H. B. STOCKS.

COMBINED INTERNAL COMBUSTION AND FLUID PRESSURE ENGINE.

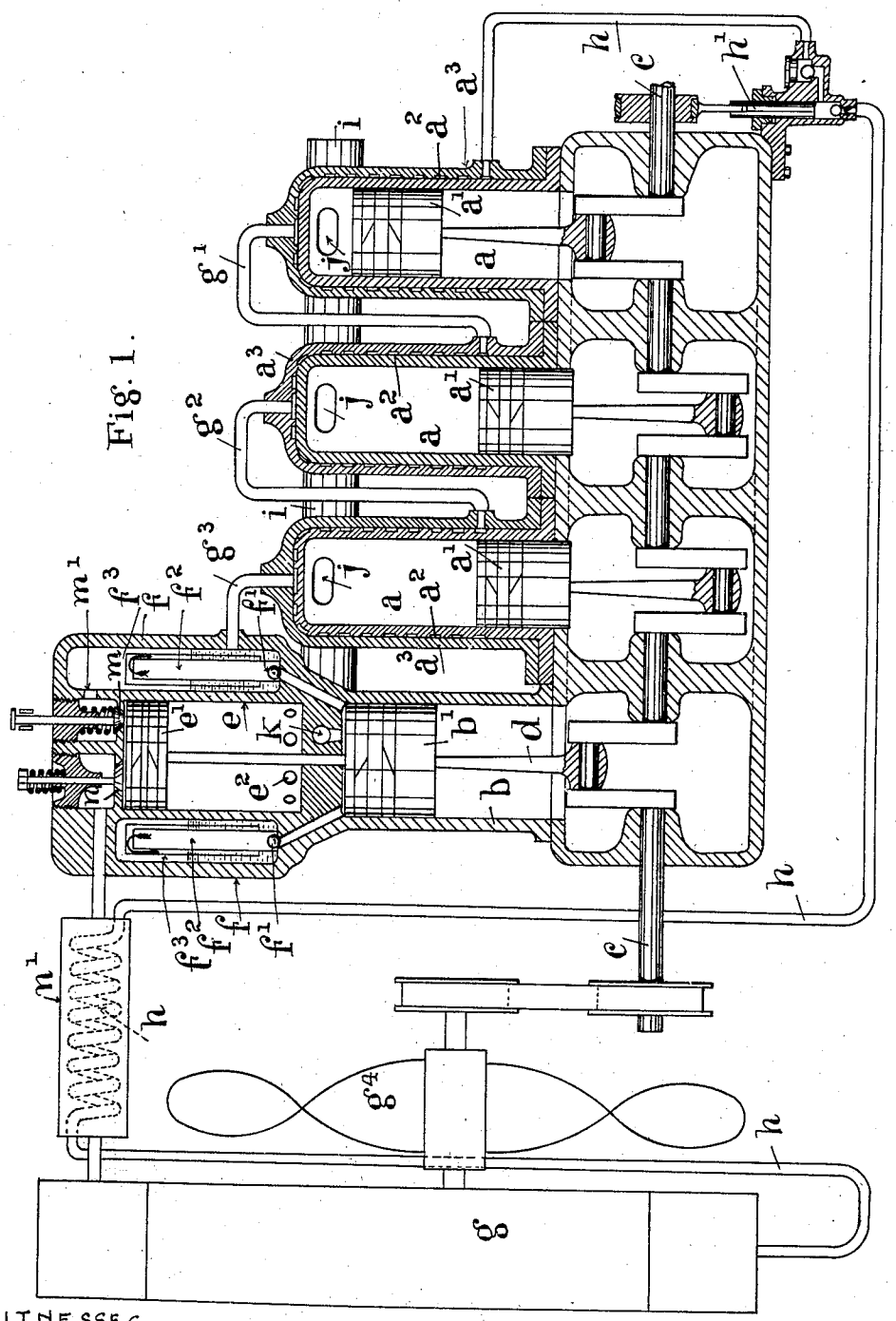
APPLICATION FILED NOV. 25, 1910.

1,011,520.

