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(54) TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINES

(54) MOTEURS A COMBUSTION INTERNE A CYCLE A DEUX TEMPS

(57) Abstract:

The invention relates to two-stroke cycle internal combustion engines such as those used for marine propulsion and exemplified by the multi-cylinder engines described in Patent Specification No. 445,241 and is concerned with such engines of the type having one or more engine driven compressors for supplying scavenging air to the cylinders for the purpose of clearing out the exhaust gases from the cylinder and of supplying air for combustion. The engine driven compressors may be of the reciprocating or rotary types (e.g. a Roots blower) and be driven from the engine by linkage mechanism or by cranks or by chains or gears from the engine crankshaft. In the case of the engines described in Patent Specification No. 445,241 the compressors are of the reciprocatory type driven by linkages from the crossheads of the cylinders.

It is an object of the invention to provide in an engine of the type described above means for supplying a super-charge of air for combustion in amounts roughly proportional or more than proportional to the power output of the engine.

The invention consists in a two-stroke cycle internal combustion engine of the above type characterised by a turbo-blower driven by the exhaust from the engine independently of the engine mechanism and arranged to supply air under pressure to the engine driven compressor or compressors thereby to increase the compressor output according to the volume and pressure of the exhaust gases and partly independently of the engine speed.

With the arrangement according to the invention the engine driven compressor alone provides the air for scavenging and combustion when the engine is being started

and during slow running, when the energy of the exhaust gases issuing from the engine is insufficient to drive the blower, and during normal or full-load running the exhaust blower supplies air under pressure to the engine driven compressor thereby increasing the output of the latter. The engine driven compressor may have a capacity, when supercharged by the exhaust blower, sufficient to deliver the whole of the air required by the engine when operating at full load or it may have a smaller capacity (e.g. sufficient only for running under light loads or under partial load) and a by-pass with a non-return valve may be provided around the compressor so that additional air may be supplied to the engine direct from the exhaust driven blower.

An intercooler may be provided between the exhaust-driven turbo blower and the engine driven compressor in order to cool the air delivered by the turbo-blower before it enters the engine driven compressor.

In engines having a large number, say six, of cylinders there may be two or more turbo-blowers driven, independently, by the exhaust gases from separate cylinders or groups of the cylinders. For example there may be two blowers at the two ends of the engine respectively and each driven by the exhaust gases from the cylinders at its end of the engine. The air outlets from the blowers may be connected to a common manifold supplying one or more engine driven compressors feeding all the cylinders of the engine or there may be two engine driven compressors feeding the cylinders at the two ends of the engine respectively and each blower be arranged to deliver independently into the inlet of the compressor feeding the cylinders from which the blower is driven.

The engine driven compressors may be of the double-acting reciprocating type as described in Patent Specification Serial No. 445,241 or of the rotary type, for example of the sliding vane or Roots types, which may be driven by gears or chains from the crankshaft of the engine or from any other shaft driven by the crankshaft. Such rotary compressors may be mounted at the back of the engine either in the centre or at either end in positions similar to those shown for the reciprocatory compressors in Patent Specification Serial No. 445,241.

Some examples of specific constructions according to the invention will now be described with reference to the accompanying diagrammatic drawings in which:-

Figure 1 shows a longitudinal view of a four-cylinder opposed-piston two-cycle single-acting engine,

Figure 2 shows a transverse section, on the line II-II in Figure 1, of the same engine,

Figure 3 shows a plan view of the same engine,

Figure 4 shows a sectional view corresponding to Figure 2 of a similar engine but with a Roots type compressor driven from the engine,

Figure 5 shows a longitudinal view of a six-cylinder opposed-piston engine of two-stroke single-acting type,

Figure 6 shows a plan view of the engine shown in Figure 5,

Figure 7 shows, partly in section and partly broken away, another six-cylinder opposed-piston two-stroke single-acting engine, and

Figure 8 shows a plan view of the engine shown in Figure 7.

