No. 822,259. PATENTED JUNE 5, 1906.

W. L. R. EMMET.

POWER GENERATING APPARATUS.

APPLICATION FILED OCT. 7, 1905.

Fig. 1.

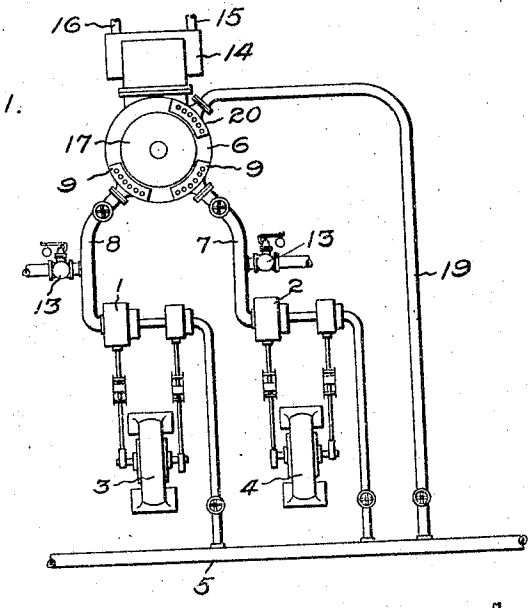


Fig. 3.

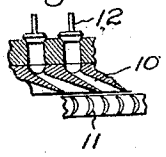


Fig. 4.

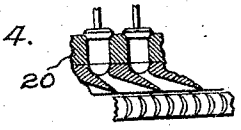
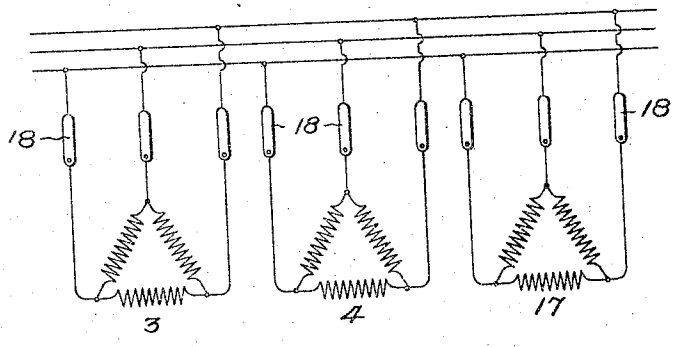


Fig. 2.



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UNITED STATES PATENT OFFICE.

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POWER-GENERATING APPARATUS.

No. 822,259. Specification of Letters Patent. Patented June 5, 1906.

Application filed October 7, 1905. Serial No. 281,785.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Power-Generating Apparatus, of which the following is a specification.

The present invention relates to power-generating plants wherein high-pressure reciprocating engines are employed, and has for its object to improve their economy of operation.

The invention is more particularly directed to existing power plants wherein it is desired to increase their capacity with a minimum expenditure of money or wherein it is desired to decrease the cost per kilowatt output by a better extraction of the available energy in the steam or both.

In carrying out my invention two or more reciprocating engines are employed which may be simple or compound and operate condensing or non-condensing. By preference these engines work between boiler-pressure and an exhaust of, say, atmosphere in the former case and eight pounds absolute at full load in the latter case, since below this pressure the economy of such an engine falls off rapidly. The pressure may of course be somewhat above or below this point, depending upon conditions.

Suitably mounted in a manner to receive the exhaust from the engines is a low-pressure turbine, preferably of the jet type, since it possesses certain advantages in the way the steam is utilized; but the invention is not necessarily limited thereto in all respects.

The turbine is or may be provided with as many sets of nozzles or other fluid-discharging devices as there are reciprocating engines. In some cases two or more engines, depending upon their size, may be connected to the same set of nozzles or other fluid-discharging devices. Ordinarily, however, where the engines are of moderate size each one discharges into a separate nozzle or discharging device on the turbine. In the connection between the low-pressure cylinder of each reciprocating engine and the turbine is a relief-valve, which is set to open at any desired increase in pressure and to close automatically when said pressure falls. The relief-valve is piped to atmosphere or other suitable point of exhaust. In addition to this each conduit leading to the turbine is provided with a shut-off valve, which may be automatic in its action or hand-operated, the latter being the preferred arrangement. By reason of this construction one or more of the reciprocating engines can supply exhaust-steam to the low-pressure turbine. When all of the nozzles or other fluid-discharging devices are in service, it will be seen that the turbine is a motive-power device that is common to the exhausts from the engines.

The turbine can be controlled by a suitable valve mechanism which opens and closes automatically to admit or cut off steam or by connecting its generator when one is driven thereby with a suitable source of current which keeps it at a definite speed. A satisfactory controlling mechanism comprises a plurality of successively-operating valves which cut sections of an expanding nozzle into and out of action. These valves may respond to changes in pressure or to changes in speed, as desired.