Patented Dec. 12, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

Harriet Stocks

Norman Kiernan

INVENTOR

Harry Benwell Stocks

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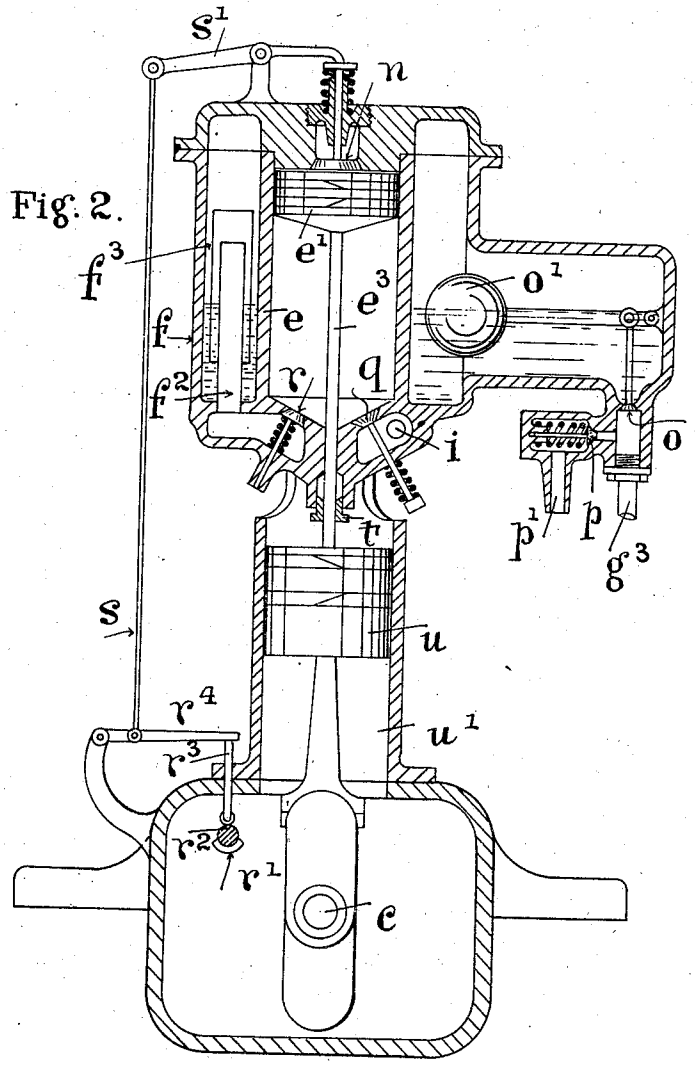
Fig. 2.



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UNITED STATES PATENT OFFICE.

HARRY BENWELL STOCKS, OF MANCHESTER, ENGLAND.

COMBINED INTERNAL-COMBUSTION AND FLUID-PRESSURE ENGINE.

1,011,520. Specification of Letters Patent. Patented Dec. 12, 1911.

Application filed November 25, 1910. Serial No. 594,193.

To all whom it may concern:

Be it known that I, HARRY BENWELL STOCKS, a subject of the King of Great Britain and Ireland, residing at "Glenroy," 107 Barlow Moor road, Didsbury, Manchester, in the county of Lancaster, England, engineer, have invented a new or Improved Combined Internal-Combustion and Fluid-Pressure Engine, of which the following is a specification.

My invention has for its object the utilization of the waste heat of internal combustion engines whereby I not only use the exhaust gases under pressure to assist in doing useful work but also utilize such exhaust gases for the purpose of raising pressure by evaporation of water or other suitable fluid.

In carrying my invention into effect I will particularly describe its application to internal combustion engines of high speed and multiple cylinders but its application can be made to engines of slow speed and one cylinder only if desirable, and the fluid pressure engine operated by the waste heat as herein described may be coupled direct to the internal combustion engines or not.

In the accompanying drawings which illustrate the application of my invention diagrammatically, Figure 1 is a sectional elevation, and Fig. 2 is a view at right angles to Fig. 1, on an enlarged scale, showing in section a modification.

