

Description

BACKGROUND OF THE INVENTION

The present invention relates to a burner which is suitable in use with, for example, a melting furnace, an incinerator, a metal furnace, a chemical reactor and so on.

As a typical burner of this type, there are known a combustion burner, a plasma burner, and the like. In the combustion burner, air is pressurized and mixed with fuel for combustion. In such a combustion burner, kerosine or heavy oil is used as fuel, and its flame temperature is at 1,600 to 1,700°C at maximum. When a temperature exceeding this range is required, in order to obtain the high temperature, it is necessary to preheat the air or decrease an amount of exhaust gas by adding oxygen to the air.

On the other hand, in the plasma burner that is known as a burner for obtaining a high temperature, air, nitrogen, argon, hydrogen, helium or the like is jetted as working gas from a plasma generating device to obtain a high temperature.

However, in the case where in order to elevate the flame temperature by the conventional burner, the air is preheated, it is necessary to use a heat exchanger for preheating the air. Accordingly, it is necessary to provide an installation space therefor, and also necessary to meet the heat discharge condition. Further, it is necessary to spend cost for the heat exchanger. Thus, it is troublesome to use such a preheating system.

On the other hand, in the case where the oxygen is added in order to elevate the flame temperature, it is necessary to purchase an oxygen generator and oxygen itself. This is also troublesome as in the case described above.

Also, in case of the plasma burner, there is such a disadvantage that the gas other than the air is costly, and a large electric power is required.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a burner that may elevate a temperature of combustion flame with ease without adding the oxygen or preheating the air.

A burner according to the present invention is characterized in that a plurality of magnets having the same polarity are arranged to be present around a periphery of a combustion chamber around an outer circumference of a combustion sleeve that forms the combustion chamber.

With such an arrangement, the magnetic action such as a magnetic mirror or a drift effect is added to the flame within the combustion sleeve so that the flame is converged. It is possible to obtain a combustion flame having a higher temperature than that of the normal combustion burner or plasma burner.

In this case, if a cooling passage is provided in each magnet arranged around the combustion sleeve that is kept at a high temperature, each magnet may be protected from the high temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a longitudinal sectional view showing an example of a burner in accordance with an embodiment of the present invention;

Fig. 2 is a cross-sectional view taken along the line I-I of Fig. 1;

Fig. 3 is a longitudinal sectional view showing a fuel injection nozzle used in the burner shown in Fig. 1; Fig. 4 is a cross-sectional view taken along the line II-II of Fig. 1;

Fig. 5 is an illustration showing a flow of eddy of flame plasma in the case where the polarity of each magnet of the burner is an N-pole; and

Fig. 6 is an illustration showing a flow of eddy of flame plasma in the case where the polarity of each magnet of the burner is an S-pole.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A burner according to an embodiment of the present invention will now be described with reference to the accompanying drawings.

The burner according to this embodiment is a plasma burner with a mixture sleeve 2 forming a mixture chamber 1. The mixture sleeve 2 is composed of a sleeve portion 2b having a flanged portion 2a at a proximal end, an enlarged diameter stepped portion 2c formed integrally with the distal end of the sleeve portion 2b, a tapered sleeve portion 2d having a smaller diameter from an inlet port toward an outlet port and formed integrally with an outer circumference of the enlarged diameter stepped portion 2c, and a flanged portion 2e provided at an outer circumference of a tip end of the tapered sleeve portion 2d.

A double wall structure type air supply portion 5 composed of an outer sleeve 3 and an inner sleeve 4 is provided in the mixture sleeve 2 on the inlet side of the mixture chamber 1. The pressurized air is fed from the outside to the air supply portion 5. The outer sleeve 3 has flanged portions 3a and 3b at both ends and is connected to the mixture sleeve 2 with its flanged portion 3a being overlapped with the flanged portion 2a. A plasma generating means 6 for making the air flow, flowing through the interior of the inner sleeve 4, under the plasma condition, thereby generating a plasma flow.

