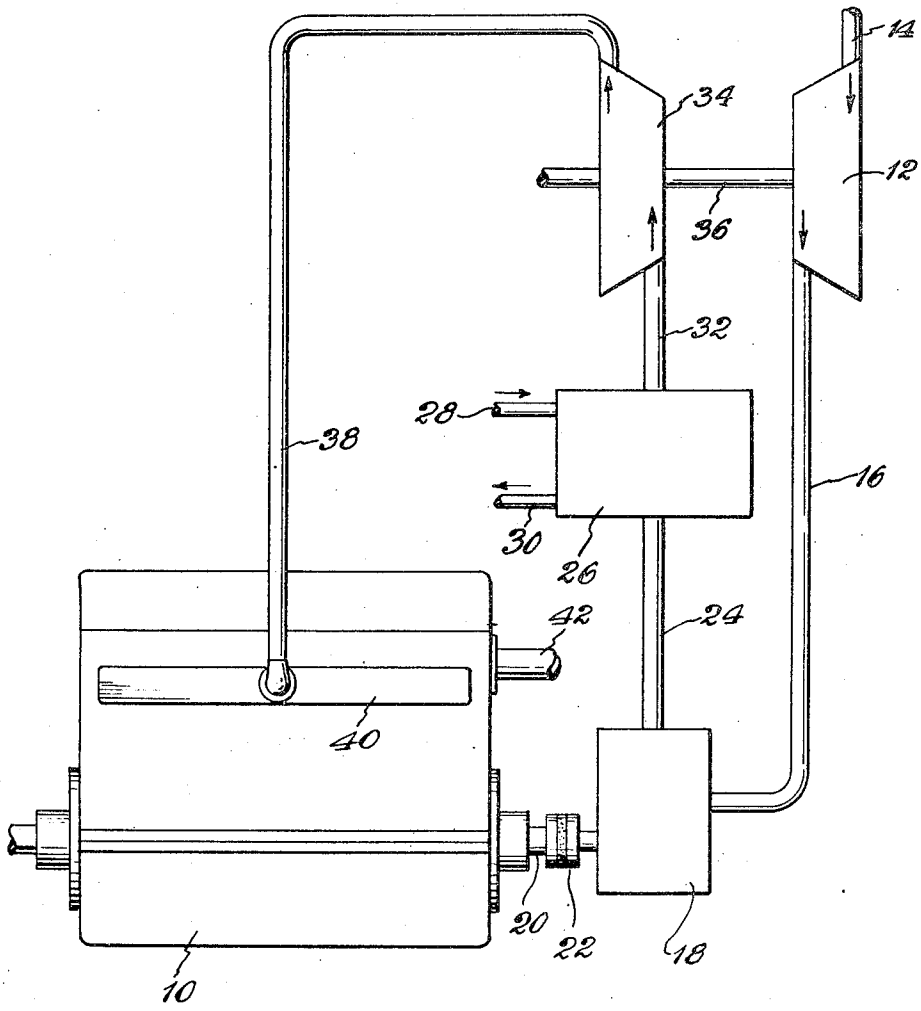
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SUPERCHARGING SYSTEM

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SUPERCHARGING SYSTEM

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My invention resides in the field of internal combustion engines and is an apparatus and method for substantially reducing the inlet temperature to the engine manifold while, at the same time, increasing the inlet pressure of the air and its density to substantially increase the output of the engine.

A primary object of my invention is an engine with an improved mechanical efficiency and an increased horsepower output.

Another object of my invention is an engine of the above type with a mechanism for increasing its output without imposing a back pressure on the engine exhaust.

Another object of my invention is an apparatus and method for increasing the output of either combustion ignition, gas or spark ignition engines.

Another object of my invention is an apparatus and method of the above type constructed particularly for two-stroke cycle engines although it is not limited to them. Other objects of my invention will appear from time to time in the enusing specification and drawing which shows a diagrammatic illustration of the invention as applied to a conventional two-stroke cycle engine.

In the drawing a conventional two-stroke cycle engine is indicated generally at **10**. A centrifugal compressor **12** draws in atmospheric air through an inlet **14**. The air is compressed and discharged through an appropriate conduit **16** to a booster **18** which is connected to the drive shaft **20** of the engine through a suitable coupling **22**. The booster additionally compresses the inlet air and discharges it through an appropriate conduit **24** to an intercooler **26**. A cooling fluid enters the intercooler through an appropriate connection **28** and is discharged through an outlet **30** after withdrawing the heat of compression from the air. The cool air from the intercooler is conveyed by an appropriate conduit **32** to an air turbine or expander **34** which, in addition to lowering the pressure of the air, substantially reduces its temperature. The expander is coupled to the compressor **12** through a drive shaft connection **36**. The high pressure cool air is conveyed from the expander through an appropriate conduit **38** to the inlet manifold **40** of the engine. The exhaust manifold **42** of the engine vents the exhaust gases to the atmosphere.