In the first example shown in Figures 1-3 the engine is of the four-cylinder two-stroke-cycle single-acting opposed-piston type and has two reciprocating compressors 1 and 2 driven by linkage mechanisms 3 from the crossheads 4 and 5 of two end cylinders 6 and 7 of the engine. The compressors 1 and 2 deliver into the engine casing 16 from which the air passes to the cylinders. There is also mounted on the engine an exhaust-gas driven turbo-blower 8 which is driven solely by the exhaust gases from all the engine cylinders conveyed to the turbine side of the turbo blower through pipes 9 and 10. The air delivered from the blower side of the turbo-blower is conveyed through a delivery pipe 11 and inter-cooler 12 to a manifold 13 which is a common inlet to the reciprocating engine driven compressors 1 and 2.

In a modification of the above examples a by-pass 14 is provided around the reciprocating compressors 1 and 2 as shown in chain lines on Figure 3 and this pipe is provided with a non-return valve 15 which may be urged towards a closed position by a spring or by its own weight and which opens when the pressure on the blower side of the pipe 14 exceeds the pressure in the engine casing 16.

Referring now to Figure 4 a transverse section is shown of a two-stroke cycle opposed-piston single-acting engine where a Roots blower 17 is driven by a chain 18 from the crankshaft 19 of the engine and this Roots blower 17 is supplied with a super charge of air from an exhaust driven turbo-blower 8 through a delivery pipe 11 and inter cooler 12 which supplies the air inlet manifold 13 of the Roots blower. There may be two Roots blowers 17 in which case the manifold pipe 13 will form a common inlet to both Roots blowers and will

act as a reservoir to damp out any fluctuations of pressure in the manifold. As in the example shown in Figures 1 and 2 the turbo-blower 8 is driven by the exhaust gases from the engine cylinders supplied to the turbine side of the turbo-blower through pipes 9 and 10.

Referring now to Figures 5 and 6 a six-cylinder two-stroke cycle opposed-piston engine has three reciprocating compressors 20, 21 and 22 driven by linkages from the cross-heads 23, 24 and 25 of three end cylinders. The engine is provided with two turbo-blowers 26 and 27 which are driven by the exhaust gases from each set of three end cylinders respectively conveyed to the turbine end of the turbo-blowers 26 and 27 respectively through the pipes 28 and 29. The air delivered by the blower side of the turbo-blower 26 is conveyed through pipe 30 to manifold 31 and the air delivered by the turbo-blower 27 is conveyed through pipe 32 also into the manifold 31. The manifold 31 acts as an air reservoir and supplies the reciprocating engine driven compressors 20, 21 and 22. Intercoolers 33 and 34 are provided between the turbo-blowers 26 and 27 respectively and the manifold 31 to cool the air between these turbo-blowers and the engine driven compressors 20, 21 and 22. By-pass pipes 35 and 36 shown in chain-lines and provided with non-return valves 37 and 38 may be provided between the delivery pipes 30 and 32 and the casing 39 of the engine to permit additional air to be by-passed from the turbo-blowers 26 and 27 into the engine casing 39 without passing through the engine driven compressors 20, 21 and 22.

Referring now to Figures 7 and 8 a six-cylinder two-stroke cycle opposed-piston engine has engine driven reciprocating compressors 40, 41 and 42 driven by linkage gear from

the engine and this engine is provided with a vertical turbo-blower 43 mounted at the back in the centre of the engine and driven by the exhaust gases from the various cylinders, supplied to it through pipes 44, 45 and 46. The air delivered by the blower through pipe 47 is passed through an inter-cooler 48 to a manifold 49 from which the reciprocating engine driven compressors 40, 41 and 42 take their air. This manifold 49 is large enough to act as an air reservoir to damp out any fluctuations of pressure. The engine driven compressors deliver into the engine casing 51 which serves as a reservoir for the air to be supplied to the engine cylinders. A by-pass pipe 50 may be provided from the air manifold 49 into the casing 51 of the engine and may be provided with a non-return valve 52 so that air may be supplied direct from the turbo-blower into the casing 51 without passing through the reciprocating compressors 40, 41 and 42.

It will be appreciated that in each of the above examples when the engine is being started the compressors mechanically driven from the engine draw air through the stationary or slow running rotor of the turbo-blower and that as the turbo-blower increases in speed with increase in the volume and pressure of the exhaust gases from the engine, it delivers its air output to the compressors and so increases the quantity and pressure of the air supplied to the engine.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. In combination, a two-stroke cycle, opposed piston, internal combustion marine engine having a positive displacement, engine-driven compressor for supplying both scavenging air and combustion air, a turbo-blower driven by the exhaust from the engine independently of the engine mechanism to supply air under pressure, means connecting said turbo-blower to said engine-driven compressor to deliver compressed air from said turbo-blower to said engine-driven compressor to increase the output of the latter, and a by-pass with a non-return valve around said engine-driven compressor whereby additional air may be supplied to the engine directly from said turbo-blower.

