(No Model.) 3 Sheets—Sheet 1.

G. DIXON.

FLUID PRESSURE ENGINE.

No. 528,866. Patented Nov. 6, 1894.

Fig. 2.

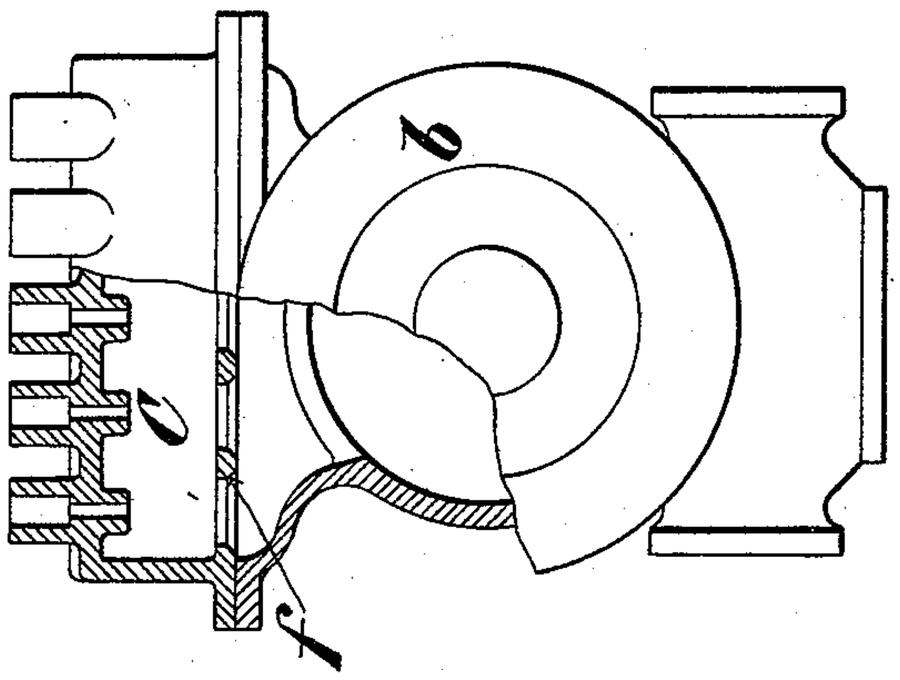
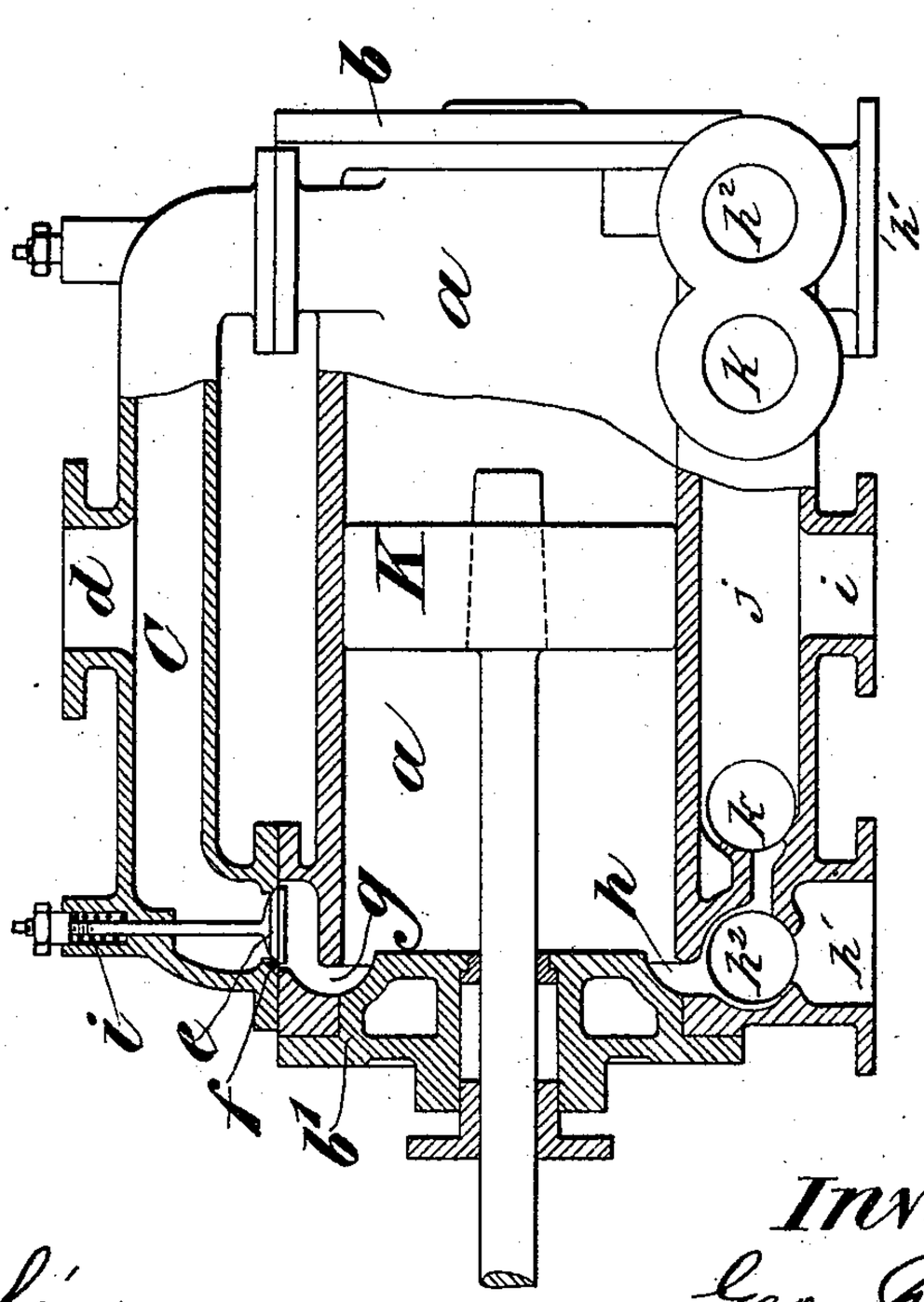


