Dec. 30, 1941. D. P. GRAHAM 2,267,709

ROTARY GAS BURNER

Filed July 15, 1938 3 Sheets-Sheet 1

Fig. 1a.

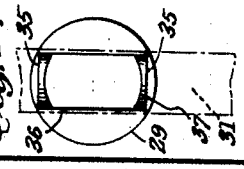
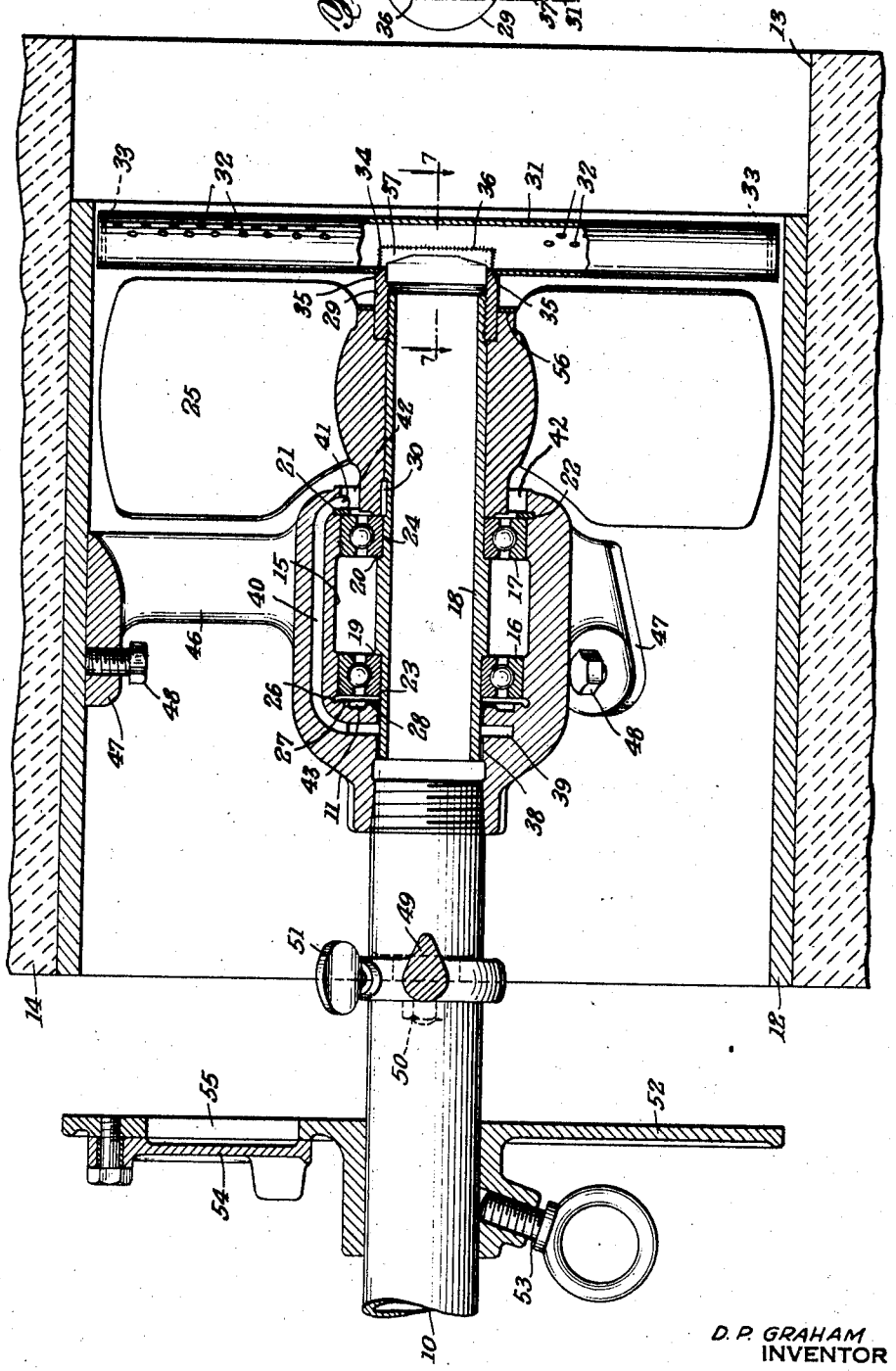


Fig. 1.



D. P. GRAHAM
INVENTOR

BY Philip S. McGraham
ATTORNEY

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ROTARY GAS BURNER

Filed July 15, 1938 3 Sheets-Sheet 2

Fig. 3.

