Oct. 4, 1949. B. J. PARMELE 2,483,780

CYCLONE BURNER

Filed Oct. 30, 1946 3 Sheets-Sheet 1

Fig. 1

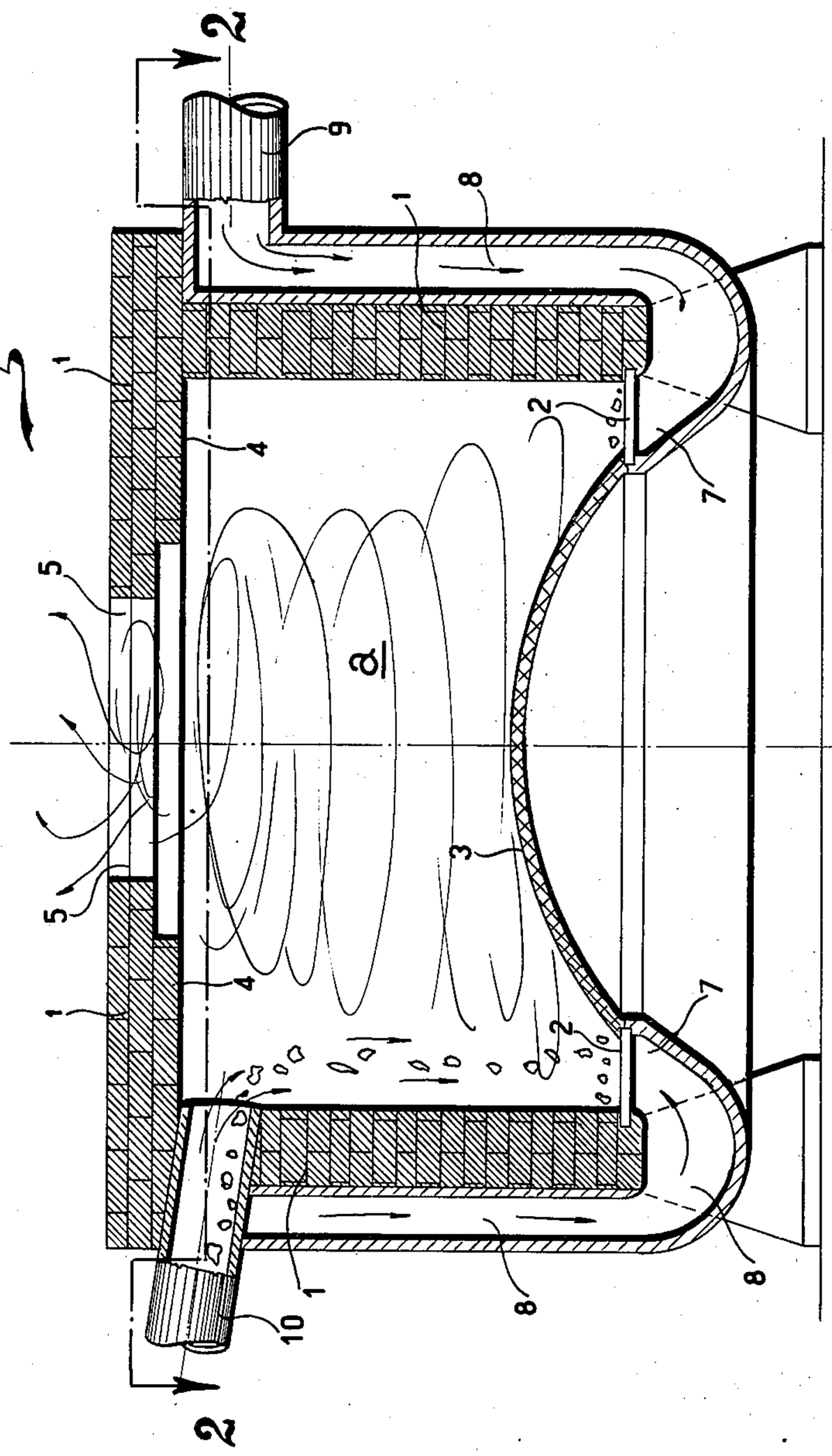

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Fig. 2

