F. C. STARR.

FUEL OIL ATOMIZING BURNER.

APPLICATION FILED JULY 3, 1915.

1,259,052.

Patented Mar. 12, 1918.

FIG. 1.

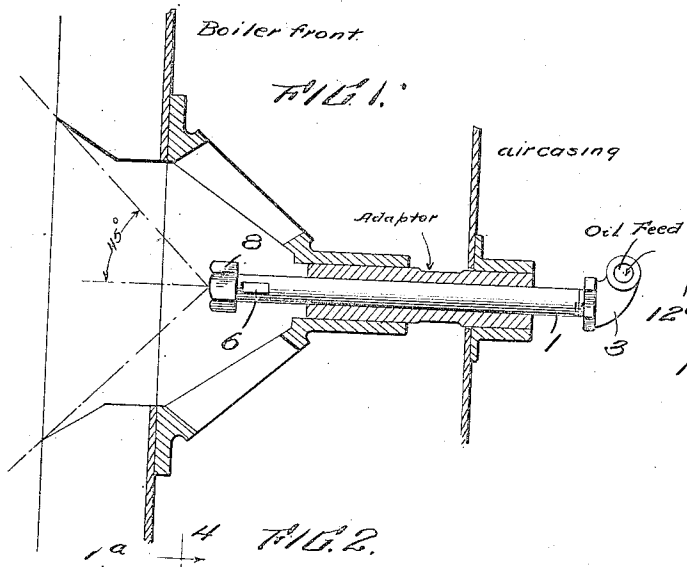


FIG. 5.

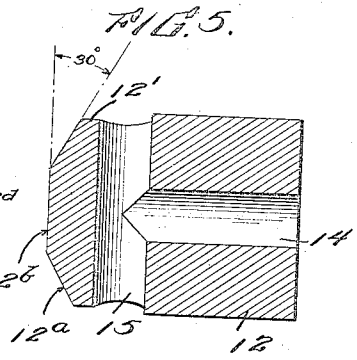


FIG. 2.

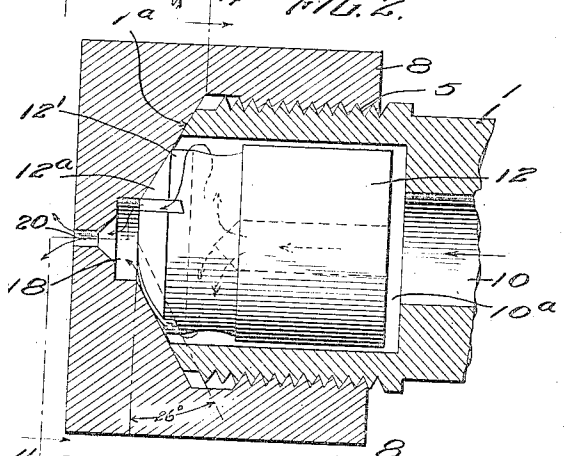


FIG. 4.

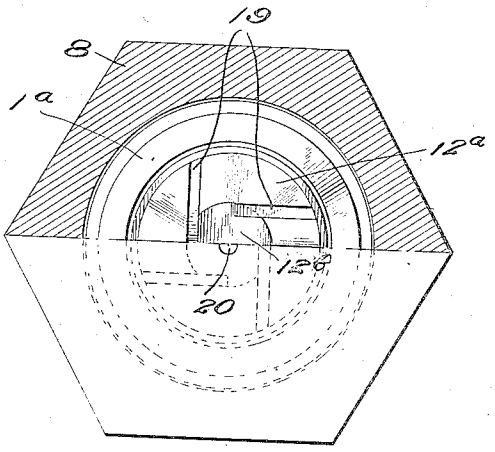


FIG. 3.

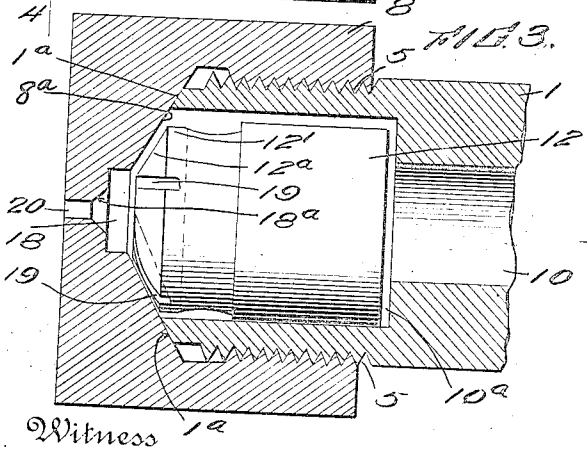
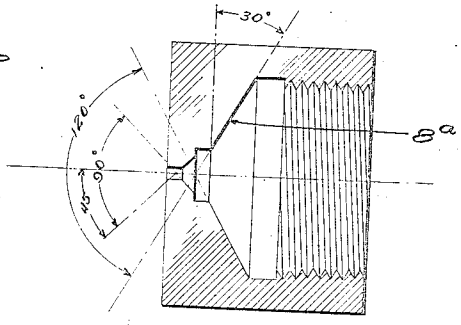


FIG. 6.



