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(54) **Automatically operated burner of coal dust or any other solid fuel**

Automatisch arbeitender Brenner für Kohlenstaub oder für irgendeinen anderen festen Brennstoff

Brûleur automatique pour charbon pulvérisé ou autre combustible solide quelconque

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Description

The present invention relates to a burner designed in particular to be supplied with coal dust, solid fuels from urban solid refuses, industrial waste, also referred to RDF (Refuse Derived Fuel), or any other solid fuel which can be turned into dust. Such a burner is known from the DE-A-32 06 074.

The burner is of the self-contained enbloc type and can operate automatically.

At the present status of art devices are used which can be operatively referred to coal dust blowers rather than burners. Such known devices need suitable combustion chambers and starting pre-heaters causing the system to be considerably "rigid", which makes the control thereof very hard, the automatic operation quite complicated, the fire control very difficult, the flow rate control insufficient, the capability of adaptation to other fuels very short, and the rate of the carrier gas rather low with deposition problems.

This invention aims at providing a burner of the mentioned kind which has the following advantages over the known systems:

a) capability of burning any fuel which can be powdered;
b) ease of installation at any furnace, high operating flexibility due to the modular regulation, use of automatic controls, automatic firing and re-firing;
c) good combustion efficiency such as high thermal efficiency, complete combustion with spent residual dusts, and high combustion temperature.

According to the invention it is provided a burner as disclosed in claim 1.

The invention will now be described with reference to the accompanying drawings which show by way of a non-limitative example a preferred embodiment of the invention.

In the drawings:

Fig. 1 is a side elevation view;
Fig. 2 is a front elevation view of Fig. 1 seen from the flame;
Fig. 3 shows in detail the meter of the dust in several section views;
Fig. 4 shows schematically an axial section view of the burner;
Fig. 5 is a front view corresponding to Fig. 4;
Figs. 6 and 7 are views in enlarged scale corresponding to Figs. 4 and 5.

With reference to Figs. 1 and 2 the invention provides a metering device 1 and a burner supplied by such metering device and formed of four coaxial bodies, namely cylindrical body 2 in which the dust is conveyed along with the carrier air, body 3 conveying the swirling air as better described afterwards, body 4 for the air-gas mixture feeding the auxiliary flame to fire the dust, and the outer sleeve 7 in which the combustion air is conveyed. There is also a fitting 5 provided with flange 6 for the connection of the whole device to the furnace (not shown), as well as a nozzle ejecting the flame 8.

The metering device (Fig. 3) includes a hopper 9 receiving the powdery fuel with the desired granulometry. At the base of the hopper a pair of rotors 10 turn in the direction indicated by the arrows. Such rotors carry radial vanes 11 which form compartments or pockets having an essentially constant volume together with the seats formed in the stationary casing 12.

Radial vanes 11 are offset so that the dust from the hopper is mixed and supplied to the feeding chamber 13 under rotors 10. A disc 14 rotating within hopper 9 is provided with tangential studs 15 and radial studs 16 having the function of avoiding dust cloggings. All of such rotating members are driven by gearmotor 17 through gears 18 and 19. It is evident that the flow rate of the dust can continuously be varied from zero to the predetermined maximum value by varying the speed of rotors 10.

From the feeding chamber 13 the dust along with the carrier air is fed through the axial pipe 20 of the burner head shown in Figs. 4 to 7.

Pipe 20 ends at the front side in a Venturi tube nozzle 21 carrying a ring of holes 22 converging to the axis of pipe 20 and misaligned sideways so as to cause air flowing from inlet 23 through the annular room 24 about pipe 20 defined by sleeve 25 to swirl.

Another annular room 26 is provided coaxially to the axis of the ejecting pipe 20, in which room an air-gas mixture flows from inlet 27. Such room 26 ends at the front side in a ring of nozzles 28 angularly spaced and intended to eject a plurality of flames surrounding the outlet of nozzle 21. A further annular room 29 defined by sleeves 3 and 4 conveyes the combustion air from inlet 30 which is generated by a known electric fan not shown.

The annular room 29 of the combustion air ends at the front side in a frusto-conical "horn" fitting 31 carrying a double ring of holes 32 converging to the axis of pipe 20 and misaligned so as to cause the combustion air to swirl in the opposite direction of rotation of the dust ejected by nozzle 21.

The operation of the device is apparent from Figs. 6 and 7: the dust swirls out of nozzle 21 and is fired by the surrounding ring of auxiliary flames ejected by nozzles 28. Once the predetermined conditions of the thermal rate are reached, the auxiliary flames can be blown out (by shutting off only the gas) so that the combustion is supported only by the dust.

