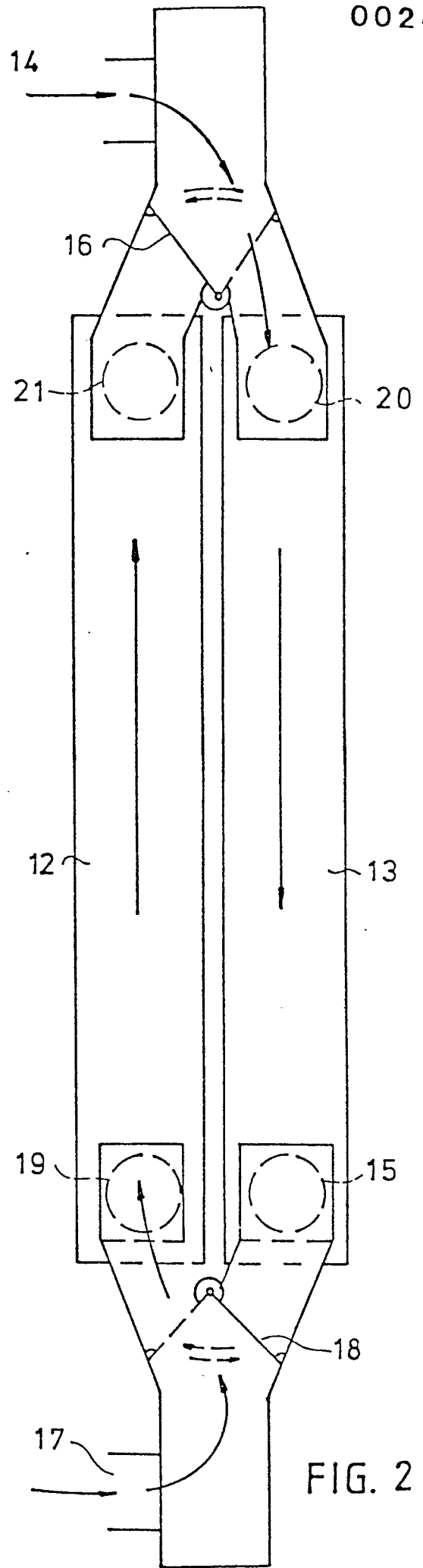
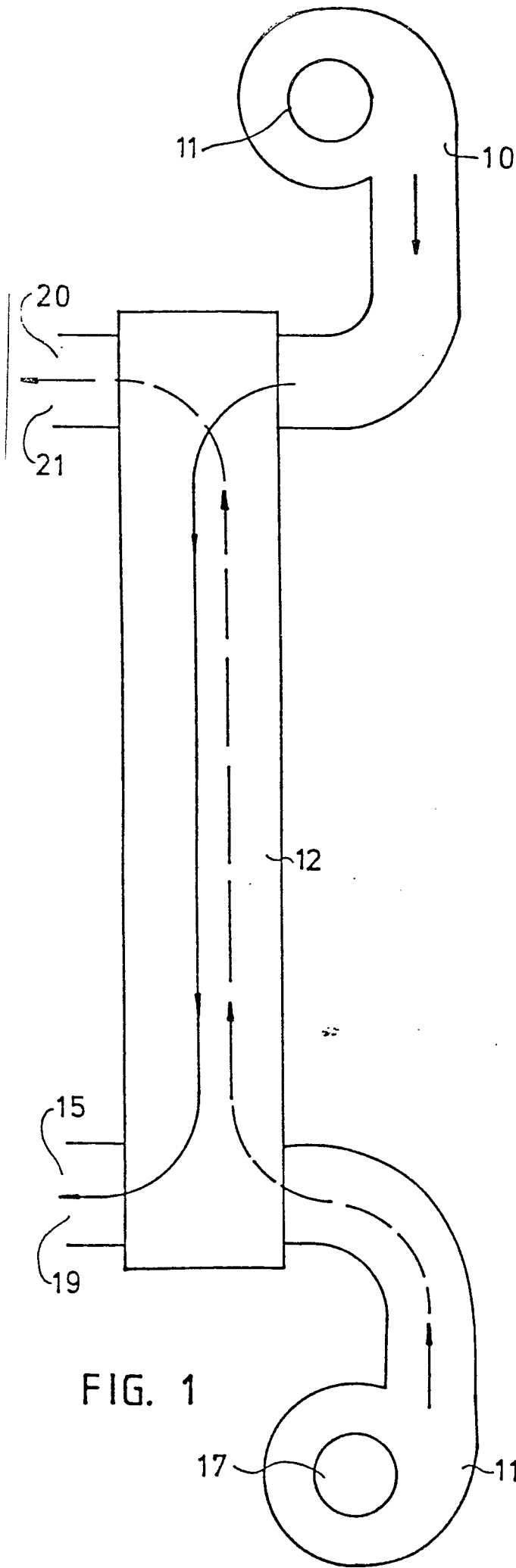
In the stage as shown in FIG. 5 the left hand accumulator 30 is cleaned by means of a small portion of the inlet air flow from chamber 32, which cleaning may take a few seconds only and