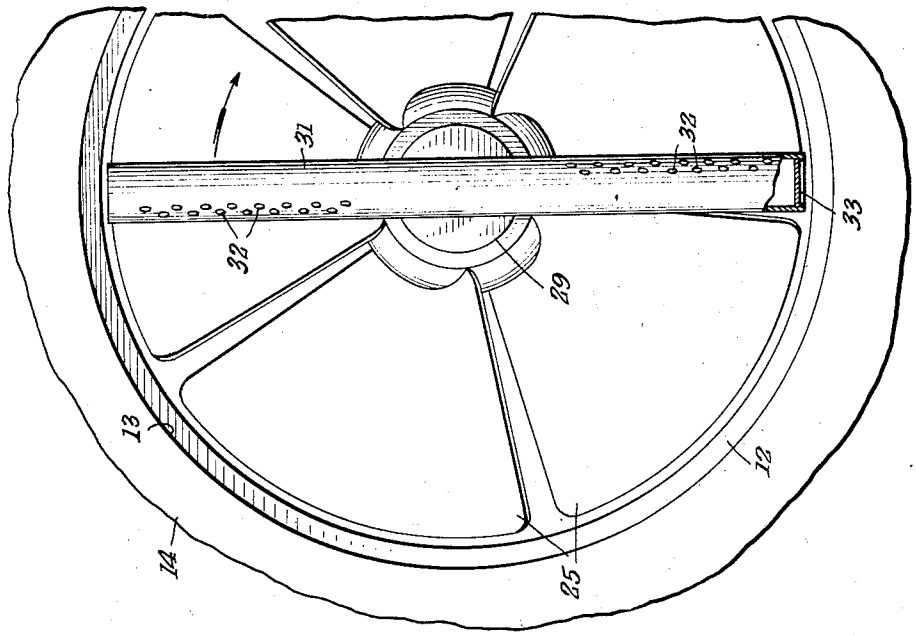
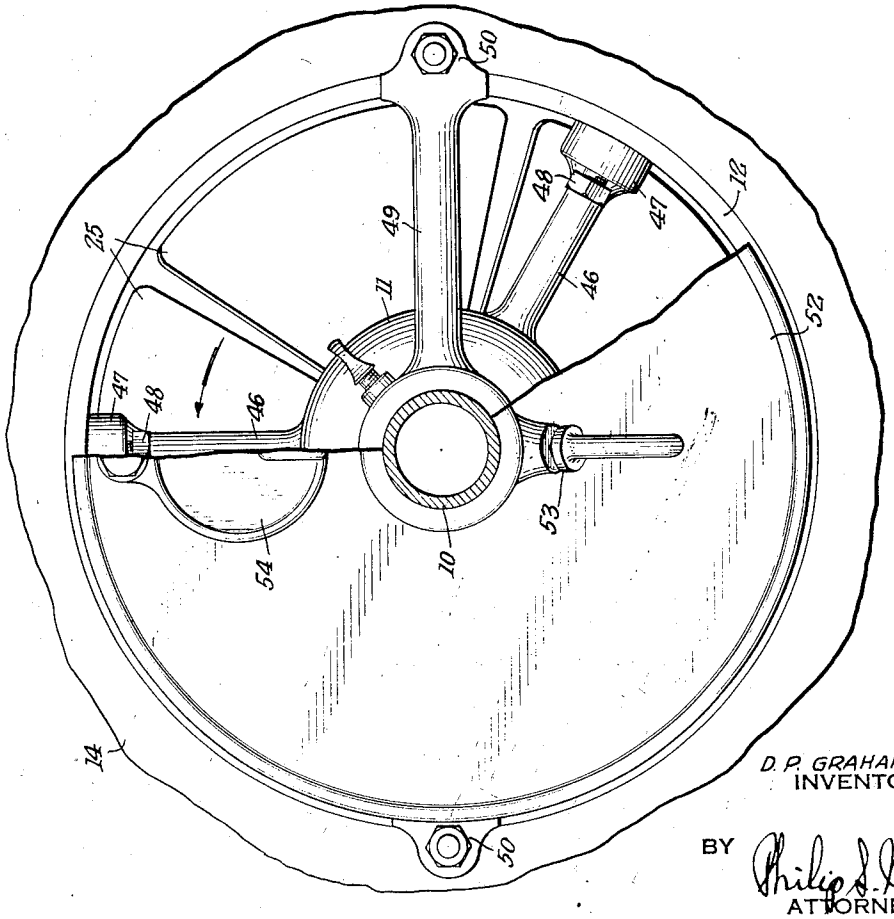


Fig. 2.