As mentioned above the operation of the dust burner is completely automatic, including firing which is provided by a little blowing air burner (drive burner) having a low thermal value, for example 7000 kcal/h. The drive burner is automatic and provided with electric firing means and flame control means. The combustion air to be supplied to the drive burner is fed by the electric fan also supplying the auxiliary burner associated to the dust

burner with the combustion air.

The firing steps are as follows:

- pre-washing the combustion chamber for eliminating any gas residue;
- firing the drive burner and waiting for the fire stabilization;
- repeating in succession the above steps of the firing cycle of the dust burner.

The drive burner operates as long as the dust burner is under operating conditions and even as the latter is blown out due to the reaching of the maximum temperature.

After the drive burner is fired, the auxiliary pre-firing gas burner formed of the nozzle ring 28 is fired. The latter burner has a prefixed thermal value of 30.000 to 60.000 kcal/h.

After the pre-firing burner is fired, a certain time is needed so that the combustion chamber can reach the requested minimum temperature; once the desired temperature is reached, the combustion air, the swirling air, the dust atomizing carrier air, and the dust at the minimum flow rate arm let in. After the dust is fired with the aid of the auxiliary flame, the flow rate of the fuel is automatically adjusted to the desired value.

After the flame has settled and a further increase in the temperature of the combustion chamber is achieved, the gas of the auxiliary burner is shut off and the combustion is supported only by the dust fuel, as previously mentioned.

The blowing out of the auxiliary burner is provided only if a good combustion can be self-sustained by means of the fuel being used; in case of a poor, hardly burning fuel, the auxiliary burner is kept fired. In any case the drive burner is kept in operation.

After the temperature or the pressure adjusted in the automatic modulation regulators located by the user to be supplied is reached, the thermal value of the burner is settled to the actual requirement of the user; if also the minimum flow rate is overflowing, the whole burner is blown out except for the drive burner. The whole burner assembly will be fired again when believed it necessary by the control means. The re-firing steps are the same as those already described.

Claims

1. A burner of coal dust or any other solid fuel of the enbloc type having a horizontal axis including: a combustion head comprising a plurality of coaxial cylindrical ducts including a sleeve (20) carrying the dust from said mixing chamber and ending in an atomizing nozzle (21), a duct (24) of the swirling air, a duct (26) to let in an air-gas mixture ending in a pre-firing hole for the auxiliary flame, and a duct (29) of the combustion air, characterized in that the atomizing nozzle (21) at the front end of the sleeve (20) transferring the air-dust mixture includes a first converging, frusto-conical input length, a second cylindrical length and a third diverging frusto-conical output length to slow down the rate of the mixture and at the same time to spread the jet, in the conical portion of the third length a plurality of cylindrical holes (22) being provided, said holes (21) having sloping axes with regard to the longitudinal axis of the burner and being misaligned with regard to the central axis of the nozzle (21), said holes (22) communicating with the swirl air inlet duct (24) coaxially surrounding the nozzle, thus providing that the air flowing through said holes be caused to swirl and be conveyed to the jet of the atomized dust.

2. The burner of coal dust of claim 1, characterized in that the atomizing nozzle (21) is provided at the centre of a pre-firing and/or auxiliary ring-shaped burner adapted to provide a flame ring surrounding said nozzle (21) ejecting the dust, said pre-firing and/or auxiliary burner being formed of a ring in which a plurality of cylindrical, equally spaced holes are provided, in which as many nozzles (28) of frusto-conical form are provided having output holes with axis parallel to that of the dust inlet duct (20) and all connected to the duct (26) of the air-gas mixture surrounding said dust inlet duct (20).

3. The burner of coal dust of the preceding claim, characterized in that said nozzles (28) of the pre-firing and/or auxiliary burner are provided with secondary holes formed in the conical wall and sloped with regard to the longitudinal axis of the burner, said holes being adapted to eject litt.le flames in order to avoid any flame breakdown.

4. The burner of coal dust of the preceding claims, characterized in that the axes of the cylindrical holes (32), provided on the frusto-conical annular body (31) outside the pre-firing and/or auxiliary gas burner, are sloped with regard to the longitudinal axis of the burner, said holes (32) being misaligned from the central axis of said combustion head, thus providing that the air conveyed through said holes swirls (22) in the opposite direction of that of rotation in the atomizing nozzle (21) in order to cause the combustion air to cross the fuel atomized in the combustion head.

5. The burner of coal dust of the preceding claim, characterized in that several flow rates can be independently adjusted so as to provide optimum combustion conditions as a function of the required thermal value, being in particular provided a wide range of control of the air that supports combustion, the swirling air and the dust carrier air.