Witness

R. S. Trogner.

M. V. Simms

By

Inventor

F. C. Starr.

Eugene C. Brown

Attorney

UNITED STATES PATENT OFFICE.

FLETCHER C. STARR, OF PHILADELPHIA, PENNSYLVANIA.

FUEL-OIL ATOMIZING-BURNER.

Specification of Letters Patent. Patented Mar. 12, 1918.

1,259,052.

Application filed July 3, 1915. Serial No. 37,818.

To all whom it may concern:

Be it known that I, FLETCHER C. STARR, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Fuel-Oil Atomizing-Burners, of which the following is a specification.

This invention relates to that type of oil burners in which the fuel is ejected from the nozzle of the burner in the form of a finely divided spray. The main objects of my invention are to increase the fineness of atomization, to eliminate the tendency to carbonization in the passages of the burner, to simplify the structure and to provide an absolutely oil-tight protected joint between the cap or nut constituting the tip and the end of the pipe or barrel of the burner. Another purpose of my invention is to increase the efficiency of burners of the atomizing type by decreasing the frictional resistances within the burner passages and so coördinating the parts traversed by the oil that the atomized particles issue from the nozzle orifice with exceedingly high vortical velocity thereby forming a conical jet having the wide angle of substantially 90°.

In the accompanying drawings, Figure 1 is a fragmentary longitudinal sectional view illustrating the manner of connecting a fuel oil burner to a boiler; Figs. 2 and 3 are enlarged longitudinal sectional views of the atomizing end of a burner embodying my invention; Fig. 4 is a front elevation of the same, partly in section, taken on the line 4—4 of Fig. 2; Fig. 5 is a longitudinal section of the floating plug; and Fig. 6 is a longitudinal section of the end nut or burner tip.

The tube 1, forming the barrel of the burner is provided with a suitable fitting 3, at one end by which it may be readily attached to the fuel oil supply pipe and at the other end it is externally threaded at 5, to receive the nut or burner tip 8. The tube may be notched or flattened at 6, to receive a wrench. The end of the tube 1^a is accurately ground at the proper angle to fit the inner front wall of the recess in the nut or cap 8, which is also accurately ground, to form an oil-tight joint within the inclosure of the nut. This protected oil-tight joint performs an important function in preventing any leakage of the high oil pressure so that no oil can escape and follow along the threads 5. The joint being upon the interior of the nut cavity is thoroughly protected from injury or corrosion.

The bore 10 of the barrel 1 is enlarged at the burner end into a recess 10^a, to form a chamber for the floating plug 12. As shown in Fig. 5, the plug is provided with a central longitudinal passage 14, extending inwardly from the rear end and intersecting a transverse passage 15. The forward end of the plug is frusto-conical and is accurately ground along the annular inclined face 12^a to fit the inner front face 8^a, of the recess in the nut 8. The flattened portion 12^b of the plug forms the rear wall of a central cylindrical recess 18, cut in the front wall of the recess in the nut and is of the same diameter. The forward end 12′ of the cylindrical body of the plug or distributing head is of reduced diameter to provide an enlarged annular space within the chamber 10^a in communication with the fuel passage 15, and this annular space communicates with the chamber 18, by means of grooves 19, cut into the conical face 12^a of the plug. These grooves are tangential to the circular rim of the flat portion 12^b and consequently to the annular wall of the chamber 18, and are cut of uniform depth and cross-section throughout their length.

In operation when the oil pressure supply is turned into the burner tube, the plug 12 which lies upon the lower side of the chamber 10^a shown in Fig. 3, is lifted by the velocity pressure of the oil into the central floating position illustrated in Fig. 2, the forward conical face being firmly pressed against the interior conical wall of the nut. The oil flowing through the passages 14 and 15 into the annual space around the plug, traverses the channels formed by the grooves 19, and enters tangentially into the chamber 18 under great pressure so that a violent whirling motion is set up which separates the oil into exceedingly fine particles, and in this form it is forced outwardly toward the nozzle orifice 20. In order that there may be no throttling or undue loss of pressure in

passing through the grooved channels, I make these grooves of uniform depth and cross-section.