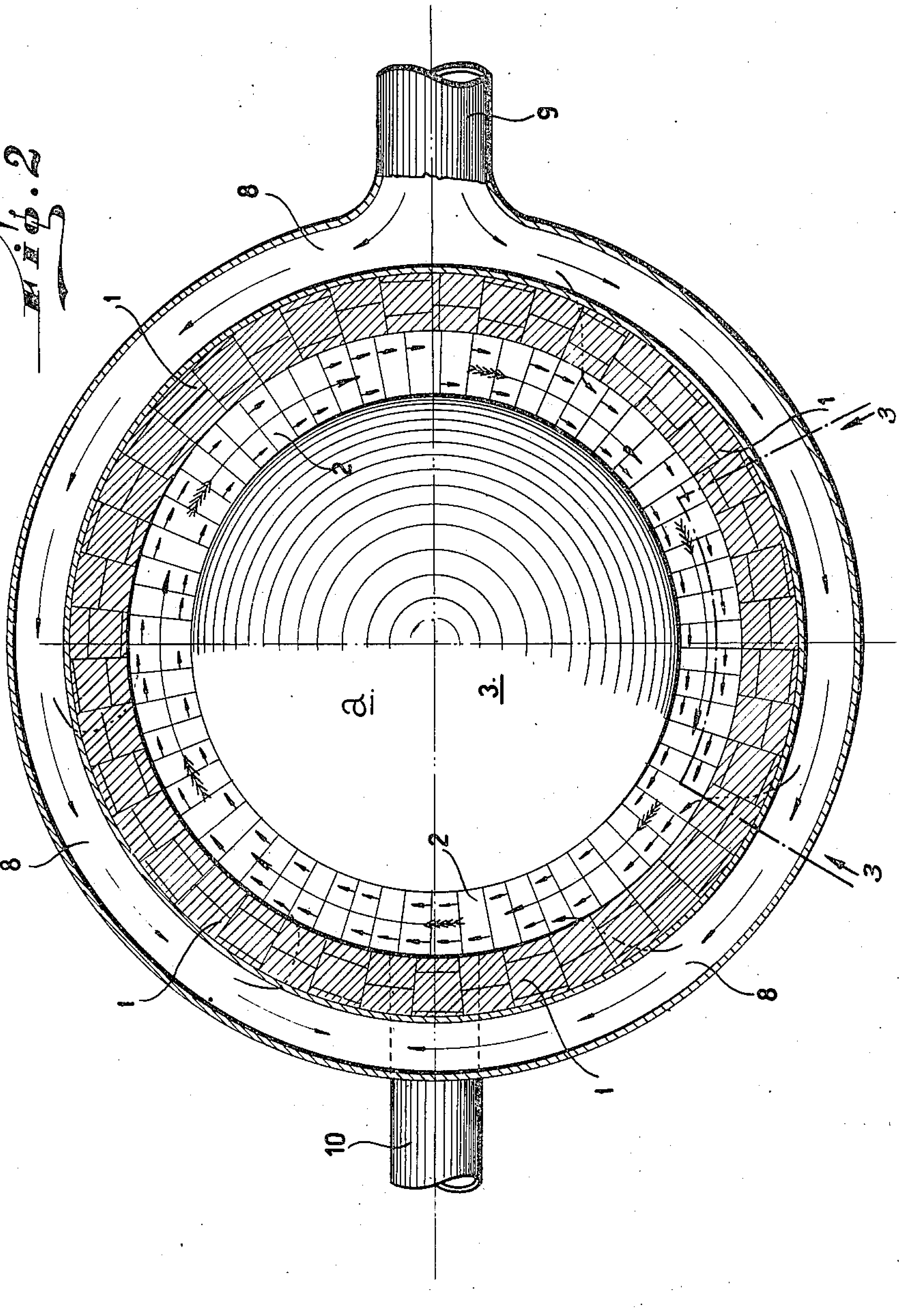

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Fig. 4

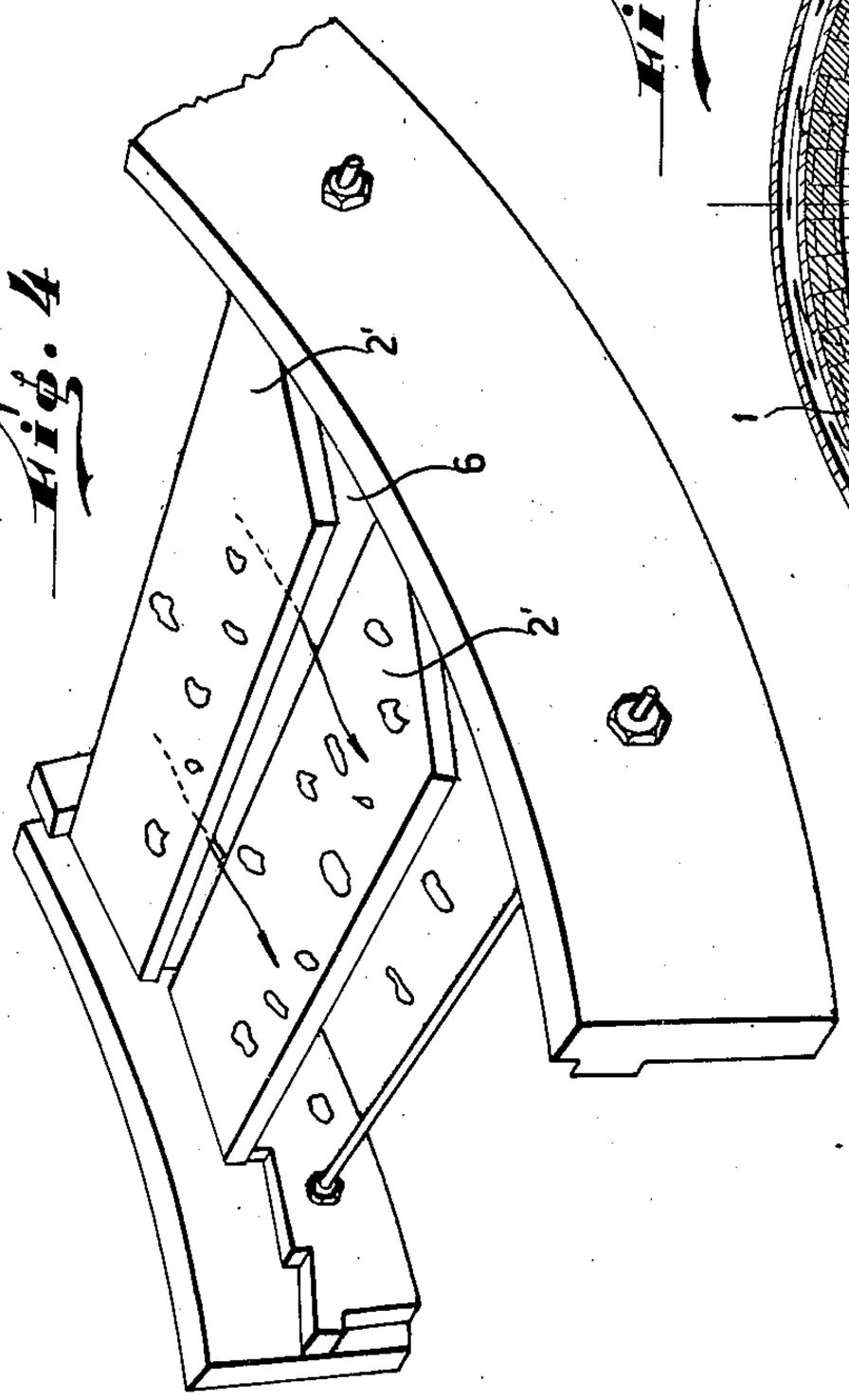