Fig. 1.



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per O. E. Duffy
Attorney

(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

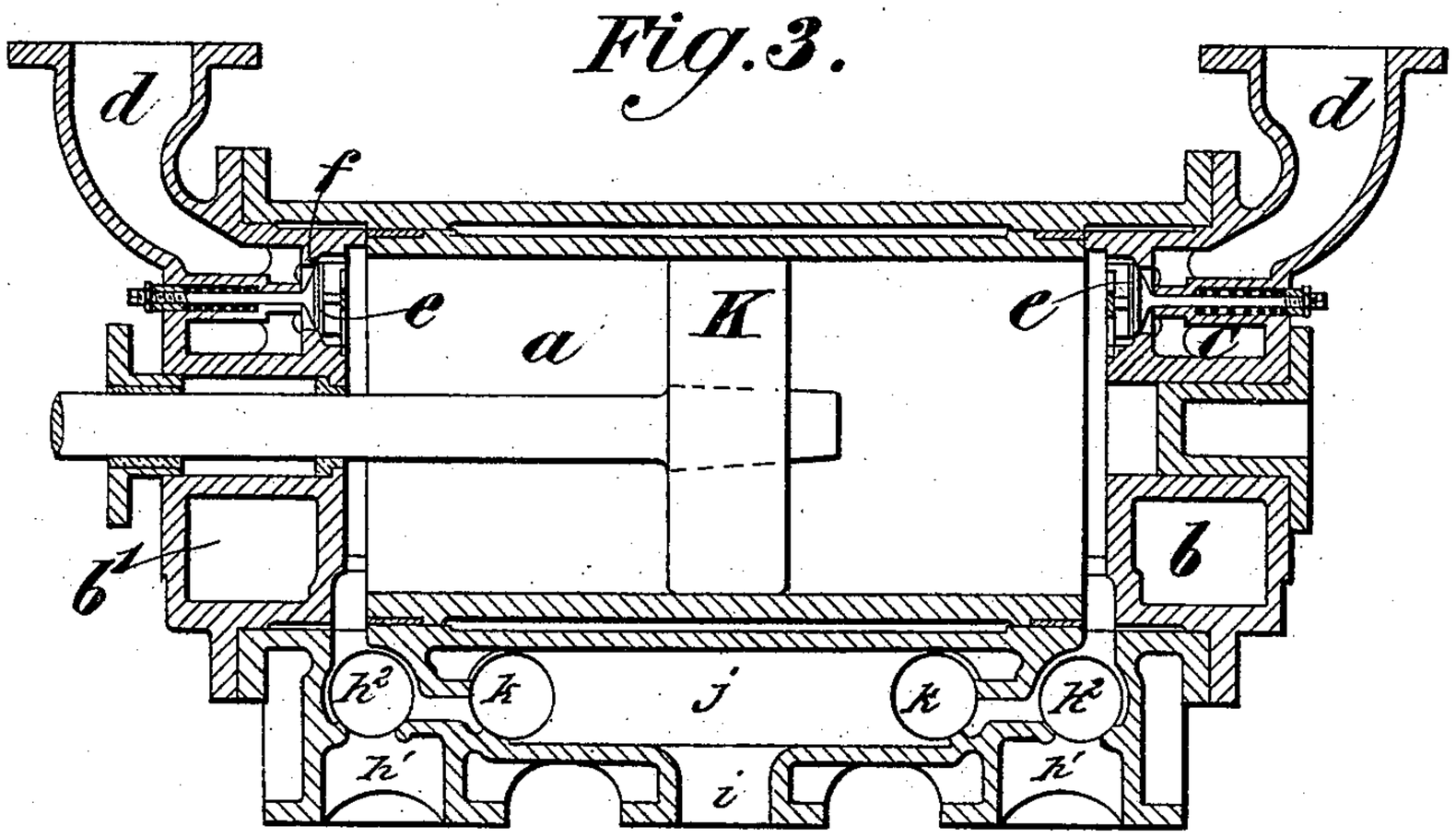

Fig. 4.

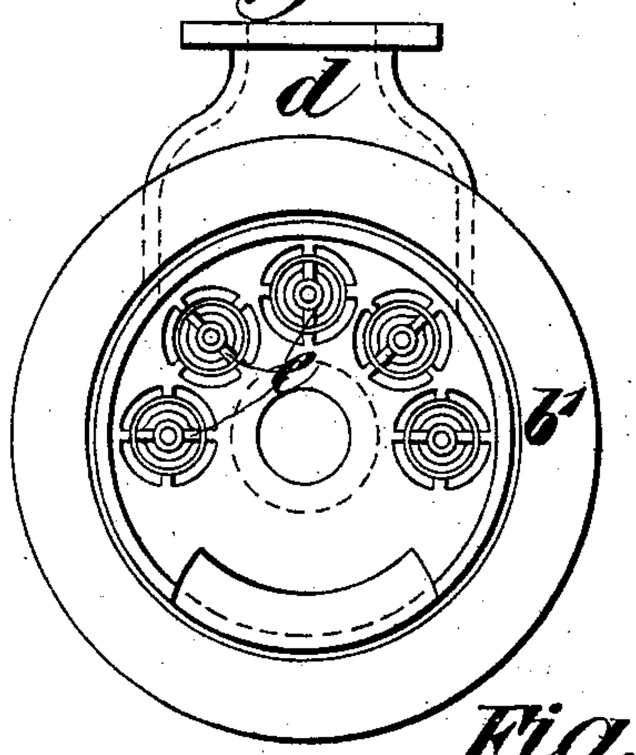

Fig. 5.

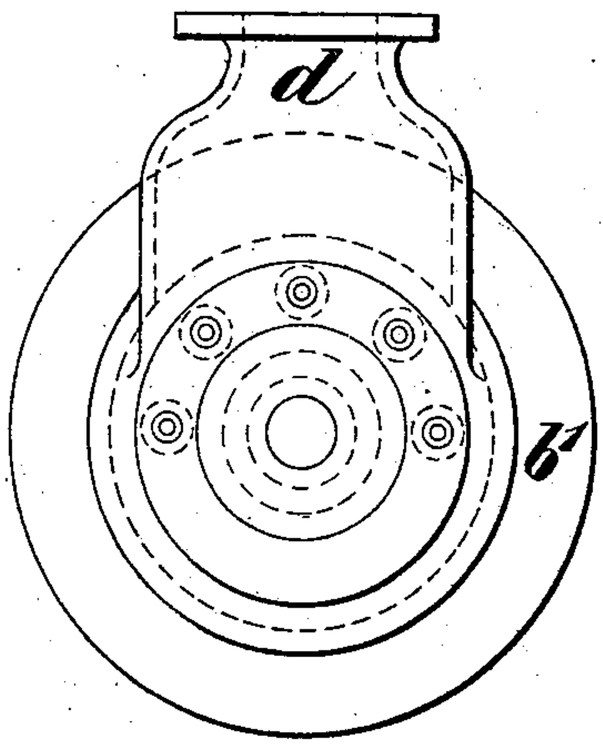

Fig. 6.

