S. A. REEVE.

APPARATUS FOR HEATING COMPRESSED AIR.

APPLICATION FILED AUG. 18, 1905.

1,014,330.

Patented Jan. 9, 1912.

4 SHEETS—SHEET 1.

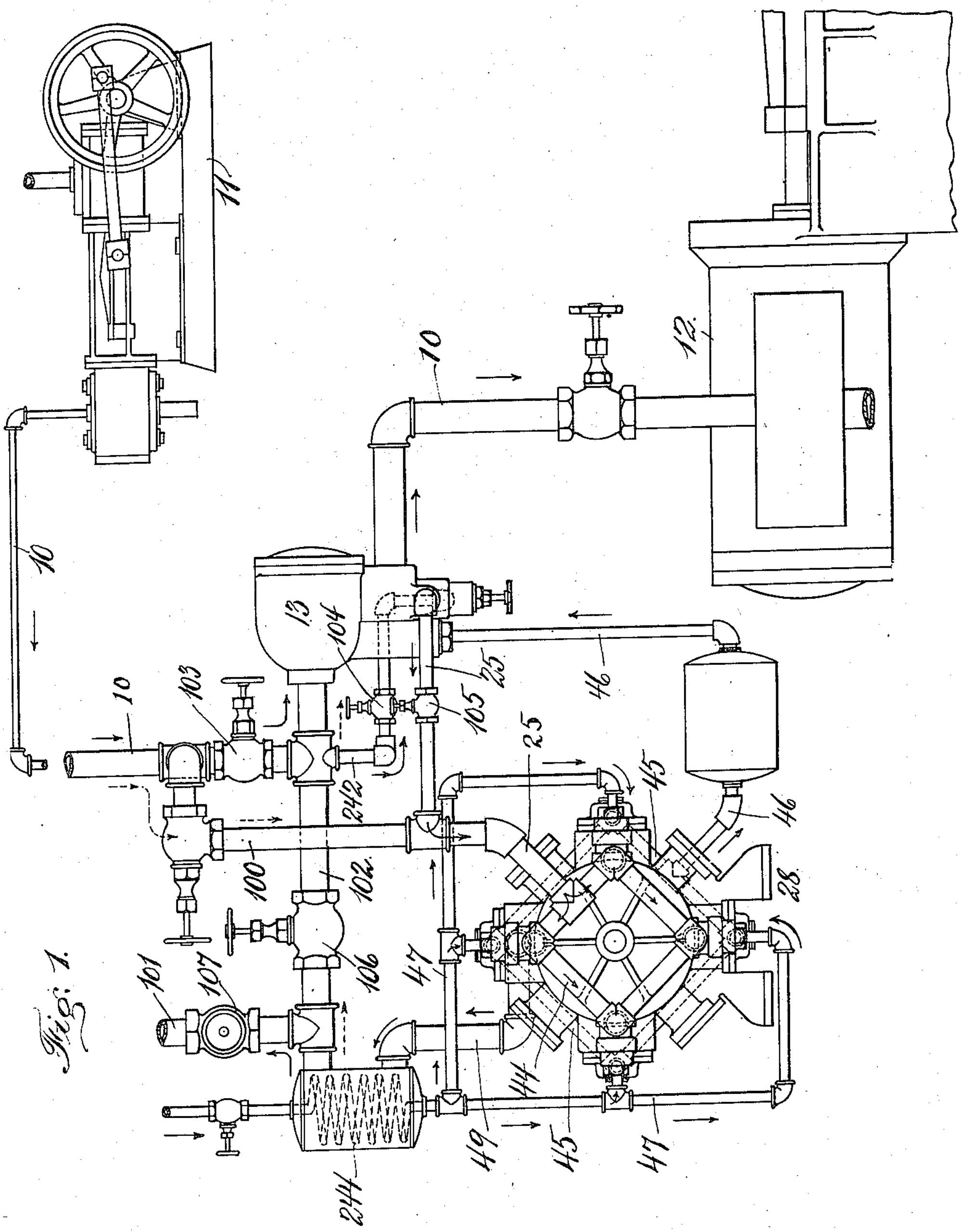

Fig. 1.