Fig. 5

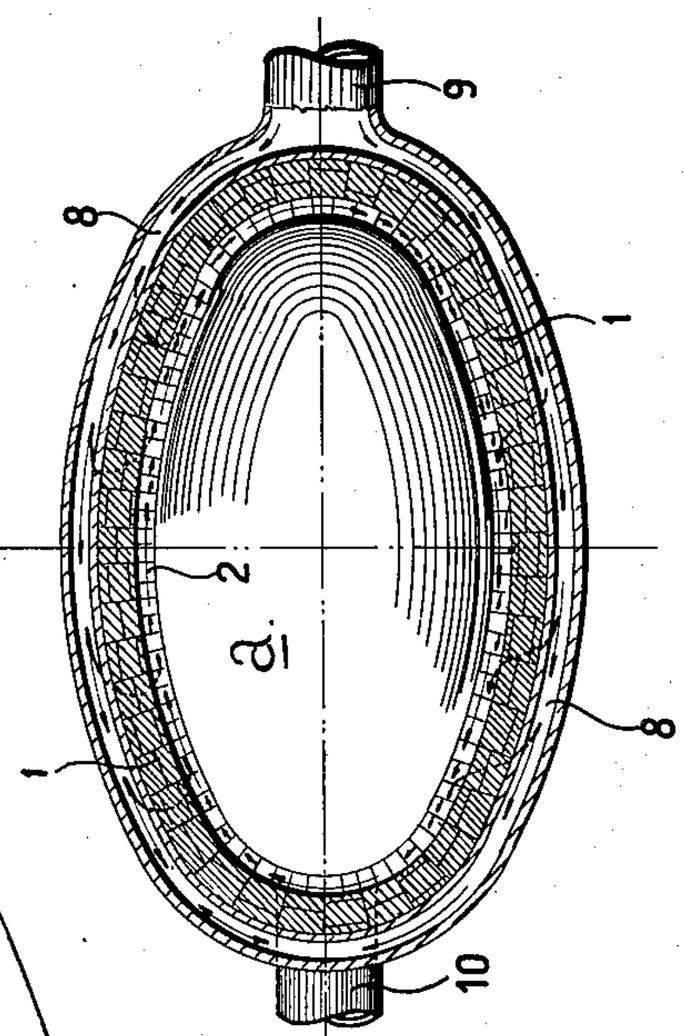
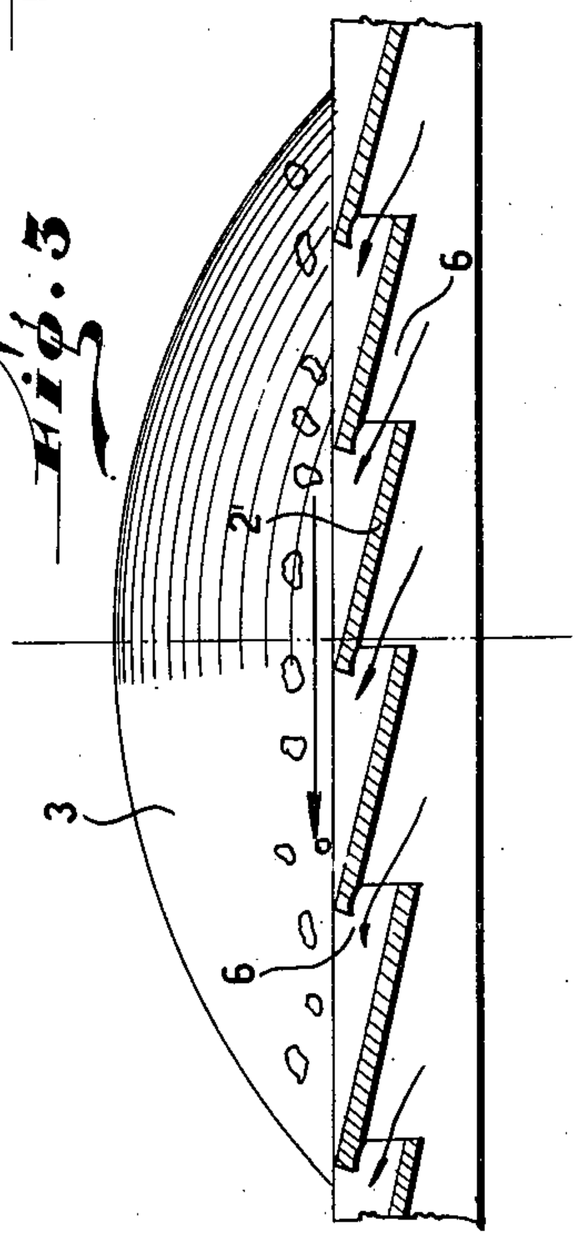


