M. & N. B. BECK.

FUEL HEATER FOR EXPLOSIVE ENGINES.

APPLICATION FILED JULY 17, 1915.

1,214,501. Patented Feb. 6, 1917.

2 SHEETS—SHEET 1.

Fig. 1

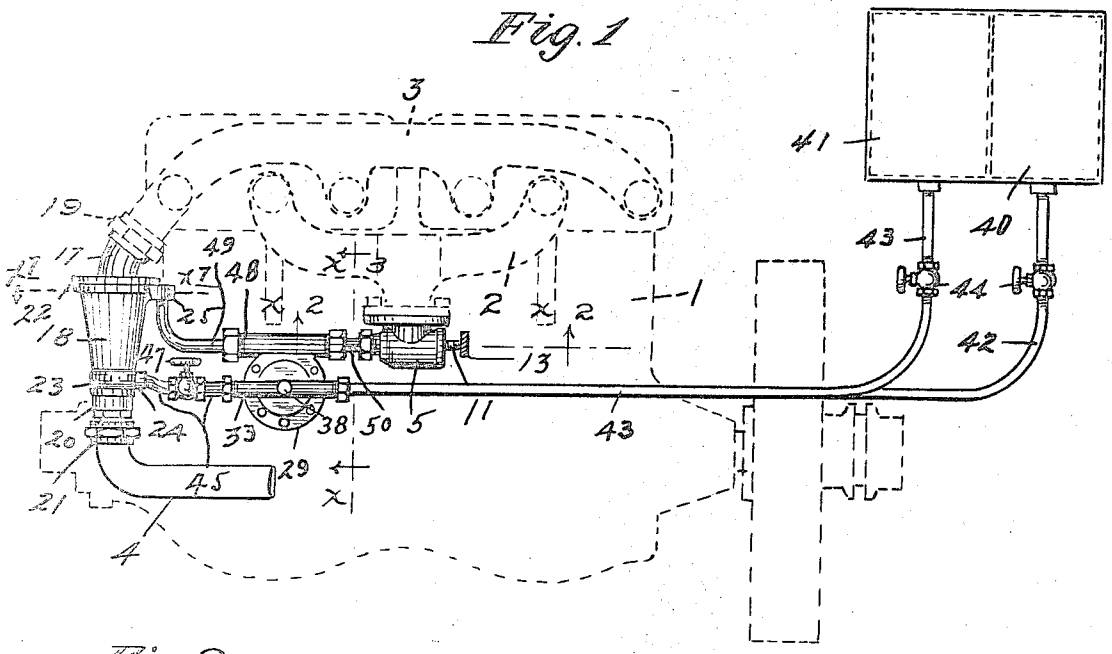


Fig. 2.

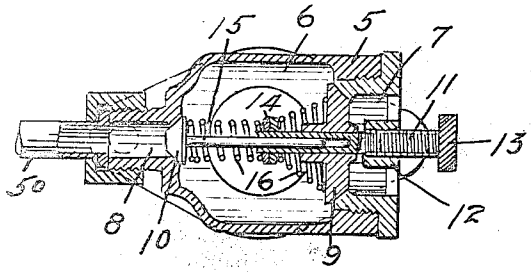


Fig. 5.

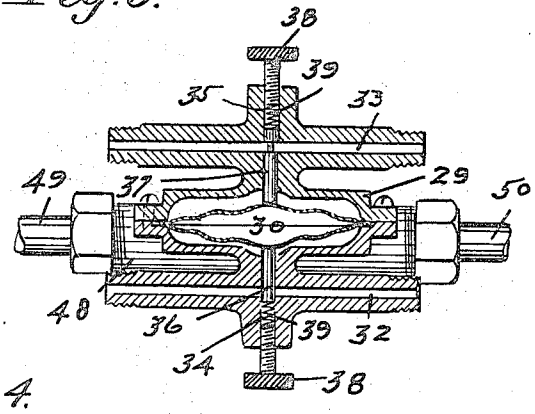


Fig. 3.