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Inventor:
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4 SHEETS—SHEET 2.

Fig: 2.

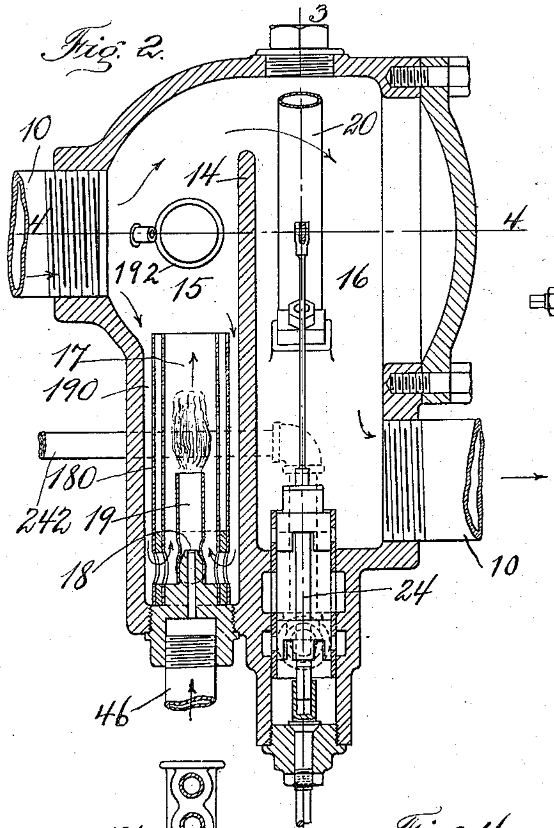


Fig 3

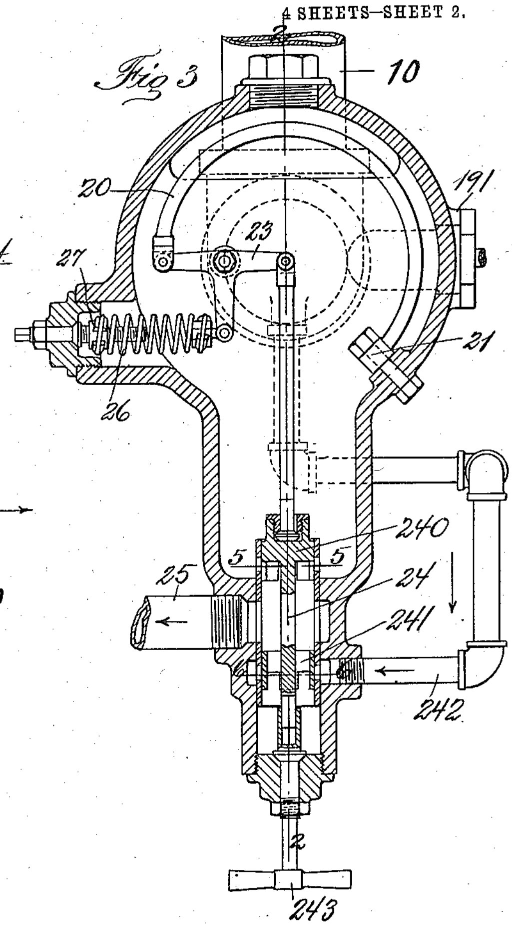


Fig: 4

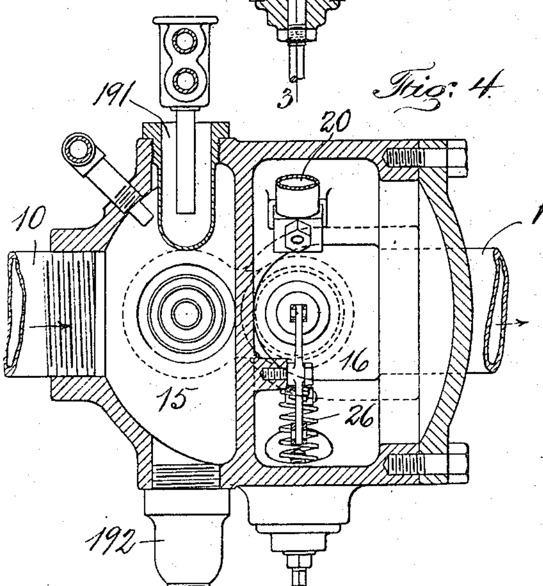


Fig: 5.