In applying my invention to say a four cylinder internal combustion motor as illustrated in Fig. 1, hereinafter described as a petrol motor but not restricting myself to the use of engines driven by petrol, I proceed as follows. Three cylinders a of the petrol motor I retain but the cylinders I construct as hereinafter described. The fourth cylinder b is a compressor cylinder coupled direct to the common crankshaft c by a connecting rod d in the usual way and hereinafter called the compressor. Directly over the compressor cylinder I mount the fluid pressure cylinder e, hereinafter called the steam cylinder. The piston e' of the steam cylinder and the piston b' of the compression cylinder are coupled together. Surrounding the steam cylinder e and totally inclosing it is a fluid pressure generator f hereinafter called the generator. Inlet and exhaust valves are provided for all cylinders, petrol, compressor, and steam, actuated by cam shafts in the usual way. A pump or pumps is or are provided to circulate water or other fluid around the petrol cylinders and for feeding the generator, said pumps being operated by suitable means.

The construction of the petrol cylinders is preferably as follows. An internal cylinder a is provided in which the piston a' moves in the usual way, and formed on the outside of this cylinder in the thickness of the metal is a spiral groove a^2 of suitable shape. Outside this internal cylinder is fitted a shell a^3 so that water pumped into the spiral groove aforesaid may pass around the whole surface of the internal cylinder on its way to the generator taking up as much heat as possible. The inlet and exhaust valve chambers pass through the outer shell and are preferably welded by oxy-acetylene process or fixed by other suitable means to the inner cylinder and outer shell to make water tight joints the valve chambers being made hollow that water from the spiral grooves may circulate around them.

The water or other fluid, but preferably water, can be admitted to the spiral grooves of the three (or more or less) petrol cylinders in series or parallel as may be found most desirable. If in "series" as shown in Fig. 1, water from the bottom of the condenser g is pumped along the pipe h to the first, and after circulating around the cylinder as described enters the second through the pipe g' and then through the pipe g^2 to the third, and so on to the generator by the pipe g^3. If in "parallel" cold water enters each cylinder at the same time, suitable branch pipes conveying it from the pump or pumps and thence to the generator. The direction of the circulation is preferably from the bottom to the top of the cylinder or from the coldest to the hottest portion thereof.

Inclosing the shell a^3 of the petrol cylinders a I may provide a suitable chamber which may be exhausted of air to prevent loss of heat by radiation or they may be lagged with suitable non-conducting material.

It will be seen by the foregoing description that the water space of the petrol cylinders a is restricted, and cooling to working temperature is effected by a rapid flow of water circulated by the pump h' which is actuated from the crank shaft c in any convenient manner. When the water leaves the

petrol cylinder heads and passes to the generator it is there further heated as hereinafter described.

Instead of forming the spiral grooves a^2 in the cylinder a, I might form them in the outer shell a^3 as shown in the drawings.

Having dealt with the heat radiated from the petrol cylinder walls I now take the exhaust or burnt gases and utilize their heat as follows. The hot gases of exhaust, by the opening of the exhaust valves of the petrol cylinders a are conducted through passages j into a suitable pipe or receptacle i which may be vacuum jacketed as mentioned above. This pipe conveys the hot gases of exhaust to the inlet valve or valves k of the compressor cylinder b the bore and stroke of which will be correctly proportioned to take charge of the gases discharged by the three petrol cylinders. On the outward stroke of the compressor piston b' the cylinder b receives a charge of hot gases under pressure through the valve k from the pipe i such pressure doing useful work on the outward stroke. On the return stroke the piston of the compressor cylinder forces the gases aforesaid into the generator f beforementioned through the valves f' and tubes f^2 into actual contact with the water contained in the generator and thereby raising steam, the path of the gases through the water being made as tortuous as possible by baffle plates or the like so that all heat may be transmitted to the water before the gases rise to the steam space. The tubes f^2 are surrounded by hoods f^3. At the commencement of the outward stroke of the compressor and steam pistons the valve m is arranged to be opened and steam from the generator is admitted through the port m' to the back of the piston e' doing useful work. On the return stroke of the pistons the valve n is opened allowing steam to exhaust preferably first into a feed water heater n' in which the feed water pipe h is coiled and from thence into circulation through the pipe h from the condenser g, which is cooled by a fan g^4. A light valve loaded air vent may be provided for the condenser g. The steam cylinder is in communication with the atmosphere through holes e^2 to prevent compression in front of the piston e'.

