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(54) **A gas burner equipped with a cooling system**

(57) A gas burner (10) equipped with a cooling system, featuring whatever configuration and size, includes a flange (12) with a central hole (14), an intermediate body or underhead (16) coupled with the mentioned flange, a distribution plate (18), if any, with slots (28) and a head (20) equipped with a multiplicity of clearance holes (22); the underhead (16) includes a base (48) forming a separation plate between the upper front that faces the head (20), on which a plurality of ribs (26) developing from the base itself (48) and coming into contact with the distribution plate (18) or the head (20) is found, and the opposed lower front equipped with an articulated canalization where the cooling fluid circulates.

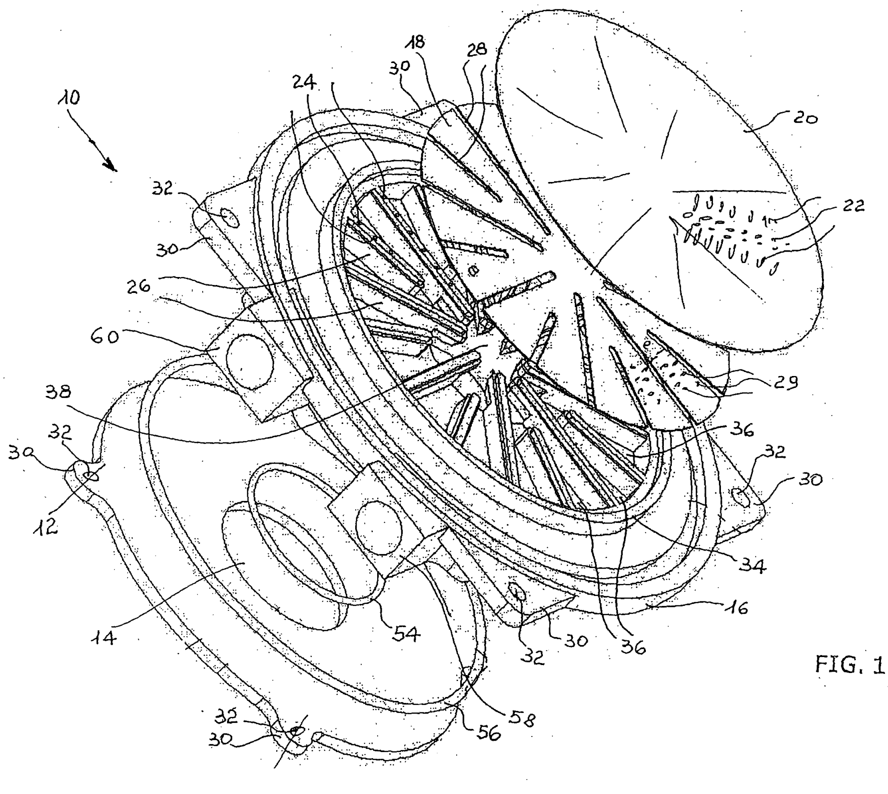

FIG. 1

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Description

[0001] This invention refers to a gas burner equipped with a cooling system. More specifically, this invention refers to a gas burner that is preferentially and not restrictively, of the pre-mixed type, of whatever configuration and development, equipped with means that are capable of cooling its surface next to the flame retention area.

[0002] There are, as already known, gas burners that typically consist of a combustion head lodging in a combustion chamber; on the head surface, otherwise called flame retention surface, a flame front stabilizes, which brings to combustion the mixture fed through the inner flues of the burner. This type of burners produces significant troubles, which are mainly due to the fairly high operating temperature values.

[0003] Especially in cases when the burner head comes directly into contact with the area where the combustion of the gas mix occurs, the surface temperatures as well as those reached by the materials that make up the burner are high; the flame front reaches temperatures ranging around 1800-2000°C and even higher as a function of the combustible gas being used and the surface of the burner, which stabilizes the flame front next to the surface itself, overheats accordingly. The burner head in typical conditions of use may reach temperatures ranging between 900 and 1100°C, especially in conditions of forced power modulation when low mixture flow rates cause a further approach of the flame front to the burner surface.

[0004] Considering that the burners at issue are not typically equipped with an own cooling system, it is therefore necessary to allow the various parts of the burner to be manufactured from sophisticated materials that are capable of resisting the high operating temperature values; this sometimes brings about problems in connection with the processing of such materials, besides high production costs.

[0005] A further trouble normally found in known burners concerns the highly polluting emissions, considering that the formation of nitric oxides in combustible gases is directly linked with the flame front temperature, and it reduces proportionally to the extent that a relatively cold flame front can be stabilized. In an attempt to remedy this problem and reduce temperature, besides air and gas premixing, the very surface of the burner head is used, which on one hand takes heat away in contact with the flame front, but on the other hand gets overheated. It follows that the burner surface is often exposed to erosion by high temperature oxidation, as well as to significant mechanical stresses which progressively debilitate the whole equipment and lead it to breaks due to thermal fatigue. In an attempt to reduce such risks, even in these cases, special materials that withstand high temperatures are used, such as, for instance, metal plates or fibres made from super-alloys with a high content of chromium or aluminium, or fibres or tiles from ceramic materials. However, even these solutions are subject to thermal and mechanical stress which, in the long run, is likely to modify intactness or strength, and hence prejudice a proper operation of the equipment as a whole. Moreover, these special materials are very expensive, and this significantly affects overall production costs.