Fig. 3



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UNITED STATES PATENT OFFICE

2,483,780

CYCLONE BURNER

Benjamin J. Parmele, Wilmington, N. C.

Application October 30, 1946, Serial No. 706,625

7 Claims. (Cl. 110—28)

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This invention relates to improvements in cyclonic burners for various fuels, and more particularly to internal combustion chambers of the so-called vertical type in which the air is supplied to the lower part of the chamber, whilst the igneous gases are discharged through a port located in the upper portion of the chamber.

For physical reasons, i. e. the ascensional power of the hot gases, the vertical chamber burners are very efficient and offer advantages with respect to the horizontal systems, but due to the fact that, in general, solid fuel is used, however much the latter is reduced to small particles, it is not always capable of accompanying the cyclonic current or stream, and if the fuel falls to the bottom of the chamber due to gravity it hardly will be incorporated in the rotating mass of the gases. Therefore, a large portion of the fuel particles are discharged from the burner chamber without having been consumed completely, so that the utilization of the fuel is only partial with the consequent reduction of the efficiency of the burner.

This means that the fuel, in order to be fully utilized, must be maintained and subjected to the combustion during a period of time which is necessary to obtain a complete consumption thereof. In view of the fact that, due to the gravity, the only stable place is that corresponding to the bottom of the chamber, it is the ash or bottom plate which must comprise the means for obtaining the stability of the particles of carbon or any other substance used.

Taking into account the above considerations, experiments were carried out with the shutter or louvre type bottoms designed to receive the air which causes the cyclonic action. One arrangement was developed in which the bottom itself is transformed into a continuous circulation path whereby the carbon particles, although having a certain weight, are compelled to pass over the bottom of the chamber during an indefinite time period until after having been converted into gases and ashes, they form part of the general cyclonic stream of the burner.

The above object, which constitutes the basis of the improvements according to the present invention, is realized in a substantially simple manner, by forming the bottom or ash plate of segments or battens in a stepped arrangement. The bottom thus acquires the characteristics of a channel comprising lateral and central limiting walls, so that the carbon particles are compelled to circulate over the battens constituting said bottom plate of the burner without there being a possibility of deviation or escape.

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It is notable how the various means of the burner have been combined to obtain a perfect operation thereof. Since the fuel is supplied without pressure together with a quantity of air which is sufficient for the carburetion, the supply of the chamber is obtained by gravity or at most by means of a weak impulse in order that the fuel particles may descend to the bottom. Since the bottom plate receives the air stream used for obtaining the cyclonic effect, the pressure of this air is used to impel said particles so that they may enter the combustion circuit where the particles are exposed to the action of the flame with the corresponding results.

Apart from the objects mentioned hereinbefore, it is one of the objects of the present invention to provide a cyclonic burner of extraordinary efficiency in which the fuel or carbon particles are maintained in circulation while being exposed to the action of the igneous mass until they are consumed completely.

A further object of this invention is to provide a cyclonic burner having means for subjecting the fuel particles to the action of the flame and thus capable of burning fuel which has been transformed into particles of considerable volume, such as the so-called granulated fuels, which give the best efficiencies in cyclonic burners under these conditions.

Another object of this invention is to prevent fuel from being discharged through the burner port prior to having been burned completely, by providing a path in the bottom of the chamber by which the carbon particles are maintained in a fixed position while they are exposed to the action of the flame.

The further objects and advantages of this invention will become apparent from the following detailed description thereof taken in connection with the accompanying drawings which illustrate, by way of example only, one of the preferred embodiments of the improved burner according to this invention and in which:

Fig. 1 is a longitudinal sectional view of the burner according to the invention.