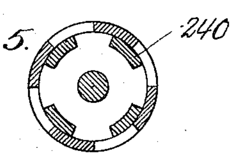
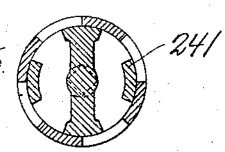


Fig: 6.



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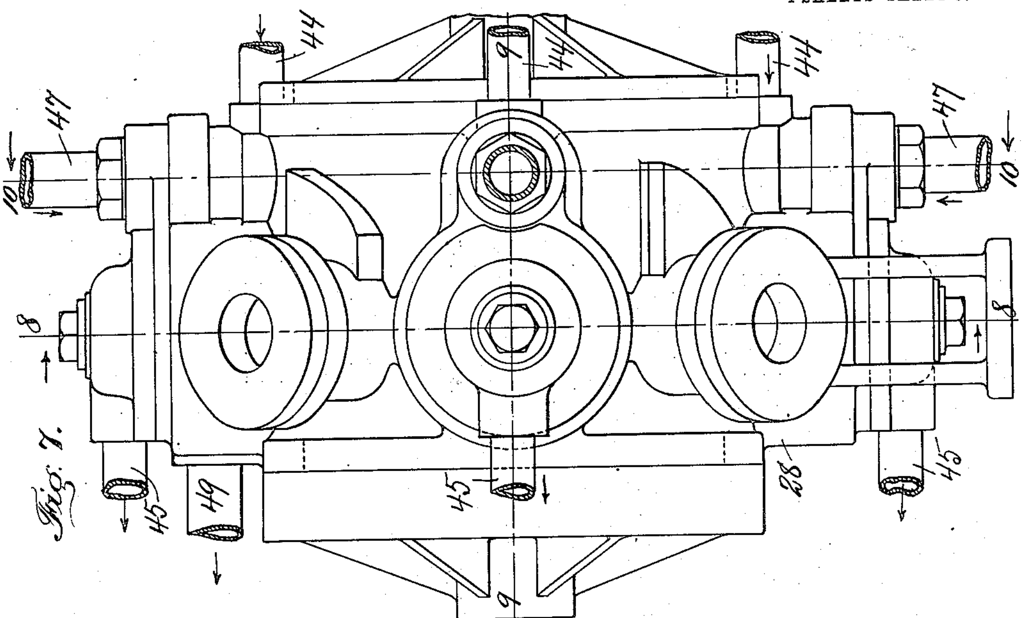

Fig. 7.