[0006] Furthermore, known burners are typically located on a front flange that closes the combustion chamber, and even such flange needs to be manufactured from high-temperature resistant materials, along with the electric cables that feed the ignition electrodes contained inside; even these requirements lead to an increase in production costs, whereas the loss of heat from the flange may entail, if excessive, insulation problems by the external walls of the unit and operating failures of the most temperature-sensitive parts, such as, for instance, burner management electronic boards.

[0007] A further inconvenience that is found in known burners is the emission of loud sound vibration owing to the different temperature conditions at which the burner operates, typically when the flame retention area is at much higher temperatures in minimum power conditions. To remedy such inconvenience, additional mixture feed circuit silencers are generally used, even though they involve constructional complications, increased costs and do not always completely solve the problem.

[0008] The object of this invention is to remedy the above-described inconveniences.

[0009] More specifically, the object of this invention is the provision of a gas burner, preferably through not critically of the pre-mixed type, which is capable of easily withstand the high working temperatures under all circumstances, even when the burner head comes directly into contact with the area where the gas mixture combustion takes place. A further object of this invention is the provision of a gas burner that does not require, for high-temperature, the use of sophisticated and expensive materials.

[0010] Not least among the objects is the provision of a burner as described above which is able to crucially polluting emissions during operation, without resorting to heat exchanges taking place on the burner head, nor resorting to special material to manufacture its components or their parts.

[0011] A further object of the invention is the provision of a gas burner which is in a position to avoid, or at least dramatically reduce, during operation, the emission of sound vibration or noise at all, without however entailing the use of additional silencers means.

[0012] A further object of the invention is the provision of a gas burner, e.g. a premixed-type one, which can guarantee high resistance and reliability over time, and also such as to allow for an easy and cheap manufacture.

[0013] These and other objects are achieved by the gas burner of this invention, such as, for instance, the pre-mixed type one, equipped with a cooling system, of whatever configuration and size, which includes a flange with a central hole, an intermediate body or underhead coupled with the mentioned flange, a distribution plate with slots, if any, and a head equipped with several clearance holes, and which is mainly characterized in that the underhead includes a base forming a separation plate between the upper front that faces the head, on which a plurality of ribs developing from the base itself and coming into contact with the distribution plate or the head is found, and the and the opposed lower front equipped with an articulated canalisation where the cooling fluid circulates.

[0014] The constructional and functional characteristics of the gas burner of this invention can be readily discerned from the following description, wherein reference is made to the accompanying figures illustrating a preferential embodiment, which does not limit the invention to the precise forms disclosed, and wherein:

- figure 1 is a schematic exploded view of the gas burner of this invention;
- figure 2 is a schematic exploded view of the same burner, as seen from a side opposite to that of figure 1;
- figure 3 is a perspective schematic view of a part, namely the underhead, of the burner of this invention;
- figure 4 is a perspective schematic view of a burner according to the invention, in association with a heat exchanger;
- figure 5 is, in a perspective schematic view, an alternative embodiment to that of figure 4.

[0015] With reference to the mentioned figures, the gas burner of this invention, e.g. a pre-mixed type gas burner, referenced as a whole with no. 10 in figure 1, includes, illustratively and not restrictively in character, a configuration with a circular base and a basically flat development and, according to the preferential embodiment illustrated in the diagrams, it incorporates a flange 12 equipped with a hole 14 for feeding the gas mixture, an intermediate body or underhead 16 coupled with the mentioned flange, a distribution plate 18, if any, meant to distribute the mixture in a uniform manner, and a head 20 on which the flame retention area is found; the head 20 is typically provided with several holes or slots 22 or clearance holes of whatever shape, obtained for instance by shearing on one or more metal plates that are coupled with one another in a known manner. The underhead 16 is equipped with ribs 26 arranged, for instance, in a radial pattern, which are advantageously obtained integrally with the underhead itself and serving the purpose indicated hereinafter.

[0016] The distribution plate 18 is equipped with slots 28 which, from its perimeter, meet towards the central area, and with holes 29 allowing the gas mixture to pass. Both the flange 12 and the underhead 16 are equipped with peripheral tailpieces 30 with holes 32 for mutual connection and stable bond through bolts or equivalent retaining means.

[0017] The head 20 and the distribution plate 18 are fastened to the upper exposed front of the underhead 16 by means of screws or equivalent means (not illustrated) which engage in holes 24 in the ribs 26 and pass through the head 20 and the plate 18 properly drilled.