2. In combination, a multi-cylinder, two-stroke cycle, opposed piston, internal combustion marine engine having at least two positive displacement engine-driven compressors for supplying to separate cylinders both scavenging air and combustion air, a turbo-blower driven by the exhaust from all the cylinders independently of the engine mechanism to supply air under pressure, and means connecting said turbo-blower to all the engine-driven compressors to deliver compressed air from said turbo-blower to said engine-driven compressors to increase the output of the latter according to the volume and pressure of the exhaust gases.

3. In combination, a multi-cylinder, two-stroke cycle, opposed piston, internal combustion marine engine having a positive displacement engine-driven

compressor for supplying both scavenging air and combustion air, at least two turbo-blowers independently driven by the exhausts from separate cylinders of the engine to supply air under pressure, and means connecting said turbo-blowers to said engine-driven compressor to deliver the compressed air from said turbo-blowers to said engine-driven compressor to increase the output of the latter according to the volume and pressure of the exhaust gases.

4. In combination, a multi-cylinder, two-stroke cycle, opposed piston, internal combustion marine engine having a positive displacement engine-driven compressor for supplying both scavenging air and combustion air, two turbo-blowers disposed respectively at the two ends of the engine and independently driven by the exhausts from separate cylinders of the engine to supply air under pressure, and means connecting said turbo-blowers to said engine-driven compressor to deliver the compressed air from said turbo-blowers to said engine-driven compressor to increase the output of the latter according to the volume and pressure of the exhaust gases.

5. In combination, a multi-cylinder, two-stroke cycle opposed piston, internal combustion marine engine having at least two positive displacement engine-driven compressors for supplying to separate cylinders both scavenging air and combustion air, at least two turbo-blowers independently driven by the exhausts from separate cylinders of the engine to supply air under pressure, and a common manifold connecting said turbo-blowers to said engine-driven compressors to deliver the compressed

air from said turbo-blowers to all said engine-driven compressors to increase the output of the latter according to the volume and pressure of the exhaust gases.

6. In combination, a multi-cylinder, two-stroke cycle opposed piston, internal combustion marine engine having two positive displacement engine-driven compressors for supplying to separate cylinders at the two ends of the engine respectively both scavenging air and combustion air, two turbo-blowers disposed respectively at the two ends of the engine and independently driven by the exhausts from separate cylinders at the respective ends of the engine to supply air under pressure, and separate manifolds connecting said turbo-blowers respectively to said engine-driven compressors to deliver the compressed air from each turbo-blower to its associated engine-driven compressor to increase the output of the latter according to the volume and pressure of the exhaust gases.