6. The burner of coal dust of claim 1, characterized in that it includes: a metering means (1) provided with charging hopper (9) to supply dust to an underlying mixing chamber where the dust is mixed with the carrier air, said metering unit (1) including a pair of rotors (10) having parallel axes and opposite directions of rotation, which are provided with vanes (11) defining a plurality of little compartments or pockets which are externally closed by the lining of the stationary casing of said rotors and communicates at the upper side with the exterior through the charging opening at the bottom of the hopper (9) and at the lower side with a chamber at the base of the metering unit (1).

Patentansprüche

1. Brenner für Kohlenstaub oder für irgendeinen anderen blockförmigen, festen Brennstoff mit einer horizontalen Achse, folgendes umfassend: einen Brennkopf mit einer Mehrzahl koaxialer, zylindrischer Leitungen mit einer Büchse (20), die den Staub von besagter Mischkammer abtransportiert und in einer Zerstäuberdüse (21) endet, eine Leitung (24) für die Wirbelluft, eine Leitung (26) zum Einlaß eines Luft-Gas-Gemisches, die in einem Vorzündloch für die Hilfsflamme endet, und eine Leitung (29) der Verbrennungsluft, dadurch gekennzeichnet, daß die Zerstäuberdüse (21) am vorderen Ende der Büchse (20), die das Luft-Staub-Gemisch überträgt, eine erste konvergierende, kegelstumpfförmige Eingangslänge, eine zweite zylindrische Länge und eine dritte kegelstumpfförmig divergierende Ausgangslänge, um den Gemischdurchsatz zu vermindern und gleichzeitig den Strahl aufzuweiten wobei im konischen Bereich der dritten Länge eine Mehrzahl von Löchern (22) angeordnet sind, wobei diese Löcher (22) bezüglich der longitudinalen Achse des Brenners schräge Achsen haben, die bezüglich der Mittelachse der Düse (21) verlagert sind, wobei diese Löcher (22) mit der Wirbelluft-einlaßleitung (24), die die Düse koaxial umgibt, in Verbindung stehen, so daß die durch diese Löcher strömende Luft verwirbelt und zum Strahl des zerstäubten Staubes befördert wird.

2. Brenner für Kohlenstaub nach Anspruch 1, dadurch gekennzeichnet, daß die Zerstäuberdüse (21) im Zentrum eines ringförmigen Vorzünd- und/oder Hilfsbrenners angeordnet ist, der einen Flammenring um die den Staub ausstoßende Düse (21) erzeugt, wobei dieser Vorzünd- und/oder Hilfsbrenner aus einem Ring gebildet ist, in dem eine Mehrzahl zylindrischer, gleichmäßig beabstandeter Löcher angeordnet ist, in denen ebenso viele kegelstumpfförmige Düsen (28) mit Ausgangslöchern deren Achsen parallel zu denen der Staubeinlaßleitung (20) sind, vorgesehen sind, und die alle mit der Leitung (26) das Luft-Gas-Gemisches, die die Staubeinlaßleitung (20) umgibt, verbunden sind.

3. Brenner für kohlenstaub nach dem vorstehenden Anspruch, dadurch gekennzeichnet, daß besagte Düsen (28) des Vorzünd- und/oder Hilfsbrenners mit zweiten Löchern ausgescattet sind, die schräg bezüglich der longitudinalen Achse des Brenners in der konischen Wand ausgebildet sind, wobei diese Löcher derart ausgeformt sind, daß sie kleine Flammen ausstoßen, um jedes Erlöschen der Flamme zu verhindern.

4. Brenner für Kohlenstaub nach dem vorstehenden Anspruch, dadurch gekennzeichnet, daß die Achsen der zylindrischen Löcher (32), die im kegelstumpfförmigen Ringkörper (31) außerhalb des Vorzünd- und/oder Hilfsbrenners vorgesehen sind, schräg bezüglich der longitudinalen Achse des Brenners sind, wobei diese Löcher (32) von der Mittelachse des Brennkopfes versetzt sind, so daß die durch diese Löcher (22) beförderte Luft in die entgegensetzte Richtung wie die der Rotation in der Zerstäuberdüse (21) verwirbelt wird, so daß die Verbrennungsluft den zerstäubten Brennstoff im Brennkopf kreuzt.

5. Brenner für Kohlenstaub nach dem vorstehenden Anspruch, dadurch gekennzeichnet, daß mehrere Flußraten unabhängig eingestellt werden können, um optimale Verbrennungsbedingungen als Funktion des benötigten Heizwertes zur Verfügung zu stellen, wobei diese insbesondere durch einen weiten Regelbereich der die Verbrennung unterstützenden Luft, der Wirbelluft und der Staub tragenden Luft zur Verfügung gestellt werden.

