This invention relates to burners for heavy liquid fuels, the subject matter of which is divided from application Serial No. 719,018 filed April 4, 1934, and provides a burner for fluids of this description, such as naphtha and the like, which is more particularly intended for the heating of ships' boilers. In contrast to the hitherto known burners for heavy liquid fuels, the burner according to the present invention is distinguished by the fact that it is capable of producing a fuel mixture which will burn completely free of smoke and soot, so that the fire-box remains perfectly free from residues of combustion and fouling matter even after prolonged working.

The burner according to the invention consists essentially of three main parts of which the first comprises a chamber in which heated heavy oil is sprayed into the combustion air simultaneously supplied to this chamber. For the introduction of the fuel into this spraying chamber there are provided a plurality of nozzles, so that the operation of the burner is not interrupted in the event of a nozzle becoming clogged by foreign matter in the fuel. The nozzles are of different cross-sectional areas as to their orifices, thus providing for convenient regulation of the total energy of the flame to suit varying needs. In addition there is provided a nozzle for the supply of steam the orifice of which issues into the same section of the compressed air conduit as the nozzles. The steam supplied through this nozzle is intended to serve not only as an addition to the fuel-air mixture but also to scour the orifices of the fuel nozzles for the removal of any foreign matter collecting therein.

In the portion of the preferably cylindrical feed pipe for the compressed air supply disposed behind the nozzle orifices from the point of view of the direction of flow there can be inserted interchangeable throttling members having passages of different cross-sectional areas. These throttling members are changed according to the boiling point of the fuel used, members of smaller internal clearance being used for fuels of higher boiling point than for fuels of lower boiling point.

The second of the said three parts of the burner comprises the casing of the atomizer which contains the mixing chamber in which there are rotatably arranged on a shaft a plurality of fan wheels which have their periphery close to the cylindrical inner wall of the casing. On both sides of these fan wheels there are provided, at right angles to the axis of rotation of the latter, fixed filters or perforated discs. The shaft of the fan wheels is attached at one end to a disc which is tightly fitted into and secured to the inside of the casing, and provided with radial slots. A second disc likewise provided with slots is rotatably mounted relatively to the first disc, so that the cross-sectional area of the passage for the fuel mixture is more or less throttled according to the extent to which the slots in these two discs are caused to register with each other. The fan wheels are set in rapid rotation, either by the mixture flowing therethrough, or by any other suitable means, for instance with the aid of an external driving shaft. Since the mixture is compelled to pass through the rapidly rotating fan wheels, the fuel droplets resulting from the spraying of the fuel through the nozzles become broken up by the edges of the blades, and extremely finely comminuted. This effect is intensified by the fact that the mixture emerges from holes in the filters or perforated discs in the form of numerous axially directed jets upon which the blades of the fan wheels impact almost at right angles as the latter rotate. By virtue of this arrangement there is obtained maximum velocity difference in the direction of the rotation of the blades, and the mixture is prevented from rotating in the casing at almost the same speed as the fan wheels. Simultaneously with the comminution of the fuel particles, the fan wheels also affect the intimate mixture of the fuel with the air.

In order to effectively prevent the transmission of heat from the fire-box to the atomizer casing, this latter is provided with a double jacketed wall having a space for the circulation of a cooling medium.

Adjoining the atomizer casing there is provided, as the third of the said parts of the burner according to the invention, the burner tube which is so shaped that the cross-sectional area of the path taken by the fuel-air mixture on its way from the atomizer to the flame constantly diminishes. In this connection the burner tube may either be conical or so shaped that its inside cross-sectional area diminishes more rapidly than in proportion to the distance from the atomizer. On the outer end of the burner tube there is mounted an interchangeable mouth-piece on the inside of which there are provided either straight or helical ribs, for the purpose of causing the mixture to enter the flame either in the direction of flow or with initial twist.

The burner is attached to the front wall of the
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fire-box preferably by means of a double walled length of tube between the walls of which a cooling medium is caused to circulate, for the purpose of preventing the burner from becoming heated by convection from the fire-box.

A form of construction embodying the invention is shown by way of example in the accompanying drawing, in which:

Fig. 1 shows the burner according to the invention, in longitudinal section taken through the axis of the burner.

Fig. 2 is a plan view taken at right angles to Fig. 1.