Fig. 2 is a plan view of the burner chamber illustrated in Fig. 1 which, in this particular case, is of a circular cross-section.

Fig. 3 is a lateral sectional view of the bottom plate of the burner chamber taken along line 3—3 of Fig. 2.

Fig. 4 is a perspective view of a portion of the channel-like bottom plate of the burner, and finally,

Fig. 5 is a plan view of an elliptic burner chamber.

In the figures, like or corresponding parts are designated by the same reference numerals or letters.

As can be seen in the drawings, *a* is the chamber which may be of any desired transverse cross-section but which, preferably, should be of the circular or elliptic type, as can be seen in Figs. 2 and 5. Since the lateral walls 1 of the chamber are substantially curved, the elements which are supplied to the chamber and are formed therein, are compelled to describe a rotary movement, as schematically indicated in Fig. 1.

The ash or bottom plate of the chamber *a* comprises a channelled path 2 which is limited by walls 1 and a central projection 3 which is sufficiently high to limit path 2. As can be observed, in Fig. 1, said projection 3 is in the shape of a spherical cap so that the highest point thereof presents a pronounced slope towards the said channelled path.

The top plate 4 of chamber *a* is provided with a stepped discharge or burner port 5 which may be arranged concentrically or eccentrically with respect to the chamber, in accordance with the use given to the burner.

The bottom of channelled path 2 is constituted of a plurality of battens 2' which, being inclined circumferentially with respect to the center of the burner chamber as shown in Figs. 3 and 4, and being separated one from each other, are mounted in a regularly stepped arrangement similar to that of shutters or louvres. Consequently, the spaces between said battens 2' of the channelled path 2 constitute apertures whose slant is determined by the same battens 2'.

Below channelled path 2 there is provided a cavity 7 to which air under pressure is supplied by means of a distributor 8 coupled to a pipe 9, said pipe 9 being connected to a compressor or any other suitable air-impelling means.

The air supplied by means of pipe 9 and conveniently distributed in cavity 7, is fed to chamber *a* not only to obtain the cyclone effect therein, but also to obtain the impeller action by which the fuel which penetrates into the burner chamber through entrance port 10, is subjected to the action of the flame during a period of time required for the complete combustion thereof.

In effect, path 2, in order to form a continuous channel, acquires the character of a closed circuit so that the carbons or fuel particles which reach this path, are compelled to describe a continuous trajectory. These fuel particles cannot deviate from channelled path 2 of the burner chamber, since, as already mentioned hereinbefore, said path is limited by lateral walls 1 and projection 3.

The circulation of the carbon particles on channelled path 2 is obtained, as already expressed hereinabove, by the impeller action of the air which passes through apertures 6 and which blows along the surface of battens 2'. Due to this impeller action, the carbon particles advance from one batten to another so that the particles describe several revolutions until they are completely burned, since the flame which rotates in the interior of chamber *a* gradually consumes the circulating fuel particles.

To sum up, the operation of the burner according to this invention, is as follows:

After preheating burner chamber *a*, compressed air is supplied to the chamber and this air, distributed by cavity 7, passes through apertures 6 forming streams, the slanting directions of which are determined by the inclination of battens 2'. The compressed air is preheated on penetrating into distributor 8 so that it does not cause any reactions due to a decrease in temperature on penetrating into the burner chamber.

The granulated or crushed fuel, intimately mixed with an abundant supply of air, is fed to the burner chamber through entrance port 10, descending to the bottom of the burner chamber as shown in Fig. 1.

If, on descending due to the gravity, the fuel falls on projection 3, it slides along the sloping surface of the latter towards channelled path 2, so that all particles of said fuel are compelled to circulate along said path.

On channelled path 2 the fuel particles are impelled by the air passing through apertures 6 and, as illustrated graphically in Figs. 2 and 5, said fuel particles, during their continuous movement in a closed circuit, are exposed to the action of the flame and are gradually transformed into inflammable gases. Thus, as the fuel particles are gradually burned, the liberated gases are incorporated into the igneous mass which rotates in the interior of the burner chamber due to the impeller action of the same air which penetrates through apertures 6.