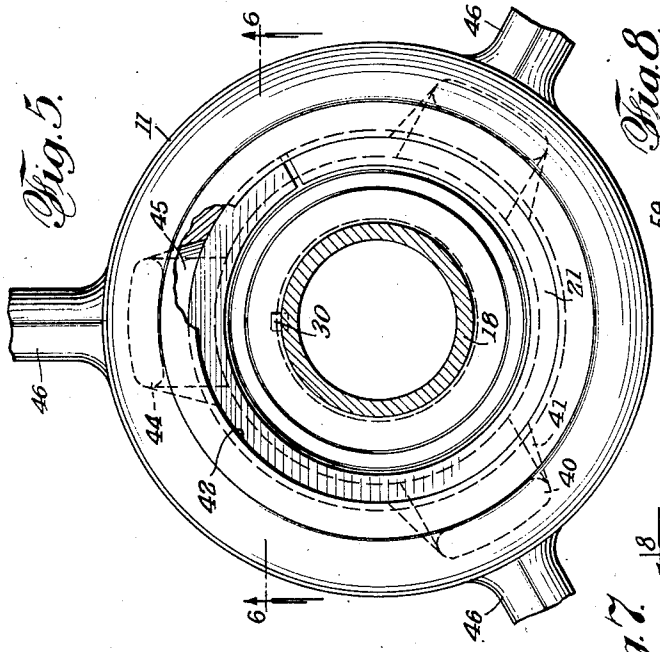
D. P. GRAHAM
INVENTOR

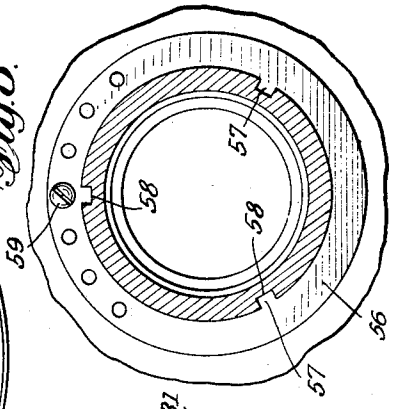
BY Philip S. McGran.
ATTORNEY

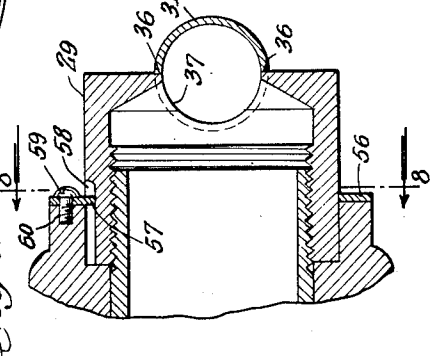
Dec. 30, 1941. D. P. GRAHAM 2,267,709

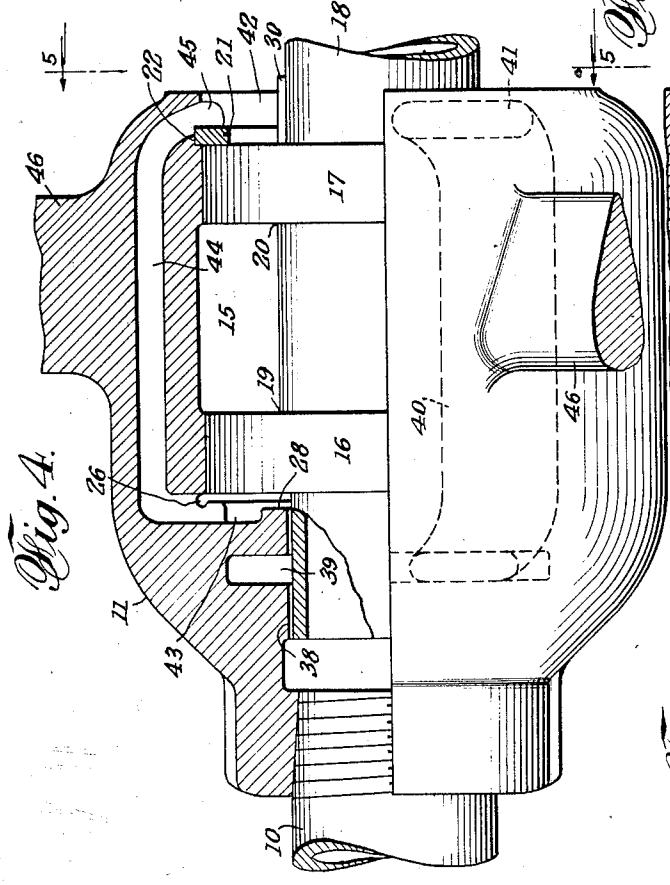
ROTARY GAS BURNER

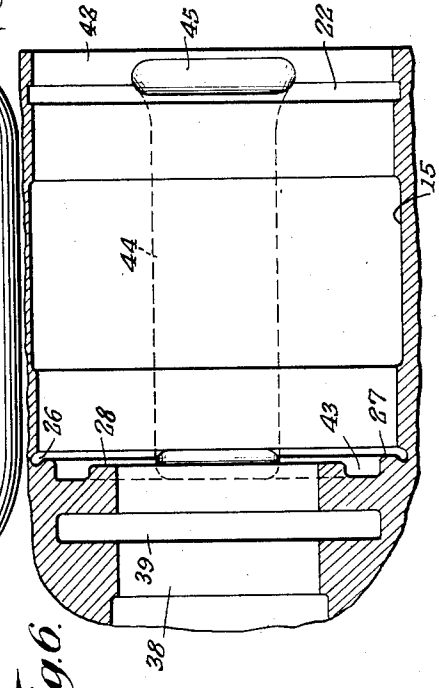
Filed July 15, 1938 3 Sheets-Sheet 3











D. P. GRAHAM
INVENTOR

BY Philip S. McGraham
ATTORNEY

FUEL BURNERS
118
Search Room

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2,267,709

UNITED STATES PATENT OFFICE

2,267,709

ROTARY GAS BURNER

David P. Graham, Flushing, N. Y., assignor to Peabody Engineering Corporation, New York, N. Y.

Application July 15, 1938, Serial No. 219,319

19 Claims. (Cl. 158—118)

The invention herein disclosed relates to rotary gas burners.

Objects of the invention are to provide a simple, practical and otherwise desirable form of rotary gas burner, which will effectively utilize the pressure of the gas supplied it, to furnish the forced draft necessary for its efficient operation; to provide such a burner consisting of but few sturdy parts; to so construct such a burner that the parts may be readily assembled, disassembled or adjusted as need be; to provide efficient antifriction mounting for the rotating portions of the burner and to protect the bearing parts against the gas flow.

Further desirable objects as well as the novel features of construction, combinations and relations of parts by which the objects are attained are set forth or will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate a practical commercial embodiment of the invention. Structure however may be modified and changed all within the true intent of the invention as will appear from the scope of the claims broadly defining the invention.

Fig. 1 is a broken longitudinal sectional view of a complete burner installation. Fig. 1*a* is an end view of the cap of the reaction element.

Fig. 2 is an end view, with the air controlling damper partly broken away and the gas supply pipe appearing in section.

Fig. 3 is a broken part sectional view showing the opposite, inner end of the burner.

Fig. 4 is an enlarged broken detail of the supporting hub and associated parts, sectioned to disclose the annular gas accumulating chambers and passages for collecting and by-passing leakage gas about the bearings.

Fig. 5 is a broken end view of the same parts, substantially as appearing on the section line **5—5** of Fig. 4.

