Sept. 23, 1952 F. R. BELL 2,611,242

INTERNAL-COMBUSTION ENGINE WITH REGENERATOR

Filed Jan. 13, 1948 2 SHEETS—SHEET 1

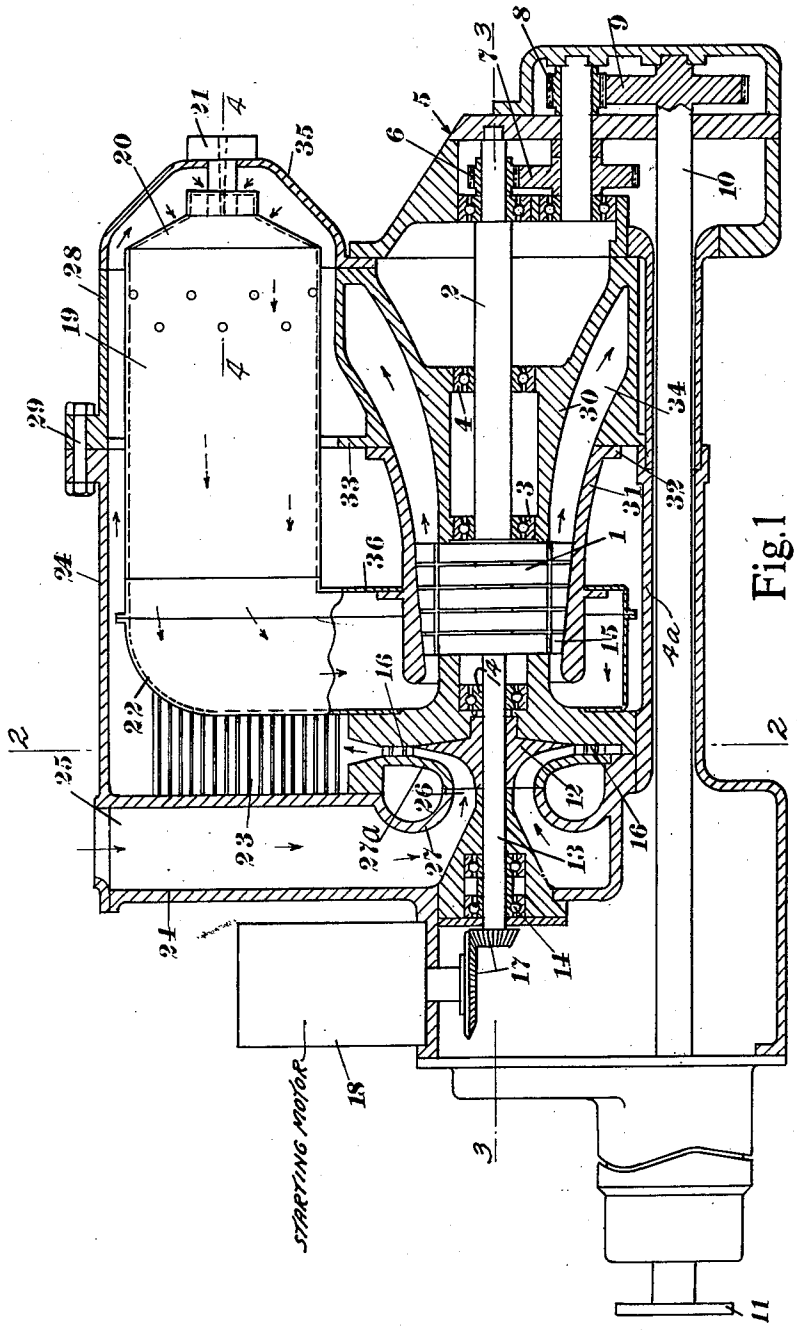

Fig.1

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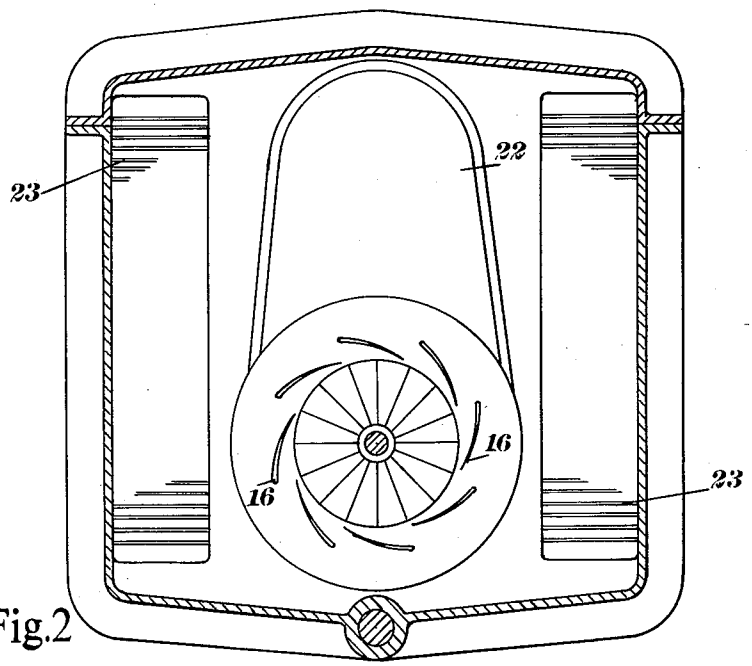

Fig.2

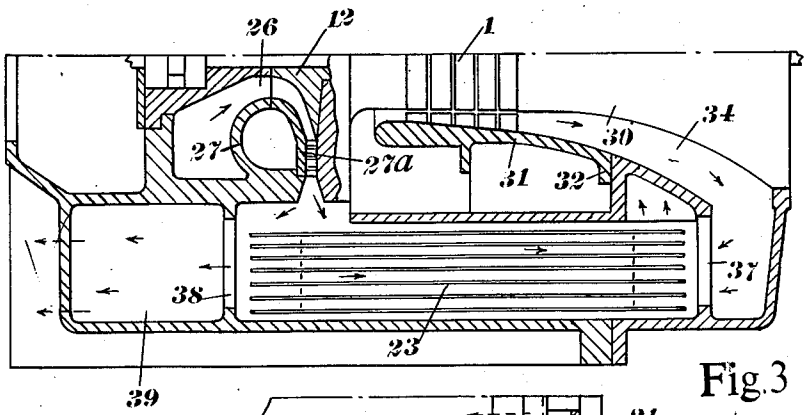

Fig.3

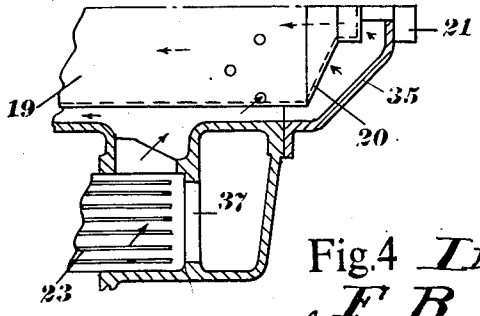

Fig.4

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UNITED STATES PATENT OFFICE

2,611,242

INTERNAL-COMBUSTION ENGINE WITH REGENERATOR

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Application January 13, 1948, Serial No. 2,111
In Great Britain January 20, 1947

1 Claim. (Cl. 60—39.51)

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This invention relates to internal combustion engines, and has for its object to provide a power unit of the turbine type adapted for the propulsion of road vehicles, locomotives, air or water craft, or the like.

In the accompanying drawings:

Figure 1 is a longitudinal section of an internal combustion engine constructed in accordance with the invention;

Figure 2 is a cross section of the engine taken through the turbo-blower taken on the line 2—2 of Figure 1;

Figure 3 is a sectional plan of one half of the engine taken on the line 3—3 of Figure 1 with parts of the heat exchangers removed;

Figure 4 is a fragmentary section, similar to Figure 2, taken on the line 4—4 of Figure 1.

In carrying the invention into effect according to one convenient mode as illustrated in the drawings, the power turbine comprises a series of axial flow turbine rotors 1 mounted on a shaft 2 carried in bearings 3 and 4 suitably supported. The turbine rotors and their associated fixed blading may be of any convenient construction and are not shown in detail since such detail does not form an essential part of the present invention. At one end of the turbine casing 4a there is provided a reduction gear box 5, the end of the power turbine shaft 2 being connected through gears 6, 7, 8 and 9 to a driven shaft 10 which extends parallel with and beneath the turbine shaft and is provided with a driving flange 11.

A separate turbo blower is provided comprising a single radial-flow air impeller 12 mounted on a shaft 13 which is supported in bearings 14. This shaft, which is separate from the power turbine shaft 2 though coaxial therewith, is rotatable in the same direction as the latter shaft, and has mounted upon it a single turbine rotor indicated at 15. The blower is provided with the usual diffuser vanes 16. The opposite end of the blower shaft 13 is connected by bevel gearing 17 to an electric starting motor 18.