I have discovered that the degree of angularity or obliquity at which the tangential streams enter the whirling chamber 18, enhances or detracts from the centrifugal energy imparted to the oil and upon which the fineness of the disrupted or separated particles depends. The obliquity of the groove is substantially the same as the inclination of the conical end face 12^a of the plug and of the wall 8^a of the recess in the nut. In prior devices of this type with which I am familiar, the inclination of these grooves or channels leading into the recess adjacent the orifice is about 45°, so that the longitudinal and transverse components of the stream with respect to the axis of the burner are equal. I have discovered that the velocity energy transmitted into centrifugal effort can be greatly enhanced by increasing the transverse component over the longitudinal component until the obliquity of the grooved chanenls 19 enters the whirling chamber at an angle of about 30° from a transverse axis or 60° from the axis of the burner as indicated in Figs. 5 and 6. Since the grooves are cut tangentially to the circumference of the chamber 18 and do not follow the elements of the conical surface, these grooves are at an angle of 26° to the transverse axis as indicated in Fig. 2.

I have also discovered that the amount of centrifugal energy which can be transmitted with the particles as they pass through the nozzle orifice is greatly affected by the configuration of the front wall of the "whirling chamber." If this front wall were perpendicular to the orifice where the latter intersected said wall, much of the velocity of the whirling particles would be expended in eddies. I therefore bevel or conically taper the forward wall of the "whirling chamber" at 18^a toward the orifice into which it merges. This reduces the frictional resistance and the constant pressure velocity of the inrushing streams crowds the rapidly whirling particles along the converging walls 18^a from the outer margins of the chamber 18, where the rotary velocity is greatest, thereby causing these particles to rush into the orifice with an exceedingly rapid vortical motion which instantly separates the particles into widely divergent conical paths as they emerge from the mouth of the nozzle. This results, therefore, in producing an atomized jet in the form of exceedingly minute particles forming a mist extending over a cone having an angle of about 90°, as indicated in Fig. 1. I have discovered that the obliquity of the sides 18^a of the "whirling chamber" should diverge less from the longitudinal axis than the obliquity of the grooved channels 19 leading into the chamber 18 in order to produce the maximum torsional velocity through the orifice and the consequent divergence of the conical jet and attenuation of the spray and that this angle should be approximately 45° as shown in Fig. 6.

One of the inherent defects in atomizing fuel burners is tendency to carbonize any oil that remains in the small channels as soon as the pressure is withdrawn and especially if the burner is subjected to the heat of adjoining burners while it is cut off. The passages thus become clogged so that they require cleaning before the burner can be used. I have overcome this defect by providing means for automatically draining the smaller passages as soon as the oil supply is cut off from the burner. I accomplish this result by means of the floating plug 12, which is held in central operative position shown in Fig. 2, by the velocity pressure of the oil passing therethrough, but the instant the oil supply is shut off, the plug drops into the position shown in Fig. 3, the conical end face causing it to slide back from the inner front wall 8^a, which constitutes the front wall of the channels 19, and thus permitting any oil entrapped therein to run down into the lower part of the recess in the nut. In the practical operation of this burner I have found that a burner may be shut off and then exposed to the heat of the other burners under the boiler without becoming carbonized and may be thrown into and out of use repeatedly without cleaning or other attention.

The simplicity of my atomizing burner, consisting of the tube, nut and loose plug, eliminates the danger of getting out of order incident to more complicated structures which require springs and parts demanding special adjustment.

The protected oil-tight joint between the ground interior face of the recessed cap nut and the end of the tube provides an oil-tight passage from the bore of the tube to the nozzle orifice and also prevents any leak along the threads of the nut and eliminates joints that are exposed to the corrosive action of the flame in the intensely heated zone under the boiler, which is a very important feature in burners of this type operating under pressures varying from about 40 lbs. to over 200 lbs. Burners constructed in accordance with my present invention are now being operated under the last mentioned pressures.

The angles of entrance and of exit of the oil passages connected to the atomizing or "whirling chamber" 18 are so correlated that the maximum centrifugal velocity is concentrated in the vortical stream of particles passing into the orifice 20, which results in

an expansive force at the mouth of the orifice causing the finely divided particles to separate into the unusually divergent conical path extending across an arc of 90°. In fact, owing to this great expansive force and to the rapidity of the rotation in the whirling chamber, the issuing jet forms an attenuated mist without the usual tendency to concentrate in drops, so that the resulting combustion is complete.