Fig. 6 is a broken sectional view as on substantially the plane of line **6—6** of Fig. 5.

Fig. 7 is an enlarged broken sectional detail as on substantially the plane of line **7—7** of Fig. 1.

Fig. 8 is a broken sectional view substantially on line **8—8** of Fig. 7.

In the embodiment of the invention illustrated, the gas under pressure is conducted by stationary piping **10**, to a hub structure **11**, centrally located in an annular supporting shell **12**, shown as set in a burner opening **13**, in a fire wall **14**.

The hub **11** is shown as chambered at **15**, to receive the outer ring elements of two annular, combination radial thrust-bearings **16**, **17**, and the tubular shaft **18**, which carries the inner race rings of said bearings. This shaft is shown as shouldered at **19**, to locate the inner ring of bearing **16**, and as shouldered at **20**, to locate the inner ring of bearing **17**. By this construction, the shaft is rotatably supported in the hub, in line with the end of gas supply pipe **10**. The outer race rings are shown as having a close slip fit in the hub chamber and as retained by a split ring **21**, snapped into a groove **22**, in the inner end of the hub over the outer ring of bearing **17**. The inner race rings are shown as engaged over the reduced end portions **23**, **24**, against shoulders **19**, **20**, respectively.

A fan **25** is mounted on the reduced inner end portion **24** of the shaft and in the illustration, the hub of this fan engages directly with the inner ring of bearing **17**, to lock the same up against the shoulder **20**. Bearing **17** is thus definitely fixed on the shaft. The other bearing **16**, while fixed in position at one side by shoulder **19**, on the shaft, is otherwise free to adjust itself slightly as may be required by expanding or contracting movements of the shaft and hub. At the outer side of bearing **16**, an annular space **26**, is provided in the hub to permit such slight outward movement as might result from expansion of the shaft and a shoulder **27**, is here provided at what might be considered the maximum of such expansion, for engagement by the outer race ring, while the wall is relieved at **28**, opposite the inner race ring, so that the latter, rotating ring can not possibly reach contact with the stationary facing wall.