Fig. 3 is a view in elevation of one of the screens of the carburetting chamber;

Fig. 4 is a front elevation of a fan employed in the apparatus;

Figs. 5 and 6 are views in elevation of throttling disks for controlling the flow of mixture of the apparatus; and

Fig. 7 is a view in elevation of a mixing disk.

Referring to the drawing, in which like reference numbers are used to denote like parts throughout, the tubing for the supply of compressed air carries the fuel nozzles 8 and 9, and also the steam nozzle 10 (Fig. 2) the orifices of which are disposed on the inside of the supply pipe 4 for the compressed air, in a transverse plane at right angles to the middle axis of this pipe. These orifices are denoted by 41. At the point of entry into the pipe 4 there are inserted throttling members 40 of different cross-sectional areas, the selection of which depends on the boiling point of the fuel used. To this nozzle tube 4 there is connected, by means of a threaded flange, the atomizer casing which preferably consists of two halves 12 and 13 held together by means of screws 30. The disc 18 provided with radial slots 45 is fixedly mounted in this casing, at right angles to its middle axis, being pressed by the screws 30 and bushes 29 and 28, against a shoulder 45 on the inside of the casing half 12. Close in front of the disc 18, but rotatable by means of the pin 15 in the casing, there is provided the disc 17 which is likewise provided with slots 45. To the middle of the disc 18 there is attached by means of screw threading and a nut, the shaft 22 upon which the fan wheels 24 and 25 are rotatably mounted by means of the ball bearings 23. In front of and behind each fan wheel there are provided sleeves or perforated discs 46 and 29 which are held fast at their periphery by the pressure of the bushes 26 and 29. The fan wheels are of a diameter but slightly less than the inside diameter of the bushes 26 and 29, so that the incoming fuel mixture is compelled to pass between the blades of the fan wheels.

Adjoining the part 13 of the atomizer casing there is provided the burner tube 38 which is connected to the former by means of screw threading, or which is held in position by the tubular member 33 which is screwed on to the threaded part of the hollow 18, and which serves for the attachment of the burner to the wall 1 of the fire-box. To the end of the burner tube, which is of tapered shape towards the outer end in accordance with the invention, there is fitted a means of screw threading, the separate mouth-piece 46 which is provided on the inside with rib 27 for the guidance or deflection of the fuel mixture which can thereby be caused to travel straight on in its direction of flow or to acquire a whirling or helical motion.

The tubular member 33 serving for the attachment of the burner to the furnace wall is jacketed for the purpose of enabling cooling media to be circulated therethrough, and is provided with pipe connections for the flow and discharge pipes for such medium.

In order to steady the flame and to give the same a straight and elongated shape, the mouthpiece of the burner tube is surrounded by a conical and sharply flared funnel 3 opening out towards the combustion chamber. This funnel is further provided on its periphery with distributed apertures which admit of the steady supply of secondary air to the flame fed by the burner.

What I claim is:

1. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the intake, at least one fuel nozzle issuing into said chamber, an atomizing chamber connected to the first mentioned chamber, and a burner tube leading from the atomizing chamber gradually reduced in diameter from its inner to its outer end.

2. A portion 4 serving for the tubing of compressing a compressed air intake, an air throttling member of suitable capacity therein, a fuel spraying and air mixing chamber connected to the intake, at least one fuel nozzle issuing into said chamber, an atomizing chamber connected to the first mentioned chamber, and a burner tube connected to the atomizing chamber and reduced in cross sectional area from its inner to its outer end.

3. A burner as set forth in claim 2, in which said mechanical atomizing means consists of at least one fan wheel rotatably mounted on a central shaft and occupying substantially the entire cross sectional area of the chamber at the point at which it is mounted.

4. A burner as set forth in claim 2, in which said mechanical atomizing means consists of a plurality of fan wheels rotatably mounted on a central shaft and occupying substantially the entire cross sectional area of the said atomizing chamber, and fixed perforated members mounted alternately in said shaft occupying substantially the entire available cross sectional area of the said atomizing chamber.

5. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the air intake, at least one fuel nozzle issuing into said chamber, an atomizing chamber connected to the said chamber, controllable mixture throttling means in the said atomizing chamber, and a tapered burner tube discharging from the atomizing chamber, said burner tube being reduced in cross sectional area from its inner to its outer end.