has no significant detrimental effect to the overall efficiency. In the stage of FIG. 7 the right hand accumulator 31 absorbs heat from the exhaust air of duct 41A whereas the left hand accumulator 30 emits heat to the inlet air which enters through duct 40B. passes the accumulator 30 and enters the ventilated space through the duct 40A. Finally, in stage four, as depicted in FIG. 8, the right hand accumulator 31 is cleaned by means of inlet air which is being branched off from the flow that would otherwise enter the ventilated space through the duct 40A.

All the valves could be designed to operate individually in the desired order but normally the valves are arranged in pair at opposite ends of one and the same shaft, as shown diagrammatically in FIGS. 5-8 whereby the general assembly becomes less complicated.

CLAIMS

1. A heat recovering system comprising at least one heat accumulator, preferably in the shape of a comparatively elongated pack of heat absorbing plates between which there are formed flow channels for the inlet and exhaust air and wherein the air flow direction through the heat absorbing pack is periodically reversed, the improvement comprising that the inlet air channels and the exhaust air channels are hermetically sealed off from each other, whereby the inlet air and exhaust air are caused to flow in different channels and the heat is transferred from one side of the partition between the channels, is stored in the partition and is finally emitted from the other side of the partition.
2. A heat recovering system comprising at least two heat accumulators, preferably in the shape of a comparatively elongated pack of heat absorbing plates between which there are formed flow channels for the inlet and exhaust air and wherein the air flow direction through the heat absorbing pack is periodically reversed, the improvement comprising said accumulators being connected at the ends thereof to distribution boxes, each having inlet means and outlet means for the exhaust and inlet air flows and flow directional means to periodically reverse the air flow through said accumulators and to at least momentarily direct at least a portion of the inlet air flow through one of the accumulators and back out into the atmosphere in order to blow said accumulator clean.