6. Brenner für Kohlenstaub nach Anspruch 1, dadurch gekennzeichnet, daß er folgendes umfaßt : eine Dosiervorrichtung (1) mit einem Beschickungstrichter (9), um Staub an eine darunter liegende Mischkammer zuzuführen, wo der Staub mit der Trägerluft vermischt wird, wobei die besagte Dosiereinheit (1) ein Paar Rotoren (10) umfaßt, deren Achsen parallel sind und die entgegengesetzte Rotationsrichtungen haben, die mit Schaufeln (11) ausgerüstet sind, die eine Mehrzahl kleiner Kammern oder Taschen umschließen, die durch die Wandung des stationären Gehäuses der Rotoren nach außen abgeschlossen sind und oben über die Beschikkungsöffnung am Boden des Trichters (9) eine Verbindung nach außen haben und unten mit einer Kammer an der Unterseite der Dosiervorrichtung in Verbindung stehen.

Revendications

1. Un brûleur pour charbon pulvérisé ou autre combustible solide quelconque du type en bloc présentant un axe horizontal comprenant : une tête de combustion comportant un ensemble de conduits cylindriques coaxiaux comprenant un manchon (20) transportant la poussière depuis ladite chambre de mélange et se terminant en une buse d'atomisation (21), un conduit (24) pour l'air en tourbillonnement, un conduit (26) pour laisser entrer un mélange air-gaz se terminant dans un trou de pré-allumage pour la flamme auxiliaire, et un conduit (29) pour l'air de combustion, caractérisé en ce que la buse d'atomisation (21) à l'extrémité avant du manchon (20) transférant le mélange air-poudre comprend un premier segment d'entrée tronconique convergent, un second segment cylindrique et un troisième segment de sortie tronconique divergent pour ralentir la vitesse du mélange et en même temps étaler le jet, un ensemble de trous cylindriques (22) étant prévu dans la partie conique du troisième segment, lesdits trous (21) présentant des axes inclinés par rapport à l'axe longitudinal du brûleur et étant désalignés par rapport à l'axe central de la buse (21), lesdits trous (22) communiquant avec le conduit d'entrée (24) de l'air en tourbillonnement entourant coaxialement la buse, en assurant ainsi que l'air passant à travers lesdits trous soit amené à tourbillonner et être transporté vers le jet de poudre atomisée.

2. Le brûleur pour charbon pulvérisé de la revendication 1, caractérisé en ce que la buse d'atomisation (21) est prévue au centre d'un brûleur annulaire de pré-allumage et/ou auxiliaire prévu pour créer un anneau de flammes entourant ladite buse (21) projetant la poudre ledit brûleur de pré-allumage et/ou auxiliaire étant formé d'un anneau dans lequel est prévu un ensemble de trous cylindriques écartés de manière régulière, dans lequel est prévu un nombre de buses (28), de forme tronconique et présentant des trous de sortie à axe parallèle, égal à celui du conduit d'entrée (20) de la poudre et tous reliés au conduit (26) du mélange air-gaz entourant ledit conduit d'entrée (20) de la poudre.

3. Le brûleur pour charbon pulvérisé de la revendication précédente, caractérisé en ce que lesdites buses (28) du brûleur de pré-allumage et/ou auxiliaire sont munies de trous secondaires formés dans la paroi conique et inclinés par rapport à l'axe longitudinal du brûleur, lesdits trous étant prévus pour projeter de petites flammes de manière à éviter toute rupture de flamme.

4. Le brûleur pour charbon pulvérisé des revendications précédentes, caractérisé en ce que les axes des trous cylindriques (32), prévus sur le corps annulaire tronconique (31) à l'extérieur du brûleur de pré-allumage et/ou auxiliaire, sont inclinés par rapport à l'axe longitudinal du brûleur, lesdits trous (32) étant désalignés par rapport à l'axe central de ladite tête de combustion, en assurant ainsi que l'air transporté à travers lesdits trous tourbillonne (22) dans la direction opposée à la direction de rotation dans la buse d'atomisation (21) de manière à amener l'air de combustion à croiser le combustible atomisé dans la tête de combustion.

5. Le brûleur pour charbon pulvérisé de la revendication précédente, caractérisé en ce qu'on peut régler de manière indépendante plusieurs vitesses d'écoulement afin d'assurer des conditions de combustion optimales en fonction de la valeur thermique requise, en prévoyant en particulier une large gamme de commande de l'air qui assure la combustion, de l'air en tourbillonnement et de l'air de support de la poudre.

6. Le brûleur pour charbon pulvérisé de la revendication 1, caractérisé en ce qu'il comprend : un moyen de mesure (1) muni d'une trémie de chargement (9) pour amener de la poudre à une chambre de mélange sous-jascente où la poudre est mélangée à l'air de support, ledit ensemble de mesure (1) comprenant une paire de rotors (10) présentant des axes parallèles et de sens de rotation opposés, qui sont munis de pales (11) définissant un ensemble de petits compartiments ou poches qui sont fermés extérieurement par le revêtement du boîtier fixe dudit rotor et communiquent au niveau du côté supérieur avec l'extérieur par l'intermédiaire de l'ouverture de chargement au fond de la trémie (9) et au niveau du côté inférieur avec une chambre à la base de l'ensemble de mesure (1).