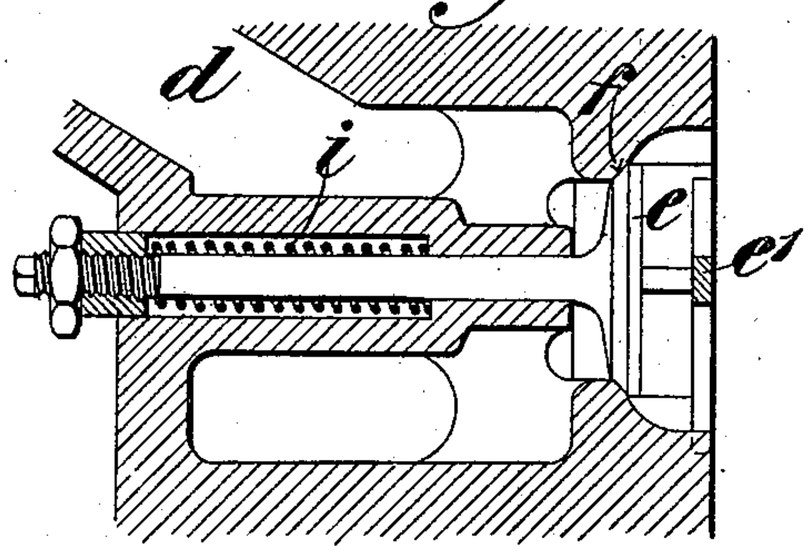

Fig. 7.

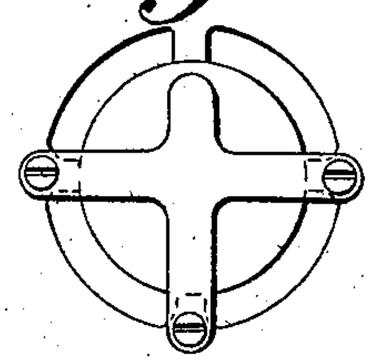

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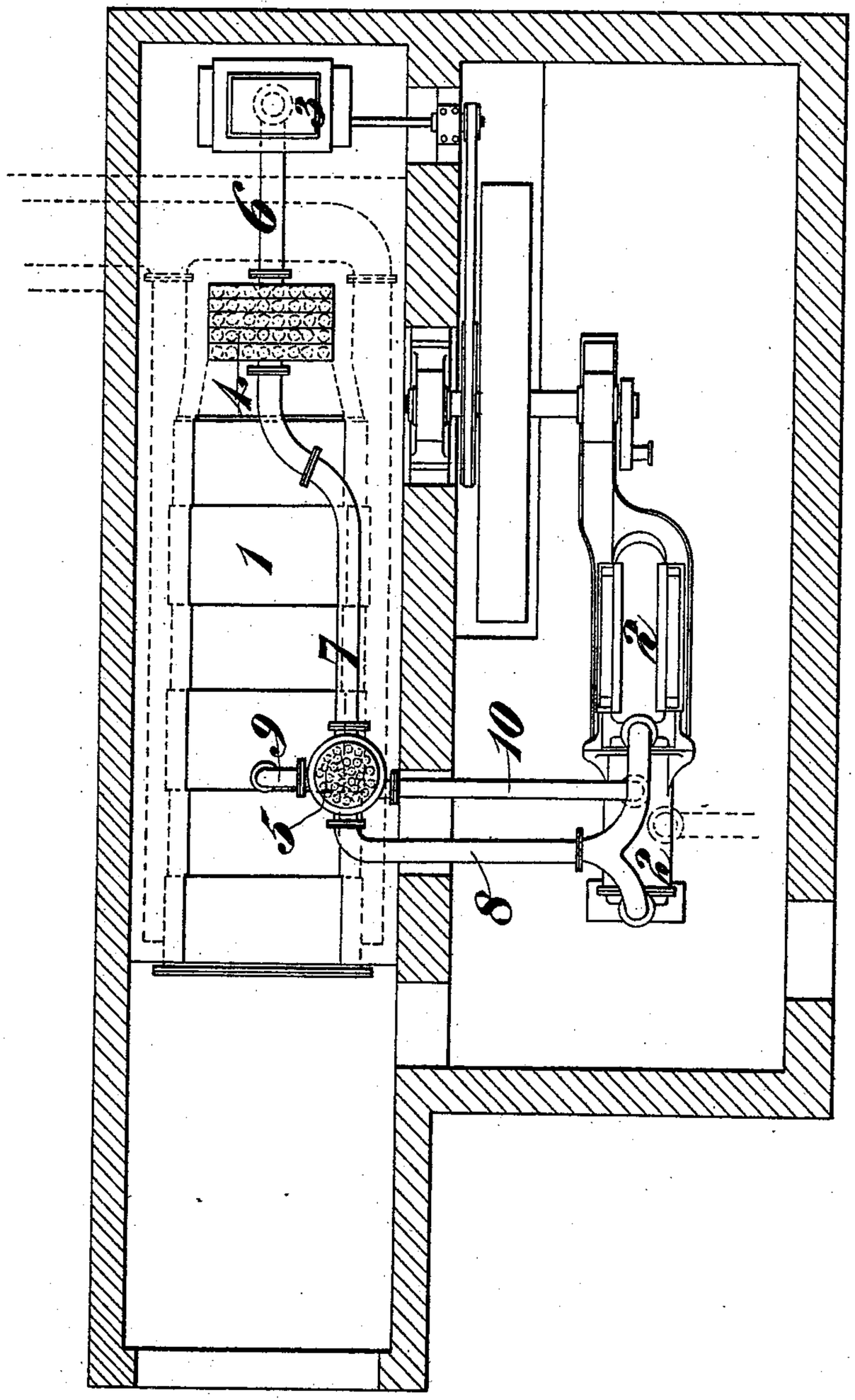
Fig. 8.