The use, operation and functions of my invention are as follows:

The compressor **12** draws in ambient atmospheric air and compresses it to an elevated temperature and pressure. This high pressure hot air is conveyed to the booster **18**, which additionally elevates its temperature and pressure by further compressing it. The hot high pressure air is then conveyed to the intercooler where the heat of compression is transferred to the cooling fluid, but the pressure of the air is maintained approximately constant. The cool high pressure air is then conveyed to the expander **34** where, due to expansion, both its pressure and temperature are substantially reduced, but the pressure remains above atmospheric pressure. The cool air is then conveyed to the inlet manifold where it enters the cylinders and is compressed by the pistons. The pressure of the air entering the manifold is greater than atmospheric and it will scavenge and supercharge the engine.

The booster **18** has only been represented diagrammatically. It should be understood that it is the volumetric type and could be either a centrifugal blower or a reciprocating piston pump. In any case, the booster **18** is coupled to the drive shaft in a suitable manner and it

serves to meter the air passing through the unit as it compresses it.

My invention is particularly well suited to a two-stroke cycle engine, because a booster is normally present for scavenging purposes. To increase the output of a given two-stroke cycle engine by my invention, it is merely necessary to provide a compressor, such as **12**, an intercooler such as **26**, and an expander, such as **34**, along with the appropriate connections.

To apply the invention to four-cycle engines would require, in addition to the other named elements, a booster, such as **18**, as it is not normally present.

When my invention is applied to a two-cycle engine, the booster **18** serves a metering function and the quantity of air that is passed through it varies in accordance with the speed but not the load on the engine. On the other hand, as the load on a two-stroke cycle engine increases, the pressure in the cylinders will increase and the period for scavenging air to flow through the cylinders will decrease. This directly affects the amount of expansion that takes place in the expander **34**, due to the increased pressure in the conduit **38**. Therefore, the amount of expansion accomplished by the expander, and the cooling of the inlet air derived from it, will vary in direct relation to the load.

The expansion of the high pressure cool air in the expander **34** drives the shaft **36** and the compressor **12**, and a part of the energy taken out of the high pressure air due to its expansion is used to drive the compressor. The booster **18** provides sufficient excess energy of compression in the air so that the energy derived from expansion in the expander **34** exceeds that required to drive the compressor **12**.

It should be understood that the booster **18** is only a volumetric blower of any conventional type, and the pressure increase in the air acquired from the compressor and the booster exceeds the pressure drop in the expander at all loads, so that a pressure differential exists between the inlet and exhaust manifolds and the engine will be properly scavenged and superchanged at all loads.

It will be realized that, whereas I have described and shown a practical and operative device, nevertheless many changes may be made in the size, shape, and disposition of parts without departing from the spirit and scope of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic rather than as limiting me to my precise showing herein.

I claim:

1. In a device for cooling the inlet air for an internal combustion engine adapted to operate under varying load conditions, comprising means for compressing the inlet air, an engine-driven booster to which the air is supplied from the compressing means for further compressing the air, means for cooling the air from the booster, and means for expanding the air from the cooling means and supplying it to the engine, the expanding means being associated with the compressing means to drive it.

2. In a device for cooling the inlet air for an internal combustion engine, comprising means for compressing the inlet air, a volumetric compressor adapted to be driven by the engine to which the air is supplied from the compressing means for further compressing it, means for cooling the air from the volumetric compressor, and means for expanding the air from the cooling means and adapted to supply it to the intake manifold of the engine, the expanding means being associated with the compressing means to drive it.

3. In a device for cooling the inlet air for a two-stroke cycle internal combustion engine having an engine-driven booster, comprising means for compressing the inlet air and adapted to supply it to the engine-driven booster for further compressing it, means for cooling the air from the booster, and means for expanding the air from the cooling means and adapted to supply it to the intake manifold of the engine, the expanding means being coupled to the compressing means to drive it.

4. A method of cooling the inlet air for an internal combustion engine, comprising the steps of initially compressing the inlet air, using energy from the engine for further compressing the air, cooling the air after it has been further compressed, expanding the air after it has been

cooled, using the energy derived from expanding the air to initially compress it, and supplying the cool air to the intake manifold of the engine.

5. A method of cooling the inlet air for a two-stroke cycle internal combustion engine having an engine-driven compressor comprising the steps of initially compressing the inlet air, supplying the compressed air to the engine-driven compressor where it is further compressed, cooling the air after it has been further compressed by the engine-driven booster, expanding the air after it has been cooled, using the energy of expansion to initially compress the air, and supplying the cool air to the engine intake manifold.

6. A method of cooling the inlet air for an internal combustion engine, comprising the steps of initially compressing the inlet air to an elevated temperature and pressure, using energy from the engine for further compressing the air to a higher temperature and pressure, cooling the air to a reduced temperature while maintaining its pressure approximately constant after it has been further compressed, expanding the air to a reduced temperature and pressure above atmospheric after it has been cooled, using the energy derived from expanding the air to initially compress it, and supplying the cool air to the intake manifold of the engine.

7. A method of cooling the inlet air for a two-stroke cycle internal combustion engine having an engine-driven compressor comprising the steps of initially compressing the inlet air to an elevated temperature and pressure, supplying the compressed air to the engine-driven compressor where it is further compressed to a higher temperature and pressure, cooling the air to a reduced temperature while maintaining its pressure approxmately constant after it has been further compressed by the engine-driven booster, expanding the air to a reduced temperature and pressure above atmospheric after it has been cooled, using the energy of expansion to initially compress the air, and supplying the cool air to the engine intake manifold.

No references cited.