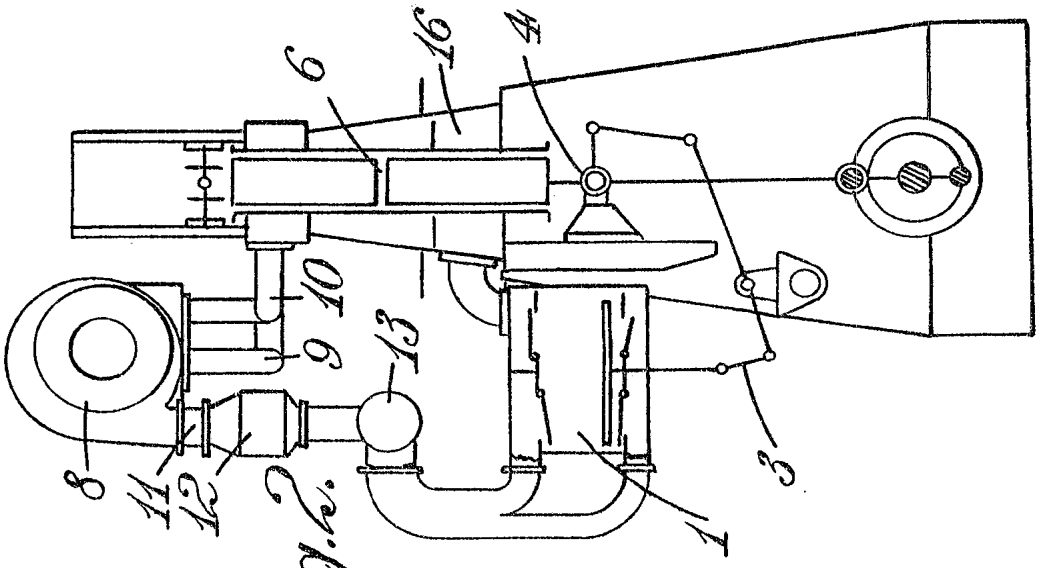

Fig. 2.