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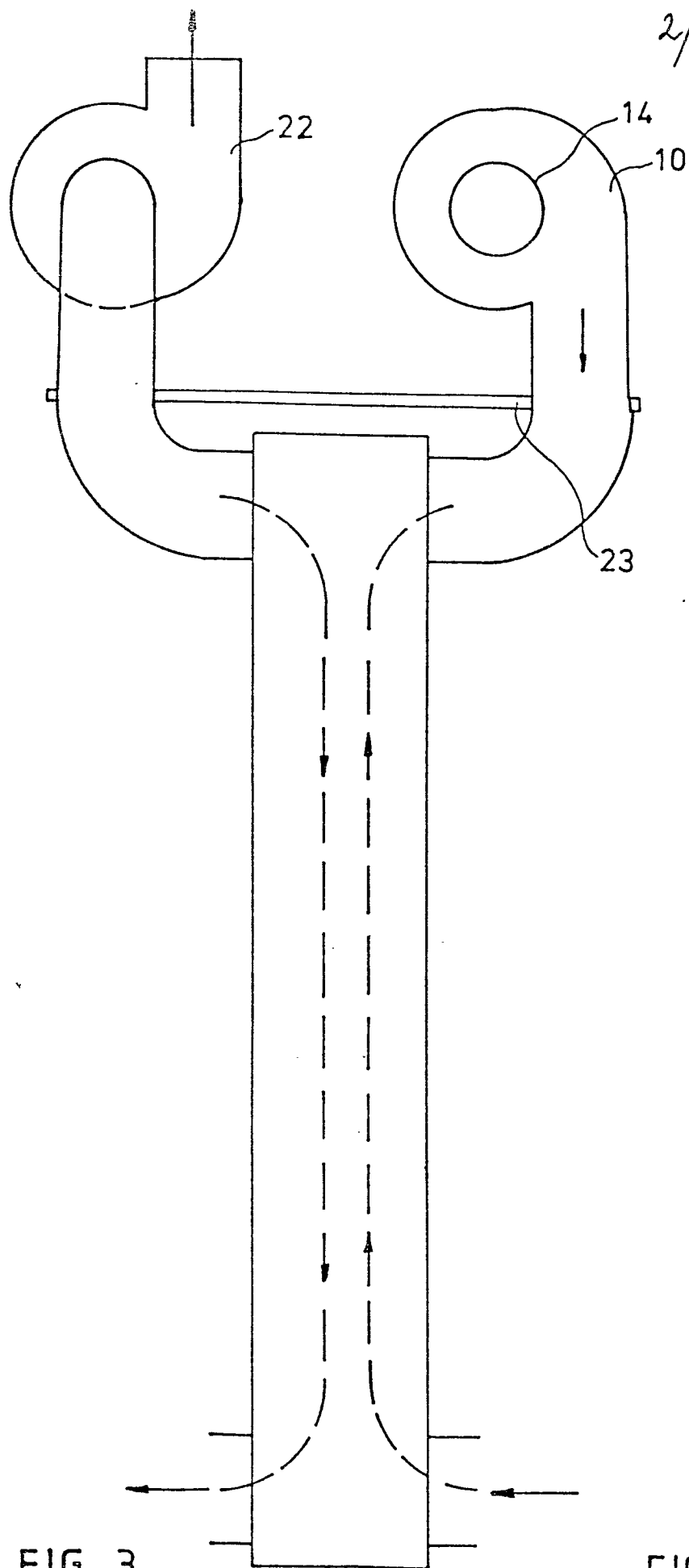