[0018] On the upper front turned towards the mentioned plate 18, the underhead 16 is provided with a circumferential rib 34 that is slightly embossed, whose inner diameter mainly matches that of the head 20 and of the distribution plate 18; the ribs 26 on which the holes 24 are made mainly depart from the inner band of the circumferential rib 34.

[0019] The gas mixture that is fed through hole 14 of flange 12 and through a corresponding aligned opening 38 made on the underhead 16 flows in the sectors lying between the ribs 26, referenced with no. 36 in figure 1.

[0020] On the underhead16, in the opposite position as to the ribs 26, that is on its lower front turned to flange 12, a plurality of curbs 40 is made. They are illustratively in the shape of an arc of a circle, concentric with each other and externally delimited by a barrier 42 that develops circumferentially, and tailpieces 44 with holes 46 are integral with it. Curbs 40 develop vertically from a base 48 that makes up the separation element or plate among the curbs themselves, made on the lower front of the underhead 16, and the ribs 26 created on the opposed upper front turned towards the head 20.

[0021] The inner face of barrier 42 and the curbs 40 form, as a whole, an articulated canalisation, where in each segment of the many channels, referenced with no. 50, a coolant, typically water or possibly air, flows. The hole 38 that feeds the gas mixture is made, for example, in a central position and is circumferentially bordered, on this lower front of the underhead 16, by a collar 52 that isolates the hole from the channels 50 where the coolant flows; the water tightness is easily guaranteed by a seal 54 located at the top of the collar 52 and cooperating with the inner face of the flange 12. A similar seal 56, located between the circumferential barrier 42 and the flange 12 prevents water from possibly spilling over the channels 50. Instead of the curbs 40, of course, other elements of a different shape and/or development can be made, such as, for instance, discontinuous projections in the shape of pegs, dents and the like.

[0022] According to the preferential embodiment illustrated in the figures, the underhead 16 is equipped with a water inlet 58 and outlet duct 60, integrally manufactured with the underhead, which can be advantageously connected in a known manner to the existing hydraulic circuit of the boiler, as described hereinafter with reference to figures 4 and 5.

[0023] The lower front of the underhead 16 then comes into contact with the cooling water fed through duct 58; the great heat which is transmitted by conduction from the head 20 to the ribs 26 is essentially phased out in the cooling water by conduction and convection. The cooling water, while flowing along the channels 50 of the underhead 16, also comes into contact with the lower face of sectors 36, where the gas mixture flows towards the head 20, so that part of the heat is also taken off the mentioned mixture, which will result in a reduction of nitrogen oxide emissions.

[0024] Theoretical models of heat exchange, confirmed by experimental results obtained by the applicant, made it possible to ascertain that the subtraction of heat from the burner surface (distribution head or plate) is based on a close connection between this very surface and that of the ribs 26, irrespective of the shape of the burner, in consideration, *inter alia,* of the materials used. By calling "As" the extent of the ribs 26 surface in close contact with the extent of surface "Ap" indicating that the burner surface is being exposed to a high temperature value, an advantageous circumstance is one where: the As/Ap ratio required to lower the high temperature (equalling, for example, 1000°C approximately) of the burner, to take it to a definitely lower temperature value (for example, 500°C approximately) ranges between 5% and 40%, preferably between 10% and 30%.

[0025] In the presence of materials featuring a limited thermal conductivity, the ratio stabilizes around the maximum value, whereas 5%-10% are values referred to materials such as aluminium or its alloys and copper. The above-listed values indicate that, by lowering below the minimum threshold, efficiency in heat subtraction is dramatically reduced, whereas by exceeding the maximum threshold, the advantage is reduced along with practical feasibility owing to the large sizes and large surfaces to be used for the exchange.

[0026] As hinted at before, the burner of this invention may advantageously use, to cool down, the water circuit of the heat exchanger that is in the boiler; thus, one can avoid placing a specific circuit, to be incorporated within the burner body, where the coolant can be circulated, since the thermal conduction between the heat exchanger and the burner body is exploited to obtain the desired cooling of the combustion head.

[0027] A similar solution is schematised in figures 4 and 5, where identical parts are identified by the same number references as in the previous figures. The body or underhead 16 of the burner is delimited by a tube-bundle heat exchanger 70; the head 20 of the burner essentially corresponds to the one previously described. 72 identifies the traditional outer shell of the heat exchanger 70 and 74 identifies a peripheral flange fastened to the front face of the heat exchanger itself and which is meant to be tied, by means of screws or equivalent means, to the underhead 16 of the burner. The latter is connected in a known manner to a traditional gas mixture feeding manifold 76. The flange 74 borders the contact surface with the burner 10, namely with its underhead 16. The heat conduction that causes the combustion head to cool down 20 may take place by direct contact between the underhead 16 and the exchanger 70 through the flange 74, or in an indirect manner through the interposition of a seal 78 made from a high-conductivity material such as a metal or graphite. The seal 78 acts as a sealing body against any possible escape of combusted gases from the combustion chamber of the burner 10, and as an element that may promote heat exchange, as it assures, between the underhead 16 and the flange 74, a large safe contact surface. The heat conductive seal 78 may alternatively be located between the underhead 16 and the first pipe, identified by reference 80, of the heat exchanger 70, as schematised in figure 5.