In this embodiment, as shown in Fig. 2, in the plasma generating means 6, an annular insulating support member 7 is mounted along an inner circumference of the inner sleeve 4, and a plurality of rod-shaped elec-

trodes 8 are penetrated into and supported to the insulating support member 7. These electrodes 8 are used as anodes and the inner sleeve 4 is used as a cathode. A high voltage is applied in between these electrodes to thereby make the air flow, flowing within the inner sleeve 4, under the plasma condition. This is just one of the applications of the plasma generating means 6 and is not limited to the embodiment shown.

As shown in Fig. 1, spiral vanes 9 are arranged in a spiral manner between the outer sleeve 3 and the inner sleeve 4, and the air flow flowing between the outer sleeve 3 and the inner sleeve 4 is made into a swirl flow to surround and converge the plasma flow. The inner sleeve 4 is supported to the outer sleeve 3 by the spiral vane 9.

A plurality of fuel injection nozzles 10 for injecting the fuel around the plasma flow within the mixture chamber 1 and mixing the fuel with the swirl flow are provided through and to the enlarged diameter stepped portion 2c of the mixture sleeve 2. As shown in Fig. 3, when the compression air is caused to flow through the fuel injection nozzles 10 as a primary air to the air flow path 11, a joint flow portion 13 with the fuel passage 12 is kept under a negative pressure by its dynamic pressure, and the fuel is sucked and atomized so that the mixture flow of the fuel and the air from the throat 14 is injected to the outside of the nozzle sleeve 15.

The combustion sleeve 16 is connected through the flanged portion 16a to the flanged portion 2e of the mixture sleeve 2 on the outlet side of the mixture chamber 1. A cylindrical combustion chamber 17 is formed in the interior of the combustion sleeve 16. A flanged portion 16b is provided at the other end of the combustion sleeve 16. A plurality of ignition plugs 18 are connected to and through the combustion sleeve 16.

Four electromagnets 19 are arranged at an interval of 90° with the same pole (N-pole in this embodiment) being located around the combustion chamber 17 around the outer circumference of the combustion sleeve 16. In these electromagnets 19, each coil 21 is wound around an iron core 20 in one direction as shown in Fig. 4, and each coil 21 is connected in series with each other to thereby supply the excited current from a direct current power source 22.

A cooling passage 23 for flowing cooling water is formed in the iron core 20 of each electromagnet 19. A cooling jacket outer wall 24 is provided coaxially around the outer circumference of the combustion sleeve 16. Both ends of the cooling jacket outer wall 24 are connected to the flanged portions 16a and 16b of the combustion sleeve 16. A cooling chamber 25 is formed between the combustion sleeve 16 and the cooling jacket outer wall 24. The cooling water is fed from an opening portion 23a of the cooling passage 23 of the iron core 20 to the cooling chamber 25. The cooling water within the cooling chamber 25 is discharged from a drain port 24a of the cooling jacket outer wall 24. A partitioning sleeve 26 for partitioning from the cooling water is pro-

vided at the positions of the ignition plugs 18.

If the plurality of electromagnets 19 are arranged around the combustion sleeve 16 with their same polarity, the magnetic action such as a magnetic mirror and a drift effect is applied to the flame within the combustion sleeve 16 so that the flame is converged. As a result, it is possible to obtain the combustion flame having a higher temperature than that of the normal combustion burner or plasma burner.

Figs. 5 and 6 are illustrations showing the action of the electromagnets 19 for the flame within the combustion sleeve 16. In the case where the N-pole of each electromagnet 19 is located around the combustion sleeve 16 as shown in Fig. 5, if the flame is caused to flow from the front side to the rear side of the paper surface, eddy flows of the flame are formed as shown in Fig. 5. Namely, the eddy is generated in the counter-clockwise direction in the circumferential portion of the combustion sleeve 16, and the eddy is generated in the clockwise direction in the central portion thereof. On the other hand, if the polarity of the electromagnet 19 is reversed, and each electromagnet 19 is located around the circumference of the combustion sleeve 16 with the S-pole of the electromagnet 19 being located around the sleeve 16, the eddy is generated in the clockwise direction in the circumferential portion of the combustion sleeve 16, and the eddy is generated in the counter-clockwise direction in the central portion thereof. The flame is converged by the action of the eddies generated in the combustion sleeve 16.