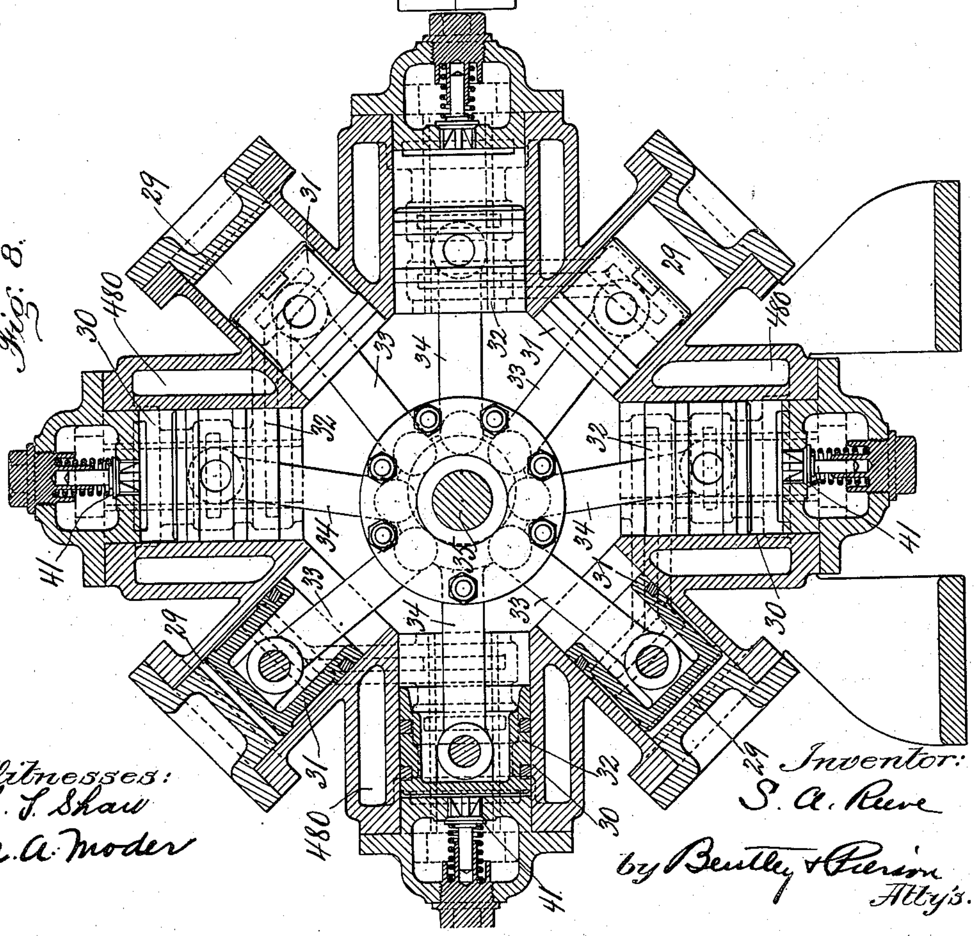

Fig. 8.

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4 SHEETS—SHEET 4.

Fig. 9.