FIG. 3

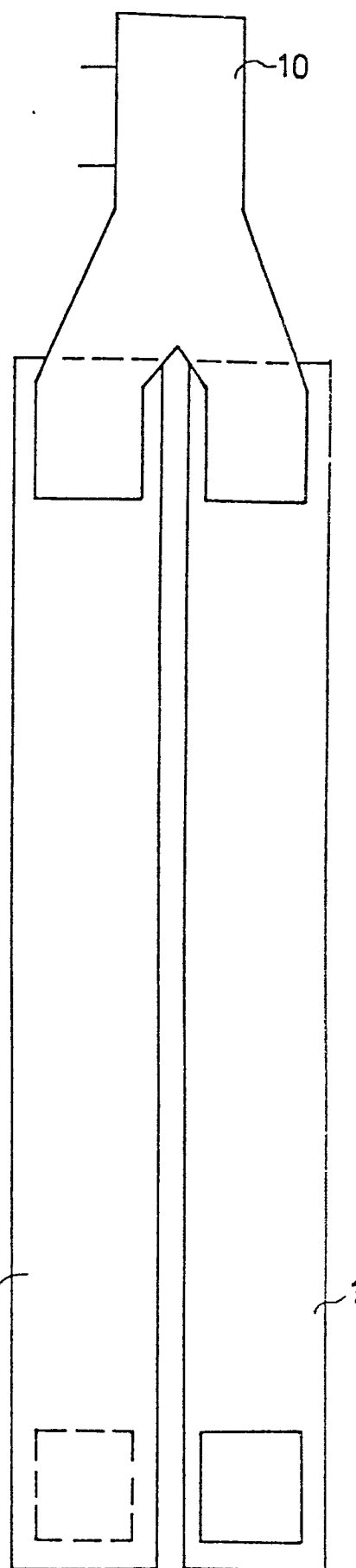


FIG. 4

FIG. 5