The fan is thrust up tight in holding engagement with the inner race of the inner bearing by a cap **29**, screwed over the inner end of the shaft in abutting engagement with the hub of the fan. To afford means for positively holding the shaft while this cap is being screwed in place, the hub of the fan is shown as having sliding keyed engagement on the shaft at **30**.

The screw cap **29** carries the hollow arm or arms of a pressure reaction wheel. In the present disclosure, the reaction elements are provided by a single length of pipe **31**, secured to the cap with its interior in communication with the hollow shaft and having reaction jet outlets **32**, angled to effect rotation of the fan in the proper direction to draw in air through the outer end of the supporting sleeve **12**. The ends of this reaction tube are closed as by means of plugs **33**. The intermediate portion is rigidly united with the cap in the present disclosure by cutting a rec-

tangular notch 34, substantially half way through the pipe, of a length just sufficient to fit over the transverse shoulders 35, of the cap, with the sides of the notch engaging the end of the cap at 36, at opposite sides of the transverse slot 37, formed across the end of the cap. The parts are welded, brazed, or otherwise secured together in this interlocked relation with the interior of the rotating pipe in full communication with the interior of the reaction tube.

The bearings are protected from injurious effect of the gas by providing gas collecting chambers and passages which will carry any escaping gas around the bearings. Slight clearance is preferably provided between the receiving end of the fan shaft and the surrounding hub at 38, and about this there is provided an annular chamber or channel 39. Extending from chamber 39 to the inner end of the hub are draw off ports 40, having flaring throats 41, opening out to an annular space 42, in the hub just back of the fan blades. Similarly, an annular chamber 43, in communication with the clearance space 26, immediately adjoining the outer bearing has ports 44, discharging through flaring throats 45, into the annular space 42, back of the fan blades.

The suction applied by the fan through passages 40, draws off gas leaking around the inlet end of rotating shaft 18, and any gas which may escape further, past the influence of chamber 39, is caught up in chamber 43, outside the outer bearing and carried off through ports 44, to the suction zone at the back of the fan there to be taken up by the air drawn in by the fan.

The reaction wheel, fan combination is adjustably mounted within the supporting ring 12, in the present instance, by having the supporting hub equipped with three equally spaced radial arms 46, with pads 47, engaging the inner surface of the mounting ring and carrying set screws 48, by which they may be fixed in any desired relation. Upon loosening such screws, the fan wheel unit may be adjusted in and out or turned axially one way or the other, wholly by means of pipe 10, and then be fixed again in desired relation by set screws 48.

To prevent the weight of pipe 10, from "cocking" the wheel unit in the annular support, an arm 49, may be secured at 50, Fig. 2, across the outer end of the mounting ring, with the pipe passing through the center of this and clamped in adjusted relation by one or more securing screws 51.

Admission of induced air is regulated in the present disclosure by an air shutter in the form of a plate 52, slidably engaged over supply pipe 10, and secured in the position to which it may be shifted toward or away from the end of the supporting ring, by clamp screw 53. This adjustable air shutter is shown as having a pivoted slide 54, controlling a sight opening 55.

In assembling the burner, the bearings may be engaged on the shaft and then after entering the shaft and engaging the bearings in the hub, the retaining ring 21, be snapped into position to lock the parts, so assembled. Then after slipping the fan into keyed position on the shaft, the shaft may be held by said fan against turning, while the end cap is screwed on over the end of the shaft to force the fan into fully seated holding engagement with the inner bearing ring, by turning the cap, using the perforated reaction pipe as a lever for so doing.

The screw-threaded mounting of the reaction element is such that the tendency of the same will be to tighten itself on the shaft. Additionally however, the reaction element is preferably positively locked in its fully engaged position on the shaft. In the present disclosure, locking means is provided in the form of a retainer ring 56, Figs. 7 and 8, surrounding the cap 29, having a lug or lugs 57, to enter key slots 58, in the cap, said ring being secured in the final position of the cap by a screw or screws 59, engaged in a screw seat or seats 60, in the end of the fan hub. With this fastening, the reaction wheel structure is locked on the shaft, through the intermediacy of the fan keyed on the shaft. At any time however, the parts may be readily disassembled by simply unfastening the locking ring 56, and then unscrewing the reaction pipe, the fan at such time providing a convenient lever for holding the shaft while the pipe member is unscrewed. Similarly, it is an easy matter to remove the fan shaft and bearings after taking out snap ring 21. The flaring throats 41 and 45, of the offtake ducts 40, 44, Figs. 1 and 4, provide convenient openings for entry of a screw driver or similar tool for prying the snap ring out of its annular seat 22.