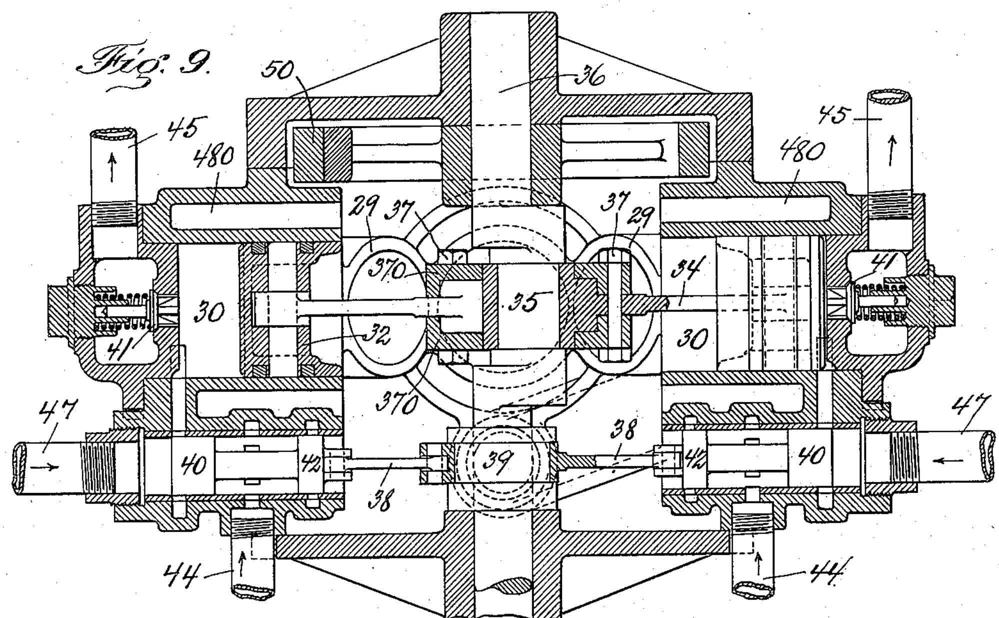
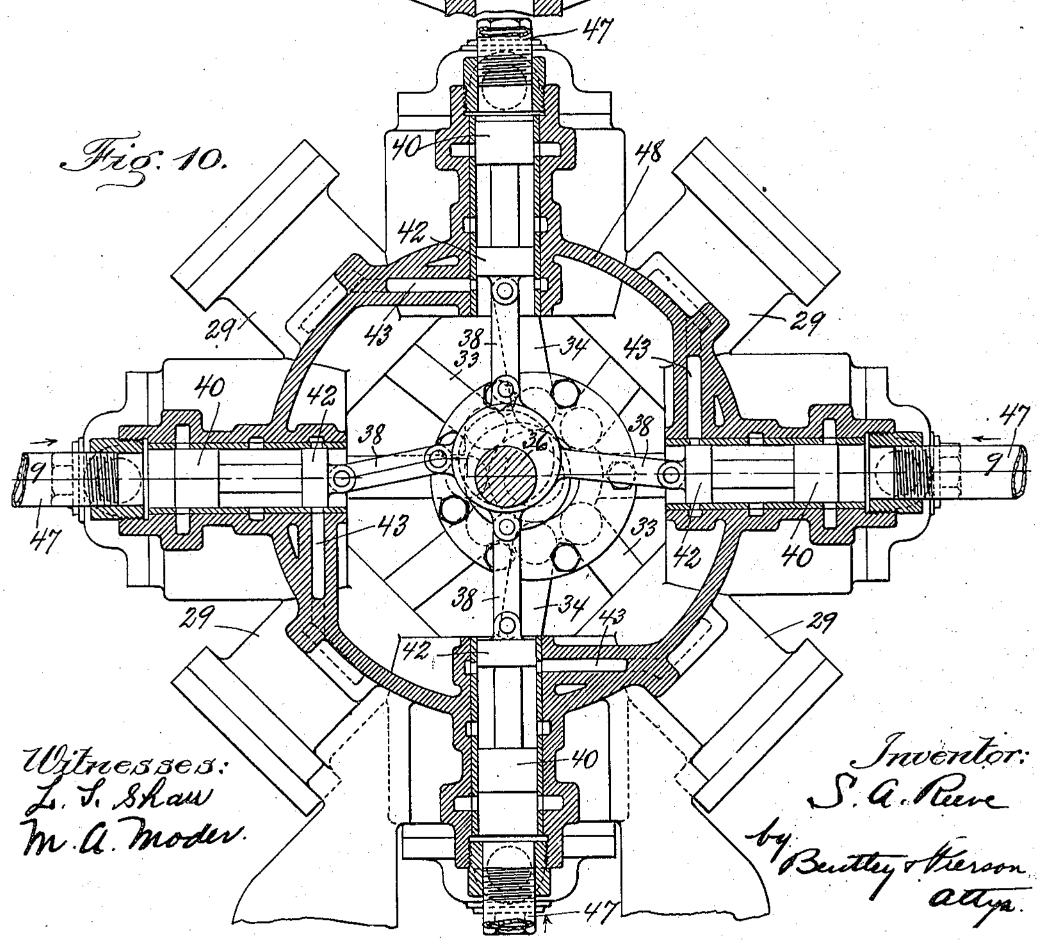


Fig. 10.



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UNITED STATES PATENT OFFICE.

SIDNEY A. REEVE, OF WORCESTER, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO C. P. POWER COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

APPARATUS FOR HEATING COMPRESSED AIR.

1,014,330. Specification of Letters Patent. **Patented Jan. 9, 1912.**

Application filed August 18, 1905. Serial No. 274,780.