Witnesses
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Hubert E. Peck

Inventor
Geo. Dixon
per O. E. Duffy
Attorney

UNITED STATES PATENT OFFICE.

GEORGE DIXON, OF BOLTON, ENGLAND, ASSIGNOR TO HIMSELF AND JAMES MUSGRAVE, OF SAME PLACE, AND EDWARD FIELD AND FRANCIS SANDERS MORRIS, OF ADELPHI, ENGLAND.

FLUID-PRESSURE ENGINE.

SPECIFICATION forming part of Letters Patent No. 528,866, dated November 6, 1894.

Application filed August 16, 1893. Serial No. 483,302. (No model.)

To all whom it may concern:

Be it known that I, GEORGE DIXON, a subject of the Queen of Great Britain and Ireland, residing at Bolton, in the county of Lancaster, England, have invented Improvements in Fluid-Pressure Engines, of which the following is a specification.

In the specification of another application for Letters Patent filed by me of even date herewith, Serial No. 483,301, there is described a method of working fluid pressure engines according to which in order to reduce the consumption of steam in the engine, heated air or gas is introduced into the engine cylinder during the period of exhaust, this heated air or gas being caused to take the place of the mixture which has already done work so that when the piston is nearing the end of its stroke and the exhaust port closes, the hot air or gas is compressed into the clearance spaces, and on the completion of the stroke, when steam is admitted for the return stroke, the surface with which it comes into contact will have been by the use of the hot air or gas raised to such a temperature that initial condensation is much reduced or even practically prevented. The presence of the heated air or gas will also have an important influence as experiments have shown that when steam is mixed with air or gas sufficiently heated great expansion takes place so that considerable economy may be expected from this source.

Now my present invention has reference to a construction of engine whereby the above described method of working such engines can be carried out in an efficient manner.

Where a sufficiently high pressure of steam is available two or more cylinders may be employed the steam being expanded in one or more cylinders in the usual way and exhausted therefrom and hot air or gas being introduced as hereinbefore described into the final or low pressure cylinder. The heated air or gas may be employed to superheat the steam after it leaves the boiler, by causing the steam to pass through vessels or pipes surrounded by the heated air or gas. The cylinders, covers, and valve chests or receivers may be jacketed and surrounded by hot air or gas circulating in the jackets to prevent radiation and maintain a suitable temperature. The air, may be heated, by means of the waste gases on their way to the chimney or by any other suitable means. The waste gases themselves may be employed in the engine cylinder in lieu of heated air after being purified of all grit or other matter likely to injure the working parts of the engine. Such purification of the gases might be effected by means of apparatus such as shown in and described with reference to Figure 7 of the drawings appended to the specification of Letters Patent of the United States granted to Edward Field, dated December 2, 1890, No. 442,027.