[0028] Such a cooling system is advantageously connected with the one previously described for burner 10 and causes an effective and constant dissipation of heat from the combustion head 20.

[0029] It is also understood that the cooling system described above can also be realized independently on whatever type of burners.

[0030] The advantages of this invention are obvious from the foregoing disclosure.

[0031] The gas burner of this invention allows low working temperatures to be maintained, especially close to the flame retention area, owing to the underhead 16 that integrates a large heat exchange area made through water circulation in the channels 50.

[0032] Heat subtraction greatly reduces temperature both on the burner head and on other components or adjoining parts, so as to allow a considerable functional lengthening of the product life as a whole to be achieved and nitrogen oxide emissions to be reduced. Such a solution is also crucial in connection with the traditional need to resort to special and expensive materials that can withstand high temperature values, since through the cooling system of this invention, traditional or however common or cheap materials can advantageously be used. The successful reduction of temperature of the burner head also allows the risk of triggering vibration or annoying acoustic phenomena to be reduced accordingly and resolutely, owing to more uniform and even temperature values throughout the operating range.

[0033] Considering that the subtraction of heat achieved through water circulation in the underhead 16 indirectly also causes the temperature of flange 12 to lower, a further advantage achieved by the burner of this invention concerns the possibility of making the electrical wiring of parts that are inserted in the flange easier and cheaper, as they do not demand the use of materials that withstand high temperatures.

[0034] Further advantageous is also the possibility to use the water circuit of heat exchanger 70 of the boiler for cooling.

[0035] The foregoing disclosure of a preferential embodiment of the present invention has been presented for purposes of illustration and description, and it is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Hence, several variations and modifications of the embodiment described herein will be obvious to one of ordinary skill in the art in the light of the above disclosure. Therefore, the scope of this invention will only embrace all those variations and modifications as defined by and inferred from the claims appended hereto.

Claims

1. A gas burner (10), for example one of premixed type, equipped with a cooling system, of whatever shape and size, comprising a flange (12) with a central hole (14), an intermediate body or underhead (16) coupled with the mentioned flange, a distribution plate (18), if any, with slots (28) and a head (20) equipped with a plurality of clearance holes (22), **characterized in that** the underhead (16) includes a base (48) forming a separation plate between the upper front turned towards the head (20), where a plurality of ribs (26) are made which stem from the base (48) itself and come into contact with the distribution plate (18) or with the head (20), and the opposed lower front equipped with an articulated canalisation for the circulation of coolant.

2. A gas burner according to claim 1, wherein the ribs (26) are arranged in a radial pattern on the upper front of the underhead (16) and depart from a circumferential rib (34), the ribs (26) having holes (24) for bonding, by means of screws or equivalent means, of the distribution plate (18) and/or the head (20) to the mentioned underhead (16).

3. A burner according to the previous claims, wherein the ratio between extent "As" of the ribs (26) surface and extent "Ap" of the head (20) or the distribution plate (18) surface exposed to high temperatures for lowering temperature through the passage of the coolant in the canalisation made on the lower front of the underhead (16) ranges between 5% and 40% for a temperature reduction ranging from 1000°C to 500°C approximately.

4. A burner according to claim 3, wherein the mentioned As/Ap ratio ranges between 10% and 30% as a function of the thermal conductivity of the materials used to manufacture the burner parts.

5. A burner according to one or more of the previous claims, wherein the articulated canalisation formed on the lower front of the underhead (16) includes a plurality of curbs (40) in the shape of an arc of a circle and externally delimited by a circumferential barrier (42), and a central collar (52) that borders a central hole (38) making up the extension of hole (14) of flange (12), between the latter and the collar (52) being arranged a seal (54).

6. A burner according to one or more of the previous claims, wherein the underhead (16) is equipped with an inlet duct (58) and an outlet duct (60) for the coolant fed into the articulated canalisation of the underhead (16).

7. A burner according to one or more of the previous claims, wherein the articulated canalisation of the underhead (16) includes a plurality of channels (50) formed by the curbs (40), the barrier (42) and the collar (52) and/or a plurality of pegs or dents.

8. A burner, according to one or more of the previous claims, wherein at least a seal (56) located between the circumferential barrier (42) and the flange (12) is comprised.

9. A burner according to any of the previous claims, wherein the flange (12) and the underhead (16) are equipped with peripheral tailpieces (30) with holes (32) for mutual connection with bolts or equivalent means.

10. A burner, according to one or more of the previous claims, wherein the circumferential barrier (42) comprises integral tailpieces (44) with holes (46).

11. A burner according to one or more of the previous claims, wherein the underhead (16) is bordered by a tube-bundle heat exchanger (70) comprising a peripheral flange (74) tied to the underhead by means of screws or equivalent means.