Above the turbine casing 4a is mounted a combustion chamber in which are generated the hot gases required to operate the turbine rotors, the said chamber being adapted for the combustion therein of liquid fuel. The combustion chamber comprises a cylindrical body 19 having a conical or domed end 20 in which is mounted a liquid fuel burner 21. The opposite end of the body 19 is connected to an angle duct 22 leading to the inlet of the turbine blading. On opposite sides of the duct 22 and part of the combustion chamber 19 are arranged heat exchangers 23 the function of which is to pre-heat the air from the blower by means of the exhaust gases from the turbine. These heat changers may be of any convenient construction, but preferably they comprise a system of thin metal plates arranged parallel with each other and adapted to form narrow passages for the air and exhaust gases respectively. The said plates are indicated in diagrammatic form only in the drawings, and conveniently comprise alternate flat and corrugated plates arranged as shown and described in United States Patent No. 2,553,030.

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The components above described are enclosed in a housing which is also adapted to form parts of the ducting associated with the said components. The housing is of substantially rectangular form and comprises three main sections which have their interfaces located in vertical parallel planes. These main sections comprise an end section 24 within which is formed a vertical air inlet passage 25 leading to the air entrance 26 of the blower. The blower casing 27a is carried by a flange 27 formed on the inner vertical face of this housing section 24.

An end section 28 is secured to section 24 by bolts 29 and has a lower part 30 which extends back towards the turbine. An intermediate casing section 31 carries the fixed blading of the power turbine and has a flange 32 which is bolted to a flanged face 33 on the lower part 30 of the end section 28. A part of the intermediate casing section 31 is shaped to form a portion of an annular exhaust gas passage 34, the remainder of this passage being formed by appropriately shaped parts of the lower part 30 of the end section 28. This part also carries the bearings 3, 4 which support the turbine shaft 2.

The combustion chamber is carried in part by an end cover 35 bolted to the outer face of the end casing section 28 and by a support 36 which also forms a part of the duct 22.

The heat exchangers 23 are located on opposite sides of the duct 22 and also lie on opposite sides of part of the length of the combustion chamber and turbine as previously described and are in communication with the exhaust passage 34 through openings 37 and at their opposite ends through openings 38 with passages indicated generally at 39 with an outlet or silencer.

With the various parts arranged as above described the air flowing into the air inlet 25 of the housing is directed into the eye 26 of the turbo-blower and is discharged from there to one end of the heat exchangers 23 along which

it passes to the end of the combustion chamber as shown by the arrows in Figure 4. The hot gases discharged from the opposite end of the combustion chamber are led to the entrance of the turbine by the duct **22**. These gases first pass through the blading of the blower turbine which is carried by the shaft **13**, after which they traverse the blading of the power turbine and thence through the annular exhaust passage **34** to the end of the heat exchangers opposite that at which the cold air enters, the path of the gases being shown by the arrows in Figure 3. After flowing through the heat exchanger in a direction opposite to that taken by the cold air the gases are discharged to a silencer, if necessary, through passages **39** formed on the housing adjacent to the air inlet passage **25**.

By the combination and arrangement of parts above described, and by forming in the housing at least a portion of the ducting between the various components, I am able to provide a power unit for such purposes as those above specified in a compact and convenient form. The invention is not, however, restricted to the example described, as subordinate details may be modified to suit different requirements.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

A power unit comprising in combination a turbine having a gas inlet at one end and an exhaust passage at the opposite end, a turbo blower arranged at the inlet end of and coaxially with the turbine, an air inlet passage leading to the blower, a combustion chamber situated alongside the turbine and communicating at one end by a duct with the inlet end of the turbine, a pair of heat exchangers arranged along opposite sides of the duct and along part of the length of the combustion chamber and forming separate narrow air and gas passages through which air from the blower and gas from the turbine can flow in opposite directions respectively, the air passages being in communication at opposite ends respectively with the blower and the end of the combustion chamber remote from the blower, and the ends of the gas passages remote from the blower being in communication with the exhaust passage of the turbine, a gas outlet communicating with the other ends of the gas passages, and a housing enclosing the turbine, turbo-blower, and heat exchangers, the air inlet passage, the exhaust passage, and the gas outlet being formed at least in part by the housing.

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