In the accompanying drawings, Figs. 1 and 2, represent the cylinder of a steam engine with valves for the admission of heated air or gas, (for example hot waste gas, that has been purified of all grit or other matter likely to injure the working part of the engine,) arranged in the sides of the cylinder, Fig. 1 being a side elevation, and Fig. 2 an end elevation, both partly in section. Figs. 3 to 7 illustrate a modification in which the hot air or gas valves are arranged in the covers of the cylinder; Fig. 3 being a sectional elevation showing the cylinder and its covers. Fig. 4 is an end view of the cover, as seen from the inside; Fig. 5, a corresponding view as seen from the outside; Fig. 6, a sectional view, to a larger scale, of the hot air or gas inlet and valve for same; and Fig. 7 a device for protecting the working parts from injury in case a valve should become detached from its spindle. Fig. 8 shows in plan a general arrangement of the system applied to a stationary engine.

Referring to Figs. 1 and 2, *a* is the cylinder. *b b'* are its covers. *c* is the hot air or gas valve chest. *d* is the inlet for the heated air or gas. *e e* are the valves for controlling the admission of heated air or gas to the cylinder. *f f* are their seats; *g g*, ports for conducting the heated air or gas into the cylinder. These ports are (as shown) so shaped as to deliver the heated air or gas into the cylinder in a longitudinal direction such as is favorable for ejecting through the port *h*, the mixture which has just previously done work in the cylinder.

The valves *e* are held closed by the springs *i*, until owing to the opening of the exhaust valves, the pressure of fluid in the cylinder is sufficiently reduced to allow the pressure of heated air or gas to open the valves *e*. The heated air or gas then flows into the cylinder, ejecting (through the port *h*) the mixture which has just before done work; and, on the closing of the exhaust valve, a portion of the heated air or gas is compressed into the clearance space, as the piston K completes its stroke.

For convenience of inspection and repair the valve chest *c* may be made separate from the cylinder, as shown. The heated air or gas enters by the branch *d*.

In the arrangement shown in Figs. 3 to 7 inclusive:—*d d* are inlet branches for the heated air or gas, *e e* are the valves and *f f* their seats. The construction and arrangement of these are shown in detail in Fig. 6. The ports and passages for the admission of steam, and for the exhaust from the cylinder, are shown as of the ordinary Corliss type, *i* being the steam inlet to the steam chest *j*, provided at *k* with rotary valves, and *h'*, *h'* being the exhaust branches controlled by other rotary valves arranged at h^2, h^2 as well understood, but any well known or suitable forms of valves and ports may be adopted. A cross piece such as *e'* (Figs. 6 and 7) is securely attached to the cover, in front of each hot air or gas valve, to prevent the possibility of a valve getting inside the cylinder.

With regard to the temperature and pressure of the air, it has been found when working such an engine with steam at a pressure of from one hundred pounds to one hundred and twenty pounds per square inch that a temperature of about 400° Fahrenheit is suitable for the air. Its pressure should be sufficient to overcome the back pressure of the exhaust. Satisfactory results have been obtained when using air at a pressure of about half a pound per square inch in excess of the back pressure of the exhaust.

The valves *e* shown in the drawings for the admission of the heated air or gas to the engine cylinder are intended to be opened by a slight fluid pressure generally say about one half pound to one pound per square inch in excess of the back pressure of the exhaust which slight pressure can be maintained by a fan, blower, or air pump that may be placed in any suitable position for causing a current of heated air or gas to flow into the cylinder; or the inflow of heated air or gas to the cylinder may be caused by creating a partial vacuum in the cylinder by means of a suitable exhauster.