As previously pointed out, the receding motion of the floating plug upon the withdrawal of the oil pressure, automatically opens the oil passages leading to the whirling chamber along one side of their entire extent, thereby causing any entrapped oil to drain and preventing the carbonization which has heretofore caused trouble whenever a "dead" burner was exposed to the heat of the other burners. This feature also enables my burner to operate successfully with the heavy oils.

I have described in detail the construction illustrated in the accompanying drawings to disclose a specific embodiment of my invention but I am aware that various changes may be made therein within the scope of my claims.

I claim:—

1. A fuel oil burner, comprising a barrel adapted to be connected with a fuel supply and having the bore at the outlet end enlarged, a recessed nut threaded upon said end and provided with a discharge orifice, and a loose or floating plug in said enlarged portion of the bore having a series of channels cut in its outer end forming fuel passages connecting the annular space around the plug and the orifice and also provided with passages terminating in said annular space and communicating with the bore of the barrel.

2. A fuel oil burner, comprising a barrel adapted to be connected with a fuel supply and having the bore at the outlet end enlarged, a recessed nut threaded upon said end and provided with a cylindrical chamber and a discharge orifice leading therefrom, and a loose or floating plug in said enlarged portion of the bore having a series of channels cut in its outer end forming fuel passages connecting the annular space around the plug and said chamber and also provided with internal passages connecting said annular space and the bore of the barrel.

3. A fuel oil burner, comprising a barrel adapted to be connected with a fuel supply and having the bore at the outlet end enlarged, a recessed nut threaded upon said end and provided with a discharge orifice, the inner wall of said recessed nut and the end of said barrel having ground surfaces engaging to form an oil-tight joint, and a distributing head within said enlarged portion of the bore having a plurality of angularly disposed channels in the outer end thereof connecting with the annular space surrounding said head, and an internal channel terminating in said annular space and communicating with the bore of the barrel.

4. A fuel oil burner, comprising a barrel having a bore adapted to be connected with a fuel supply and exteriorly threaded at the burner end, a recessed nut engaging said threaded end and provided with a discharge orifice, the inner wall of said recessed nut tapering toward said orifice, said tapering inner wall and the end of said barrel having ground surfaces engaging to form an oil-tight joint, and a distributing head within the bore of the barrel having a conical end face corresponding with the taper of said inner wall and provided with a plurality of passages connecting the surrounding annular space with said orifice and angularly disposed to impart a rotary motion to the oil passing therethrough, and an internal passage terminating in said annular space.

5. A fuel oil burner, comprising a barrel adapted to be connected at one end to a fuel supply, a recessed nut threaded to the other end to form a cap over the mouth of the barrel, and formed with a discharge orifice and with a cylindrical whirling chamber opening thereinto, the inner wall of said recessed nut tapering and converging into the rear end of said chamber and having a ground surface forming a seat, the forward end of said chamber tapering toward said orifice but with less obliquity than the taper of said inner wall, and a floating plug fitting loosely within the barrel having a frusto-conical end the conical part of which is adapted to bear against said seat when the plug is actuated by fuel pressure, and the plane portion forming the rear wall of said whirling chamber, said plug having channels cut in its conical surface and disposed tangential to the periphery of said chamber, and also provided with passages connecting the bore of the barrel with the annular space surrounding the plug.

6. A fuel oil burner, comprising a barrel adapted to be connected at one end to a fuel supply, a recessed nut threaded to the other end to form a cap over the mouth of the barrel, and formed with a discharge orifice and with a cylindrical whirling chamber opening thereinto, the inner wall of said recessed nut converging toward the rear end of said chamber and forming an annular conical seat around its periphery and a floating plug fitting loosely within the bore of the barrel having a frusto-conical end the conical part of which is adapted to bear against said seat when the plug is centrally held by the velocity pressure of the fuel, said

plug having grooves cut into said conical end surface the open sides of which are closed by said conical seat, when the plug is lifted into central position by the fuel pressure and are automatically opened by the dropping of the plug when the pressure is withdrawn, thereby permitting said grooves to drain, the forward portion of said plug having a smaller diameter than the remaining portion thereof to form an enlarged surrounding annular chamber and being provided with passages terminating in said annular chamber.

In testimony whereof I affix my signature in presence of two witnesses.

FLETCHER C. STARR.

Witnesses:
W. H. LEE,
S. C. MILLWARD.