12. A burner, according to one or more of the previous claims, wherein a heat-conductive seal (78) is located between the peripheral flange (74) of the heat exchanger (70) and the underhead (16).

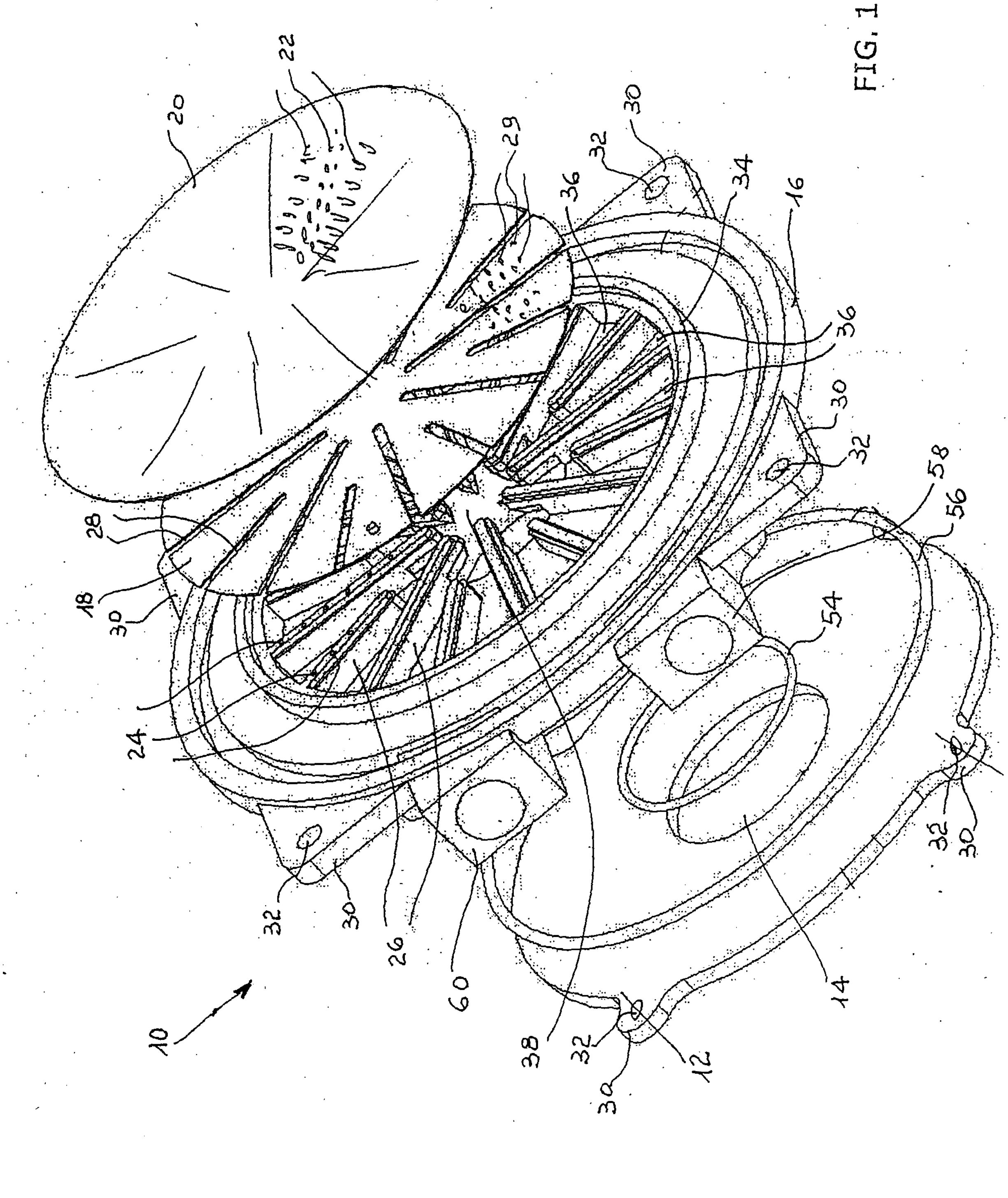
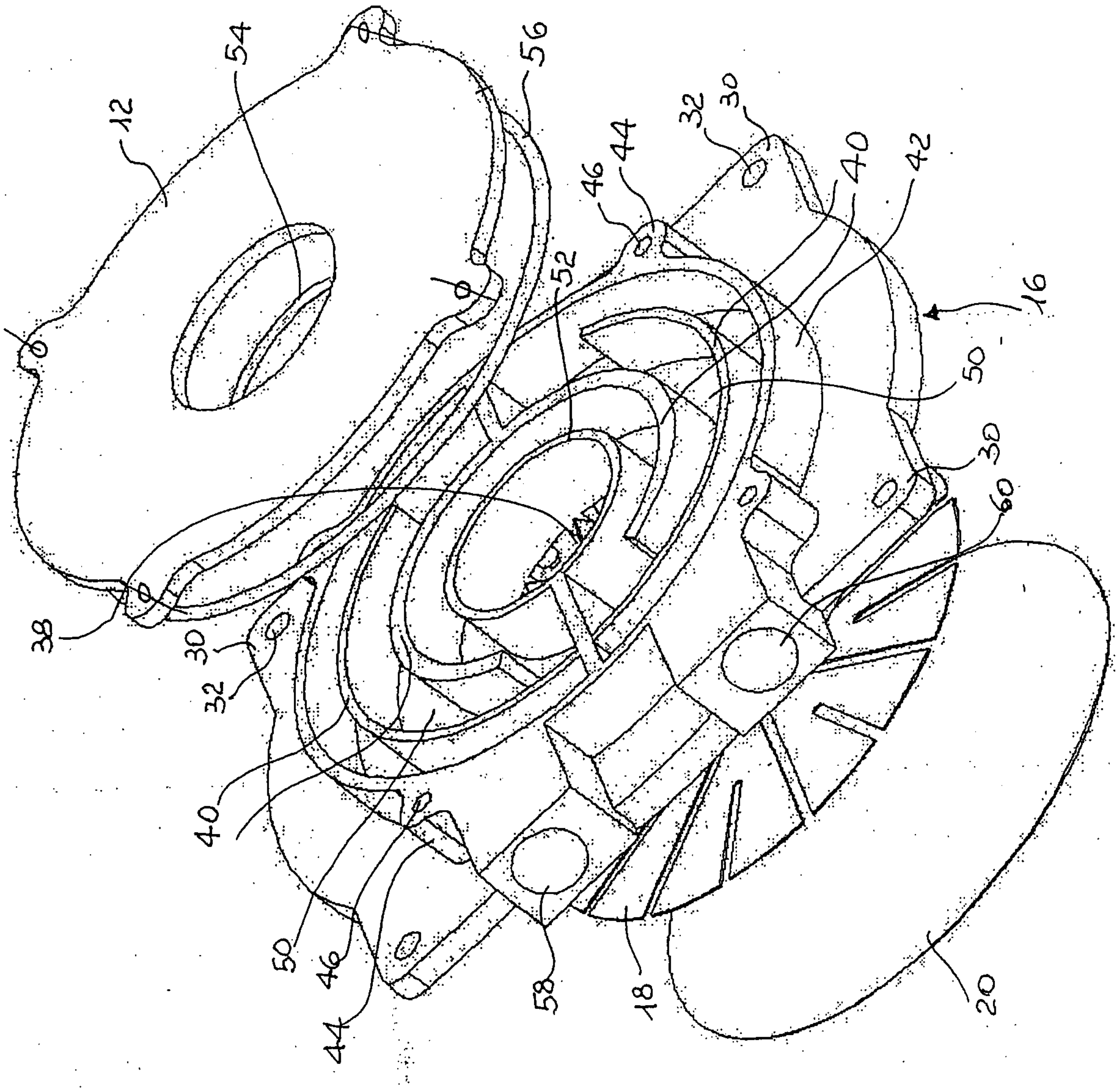