In the embodiment, since the electromagnets 19 are used as the magnets, it is possible to adjust the convergence of the flame plasma by adjusting the exciting current and it is also possible to adjust the temperature of the flame plasma. Also, if the cooling passage 23 is provided in each magnet 19 arranged around the combustion sleeve 16 that is kept at a high temperature and the cooling jacket outer wall 24 is arranged around the combustion sleeve 16 to thereby cool the magnets with the cooling water, it is possible to protect the respective electromagnets 19 from a high temperature. In particular, if the cooling passage 23 is provided within the iron core 20, it is possible to effectively cool the iron core 20.

The burner according to the present invention is not limited to the plasma burner having the above-described structure but may be a plasma burner having other structure or a fuel burner having other structure. In any case, the plurality of magnets are arranged so that the same polarity of the magnets is present around the combustion chamber around the outer circumference of the combustion sleeve forming the combustion chamber so that the magnetic action such as a magnetic mirror or a drift effect is applied to the flame within the combustion sleeve and it is possible to obtain a high temperature combustion flame in comparison with the normal combustion burner or plasma burner.

In the embodiment described above, the electromagnets 19 are arranged around the combustion sleeve

16 but it is possible to arrange permanent magnets around the sleeve with the same polarity instead of the electromagnets 19.

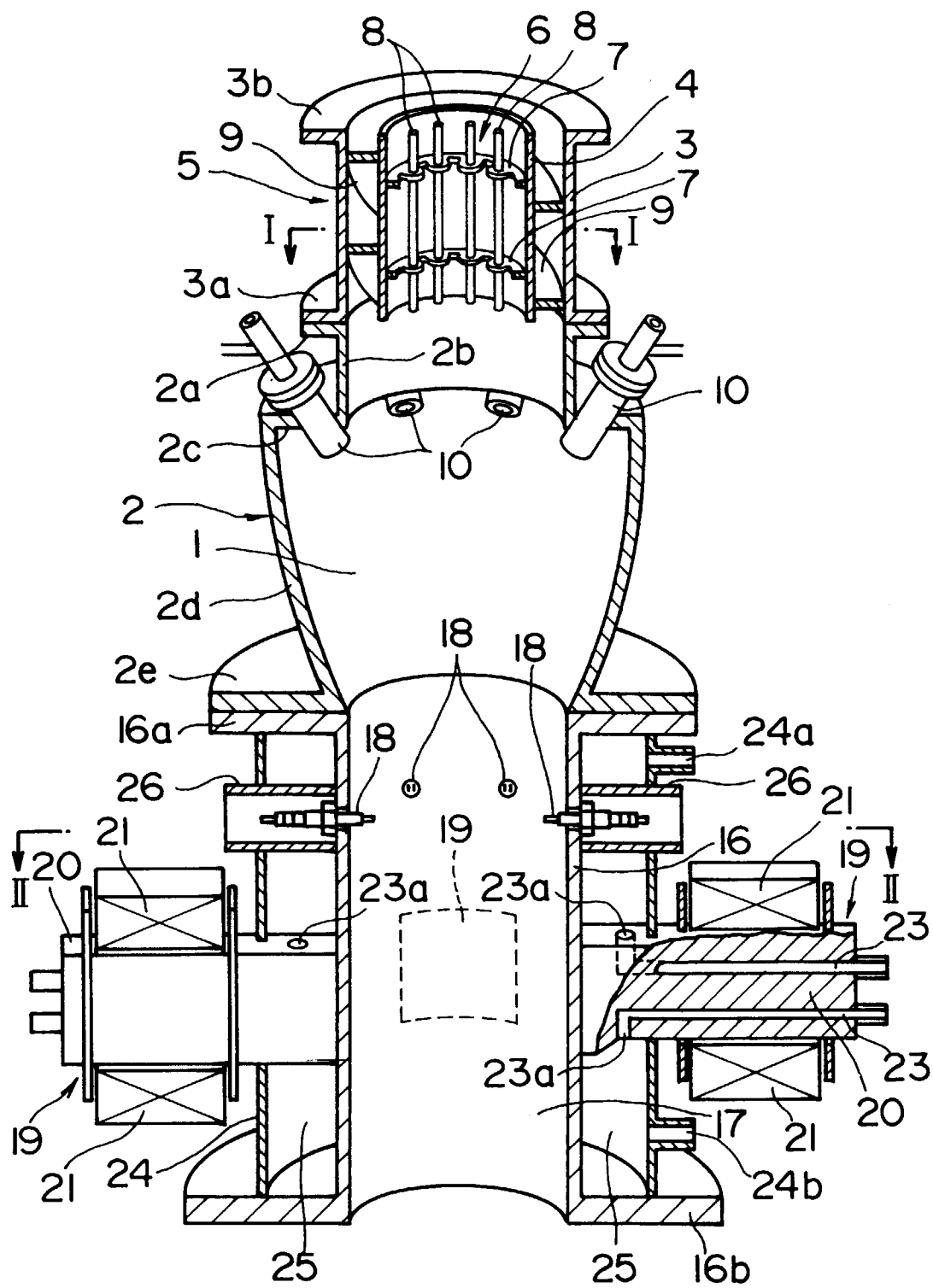
In the burner according to the present invention, since the plurality of magnets are arranged around the outer circumference of the combustion sleeve forming the combustion chamber with the same polarity being located around the combustion chamber, so that the magnetic action such as a magnetic mirror or a drift effect is applied to the flame within the combustion sleeve and the flame is converged and it is possible to obtain a high temperature combustion flame in comparison with the normal combustion burner or plasma burner.