As usual, the igneous gases, after having completed the helical ascensional cycle, are discharged through the burner port 5 and are directed towards the furnace.

Thus, it is possible to use carbon which has been crushed to particles of considerable proportions without the danger that part of the fuel will not be burned, since the fuel particles must descend to the channelled path and, once on this path, are compelled to circulate until they are converted into inflammable gases, ashes and slag. The ashes and slag which are also carried away by the turbulent igneous mass, are discharged through burner port 5 and are collected in an adequate receptacle provided in the furnace.

It will be appreciated that modifications of the disclosed embodiments of my invention are possible without departing from the scope and spirit of my invention as defined in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Improvements in cyclonic burners for various fuels, of the type comprising a vertical combustion chamber provided with a discharge port in the upper portion thereof and the lower portion of which comprises a bottom plate, constituted of battens in a slanting and stepped arrangement forming passage apertures for the compressed air supplied to the burner, and a central projection having lateral walls, said bottom plate, in its part constituted of the battens slantingly arranged in the form of a louvre, being delimited by the lateral walls of the chamber and the central projection and forming therewith a channel providing a closed continuous circuit constituting a circulation path for the fuel.

2. Improvements in cyclonic burners for various fuels, comprising a vertical combustion chamber having substantially curved lateral walls, an upper portion comprising a burner port and a lower port portion including a bottom plate constituted of a pluraltiy of battens mounted in a slanting and stepped arrangement and forming air supply passages, said lower portion of the

chamber further including a central projection having lateral surfaces which, together with said lateral walls of the burner chamber, delimit said bottom plate, in its part constituted of the said battens, to form a channeled circulation path for the fuel supplied to the burner chamber, said battens being arranged radially with respect to the center of the burner chamber.

3. Improvements in cyclonic burners for various fuels, comprising a vertical combustion chamber having substantially curved lateral walls, an upper portion comprising a burner port and a lower portion including a bottom plate constituted of a plurality of battens mounted in a slanting and stepped arrangement and forming air supply passages, said lower portion of the chamber further including a projection occupying the central portion of said bottom plate and the lateral surface of which is inclined towards said battens throughout the 360° of its circumference, the lateral surface of said central projection, together with said lateral walls of the chamber, delimiting said bottom plate, in its part constituted of said battens, to form a channeled and continuous circulation path for the fuel supplied to the burner chamber.

4. Improvements in cyclonic burners for various fuels, comprising a vertical combustion chamber having substantially cylindrical lateral walls, an upper portion comprising a burner port and a lower portion including a bottom plate constituted of a plurality of battens mounted in a slanting and stepped arrangement and forming air supply passages, said lower portion of the chamber further including a projection, the lateral surface of which is inclined towards said battens throughout the 360° of its circumference and delimits, together with said cylindrical lateral wall of the

chamber, the said bottom plate in its portion corresponding to said battens, to form a substantially annular channeled circulation path for the fuel supplied to the burner chamber.

5. Improvements in cyclonic burners for various fuel, comprising a vertical combustion chamber of substantially elliptic cross-section and having curved lateral walls, an upper portion comprising a burner port and a lower portion including a bottom plate constituted of a plurality of battens mounted in a slanting and stepped arrangement in the form of a louvre including air passage apertures, said lower portion of the chamber further including a projection, the lateral surface of which is inclined towards said battens throughout the 360° of its circumference, said lateral surface, together with said lateral walls of the chamber, delimiting the said bottom plate in its portion corresponding to said battens to form a substantially elliptic channeled circulation path for the fuel supplied to said chamber.

6. Improvements in cyclonic burners for various fuels according to claim 2, in which a fuel entrance port terminates directly in the interior of said chamber on a plane located above said bottom plate.

7. Improvements in cyclonic burners for various fuels according to claim 1 in which said central projection is a spherically-shaped cap.

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The following references are of record in the file of this patent:

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