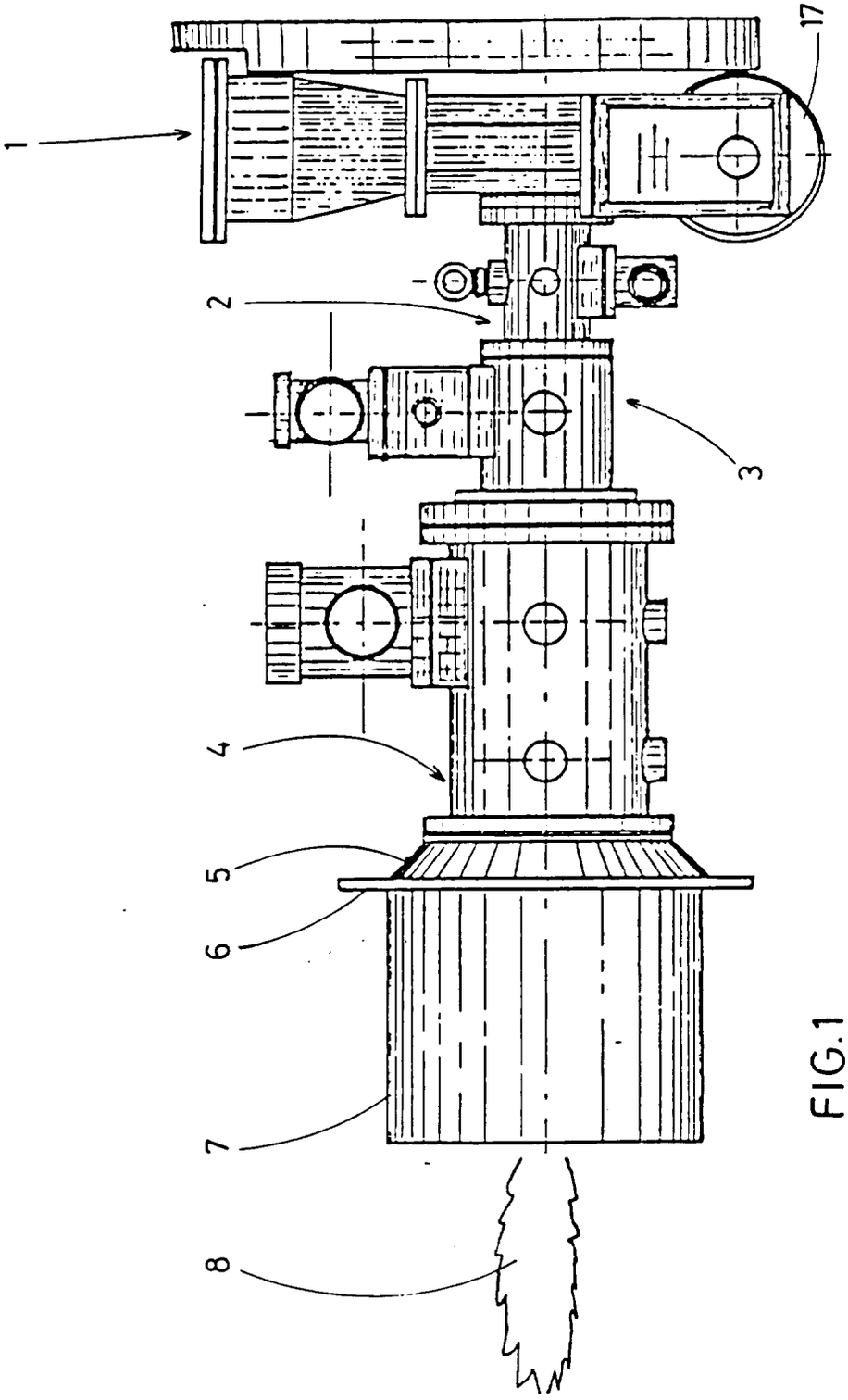

FIG.1

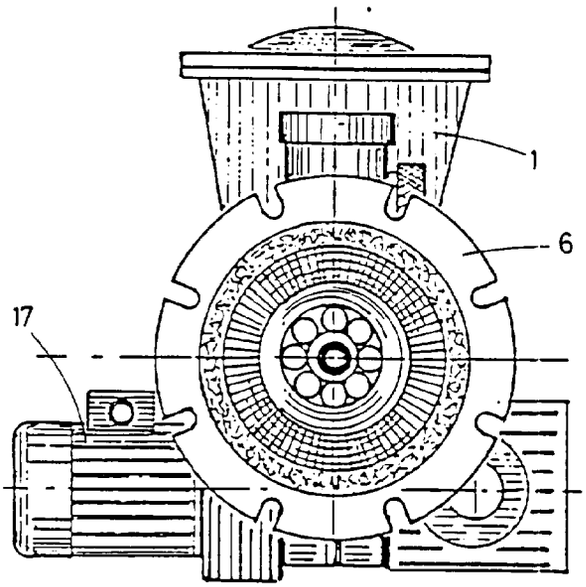