The fan and reaction impeller being separate units enables each being designed to best fulfill its particular purpose and this construction enables different designs or sizes of fans and impellers to be readily combined to meet particular requirements. The ready adjustability of the mounting spider hub 11, and arms 46, enables the fan and impeller to be quickly set where they will operate to best advantage in the annular support 12, defining the air admission conduit of the burner. This construction also enables complete removal of the burner parts as a unit from the mounting structure upon loosening the spider securing bolts 48, and removing bolts 50, which secure the pipe supporting arm 49, at the entrance to the tubular support.

The shutter 54, enables the blaze to be observed without disturbing any of the parts and the quick releasable fastening 53, permits of the air flow controlling disc or shutter plate 52, being adjusted at will to control the volume of air taken in by the fan.

The provision of the reaction jet openings at different radial positions along the arms of the reaction device causes a distribution of the fuel across the area of the air passage, thus to assure desired mixture of the fuel with the air. By different spacing and inclination of the jet openings, different desired results may be accomplished to meet various requirements.

The formation of the reaction device as a separate entity enables this device to be mounted in desired angular relation to the fan and when set in such desired angular relation, the reaction device may be locked and secured in that position by the locking means such as shown in Figs. 7 and 8.

What is claimed is:

1. A gas burner, comprising a tubular member adapted to be mounted in a furnace wall and to thereby form an air admission conduit, a spider adjustably supported by and removably mounted in said tubular member and having a hollow hub, a stationary gas supply pipe connected with the outer end of said hollow hub, a tubular shaft rotatably mounted in said hollow hub in line with said stationary gas supply pipe to form a rotary continuation of the same, a fan mounted on said shaft and a reaction impeller secured

FUEL BURNERS

Search Room

118

over the end of the shaft and in open communication with the interior of said shaft.

2. A gas burner, comprising a hollow supporting hub, a gas supply pipe connected with one end of said hollow hub, a tubular shaft journalled in said hub in line with said gas supply pipe, anti-friction bearing means about said shaft and including outer and inner annular ball bearing rings respectively seated in said hub and in spaced shouldered engagement on said shaft, releasable locking means for securing said anti-friction bearing means in the hub, and including a locking ring for securing one of the outer annular ball bearing rings in the hub, a fan mounted on said shaft and a reaction impeller engaged over the end of the shaft in position for securing the fan thereon and means for locking said impeller in fan securing position on said shaft.

3. A gas burner, comprising a tubular rotatably mounted shaft, a gas supply pipe open to the end of said tubular rotatably mounted shaft, a transversely slotted cap screwed over the opposite end of said tubular shaft, a transversely notched pipe secured in position with the notch in the same co-extensive with the transverse slot of the cap, said pipe having impelling jet openings and a fan having a hub portion engaged over said tubular rotatable shaft, said screw cap engaged with the hub portion of said fan for securing said fan in position on the shaft.

4. In a gas burner, a tubular rotatably mounted shaft, a fan slidingly keyed thereon, means on said shaft against which said fan is adapted to seat a cap having screw engagement with the end of said shaft and engageable with said fan for forcing the latter to fully seated position on the shaft and a tubular jet arm or arms carried by said cap.

5. A gas burner, comprising a rotatably mounted tubular shaft having a shoulder, an anti-friction bearing element engageable over said shaft into position against said shoulder, a fan slidingly keyed on said shaft and movable thereover into position to hold said bearing element against said shoulder and a reaction impeller engageable over the end of the shaft to force said fan into holding engagement with said bearing element.

6. A gas burner, comprising a rotatably mounted tubular shaft having a shoulder, an anti-friction bearing element engageable over said shaft into position against said shoulder, a fan slidingly keyed on said shaft and movable thereover into position to hold said bearing element against said shoulder, a reaction impeller engageable over the end of the shaft to force said fan into holding engagement with said bearing element and a retainer for locking said impeller in position on said shaft.

7. A gas burner, comprising a hollow supporting hub, a gas supply pipe connected with one end of said hollow hub, a tubular shaft in line with said gas supply pipe and having spaced shoulders, anti-friction bearings having outer and inner race members, said outer members seated in the hollow hub and said inner race members engaged on the shaft against said shoulders, a retaining element in the hub in engagement with the outer race member of one of the bearings, a fan on the shaft in engagement with the inner race member of the same bearing and a reaction impeller screwed on the end of the shaft over said fan for securing the latter in position holding said inner race ring.

