

1,384,512.

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UNITED STATES PATENT OFFICE.

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ENGINE-FUEL-SUPPLY SYSTEM.

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To all whom it may concern:

Be it known that I, ALFRED BÜCHI, a citizen of the Republic of Switzerland, residing in Winterthur, in the Canton of Zurich, Switzerland, have invented certain new and useful Improvements in Engine-Fuel-Supply Systems, of which the following is a full, true, and complete specification.

This invention relates to heavy oil internal combustion engines operating on fuel of viscous character which is rendered sufficiently fluid to move freely through the fuel supply system by the application of heat, the particular object of the invention being to maintain a proper temperature and degree of fluidity for all conditions of engine operation, that is to say when the fuel demand is heavy as well as when it is light, and thereby to provide for accurate and satisfactory engine regulation and operation. The oil is conducted from the reservoir or supply source to a heater by means of parts or piping wherein a relatively large body of oil is kept in agitation or circulation, the amount being sufficiently large with relation to the requirements of the engine to permit the entrance of fresh oil thereto, from the reservoir corresponding to the withdrawal for the engine, without appreciably altering its temperature, and the heat supplied is sufficient to maintain a substantially constant supernormal temperature therein suited to preserve a requisite degree of fluidity.

The accompanying drawing illustrates schematically an embodiment of the invention.

An engine of the character stated is represented at *a*, with an exhaust pipe *b* and fuel valve *c*, whereby the liquid fuel is admitted to the cylinder in well-known manner. The fuel injection pump *d* which delivers the fuel in proper quantity through pipe *s* to the fuel valve is operated from the upright, engine-driven shaft *k*, and may be subject to the customary, hand or governor, regulation to vary the fuel feed in accordance with the load. The said pump draws its supply from a circulatory loop *f*, the

piping of which is shown as of somewhat larger diameter than the injection line *s*. Included in this loop is a coil *i* encircling the exhaust pipe, and representing in the present case any form of heating apparatus. The loop also includes a circulating pump *g* which is shown as driven from the same upright shaft *k* as the service pump *d* and constitutes a means of forcing circulation through the loop,—an effect which however is not necessarily essential to the invention inasmuch as it is possible to obtain an adequate natural circulation by the thermal variation of the density of the liquid in the loop. In the arrangement shown the said pump *g* is supplemental to and assists the natural thermal circulation, drawing the warmed fuel from the upper end of the heater coil *i* and delivering it part through external branch pipe *m* to the inlet of injection pump *d*, and the remainder through the internal branch *f'*, forming part of the loop and containing a valve *n*.

The fuel reservoir *e* is preferably external to the loop, being connected therewith at a point in the descending or cooler side of the system by a valved connection *r* of minimum length. The oil passes through this connection at a rate equivalent to the discharge through the injection valve, enters immediately into a heated circulating stream with which it mingles and by which it is warmed. The coil *t*, shown inside the reservoir *e* is for preheating the fuel therein when necessary, by means of steam or hot gases. The circulatory system is so proportioned and adjusted in its various parts as to allow the oil to flow or circulate between the entrance from the reservoir and the exit to the injection pump *d*, in volume considerably in excess of the immediate needs of the engine, so that a sufficient amount of heated oil will always be returned through the section *f'* to keep the piping warm and oil in pump *d* and the injection line *s* in a desired fluid state. When the exhaust pipe serves as the source of heat, as in the present case, the temperature of the injection line is kept practically constant and the accuracy of

regulation of the engine is accordingly improved.

When the fuel in reservoir *e* is too viscous to start the engine on, when cold, it may
5 either be heated by the use of a preheater such as diagrammatically indicated at *p*, as an electric heater, or lighter fuel may be drawn from an auxiliary reservoir *o*, for starting purposes. This auxiliary reservoir
10 is normally cut off from the circulatory system by the valve in the pipe *v*. Such valve is opened and the valve *r* is closed just before the engine is to be shut down so as to fill the circulating system with the lighter
15 fuel in readiness for use whenever the engine is to be started. When the exhaust pipe *b* has become hot the setting of the valves is reversed and the combustion thereafter proceeds on the heavy oil as above described.
20

The means for circulating the liquid in the loop need not necessarily be dependent upon the engine, as is suggested by a pump represented diagrammatically at *g*¹, which
25 pump may be driven by any available source of power other than the engine. Such independent circulating means may be operated when the preheater *p*, also not dependent upon the operation of the engine, is in use,
30 thus enabling the engine to be quickly started upon the regular or viscous fuel.