FIG.2

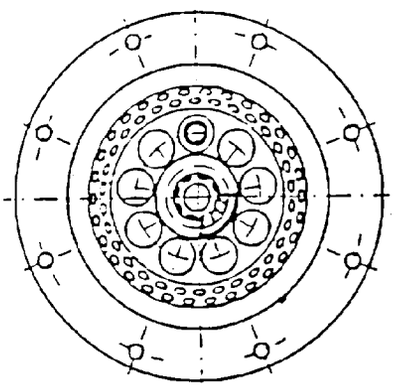

FIG.5

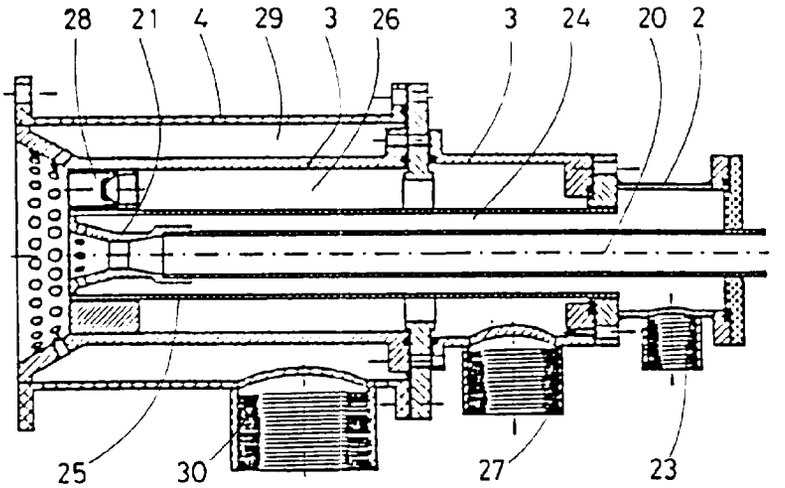