To all whom it may concern:

Be it known that I, SIDNEY A. REEVE, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Heating Compressed Air, of which the following specification and accompanying drawings illustrate the invention in a form which I now regard as the best out of the various forms in which it may be embodied.

This invention relates to the art of locally heating a pressure-fluid in a transmission line which conducts the fluid from the primary source of supply to a mechanically separate and more or less remote primary user. An example is the reheating of compressed air at a point adjacent to the compressed-air engine, tool or other user.

The object is to provide a self-regulating internal-combustion reheater, which in a preferred form includes a suitable motor driven by the compressed air from the conduit whose contents are to be heated and operating a fuel pump which injects a supply of fuel into the air conduit. This fuel burns in the compressed air and heats the same to such a temperature as will increase the economy without injury to the using or controlling apparatus. In conjunction with the foregoing I may employ a suitable thermostatic regulator controlling the operation of the pump in such manner as to check the supply of fuel when the temperature has reached the desired maximum. Thereby the amount of fuel consumed is adjusted in proportion to the rate of flow or consumption of the compressed air. The automatic regulation may also be secured without the thermostat as I shall hereinafter explain. This apparatus can be employed with some modification to heat or superheat other fluids, such as steam.

Of the accompanying drawings, Figure 1 represents an elevation of a compressed-air heating apparatus organized in accordance with my invention, parts of the view being drawn to different scales, Fig. 2 represents a vertical section of the burner and thermostatic regulator, Figs. 3 and 4 represent sections on the lines 3—3 and 4—4 of Fig. 2, Figs. 5 and 6 represent sections on the lines 5—5 and 6—6 of Fig. 3, Fig. 7 represents an edge view of the motor-pump for injecting the fuel into the compressed-air conduit, Figs. 8, 9 and 10 represent sections on the lines 8—8, 9—9 and 10—10 of Fig. 7.

The same reference characters indicate the same parts in all the figures.

In the drawings, 10 indicates a conduit supplied with compressed air from an air-compressor 11 and delivering to a suitable translating device or devices 12 such as a compressed-air tool or motor. The conduit 10 is shown provided with an enlargement 13 having a partition 14 partially dividing its interior into two chambers 15 16 in series, in the former of which is located the burner 17, constructed as a Bunsen burner, with a gas-nozzle 18 and a mixing-tube 19 into the lower part of which the air is drawn by the force of the gas jet in such proportion as to provide a flame within the chamber 15. The burner has also an outer or secondary mixing-tube 180 perforated and double-walled to provide air-insulation for separating the interior upward hot flow from the outer downward flow of cold air going to the burner through the annular passage 190.

191 is an externally-heated reëntrant hot-tube igniter for the burner and 192 is a glazed peep-tube for observing the condition of the flame and combustion-chamber walls.

In the opposite chamber 16 is located a thermostat shown as a Bourdon tube 20 partially filled with a vaporizing liquid such as water and hermetically sealed. This tube is fixed at one end 21 and its other end connects with a pivoted lever 23 carrying a valve 24 which controls the outlet from conduit 10 to a tap or branch conduit 25. The main resistance to the expansion of the Bourdon tube is furnished by a spring 26 having an adjustment 27 for regulating its tension. The pipe 25 conducts a supply of compressed air from the air conduit 10 to a combined motor and gas-compressor 28 composed of four motor cylinders 29 alternating with four gas-compressor cylinders 30. All of the pistons 31 32 are connected by pitmen 33 34 with a single crank 35 upon a crank-shaft 36. One of the pitmen 34 has an enlarged head, upon which the ends of the other pitmen are stepped and prevented from outward disconnection by bolts 37 and side-plates 370. The pistons are all single acting.