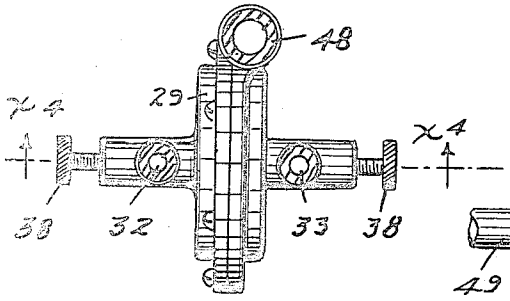
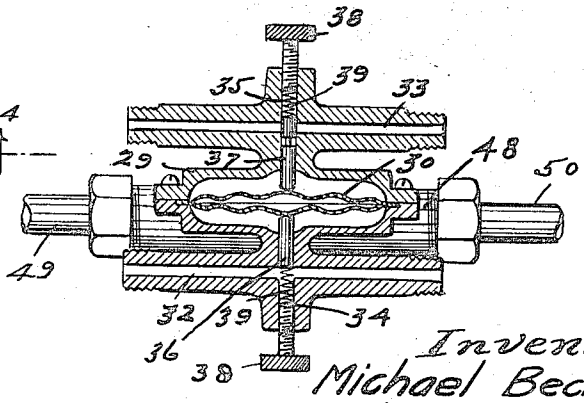


Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 6.

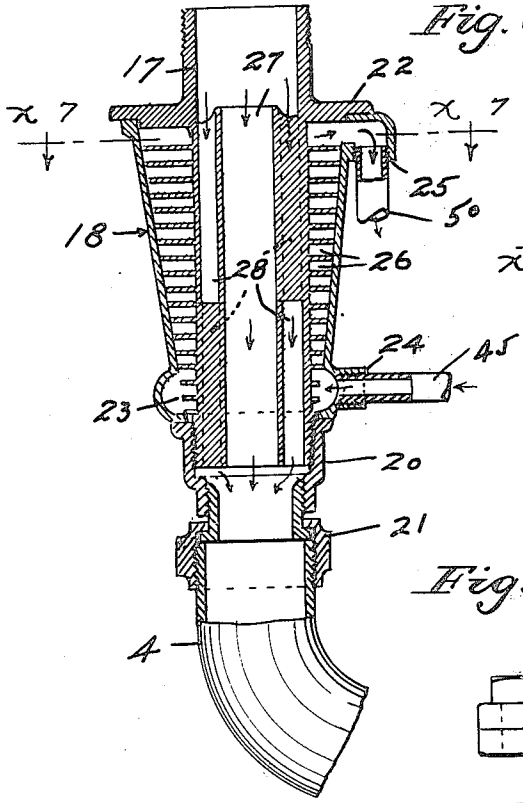


Fig. 7.

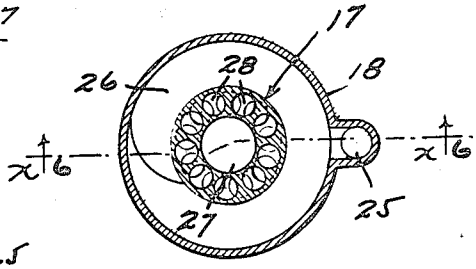
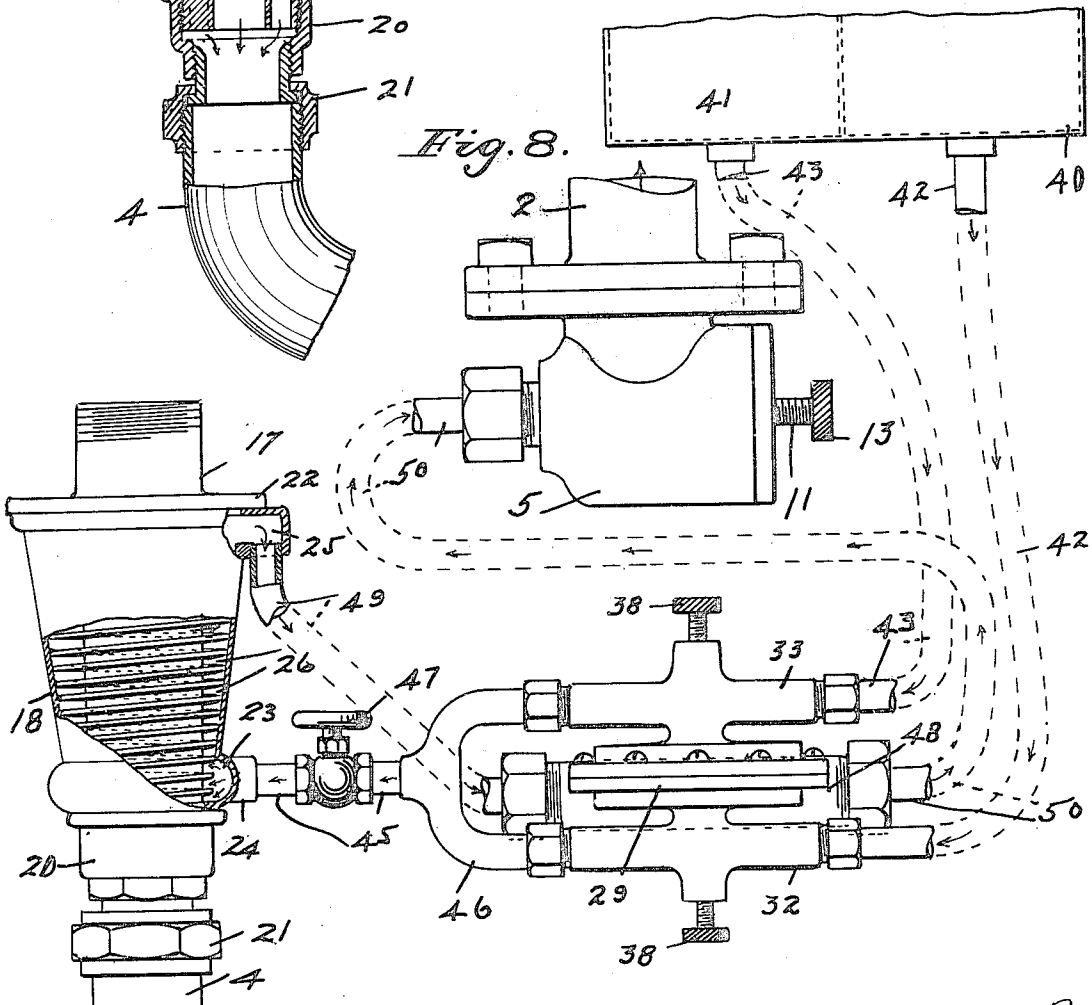