I claim—

1. The combination with an internal combustion engine using normally viscous fuel
35 and a supply source of such fuel, of means for heating and circulating a mass of said fuel in liquid form between the source and the engine, whereby the engine is served with liquid fuel drawn from a circulation of
40 heated oil in excess of its immediate requirements.

2. The combination with an internal combustion engine using normally viscous fuel, of a supply source of such fuel, a loop circulating system therefor, external of and
45 connected to said source, and means whereby the heat of the engine's combustion is transmitted to the fuel in said loop system.

3. The combination with a heavy oil internal combustion engine, of a heater for the oil, means whereby the oil in liquid form is circulated through, from and back to the
50 heater at a rate in excess of the rate of fuel consumption of the engine, a fuel valve supplied by said circuit and a fuel source also connected thereto and serving to replenish
55 said circuit.

4. The combination with a heavy oil internal combustion engine having a fuel valve
60 and means for feeding liquid oil thereto, of a heater connected with the fuel feeding means, a source of supply also connected thereto, and means comprising a loop circulating system for conducting liquid oil from

the source through the heater to said feeding
65 means, said loop system embodying means other than said fuel feeding means for circulating the liquid oil at a rate exceeding the requirements of the engine.

5. The combination with a heavy oil internal combustion engine having fuel injecting means and an injection pump and oil line
70 connected therewith, of a heater for the oil, a source of oil supply, and a loop external of and connected with the source of supply
75 and including the heater, whereby a circulation of heated oil in excess of the requirements of the engine is maintained, said pump having its suction connected to the loop.

6. The combination with a heavy oil internal combustion engine having a liquid
80 fuel intake, a reservoir, means between said fuel intake and reservoir containing a body of liquid fuel, heating means for the liquid fuel in said means, a pump for agitating
85 the oil being heated, and means receiving heated liquid fuel from the first mentioned means and delivering the same to said intake.

7. The combination with a heavy oil internal combustion engine, of fuel supply
90 means comprising a loop system around which liquid fuel circulates at a rate exceeding the requirements of the engine, and means for heating the oil in circuit by the
95 waste heat of the engine.

8. The combination in an internal combustion engine using normally viscous liquid fuel, of a fuel supply system therefor including an injection pump, means supplying
100 liquid fuel to said pump, and automatic means for imparting a substantially constant supernormal temperature to the liquid fuel moving to said pump.

9. The combination in an internal combustion engine using heavy liquid fuel, of a
105 reservoir an injection pump, a fuel supply system delivering liquid fuel to said pump and containing a relatively large body of fuel between said pump and the reservoir,
110 and means for maintaining a substantially constant supernormal temperature in said body of fuel.

10. The combination in an internal combustion engine using normally viscous liquid
115 fuel, of a fuel injection valve, fuel supply means comprising a loop circulating system for the fuel oil adapted to pass oil at a rate exceeding the requirements of the engine, a source of supply connected with and
120 exterior to the loop, means for withdrawing oil from the loop to serve the injection valve, and means for heating the oil in circuit in the loop.

11. The combination in an internal combustion engine, of a fuel reservoir, a circulating system receiving fuel therefrom and
125 embodying heating means arranged to in-

duce a thermal circulation in said system, and means for withdrawing heated fuel from said system for the use of the engine.

12. The combination in an internal combustion engine using heavy liquid fuel, of a
5 circulating fuel system embodying heating means arranged to induce a thermal circulation of liquid fuel therein, a fuel reservoir connected to supply fuel to said system on

the cooler side thereof, and means for withdrawing heated liquid fuel from said system for the use of the engine. 10

In testimony whereof, I have signed this specification in the presence of two witnesses.

ALFRED BÜCHI.

Witnesses:

CARL GUBLUCK,
OLGA ANRIG.