The air and gas distribution is controlled by four valve-rods 38 operated from a single eccentric 39 located approximately at an angle of 90° with the crank 35, the valve structures being alongside of the compressor cylinders. Each valve structure embodies a piston valve 40 controlling the admission of gas to one of the compressor-cylinders 30, the discharge being controlled by an ordinary check-valve 41, and a second piston valve 42 controlling both the admission and exhaust of compressed air to and from one of the motor cylinders 29 through a port or duct 43. The compressed air pipe 25 has branches 44 leading to the several valve-chests and the compressed gas is led by branches 45 into a pipe 46 connecting with the burner 17. Admission of gas to the valve-chests is by way of pipes 47. Exhaust air discharges into the central portion of the air-tight casing 48 of the motor-pump, jacketing the gas-compressor cylinders by means of annular spaces 480, and emerges by a pipe 49. The shaft 36 carries a fly-wheel 50.

Valve 24 actuated by the thermostat 20 has upper and lower pistons 240 241, the upper one of which controls the supply of heated air going to the motor-pump through pipe 25, while the lower one controls a supply of non-heated air going through said pipe from a by-pass pipe 242 branching from the air-conduit 10 back of the burner. These pistons are crown-toothed and rotatable by means of a handle 243. They open and close their respective ports proportionately by longitudinal motion and inversely by rotatory motion, so that by turning the handle, the proportions of heated and non-heated air going to drive the motor pump, may be regulated. Such adjustment determines the degree of coldness of the motor exhaust and hence determines, first, the amount of cooling of the gas-compressor cylinders by means of the jacketing motor-exhaust, and secondly the amount of cooling of the gas going to the gas-compressor cylinders, which before reaching said cylinders passes through a gas-refrigerator 244 cooled by the motor-exhaust.

In the operation of this apparatus a small portion of heated compressed air from the conduit 10 is tapped off through pipe 25 to the motor-pump 28, mixed if desired with a proportion of non-heated air from branch 242, and there affords power for the compression of gas (or it may be the pumping of liquid fuel) to a pressure higher than that of the air conduit 10. This fuel burns in the compressed air in chamber 15 and serves to impart thereto any desired moderate temperature, say 600° F. There is of course a very large excess of air in the conduit over what will satisfy the amount of fuel introduced. The maximum temperature attained is determined by the thermostat, whose temperature-controlled element is the Bourdon tube 20. When the critical temperature is reached, this tube, expanding, tends to close the valve 24 against the tension of spring 26 and thus diminish the supply of compressed air to the motor-pump 28, whereupon the speed of the latter is checked and the supply of fuel maintained at a point which will keep the temperature of the air constant. This temperature is maintained irrespective of the quantity of air flowing in conduit 10, for obviously if the flow is increased the temperature will tend to drop and the valve in 24 will open, sending more compressed air to the motor and affording an increased supply of fuel. The temperature imparted to the air should not be higher than is suited to the ordinary uncooled compressed-air tools and motors in common use.

The motor pump 28 will operate with a wide range of speed and very little vibration. Owing to its absence of dead-centers its crank will creep around at a very slow rate when required. It is to be noted, furthermore, that the application of maximum power is almost in a direct line. For example, in Fig. 8 the compressor-cylinder requiring greatest application of power in the position of parts there shown is the uppermost one in the figure, while the motor cylinder best able to afford power, owing to the beginning of its stroke with compressed air at full pressure, is the cylinder 29 immediately to the left of the lowermost compressor-cylinder 30, and the two pistons are almost in a straight line with each other. I therefore prefer this kind of a compressor-pump for using the air-power and delivering the fuel, although it is obvious that other forms of apparatus might be used for a like purpose.