FIG. 1

FIG. 2



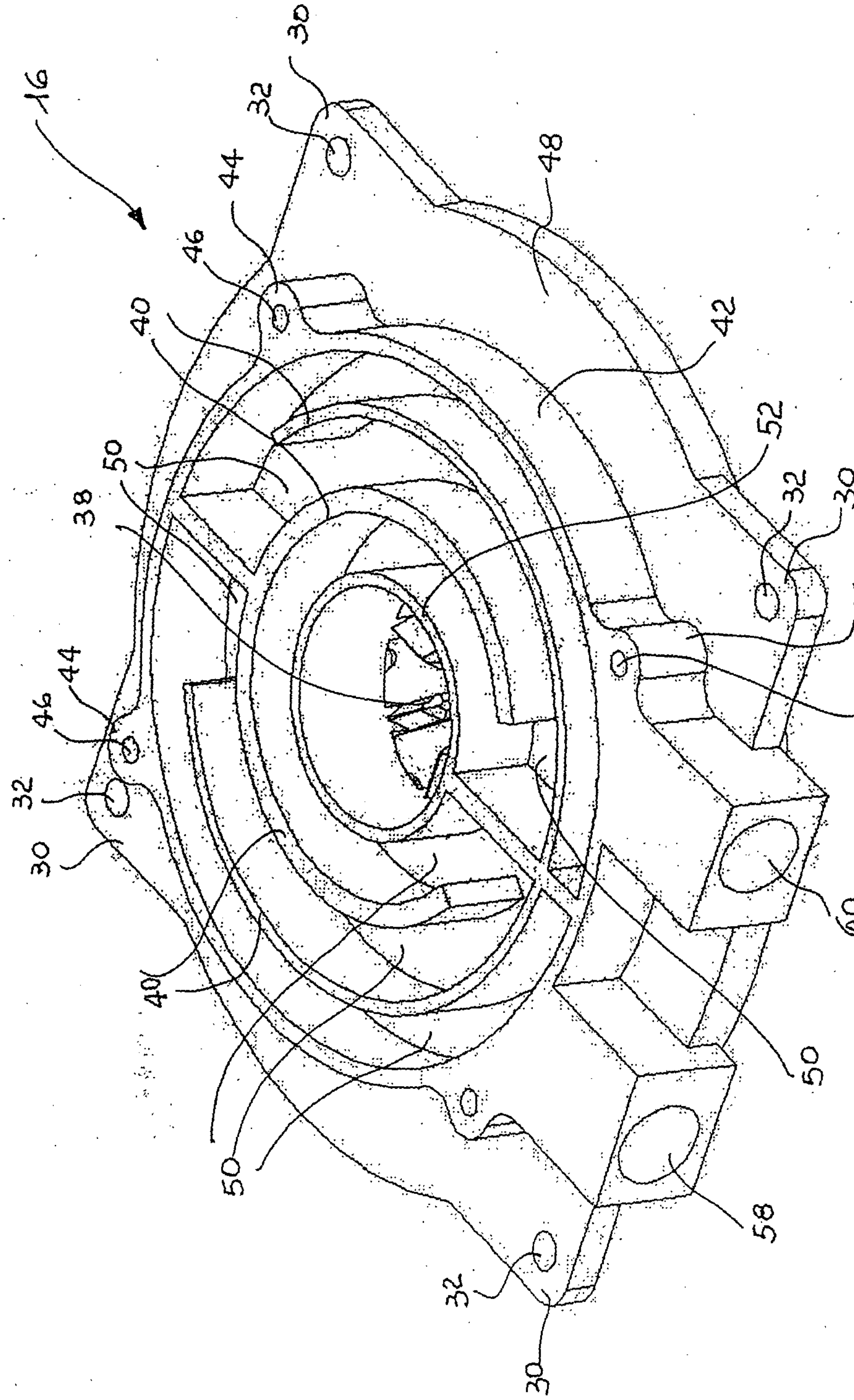


FIG. 3

FIG. 4

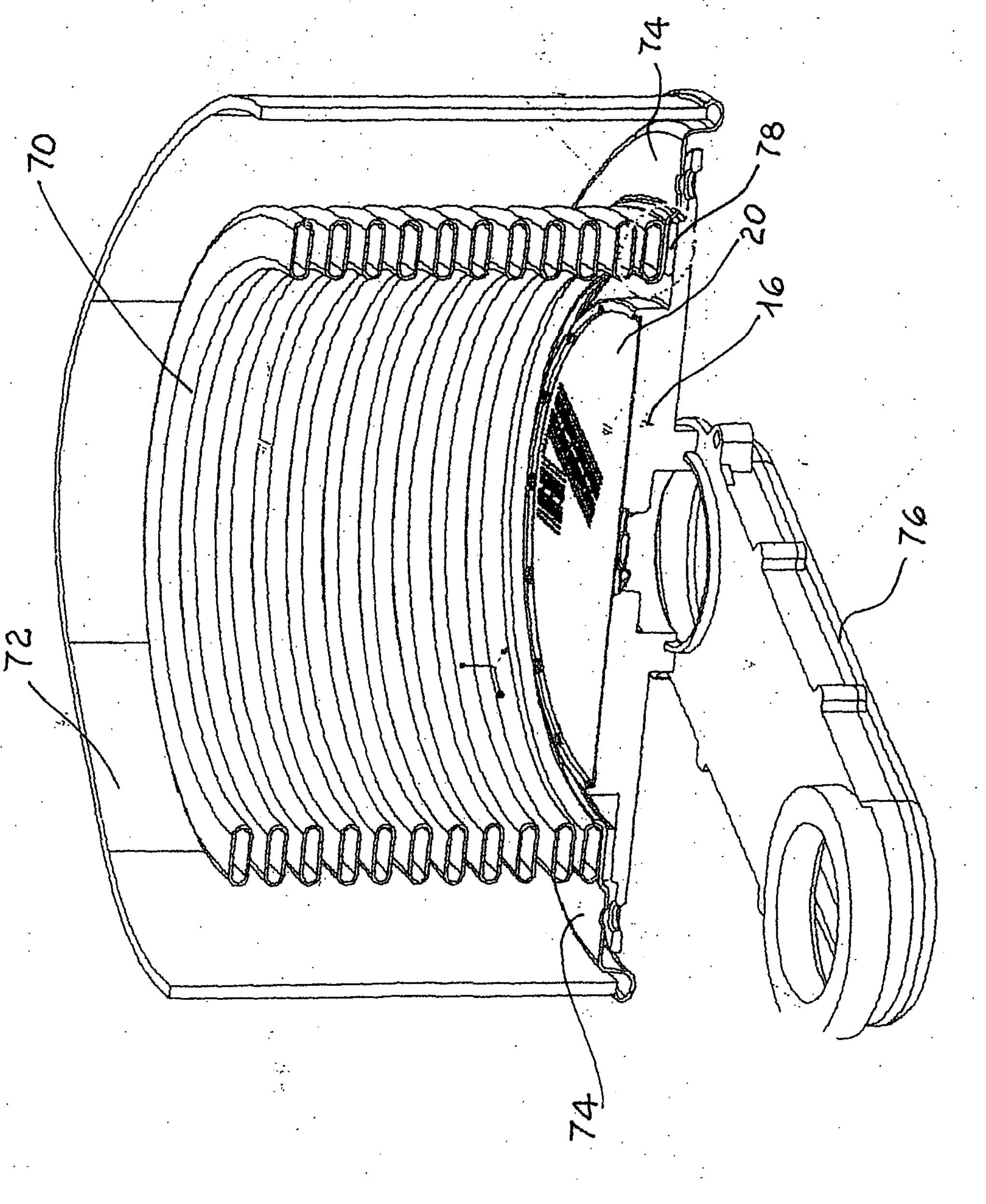