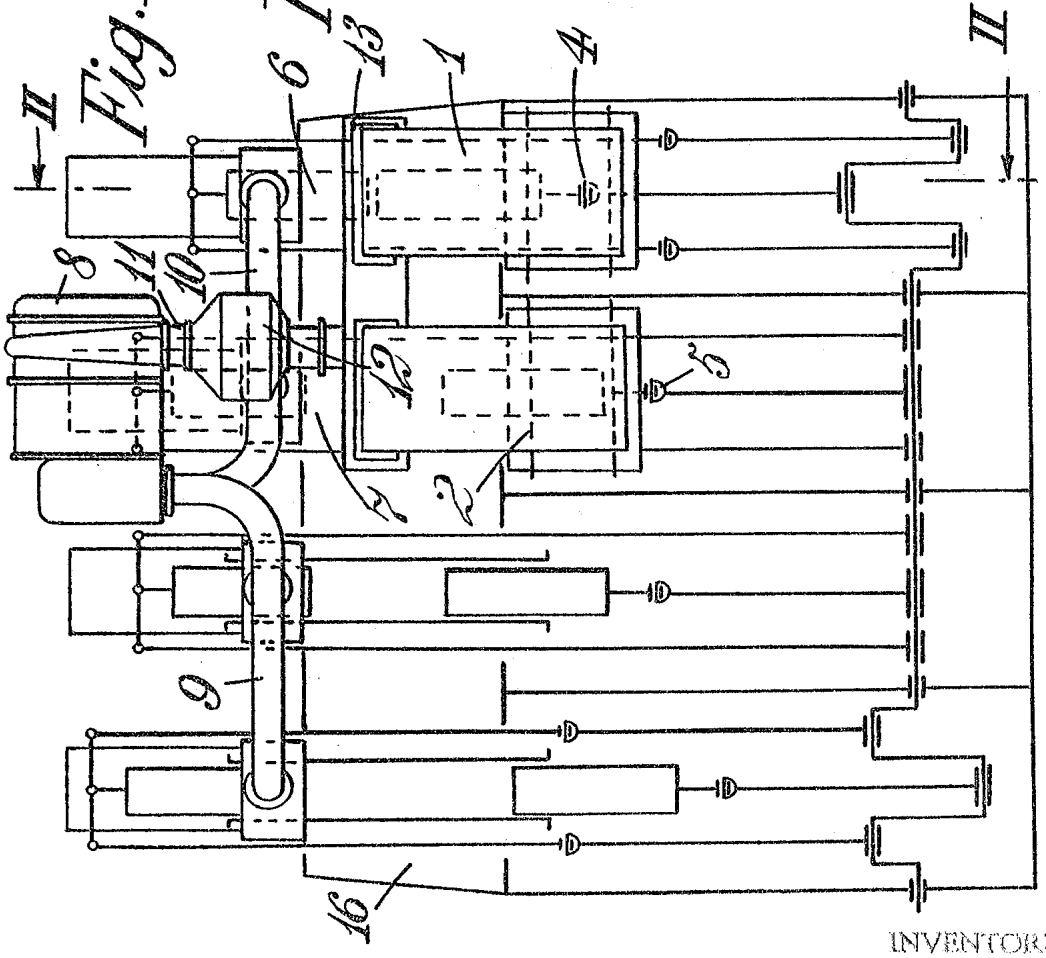

Fig. 1

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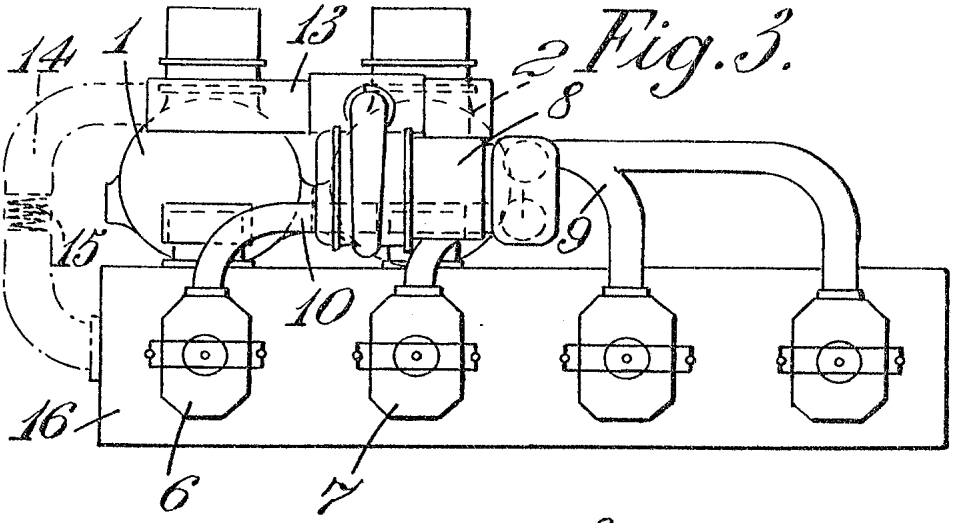

Fig. 3.

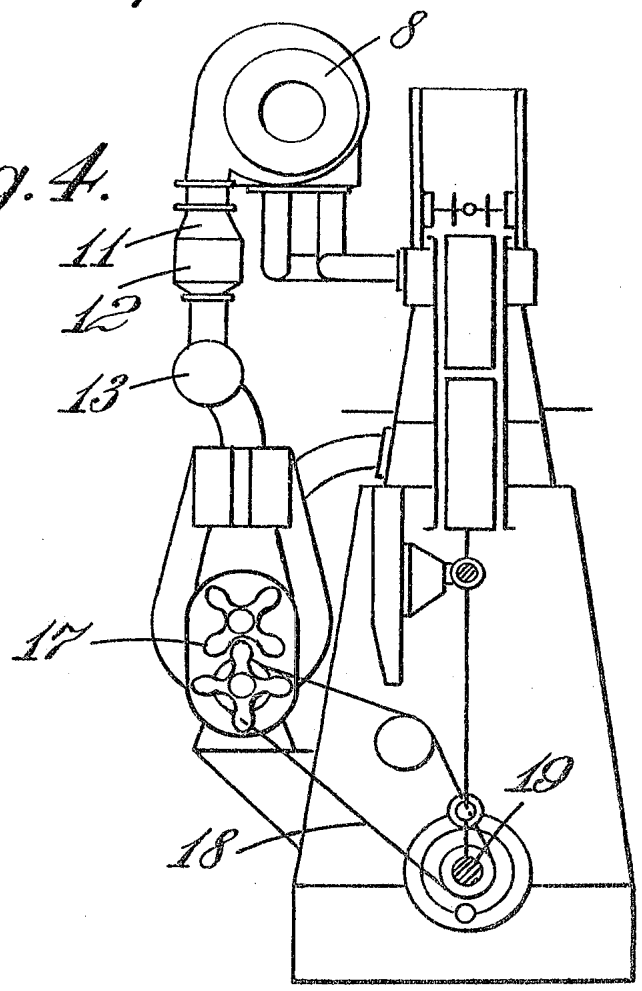

Fig. 4.