FIG.4

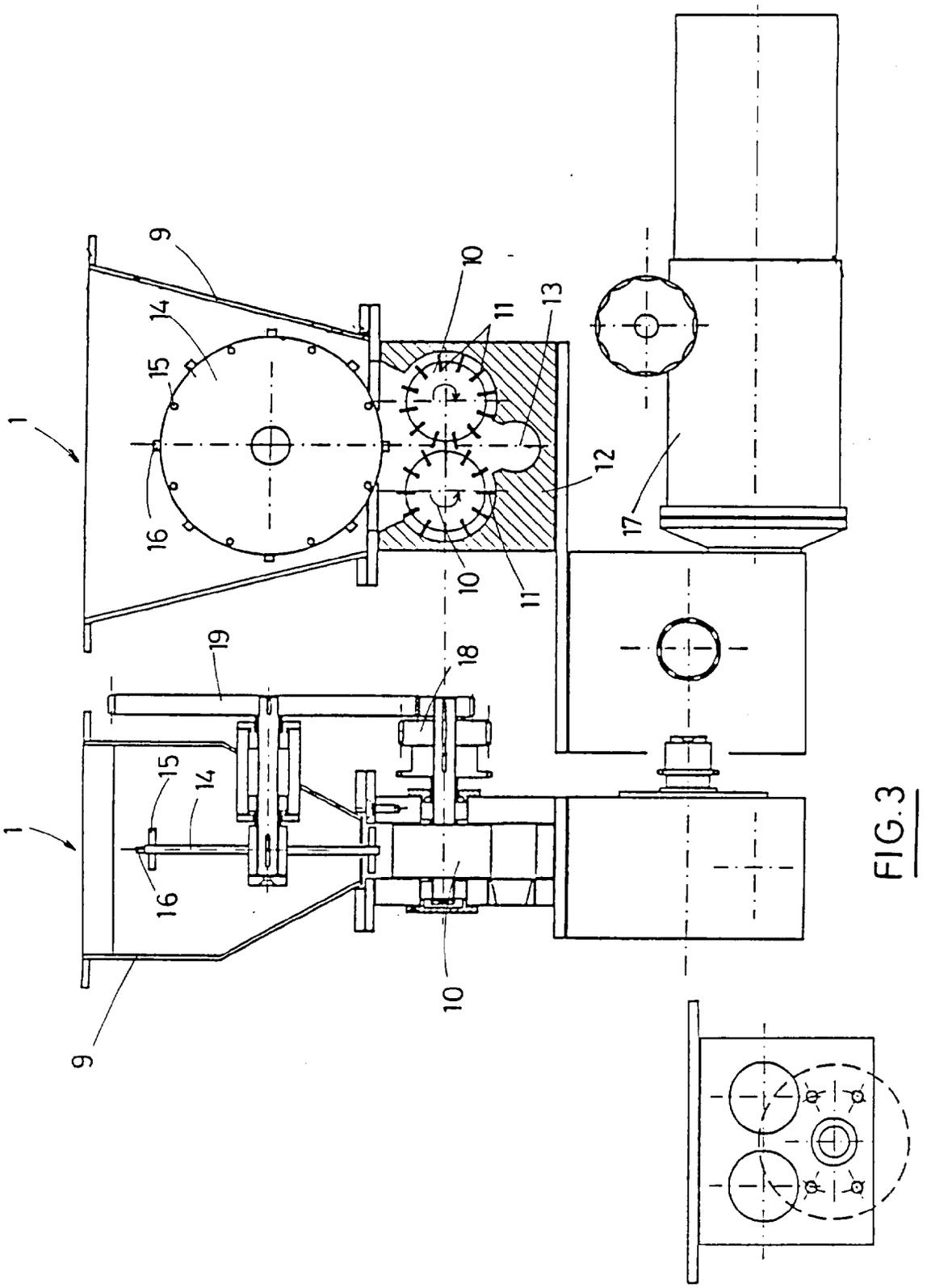

FIG.3