Fig. 8.



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UNITED STATES PATENT OFFICE.

MICHAEL BECK AND NICHOLAS B. BECK, OF MINNEAPOLIS, MINNESOTA.

FUEL-HEATER FOR EXPLOSIVE-ENGINES.

1,214,501. Specification of Letters Patent. Patented Feb. 6, 1917.

Application filed July 17, 1915. Serial No. 40,433.

To all whom it may concern:

Be it known that we, MICHAEL BECK and NICHOLAS B. BECK, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Fuel-Heaters for Explosive-Engines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to improvements in fuel heaters for explosive engines; and, to this end, it consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

In the accompanying drawings which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings, Figure 1 is a side elevation of an explosive engine diagrammatically indicated by means of broken lines and having incorporated therein, the invention which is illustrated by means of full lines; Fig. 2 is a view principally in horizontal section taken on the line x^2 x^2 on Fig. 1, on an enlarged scale; Fig. 3 is a view partly in elevation and partly in vertical section taken on the line x^3 x^3 on Fig. 1, on an enlarged scale; Fig. 4 is a view principally in horizontal section taken on the line x^4 x^4 on Fig. 3; Fig. 5 is a view corresponding to Fig. 4 but showing some of the parts in different positions; Fig. 6 is a detail view partly in side elevation and partly in vertical section taken on the irregular line x^6 x^6 on Fig. 7; Fig. 7 is a transverse section taken on the line x^7 x^7 on Fig. 6, and also on the line x^7 x^7 on Fig. 1, on an enlarged scale; and Fig. 8 is a view partly in side elevation and partly in section diagrammatically illustrating the invention with portions of the fuel conveying conduits indicated by means of broken lines, and with some parts turned in different position to more clearly show the connections between the several parts.

The explosive engine, diagrammatically illustrated for the purpose of showing the invention applied in working position, is indicated as an entirety by the numeral 1, with the exception of the intake manifold 2, exhaust manifold 3 and exhaust pipe 4.

A casing 5 is bolted to the intake manifold 2 and has a mixing chamber 6 and axially alined air intake and gas ports 7 and 8, respectively. These ports 7 and 8 are normally closed by valves 9 and 10, respectively, both of which valves are yieldingly and normally held closed and adapted to be opened under the suction stroke of the engine, as is customary in such engines.

The air valve 9 is loosely mounted for longitudinal and sliding movement on a valve stem 11 having screw-threaded engagement with a spider bracket 12 integrally formed with the wall of the air port 7. On the outer end of the valve stem 11 is a knurled head 13, by which said stem may be rotated for longitudinally adjusting the same through the spider bracket 12. The inner end of the valve stem 11 is of tubular form, and is provided with a radially projecting annular abutment 14.