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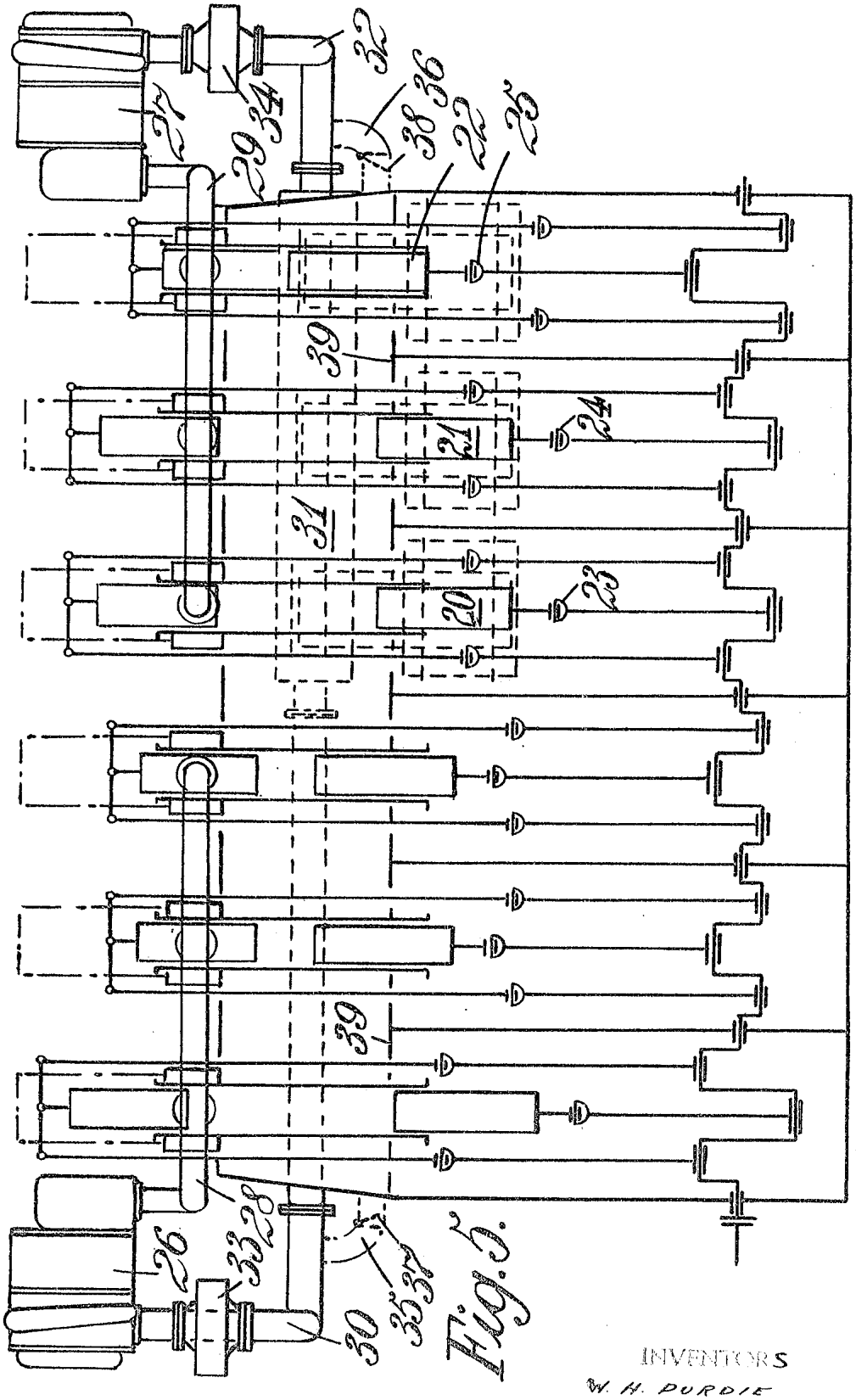