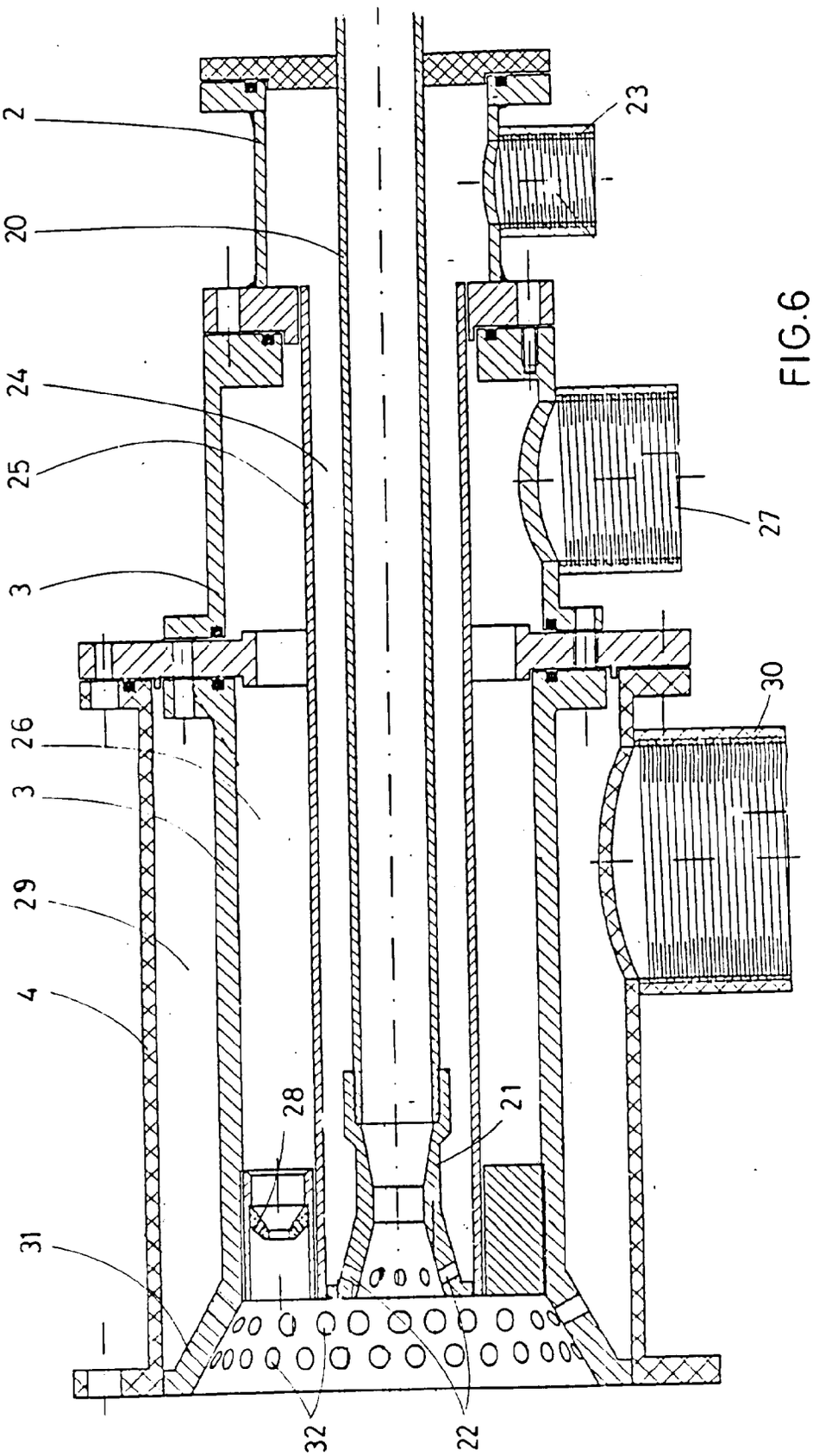

FIG.6

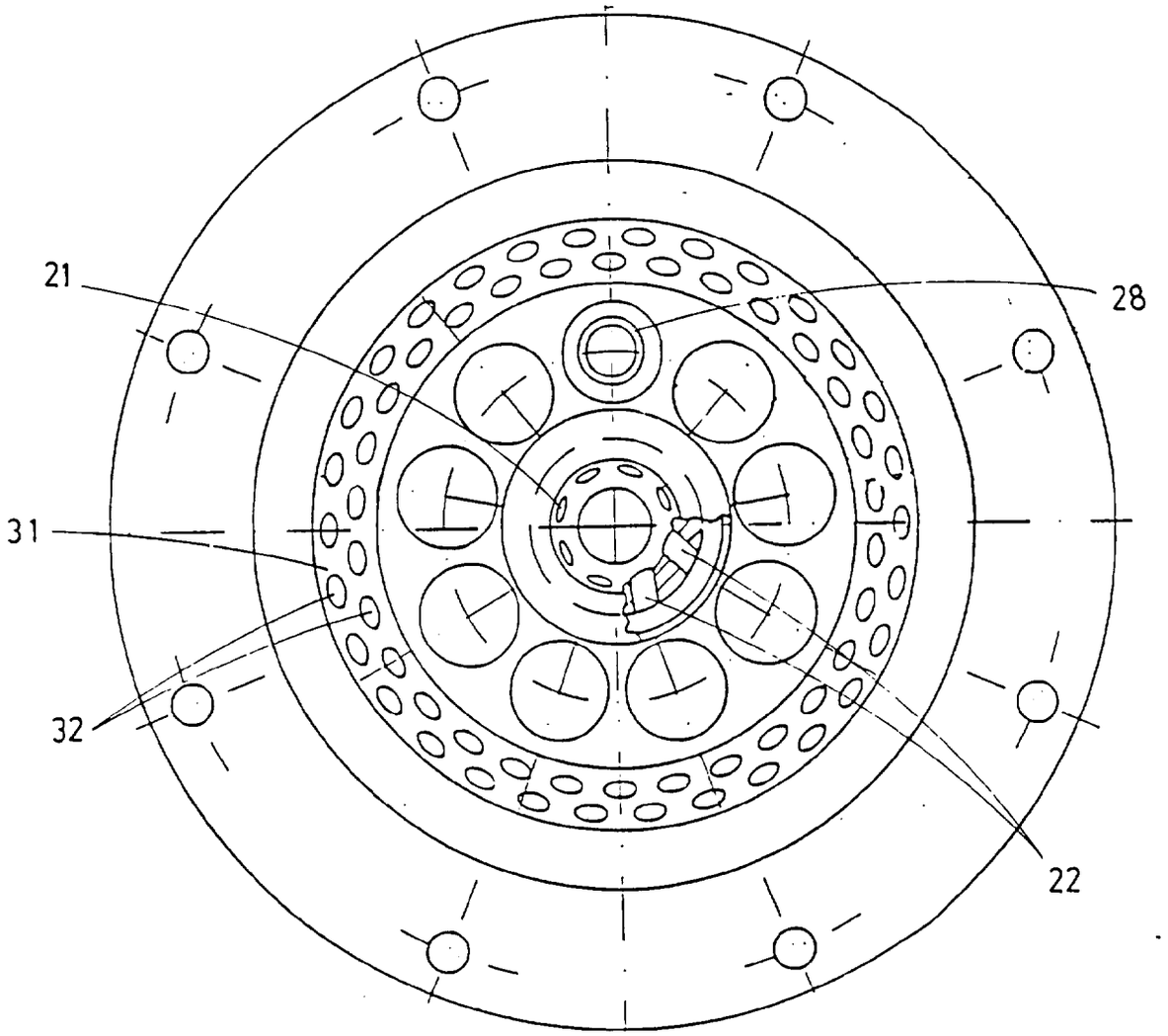

FIG. 7