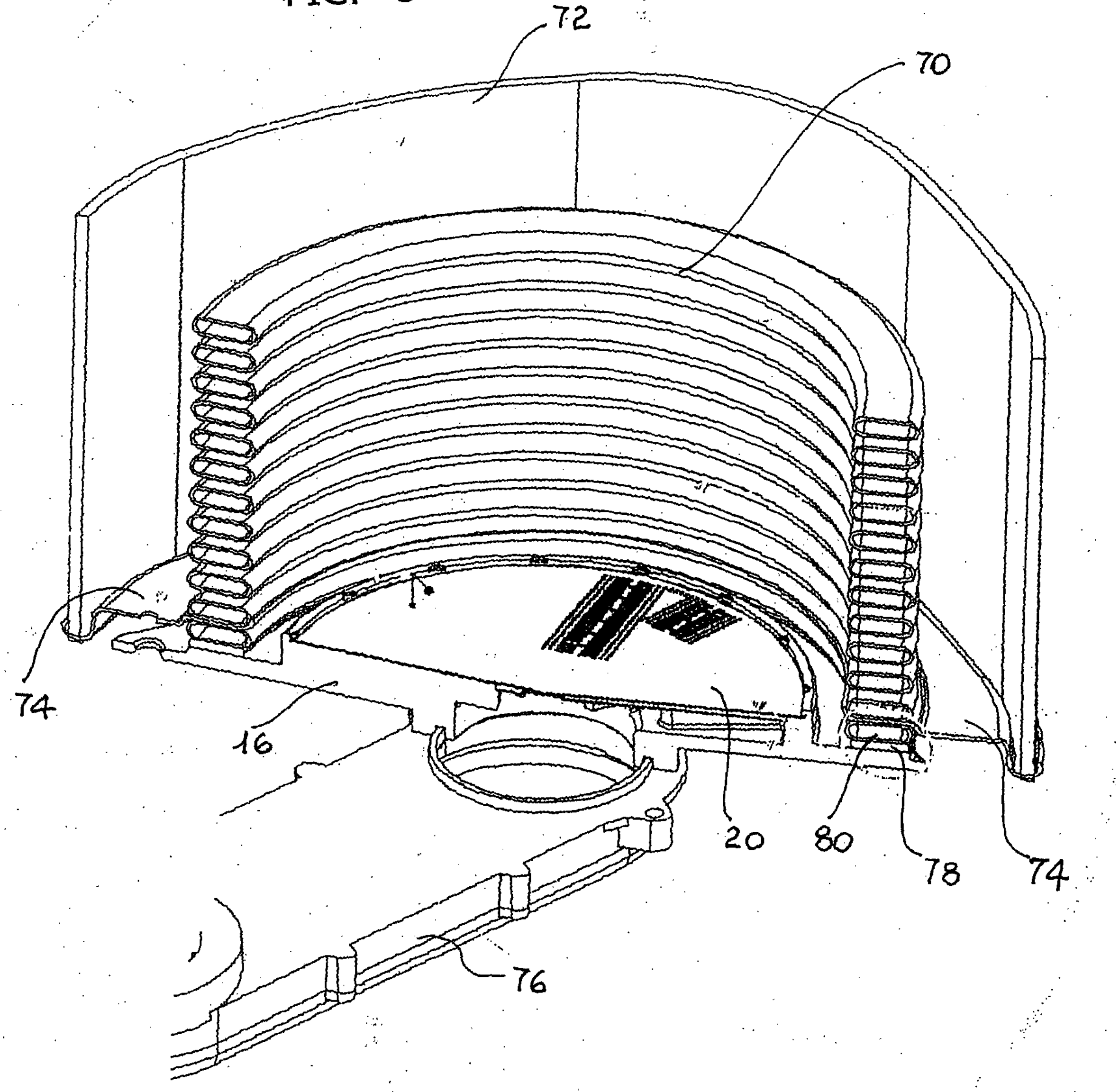


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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