6. A burner as set forth in claim 5, in which the said controllable mixture throttling means consists of two adjacent mounted slotted plates, one of the said plate being fixed and the other movably relatively thereto to bring the slots therein more or less in registry with each other, and means for moving the said second plate from the outside of the burner.

7. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the air intake, at least one fuel nozzle issuing into said chamber, a jacketed atomizing chamber, means for admitting and means for discharging a tem-
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perature changing means for the jacket, and a tapered burner tube discharging from said atomizing chamber, the said tube having a gradually reduced internal diameter from its inner to its outer end.

8. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the air intake, at least one fuel nozzle issuing into said chamber, an atomizing chamber connected to the said chamber, a burner tube connected to the atomizing chamber, the said tube having a diameter which is gradually reduced from its inner to its outer end, a jacketed tubular connecting a fuel spraying and air mixing chamber and adapted to serve for an attachment of the entire burner to a front of a fire-box, and flow and discharge pipe connections for the said jacket.

9. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the intake, at least one fuel nozzle issuing into said chamber, an atomizing chamber connected to the said chamber, a tapered burner tube connected to the atomizing chamber, the said burner tube having cross sectional area gradually decreased from its inner to its outer end, and a flared mouth-piece attached to the outer end of said burner tube.

10. A burner as set forth in claim 9, in which the flared mouth-piece on the outer end of the burner tube is provided with ribs on the inner side of its flared mouth-piece.

11. A burner for heavy liquid fuel comprising a compressed air intake, an air throttling member of suitable capacity in said intake, a fuel spraying and air mixing chamber connected to the air intake, at least one fuel nozzle issuing into the said chamber, an atomizing chamber connected to the said chamber, a tapered burner tube discharging from the atomizing chamber, a flared mouth-piece attached to the outer end of said burner tube, and a protecting funnel surrounding the outer end of said burner tube and flared mouth-piece, the said funnel expanding toward the interior of a combustion chamber into which the burner discharges.

12. A burner as set forth in claim 11, in which the said funnel has secondary air inlet apertures.

13. In a burner for heavy liquid fuel, means for supplying a combustible mixture thereto comprising a chamber having an inlet and an outlet, means for mixing air with sprayed liquid fuel and injecting the mixture into said chamber through the inlet, means for regulating the temperature of the mixture passing through the chamber for maintaining the temperature at a point at which vaporous contents of the mixture will be condensed to form minute liquid particles, and means within the said chamber for breaking up particles of liquid fuel in the mixture and commingling them with the aforesaid minute liquid particles and air.

14. In a burner for heavy liquid fuel, means for supplying a combustible mixture thereto comprising a chamber having an inlet and an outlet, means for mixing air with sprayed liquid fuel and injecting the mixture into said chamber through the inlet, means for regulating the temperature of the mixture passing through the chamber for maintaining the temperature at a point at which vaporous contents of the mixture will be condensed to form minute liquid particles, and filters within the chamber between the inlet and outlet for breaking up particles of liquid fuel in the mixture and commingling the same with the aforesaid minute liquid particles and air.

15. In a burner for heavy liquid fuel, means for supplying a combustible mixture thereto comprising a chamber having an inlet and an outlet, means for mixing air with sprayed liquid fuel and injecting the mixture into said chamber through the inlet, means for regulating the temperature of the mixture passing through the chamber for maintaining the temperature at a point at which vaporous contents of the mixture will be condensed to form minute liquid particles, and filters and members having deflecting blades mounted in said chamber in spaced relation to each other between the inlet and outlet for breaking up particles of liquid fuel in the mixture and commingling them with the aforesaid minute liquid particles and air.

16. In a burner for heavy liquid fuel, means for supplying a combustible mixture thereto comprising a chamber having an inlet and an outlet, means for delivering intermingled air and sprayed vaporizable liquid fuel into said chamber through the inlet, said chamber increasing in diameter from its inlet whereby the intermingled air and liquid fuel may expand in the chamber to cool the mixture and cause condensation of the vaporous portions to form minute liquid particles, and means in said chamber for breaking up particles of the liquid fuel passing through the chamber and mixing the same with the aforesaid minute liquid particles and air.

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