8. A gas burner, comprising a hollow hub, a gas supply pipe connected with one end of said hub, a tubular shaft opposed to the end of said gas supply pipe, an anti-friction bearing for said shaft removably mounted in said hub, a retainer ring for removably securing said bearing in the hub, a leakage gas by-pass about said bearing extending from a position about the inlet end of the shaft and having a discharge port in position exposing said retainer ring for the entry of a releasing tool, a fan on the shaft adjacent said outlet of the by-pass and a reaction impeller connected with the shaft.

9. A gas burner comprising fan blades for forcing air for supporting combustion into a furnace, a reaction device separate from but connected to the fan blades for rotating them, said reaction device receiving combustible gas under pressure and having hollow radial arms with reaction jets opening at different radial positions along the arms to cause rotation of the reaction device and fan blades and wherein means for supplying combustible gas to the reaction device comprises a rotatable tubular shaft which supports the reaction device and fan blades, and a fixed hub having bearing means for rotatably supporting the tubular shaft, said fixed hub having passages therein for discharging gas which would otherwise flow through the bearing means to a point outside the hub.

10. A gas burner, comprising a hollow supporting hub, a gas supply pipe connected with one end of said hub, a tubular shaft rotatably mounted in said hub with one end opposed to the inlet end of said gas supply pipe and the opposite end projecting from the opposite end of the supporting hub, anti-friction bearing means in said hub rotatably supporting said tubular shaft therein and said hub having a passage or passages around said bearing means and extending from near the inner end of said tubular shaft to the opposite end of the hub for discharging gas which otherwise would flow through the anti-friction bearing to a point outside the hub, a fan on the projecting portion of the tubular shaft for carrying off such gas and an impeller on the projecting end of the shaft and open to the interior of the same for imparting rotation to said shaft and the fan carried thereby.

11. A burner for fluid fuel comprising a casing forming an air passage, a fan in said passage to draw air therethrough in a quantity dependent upon the speed of rotation of said fan and to discharge said air axially of said passage to a burner throat or the like, and fuel supply means comprising reaction means for driving said fan, said reaction means including radially extending arms connected with said fan and having fuel passages and a set of orifices disposed along said arms to discharge the fuel from said fuel passages in a film extending across substantially the entire active air passage area, said orifices being disposed to direct the fuel across the current of air created by said fan in said air passage so as to obtain a uniform and complete mixture of air and fuel at about the plane of fuel discharge and means for supplying fuel under pressure to said reaction means whereby the reaction of the fuel discharged drives said fan at a speed dependent upon fuel pressure said radially extending arms being spaced from the fan forwardly in the direction of air flow so as to discharge the fuel into the current of air after the air has advanced from the fan whereby the action of the fan blades is unaffected by the fuel discharged from said arms or by the air displaced by said arms.

12. A burner for fluid fuel comprising a casing forming an air passage, a fan in said passage to draw air therethrough in a quantity dependent upon the speed of rotation of said fan and to discharge said air axially of said passage to a burner throat or the like, and fuel supply means comprising reaction means for driving said fan, said reaction means including radially extending arms connected with said fan and having fuel passages and a set of orifices disposed along said arms to discharge the fuel from said fuel passages in a film extending across substantially the entire active air passage area, said orifices being disposed to direct the fuel across the current of air created by said fan in said air passage so as to obtain a uniform and complete mixture of air and fuel at about the plane of fuel discharge, and means for supplying fuel under pressure to said reaction means whereby the reaction of the fuel discharged drives said fan at a speed dependent upon fuel pressure, said fan and reaction arms being mounted on a common rotary hollow shaft member and the means for supplying fuel under pressure including a fixed fuel supply pipe communicating with said rotary shaft member to supply fuel thereto, bearing means for said shaft member, a support for said bearing means, leakage fuel collecting means tending to prevent fuel from entering said bearing means, said support having a fuel discharge channel extending from said leakage fuel collecting means about said bearing means to said passage at a point adjacent said fan.

13. A gas burner, comprising a tubular member adapted to be mounted in a furnace wall and to thereby form an air admission conduit, a spider in said tubular member, said spider having a hollow hub structure, a stationary gas supply pipe connected with the outer end of said hollow hub structure, a tubular shaft rotatably mounted in said hollow hub structure in line with said stationary gas supply pipe to form a rotary continuation of the latter, a fan mounted on said tubular rotary shaft and a reaction impeller secured to said shaft, spaced from said fan in the direction of air flow created by said fan and in open communication with the interior of said tubular shaft.