Various details of the invention may be changed without departing from its spirit nor its scope. Furthermore, the foregoing description of the embodiments according to the present invention is provided for the purpose of illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

Claims

1. A burner characterized in that a plurality of magnets having the same polarity are arranged to be present around a periphery of a combustion chamber around an outer circumference of a combustion sleeve that forms the combustion chamber.
2. A burner according to claim 1, wherein a cooling passage is provided in each magnet.

FIG. 1.



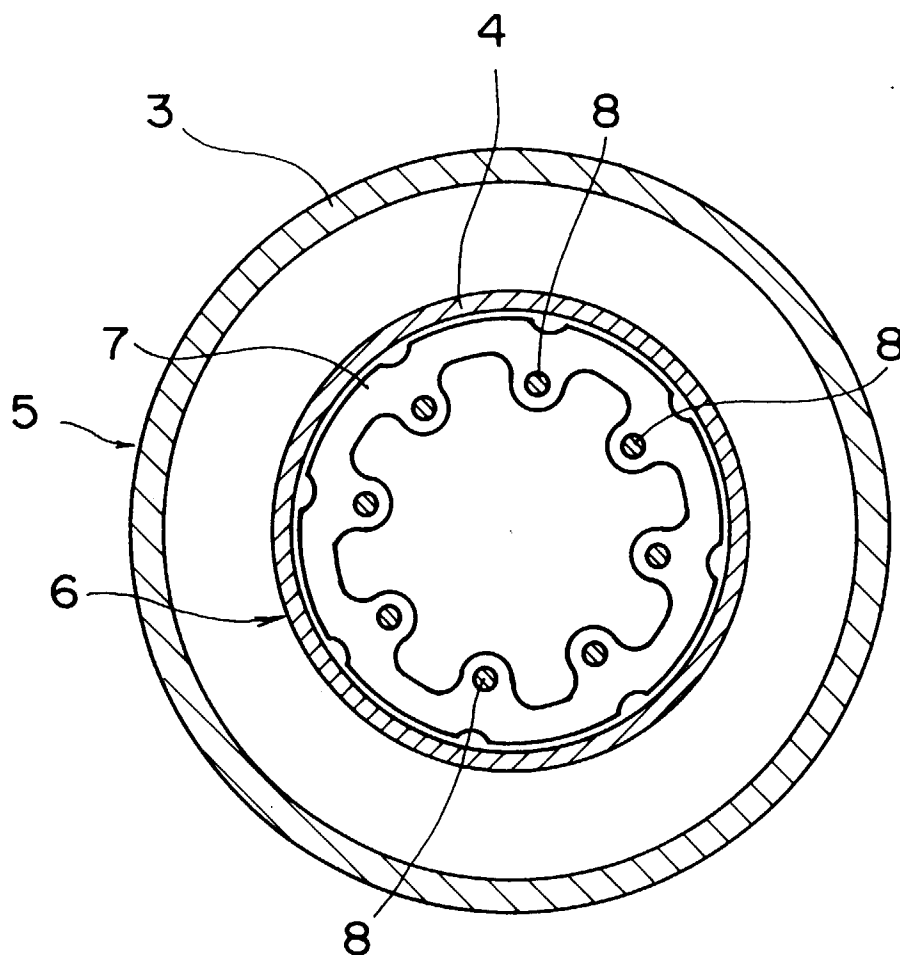


FIG. 2

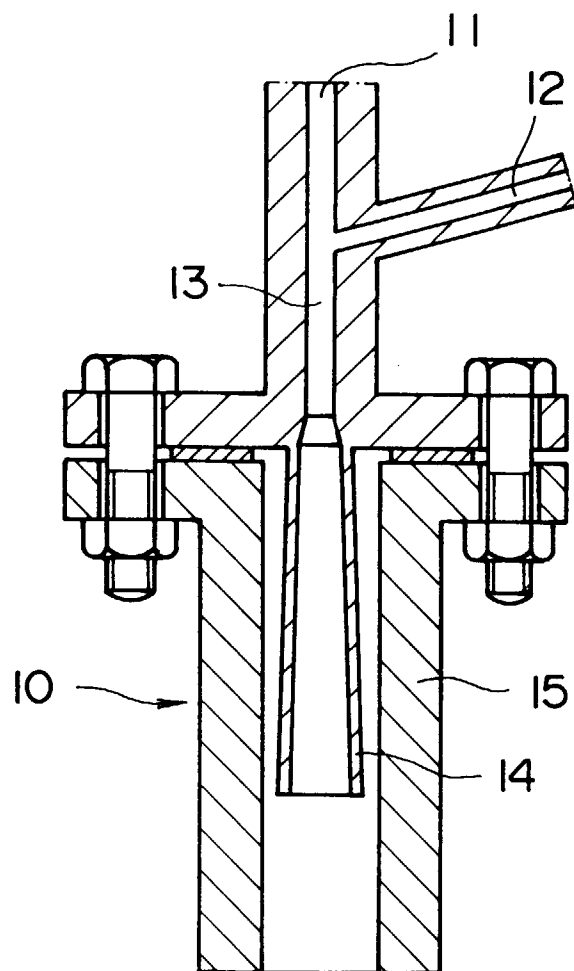


FIG. 3

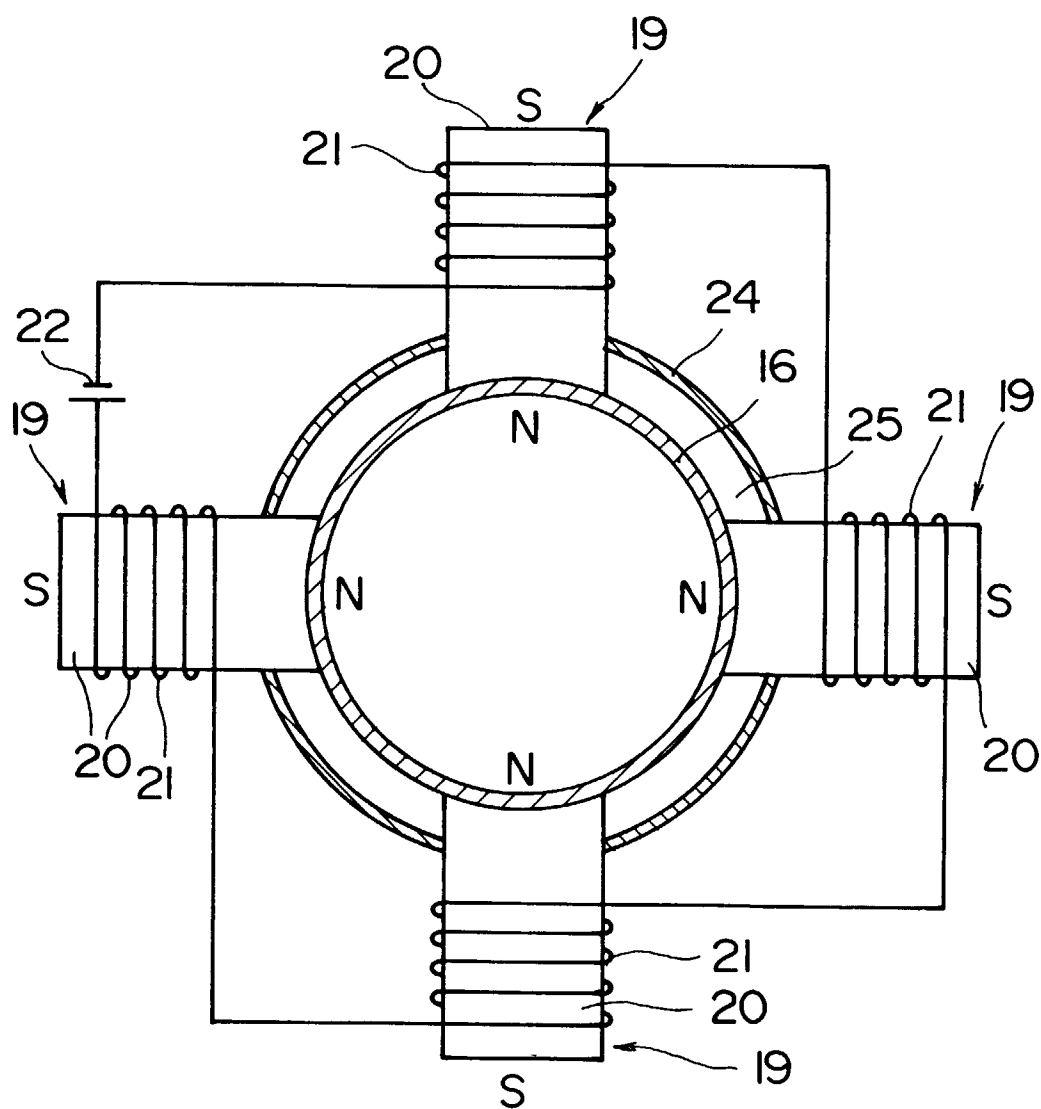


FIG. 4.

FIG. 5.

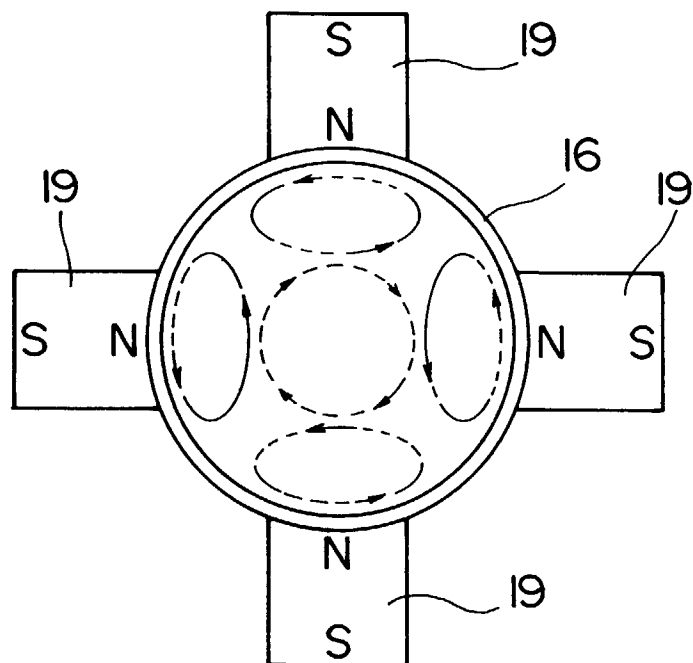


FIG. 6.