The gases compressed by the compressor assist with the steam to operate the piston of the steam cylinder, and further serve to prevent the condensation of the steam in the steam cylinder. As before described the steam cylinder is surrounded by the generator so that heat losses by condensation may be minimized. The steam cylinder may be single or double acting but preferably single acting, as shown to simplify valve gear. The valves m, n, f', k may be actuated in any suitable manner such as by cams or by spring or gravity loads. The generator being fed by hot water from the petrol cylinders will contain as little water as is consistent with the supply of steam necessary for the steam cylinder to do useful work.

Means are provided to maintain a constant level of water within the generator. These means are indicated in Fig. 2 and consist of a valve o closed by a float o' on the water level being attained, the valve opening when the water level falls to admit water by the pipe g^3. When the level is attained the circulating water is discharged through a spring loaded valve p set to the working pressure of steam so that boiling point of water for that pressure is constantly maintained the water being discharged to the condenser tank through the pipe p' when the valve o is closed.

The generator may be covered by non-conducting material or be vacuum jacketed as before described in regard to the exhaust pipes and petrol cylinder shells. I may arrange for the steam exhausted from the cylinder e to be expanded into another cylinder. A relief or safety valve may be fitted to the generator. When fitted to two stroke motors suitable valve gear will be provided to operate the steam cylinder valves and same can be made reversible.

A modification is shown in Fig. 2 in which the steam cylinder e is arranged to serve also as a compressor cylinder. On the upward stroke of the piston e' the valve q is drawn off its seat by the suction of the piston and exhaust gases under pressure pass into the cylinder e. On the down stroke, the valve m (not shown in this view) is opened to admit steam from the generator behind the piston and the valve r is thrust off its seat to admit the compressed gases to the generator f. On the upstroke the exhaust valve n is opened to allow the exhaust steam to pass to the feed water heater and the condenser as described with reference to Fig. 1. The valve n is actuated by a cam r' on the side shaft r^2 actuating a plunger r^3 which oscillates a pivoted lever r^4 to which is attached the rod s connected to the lever s' actuating the valve n. The piston rod e^3 passes through a packed gland t and is connected to a piston u working idly in a cylinder u' which is coupled to the crank shaft c and serves to guide and steady the piston e' of the cylinder e. In this arrangement the cylinder e is not open to atmosphere as in Fig. 1.

It must be understood that the arrangements shown are capable of various modifications so long as the spirit of my invention is preserved.

I declare that what I claim is.

1. In combination, an internal combustion engine, a steam generator into which water

heated by the cylinders of the internal combustion engine is pumped, a compressor to force exhaust gases from the engine into the steam generator, and a steam cylinder in which steam from the steam generator is used, substantially as described.

2. The combination with one or more internal combustion engine cylinders, of a steam cylinder and a steam generator, means to heat water by the engine cylinders and to force it from the cylinders to the steam generator, and a compressor to force exhaust gases of the internal combustion engine cylinders into the steam generator to raise the water to steam, and means to conduct the steam to the steam cylinder, substantially as described.

3. In combination, an internal combustion engine, a steam cylinder with steam inlet and exhaust valves, a generator surrounding said steam cylinder, a piston within the steam cylinder acted upon by steam from the generator, and a compressor combined with the steam cylinder for forcing exhaust gases of the internal combustion engine within the steam generator, substantially as described.

4. In combination, an internal combustion engine of one or more cylinders, a receiver to contain the exhaust gases of such cylinders, a steam cylinder surrounded by a steam generator, a condenser, means to circulate water around the internal combustion engine cylinders to the steam generator and to maintain therein a constant level of water, and from thence to said condenser and again to the internal combustion engine cylinders, a compressor to which the exhaust gases are conducted from the receiver and forced thereby to the generator to mingle with the water in the steam generator and raise the water to steam, and means to conduct the steam to the steam cylinder to act upon the piston in the steam cylinder to do useful work, and means to exhaust the steam thereafter from the steam cylinder to the condenser, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY BENWELL STOCKS.

Witnesses:

ALFRED STUART YATES,

NORMAN KIERNAN.