14. A burner for fluid fuels, comprising in combination with a casing forming an air passage, a stationary hollow hub disposed substantially centrally of said air passage, a stationary gaseous fuel supply pipe connected with the outer end of said stationary hollow hub, the inner end of said stationary hub being open, an open-ended tubular rotary shaft entered through said open inner end of said stationary hub and extending toward said outer end of the hub, bearing means about said entered portion of said tubular shaft and rotatably supporting said tubular shaft in said stationary hub with the open end of the shaft in communication with the interior of said hollow stationary hub to receive gaseous fuel supplied by said stationary pipe, an air flow creating fan carried by said tubular rotary shaft at said inner end of said stationary hub and a reaction device for rotating said fan and in communication with the interior of said tubular rotary shaft.

15. A burner for fluid fuels, comprising in combination with a casing forming an air passage, a stationary hollow hub disposed substantially centrally of said air passage, a stationary gaseous fuel supply pipe connected with the outer end of said stationary hollow hub, the inner end of said stationary hub being open, an open-ended tubular rotary shaft entered through said open inner end of said stationary hub and extending toward said outer end of the hub, bearing means about said entered portion of said tubular shaft and rotatably supporting said tubular shaft in said stationary hub with the open end of the shaft in communication with the interior of said hollow stationary hub to receive gaseous fuel supplied by said stationary pipe, an air flow creating fan carried by said tubular rotary shaft at said inner end of said stationary hub and a reaction device for rotating said fan and in communication with the interior of said tubular rotary shaft, said reaction device being separate from said fan and means enabling the setting of said reaction device in fixed relation to said fan.

16. A burner for fluid fuels, comprising in combination with a casing forming an air passage, a stationary hollow hub disposed substantially centrally of said air passage, a stationary gaseous fuel supply pipe connected with the outer end of said stationary hollow hub, the inner end of said stationary hub being open, an open-ended tubular rotary shaft entered through said open inner end of said stationary hub and extending toward said outer end of the hub, bearing means about said entered portion of said tubular shaft and rotatably supporting said tubular shaft in said stationary hub with the open end of the same in communication with the interior of said hollow stationary hub to receive gaseous fuel supplied by said stationary pipe, an air flow creating fan carried by said tubular rotary shaft at said inner end of said stationary hub and a reaction device for rotating said fan and in communication with the interior of said tubular rotary shaft, said bearing means being of the antifriction type and said stationary hollow hub being chambered to accommodate said antifriction bearing means and having a by-pass about said bearing means to avoid flow of leakage gas through said bearing means.

17. A burner for fluid fuel, comprising in combination with a casing forming an air passage, a rotary fan and reaction means for driving the same, an antifriction bearing rotatably mounting said fan and reaction means in said air passage, a stationary support containing said antifriction bearing, a gas supply pipe connected with said stationary support and said stationary support having a passage for leakage gas extending away from said contained antifriction bearing to said air passage at the suction side of said fan.

18. A gas burner, comprising a hollow stationary supporting hub, a stationary gas supply pipe separate from but connected with one end of said hub, a tubular shaft extending into and rotatably mounted in said hub with one end adjacent to one end of said stationary gas supply pipe and the opposite end projecting from the opposite end of the supporting hub, anti-friction bearing means in said hub rotatably supporting said tubular shaft therein, fan blades for forcing air for supporting combustion into a furnace, a reaction device separate from but connected to the fan blades for rotating them, said reaction device receiving combustible gas under pressure through said tubular shaft from said supply pipe and having hollow radial arms axially spaced from and separate from the fan blades and provided with reaction jets opening at different radial positions along the arms to cause rotation of the reaction device and fan blades, said reaction

FUEL BURNERS
118

device and fan blades being mounted on the free projecting end of said tubular shaft, said hub having passages therein for discharging gas, which would otherwise flow through the anti-friction bearing means, to a point outside the hub.

19. A gas burner comprising a housing for connection with a furnace, a fan therein for forcing air for supporting combustion into the furnace, a reaction device separate from but connected to the fan, said device receiving combustible gas under pressure and having hollow radial arms spaced from the fan and between the fan and the furnace and provided with reaction jets opening at different radial positions along the arms to cause rotation of the reaction device and fan, means for supporting the fan and reaction device comprising a fixed hollow stationary hub having anti-friction bearings therein, a tubular shaft rotatable in said bearings, said shaft having a free end, extending toward the furnace, upon which the fan blades and reaction device are mounted, and means for supplying combustible gas to the reaction device which includes the aforesaid tubular rotatable shaft, and a fixed stationary gas supply pipe which is connected to one end of the stationary hub for delivering gas to the interior of the tubular shaft for ultimate delivery through the shaft to the reaction device.

DAVID P. GRAHAM.