My invention may be used for superheating steam or heating other fluids besides air, in which case the burner 17 would be supplied with both air and fuel from the motor pump 28 with suitable changes therein which could be effected by a skilled mechanic. Fig. 1 also shows an alternate arrangement of connections, in which the course of the air is indicated by dotted arrows, whereby all of the compressed air used in the power-transmission line is passed through the motor-pump 28, being reduced in pressure only slightly by performing work in the motor cylinders and passed on to do further work in the main translating devices. In this case the air goes to the compressor-cylinders of motor-pump 28 through a valved pipe 100, and after exhausting from said cylinders, it enters the burner casing 13 through pipe 102 instead of passing out into the atmosphere by branch 101. For this arrangement a stop-valve 103 is provided in the air conduit 10 to prevent direct passage of the air into casing 13, and other stop-valves 104 105 106 107 in the various pipes as shown, to direct the air in either of the two alternate paths described. When all of the air passes through the motor-pump, the motor cylinders act as meters of the quantity of air going to the translating devices and they automatically provide the necessary quantity of gas required to furnish the desired moderate temperature, the capacities of the gas-compressor cylinders being so established as to be in the necessary proportion to the air-compressor cylinders. The thermostat may then be omitted or disconnected. For convenience of illustration I have shown the same motor-pump adapted for both the described methods of regulating the amount of fuel, although in practice it might be preferable to have this device differently proportioned in the two cases.

What I claim as new and desire to secure by Letters Patent is:

1. In the art of reheating elastic pressure fluids, the combination with a fluid conduit supplied from a remote point, of a local heater for said conduit comprising an internal-combustion burner in the conduit adapted to moderately heat the fluid, and a pumping and regulating device supplied with motive fluid from the conduit and adapted to inject the fuel for said burner, said device being sensitive to the quantity of fluid flowing in the conduit, so as to inject fuel in proportion to said quantity of flow.

2. A compressed air system comprising mechanically-separate primary air compressing and using devices connected by a transmission conduit, an internal-combustion burner in said conduit adjacent to the air-using device, and local pumping means supplied with motive fluid from the conduit for injecting the burner fuel.

3. The combination of an air-compressor, a separate air-engine, a transmission conduit connecting the two, and a local self-regulating internal-combustion burner and fuel-pumping mechanism for reheating the air adjacent to the point of use, said mechanism being supplied with motive fluid from the conduit and sensitive to the quantity of air-flow in the conduit.

4. Fluid reheating means comprising a pressure conduit adapted to be interposed between a source of pressure-fluid supply and a remote using device, an internal-combustion reheating burner in said conduit, an independently-running motor-pump supplied with motive fluid from said conduit for injecting the burner fuel, and a thermostat subject to the reheating temperature and controlling the motive-fluid supply to said motor-pump.

5. In combination, a pressure-fluid conduit, an internal-combustion heater therein, a local motor-pump supplied with fluid by a branch from said conduit and adapted to inject the burner fuel, a throttle-valve in said branch, and a thermostat subject to the burner temperature and controlling said throttle-valve.

6. A reheating apparatus comprising a compressed-air conduit, an internal-combustion burner therein, a gas-compressor to supply said burner, a motor using the conduit-air, and means for refrigerating with the motor exhaust the gas supplied to said compressor.

7. A reheating apparatus comprising a compressed-air conduit, an internal-combustion burner therein, a gas-compressor to supply said burner, a motor using the conduit air, and means for jacketing the gas-compressor with the motor-exhaust.

8. A compressed-air reheater comprising a compressed-air conduit, an internal-combustion burner therein, a motor-pump driven by the conduit-air for supplying fuel to said burner, means for cooling the fuel-supply with the motor exhaust, and means for varying the temperature of the conduit-air supplied to said motor-pump.

9. A compressed-air reheater comprising a compressed-air conduit, an internal-combustion burner therein, a local motor supplied with conduit-air from points anterior and posterior to said burner, distributing valve-mechanism in the motor-supply line for adjusting the proportions of heated and unheated air going to the motor, and a thermostat subject to the temperature of the heated air and controlling said valve-mechanism for causing the latter to variably throttle the air supplied to the motor.

10. Reheating apparatus comprising a fluid conduit having an enlarged section provided with a deflecting partition, a burner in the conduit on one side of said partition, a branch outlet and outlet-valve on the remote side of said partition, a motor-pump supplied with heated air from said outlet and adapted to supply fuel under pressure to the burner, and a thermostat on the remote side of the partition controlling said valve.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses, the 6th day of May 1905.

SIDNEY A. REEVE.

Witnesses:
Henry P. Murray,
Roy W. Burgess.