In the general arrangement of the system shown in Fig. 8, 1 is the boiler, 2 the engine, and 3 the fan or blower, which may be of the well known "Root" type. 4 is the air heater, constructed, in this example, with metal pipes through which the air passes, the hot gas circulating around the outsides of these pipes; but this arrangement might obviously be reversed. The heater is shown placed in the boiler flue. 5 is a super-heater through which the steam and air pass one within and the other around metal pipes. The pipes 6, 7, 8 constitute the air supply. They respectively connect the blower to the heater; the heater to the superheater; and the superheater to the engine cylinder. The pipes 9, 10, conduct the steam, respectively, from the boiler to the superheater and from the superheater to the engine.

The air heater may be placed in any suitable position. It may either take the heat directly from the furnace of the boiler; or it may take only the waste heat on its way to the chimney; or the heater may be divided, part being heated by waste heat, and part by direct heat; or a special furnace may be provided. In iron, steel, or other works, the waste heat from the various furnaces in use may be utilized to heat the air.

As will be evident, this invention may be carried out in various forms and applied in engines designed for various purposes whether stationary marine, or locomotive, simple or compound and whether the steam be expanded once or twice or other number of times successively. Again instead of introducing the hot air or gas into the cylinder entirely through valves in the sides or ends of the cylinder or through a hollow piston, it might be introduced into the cylinder partly through valves in the cylinder sides or ends (or both) and partly through a hollow piston. In lieu of air valves of the forms shown in the drawings valves of any other suitable construction might be employed, such for example as slide valves, Corliss valves, or piston valves these being actuated as well understood by any suitable means such as eccentrics, levers, cams, or slip motions for admitting or cutting off the supply of hot air or gas to the cylinder at any required point of the stroke taking care to provide against the opening of the valves for admitting hot air or gas to the cylinder until after the pressure in the cylinder has been reduced below the available pressure of hot air or gas and also to provide for the closing of the air or gas admission valves before the proper time for commencement of the compression of the hot air or gas in the cylinder.

Engines according to this invention may be constructed with two or more cylinders in each or some of which steam direct from the boiler may be used in conjunction with heated air or gas introduced into the cylinder as and for the purpose above set forth.

What I claim is—

1. In a fluid worked engine, an engine cylinder having at one or at each end thereof separate steam and gaseous fluid supply pipes or passages, a valve acting to place the gaseous fluid supply pipe or passage in communication with said cylinder during the period of exhaust, and a valve acting to place the steam

supply pipe in communication with said cylinder after compression of gaseous fluid therein.

2. In a fluid worked engine, the combination with an engine cylinder having a steam inlet and valve at one or at each end thereof, of a gaseous fluid supply pipe or passage to one or to each end of said cylinder, and a valve or valves acting to open communication between said pipe of passage and said cylinder during the period or exhaust thereof.

3. The combination with a steam engine cylinder and its steam supply and exhaust valve or valves, of a pipe or passage for supplying hot air to said cylinder, and a valve or valves acting to open and admit hot air to said cylinder during the period of exhaust thereof substantially as described.

4. The combination with a steam engine cylinder and its steam supply and exhaust valve or valves, of a supply pipe or passage for supplying hot air to said cylinder, and a non-return valve or valves adapted to open automatically during the period of exhaust of said cylinder and to close when the pressure within said cylinder exceeds that of the hot air in said pipe or passage substantially as described.

5. In a fluid worked engine an engine cylinder provided at each end with an inlet passage and port for gaseous fluid, a non-return valve controlling the same and arranged to open inward when the pressure within the corresponding end of said cylinder falls below that of the gaseous fluid supplied to said inlet passage, a separate steam inlet passage and port, and a valve for controlling the same substantially as herein described.

6. In a fluid worked engine an engine cylinder provided at each end with a port that serves alternately as a steam port and as an exhaust port and a valve for controlling said port, and with a hollow cover provided with an inlet passage for hot gases in communication with its interior and also provided with one or more inlet ports each controlled by a non-return valve opening inward and normally held against its seat by a spring substantially as herein described.

7. The combination with an engine cylinder having separate inlets for heated gaseous fluid and for steam and valves for controlling said inlets, of a heater, pipes connecting the the same with the gas inlet passages of said engine cylinder, a blower for forcing gas through said heater and connecting pipes, a steam generator, and a steam superheater arranged in the steam pipe between said steam generator and engine cylinder and formed with separate but adjacent passages for steam and hot gaseous fluid substantially as described for the purpose specified.

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

GEORGE DIXON.

Witnesses:

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JAMES HAMMOND,

229 *Chorley Old Rd., Halliwell, Clerk.*