It is sometimes desirable to have the turbine drive a greater load than can be taken care of by the exhaust-steam from one or more reciprocating engines, and to take care of this excess load one or more nozzles or other fluid-discharging devices are provided which receive steam directly from the high-pressure source or through a suitable pressure-reducing valve. These overload nozzles preferably have a somewhat greater ratio of expansion than the main nozzles, because of the high-pressure steam which supplies them. Each nozzle or device is provided with a suitable shut-off valve, whereby it may be cut out of service. Normally they will not be in service, but come into use on overload requirements or when the reciprocating engines are shut down and it is desired to operate the turbine only.

The turbine is connected as directly as possible to a condenser of any approved type. By preference as good a vacuum as possible is continuously maintained.

While I have referred for convenience to steam as the motive fluid, it is evident that the invention is not limited thereto, since other fluids can be utilized.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a diagrammatic view illustrating high-pressure reciprocating engines and a low-pressure turbine receiving exhaust therefrom.

Fig. 2 is a diagram illustrating the circuit connections of the generators driven by the engines and turbine. Fig. 3 is a detail view showing the nozzles which admit steam from the reciprocating engines to the turbine, and Fig. 4 is a detail view of a nozzle having a somewhat greater ratio of expansion that admits fluid from a source of higher pressure to the turbine.

1 and 2 represent compound reciprocating engines arranged to drive alternating-current generators 3 and 4. Steam or other elastic fluid is supplied to the engines from the main 5, and the exhaust from the engines passes to the vertical turbine 6 through conduits 7 and 8. The turbine is preferably of the jet type. Each of the conduits 7 and 8 discharge into a separate steam-chest 9, which supplies steam to nozzles 10, Fig. 3. These nozzles are preferably, though not necessarily, of the sectionalized expanding type, having the several sections so arranged that the fluid is discharged in the form of a solid column against the wheel-buckets 11. If desired, the passage of steam through these various nozzle-sections can be controlled by valves 12, that are actuated by hand, by variations in pressure, or in response to speed changes of the turbine. Each of the conduits 7 and 8 is provided with an automatic relief-valve 13, which is set to open at a definite increase in pressure and to close when the pressure is restored to normal. The turbine exhausts into a condenser 14 of suitable construction. The one shown is of the surface type, and 15 represents the inlet-pipe for the cooling-water, and 16 the discharge-pipe. Mounted on top of the turbine and driven by the main shaft thereof is an alternating-current generator 17, that is connected in parallel with the generators 3 and 4 by suitable conductors. The circuits of the generators are controlled by switches 18.

It sometimes happens that the load on the turbine is greater than that which can be handled by the exhaust-steam from the reciprocating engine, and to meet these conditions a valved conduit 19 is provided, which connects the main 5 with an auxiliary nozzle or nozzle-sections 20, Fig. 4, which have a somewhat greater ratio of expansion than the main nozzle shown in Fig. 3. Instead of connecting the conduit to the main 5 it can be connected to a point of lower pressure—for example, between the high and the low pressure cylinders of the reciprocating engine. It is a somewhat better arrangement, however, to connect the conduit 19 to the high-pressure main, since by so doing the turbine can be operated when for any reason it is necessary without, however, operating the reciprocating engine.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof. I desire to have it understood, however, that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination, two or more high-pressure reciprocating engines, a low-pressure turbine which is common thereto, and separate nozzles or other fluid-discharging devices which receive the exhaust from the engines and discharge it into the turbine.

2. In combination, two or more high-pressure reciprocating engines, a low-pressure turbine which is common thereto, nozzles or other devices which discharge fluid to the turbine, and a conduit that extends from the low-pressure cylinder of each of the reciprocating engines to a nozzle or other fluid-discharging device.

3. In combination, two or more high-pressure reciprocating engines, a low-pressure turbine that is common to and receives the exhaust from the engines, a separate device which discharges the fluid from each engine to the turbine, and shut-off valves that control the passage of exhaust-steam to the said devices.

4. In combination, two or more high-pressure reciprocating engines, a low-pressure turbine that is common to and receives the exhaust from the engines, a separate device which discharges the fluid from each engine to the turbine, and a relief-valve for each reciprocating engine which opens upon a definite increase in exhaust-pressure.

5. In combination, a high-pressure reciprocating engine, a low-pressure turbine receiving exhaust from the engine, a condenser connected to the turbine, a nozzle on the turbine through which the exhaust from the engine passes, and another nozzle also on the turbine having a greater ratio of expansion than the first, through which steam of higher pressure passes.

6. In combination, a high-pressure reciprocating engine, a low-pressure turbine receiving exhaust from the engine, a condenser connected to the turbine, a nozzle on the turbine through which the exhaust from the engine passes, another nozzle also on the turbine having a greater ratio of expansion than the first through which steam of higher pressure passes, and a high-pressure main that supplies the high-pressure reciprocating engine and the last-mentioned nozzle.

In witness whereof I have hereunto set my hand this 5th day of October, 1905.

WILLIAM L. R. EMMET

Witnesses:
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