The valve 10 is rigidly secured to one end of a valve stem 15, the free end of which is telescoped into the tubular inner end of the valve stem 11. A pair of coiled springs 16 surround the valve stems 11 and 15 and are compressed, the one between the valve 9 and abutment 14, and the other, between the valve 10 and said abutment.

Obviously, by rotating the valve stem 11, by means of its knurled thread 13, the tension of either one of the springs 16 may be increased while the tension of the other thereof, is simultaneously decreased. For instance, if it is desirable to have a fuel mixture with more gas and less air, the stem 11 is rotated in a direction to shorten the distance between the valve 9 and abutment 14, thereby placing the respective spring under greater compression. This same movement also lengthens the distance between the valve 10 and the abutment 14, releasing the tension on the respective spring 16.

A combined fuel heater and exhaust retarding device is interposed in the exhaust from the engine between the exhaust manifold 3 and the exhaust pipe 4, and affords the connection between said manifold and exhaust pipe. This device comprises telescopically connected co-axial inner and outer casing 17 and 18, respectively. The upper end of the casing 17 is directly secured to the exhaust manifold 3, by a union 19, and a sleeve 20 surrounds the lower end of the

casing 17 and is adjustably secured thereto by screw-threaded engagement. A union 21 connects the sleeve 20 to the exhaust pipe 4.

Integrally formed with the upper end portion of the casing 17 is a radially projecting annular flange 22. The casing 18 is of inverted conical form and is seated against the under face of the flange 22 and the inner end portion of the sleeve 20. By rotating the sleeve 20 on the casing 17, the casing 18 may be rigidly clamped in position by said flange and sleeve. The lower extremity of the casing 18 is circumferentially expanded to form a fuel receiving chamber 23 having a receiving nipple 24. Integrally formed with the upper end of the casing 18 is a fuel discharge nipple 25.

A spiral fuel conveying conduit 26 fills the space between the casing 17 and 18 and is integrally formed with the casing 17 through which the exhaust passes. This spiral fuel passage 26, at its receiving end, extends into the chamber 23 and progressively increases in cross section in the direction of the passage of the fuel upward therethrough, and is arranged to deliver into the discharge nipple 25.

To increase the efficiency of the fuel heater, the passage of the exhaust therethrough is retarded. As shown, this retarding of the exhaust is accomplished by forming axially within the casing 17 a relatively large passageway 27, between which and the inner wall of said casing is formed upper and lower series of circumferentially spaced, relatively small passageways 28. Said two series of passageways 28 are axially offset in respect to each other, as best shown in Fig. 7.

A thermally-actuated fuel selector is provided for automatically opening and closing conduits provided for supplying the engine with fuel. This selector comprises a circumferentially divided angular casing 29 within which is mounted a diaphragm 30 having an air-filled chamber. The diaphragm 30 is rigidly secured to the casing 29 by clamping its peripheral edges between the sections of said casing. Integrally formed with one section of the casing 29 is a fuel conveying conduit section 32, and integrally formed with the other section thereof is a like conduit section 33. These conduit sections 32 and 33 extend parallel to each other and to the diaphragm 30 which is located therebetween. Bores 34 and 35 are extended transversely through the conduit sections 32 and 33, respectively, and axially through the sections of the casing 29.

Slide valves 36 and 37 are mounted for endwise sliding movement in the bores 34 and 35, respectively. Screwed into the outer end portion of each bore 34 and 35 is an adjusting screw 38 having a knurled head by which it may be turned. Coiled springs 39 are compressed between the outer ends of the valves 36 and 37 and the adjusting screws 38. These springs 39 yieldingly hold the inner ends of the axially alined valves 36 and 37 in direct engagement with the diaphragm 30 at the axis thereof.

Fig. 4 shows the position of the valves 36 and 37 before the engine is started, and also after the same is started but still cold. In this position of the valves 36 and 37, the conduit 32 is open and the conduit 33 is closed. In Fig. 5, the valves 36 and 37 are shown in the positions they have been automatically set after the engine has been running a sufficient length of time for the exhaust pipe to become thoroughly heated. In this position of the valves, the conduit 32 is closed and the conduit 33 is open.