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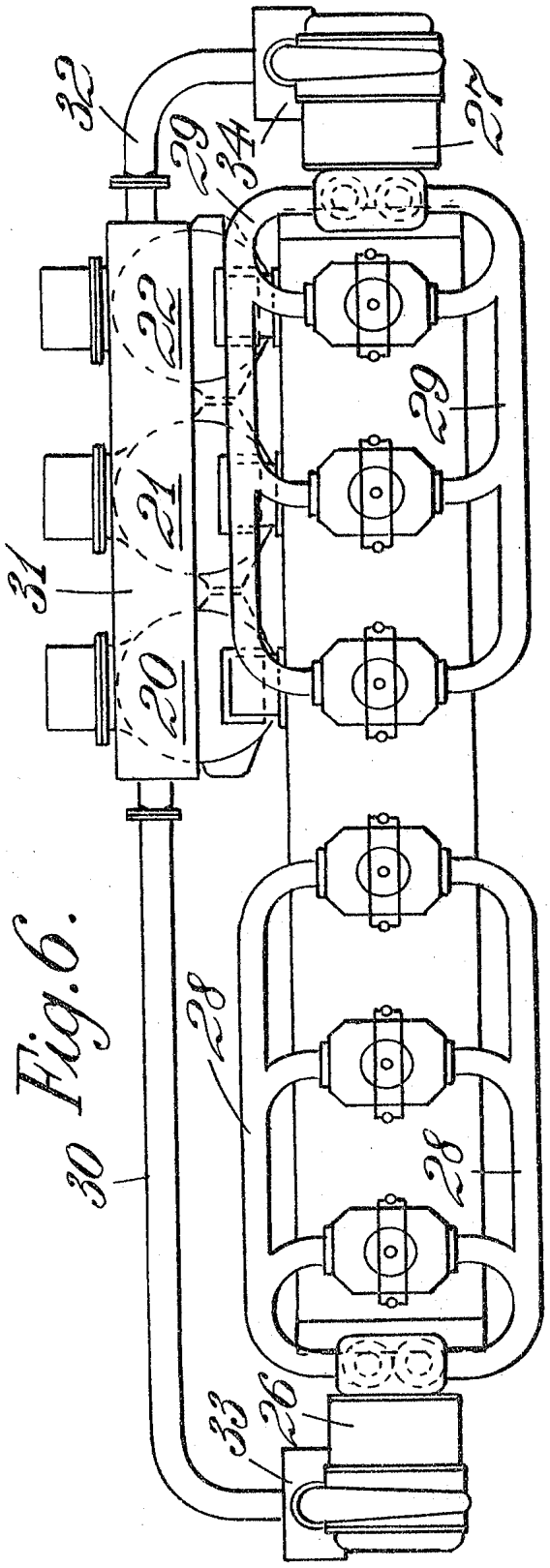

Fig. 6.

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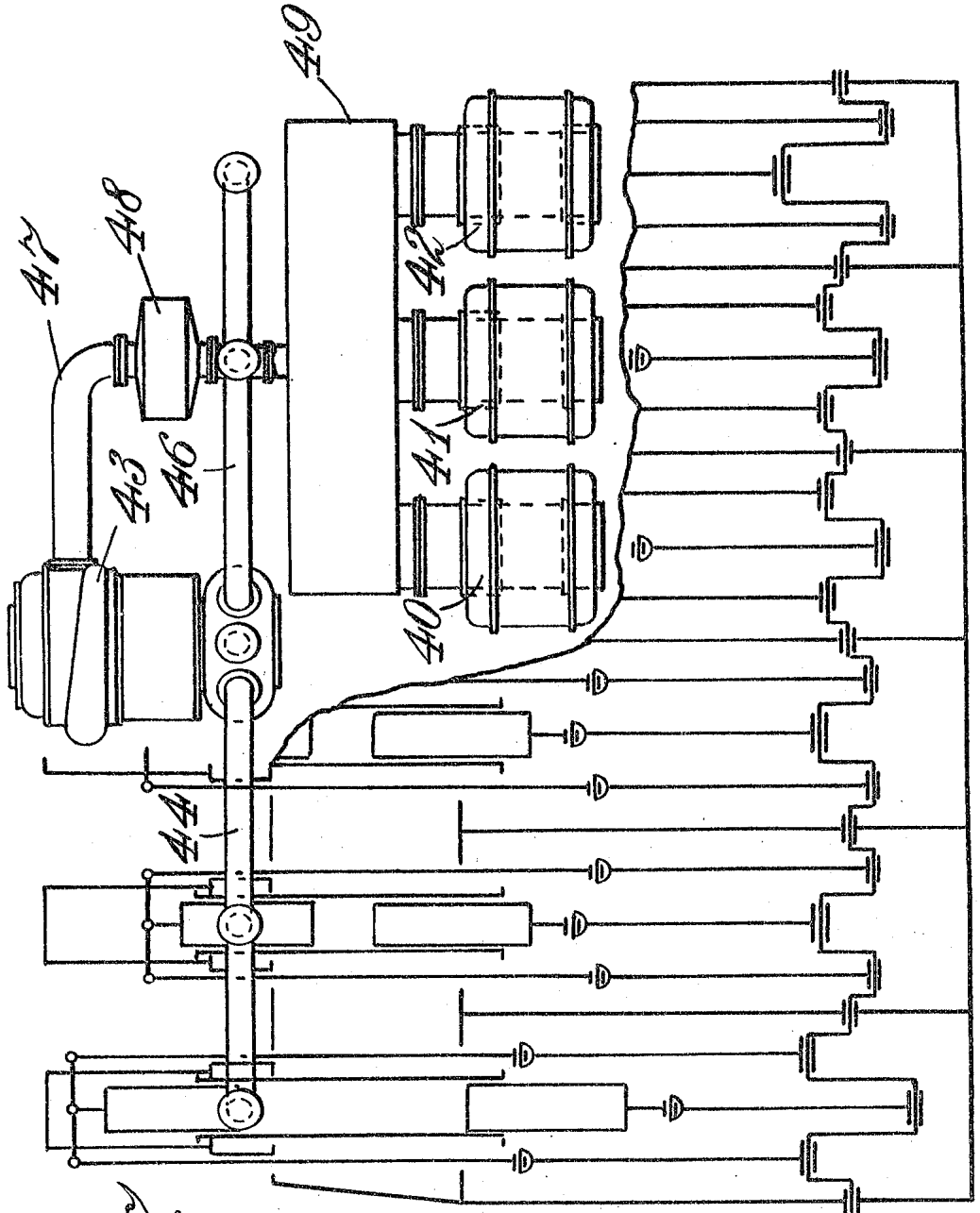