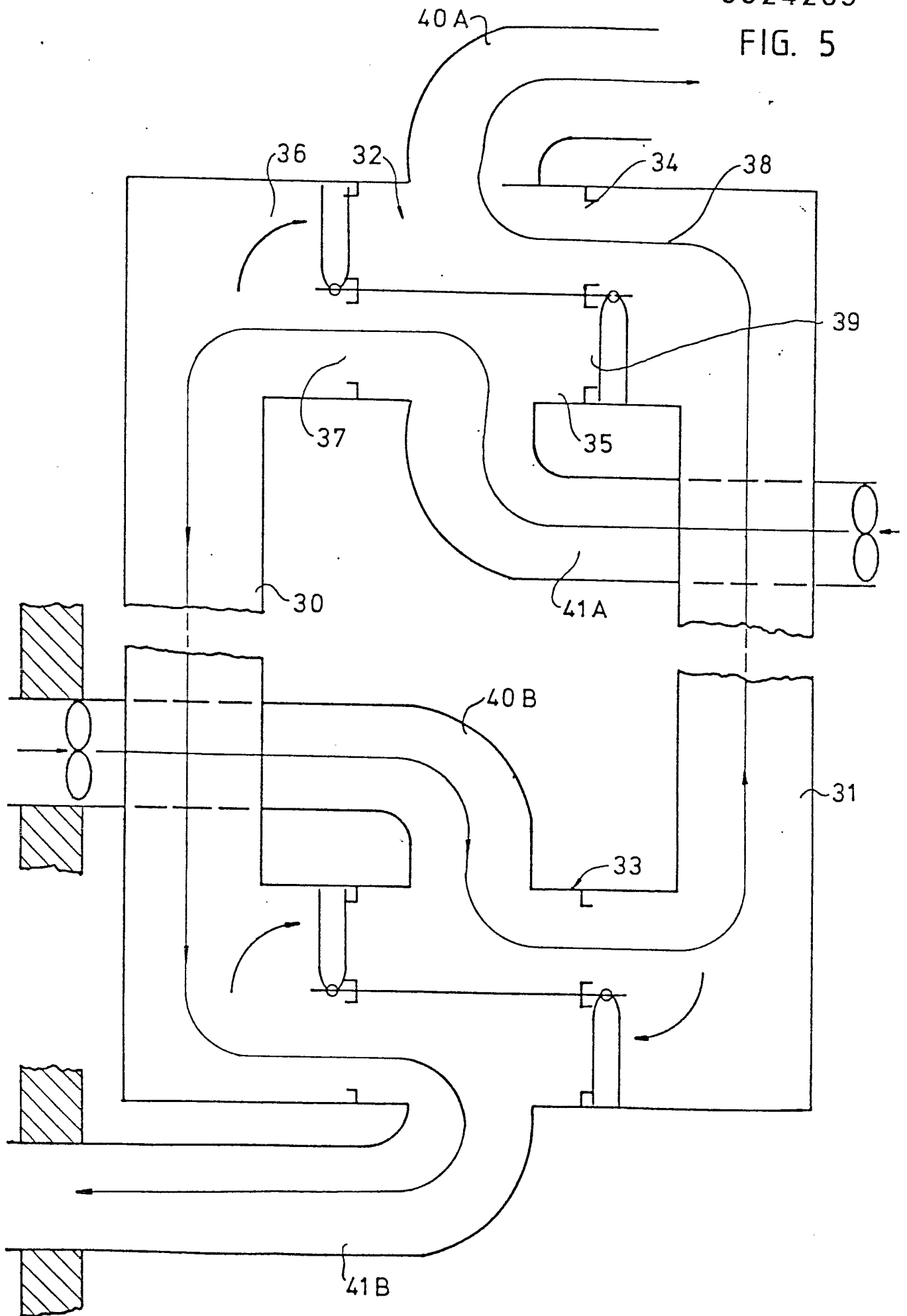


FIG. 6

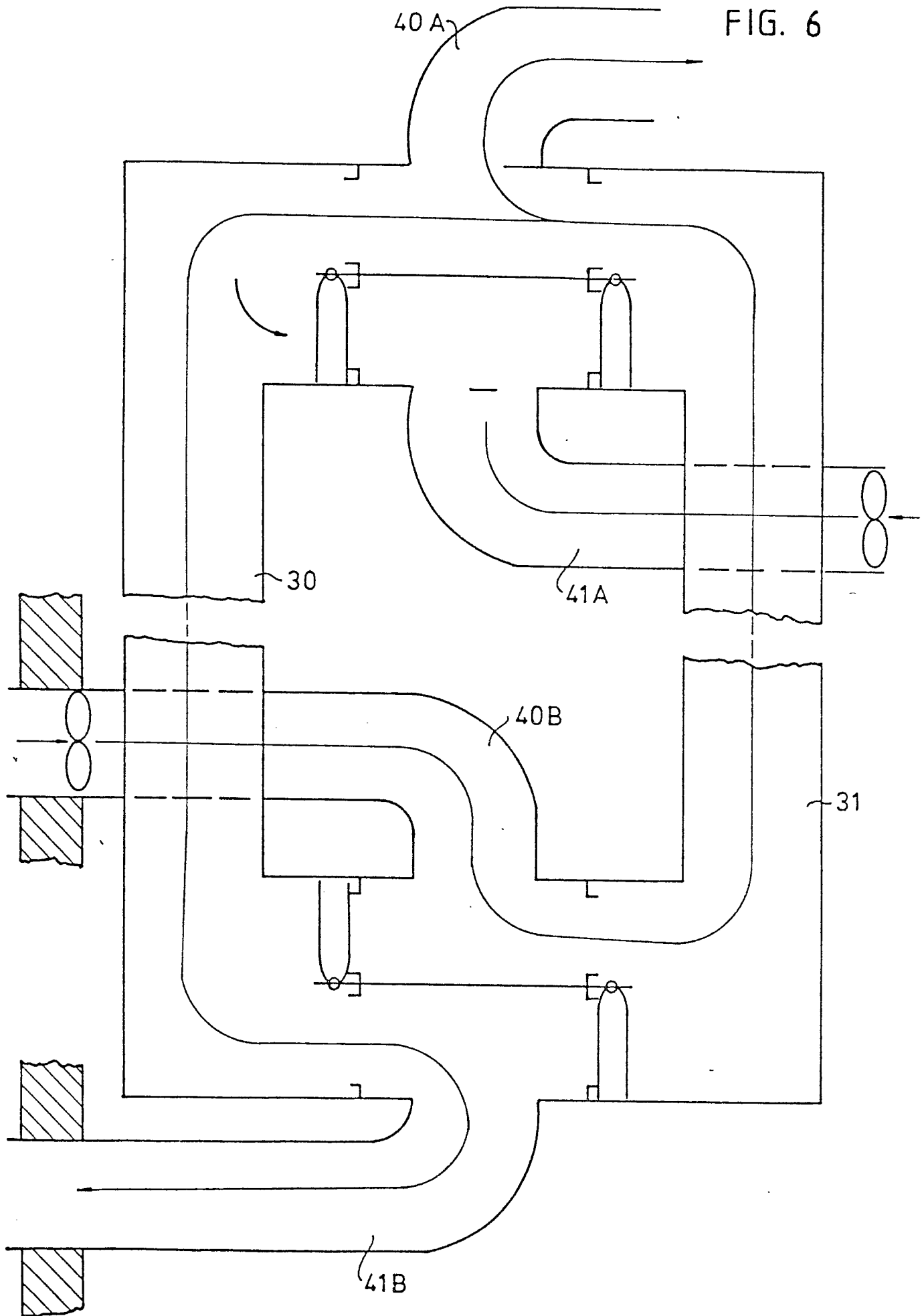