Fuel, such as gasolene, or other lighter hydrocarbon oils or liquids, is delivered to the engine 1 from a tank 40, and fuel, such as kerosene, or other heavier hydrocarbon oils or liquids is delivered to the engine 1 from a tank 41. A fuel conveying conduit 42 connects the tank 40 with the conduit section 32 and a fuel conveying conduit 43 connects the tank 41 with the conduit section 33. Interposed in each conduit 42 and 43 is a hand valve 44, by which the fuel supply may be entirely cut off. The other or delivery ends of the conduit sections 32 and 33 are connected to a common fuel conveying conduit 45 by a Y connection 46. The other or delivery end of the conduit 45 is screwed into the nipple 24 of the heater. A hand valve 47 interposed in the conduit 45 is provided for regulating the amount of fuel passing to the heater.

Integrally formed with the sections of the casing 29 having the conduit section 32, is a conduit section 48 which extends parallel to conduits 32 and 33. A fuel conveying conduit 49 connects the nipple 25 of the heater with the receiving end of the conduit section 48, and a fuel conveying conduit 50 connects the delivery end of the conduit section 48 with the gas port 8.

Operation: The operation of the invention may be briefly described as follows: As previously stated, Fig. 4 shows the position of the valves 36 and 37 before the engine is started. In this position of said valves the conduit 32 is open permitting a free passage of the lighter fuel from the tank 40 to the gas port 8, which is normally closed by the valve 10, and the conduit section 33 is closed, cutting off the supply of the heavier fuel from the tank 41. By means of the lighter fuel, the engine is started and is continuously fed thereto until the exhaust becomes hot. The lighter fuel, in passing around the exhaust through the spiral passage 26, is thoroughly heated. By progressively increasing the size of the spiral passage 26 in the direction of the travel of the fuel therethrough, said fuel

is continuously spread out over a large area of the heated surface of the passageway, thereby very quickly and thoroughly heating the fuel and converting the same into a gas or vapor. From the spiral passage 26 the hot fuel is conveyed to the gas port 8 through the conduit sections 49, 48 and 50. The heat from the fuel, in passing through the conduit section 48, is transmitted to the diaphragm 30 through the metals from which the conduit section 48 and casing 29 are constructed. As the air in the diaphragm 30 becomes heated, said diaphragm expands, as shown in Fig. 5, and moves the valve 36 into a closed position to cut off the supply of lighter fuel, and opens the valve 37 to allow a free passage of the heavier fuel to the engine. The heavier fuel, in passing through the heater, is also converted into a gas or vapor before it is introduced into the gas port 8. The heat from this gas or vapor, in passing through the conduit section 48, will keep the diaphragm 30 in an expanded position to permit a continuous feed of the heavier fuel. After the engine has been stopped and the heater cools off, the diaphragm 30 will contract and allow the valves 36 and 37 to assume the positions shown in Fig. 4. In these positions of the valves, the conduit for the heavier fuel is closed and the conduit for the lighter fuel is opened, with the lighter fuel ready for use when the engine is again started.

What we claim is:

1. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having an exhaust passage and a spiral fuel conveying passage surrounding said exhaust passage, the convolutions of said spiral fuel conveying passage having progressively increasing horizontal width.

2. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having an exhaust passage and a spiral fuel conveying passage surrounding said exhaust passage, the convolutions of said spiral fuel conveying passage having progressively increasing width in the direction of the passage of the fuel therethrough.

3. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having an exhaust passage and a spiral fuel conveying passage surrounding said exhaust passage, said spiral fuel conveying passage progressively increasing in cross section from its receiving end toward its delivery end.

4. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an explosive engine and having a cellular exhaust passage and a fuel conveying passage surrounding said exhaust passage.

5. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having a cellular exhaust passage and a fuel conveying passage surrounding said exhaust passage, the openings at the receiving end of said exhaust passage being axially staggered with respect to the openings at the delivery end thereof.

6. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having a cellular exhaust passage and a spiral fuel conveying passage surrounding said exhaust passage, the openings at the receiving end of said exhaust passage being axially staggered with respect to the openings at the delivery end thereof.

7. A fuel heater for explosive engines comprising a casing interposed in the exhaust pipe of an engine and having an exhaust passage and a spiral fuel conveying passage surrounding said exhaust passage, the convolutions of said spiral fuel conveying passage having a constant vertical width and a progressively increasing horizontal width.

In testimony whereof we affix our signatures in presence of two witnesses.

MICHAEL BECK.
NICHOLAS B. BECK.

Witnesses:
BERNICE G. WHEELER,
HARRY D. KILGORE.