Fig. 1.

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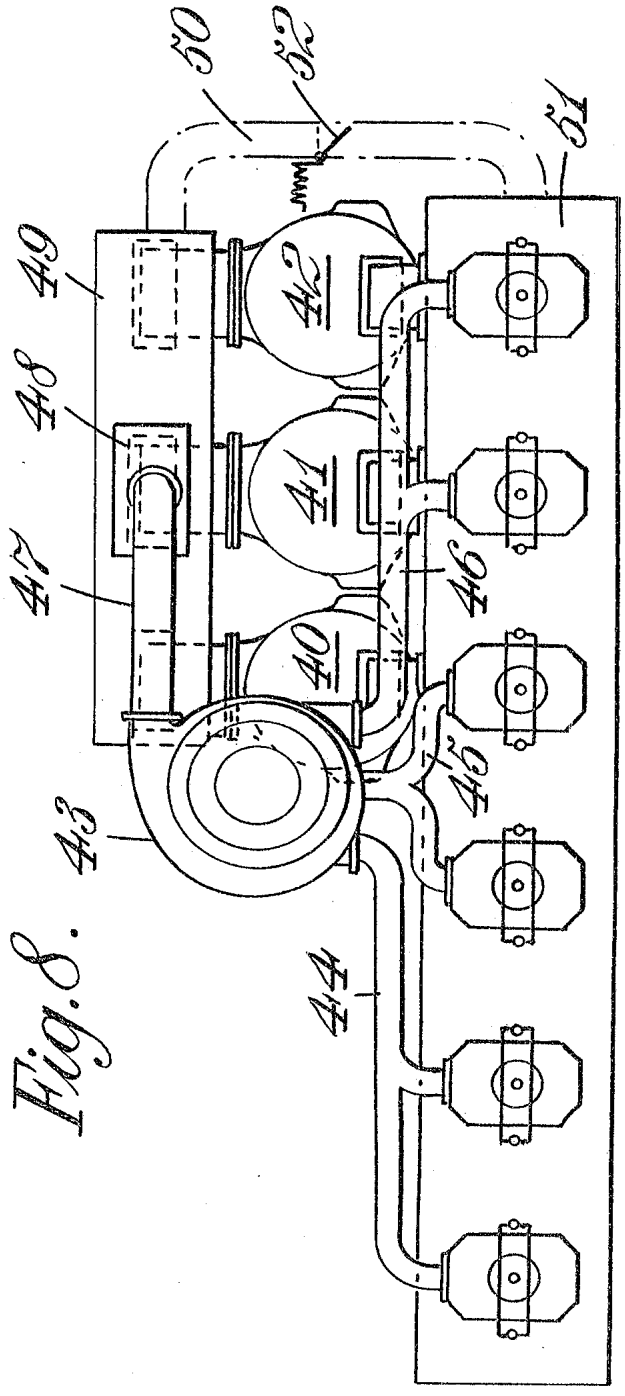

Fig. 8.

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