FIG. 7

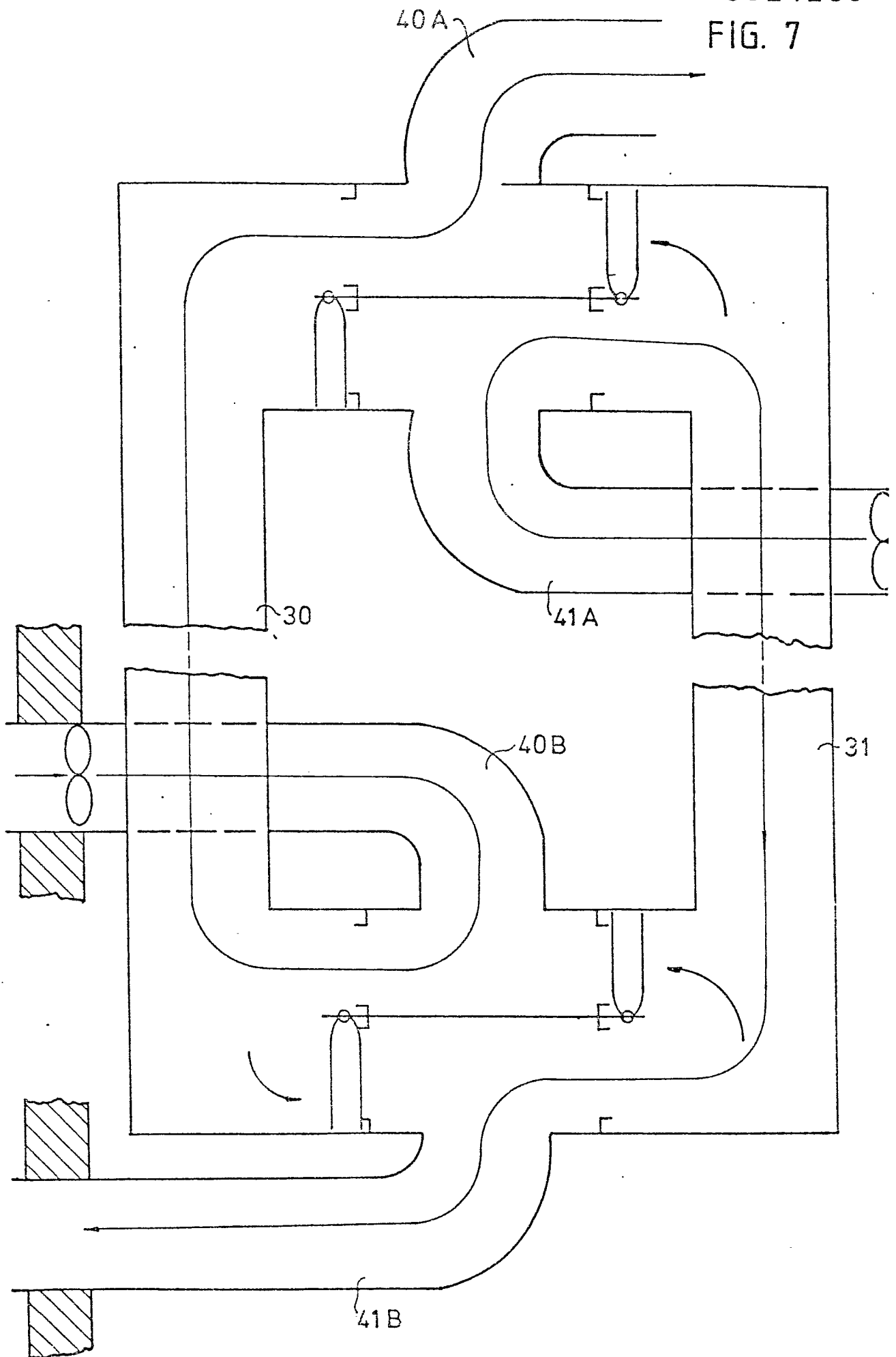


FIG. 8

