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F. LJUNGSTRÖM ET AL

TURBINE DRIVEN LOCOMOTIVE

Filed April 13, 1922

2 Sheets-Sheet 1

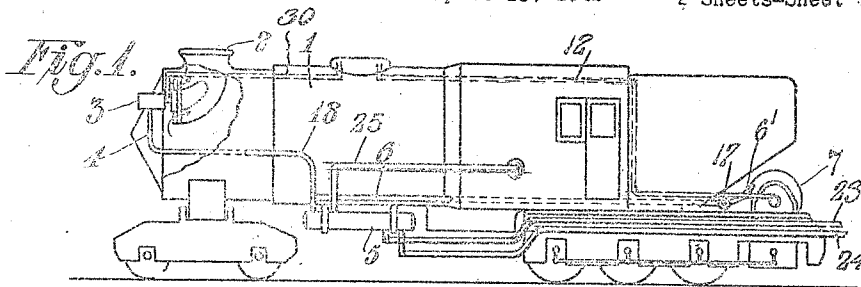
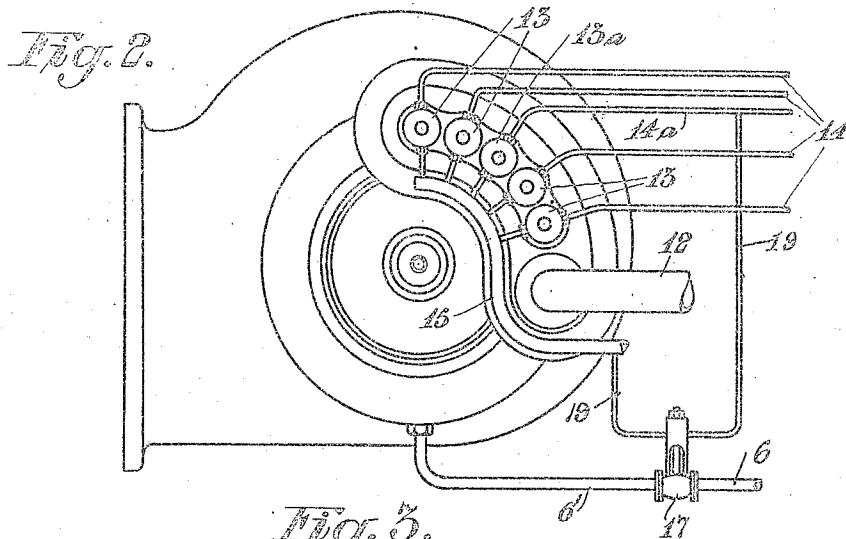


Fig. 3.

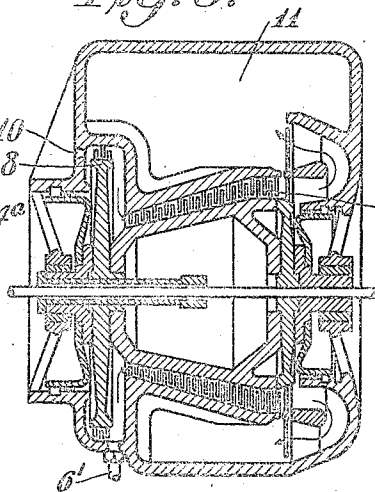


Fig. 4.

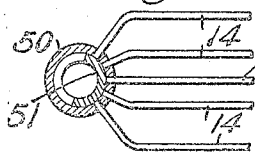
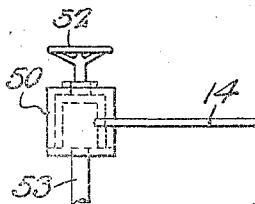


Fig. 5.

Inventors
F. Ljungström
I. Öroberg
By Markedahl
Attys.

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Fig. 7

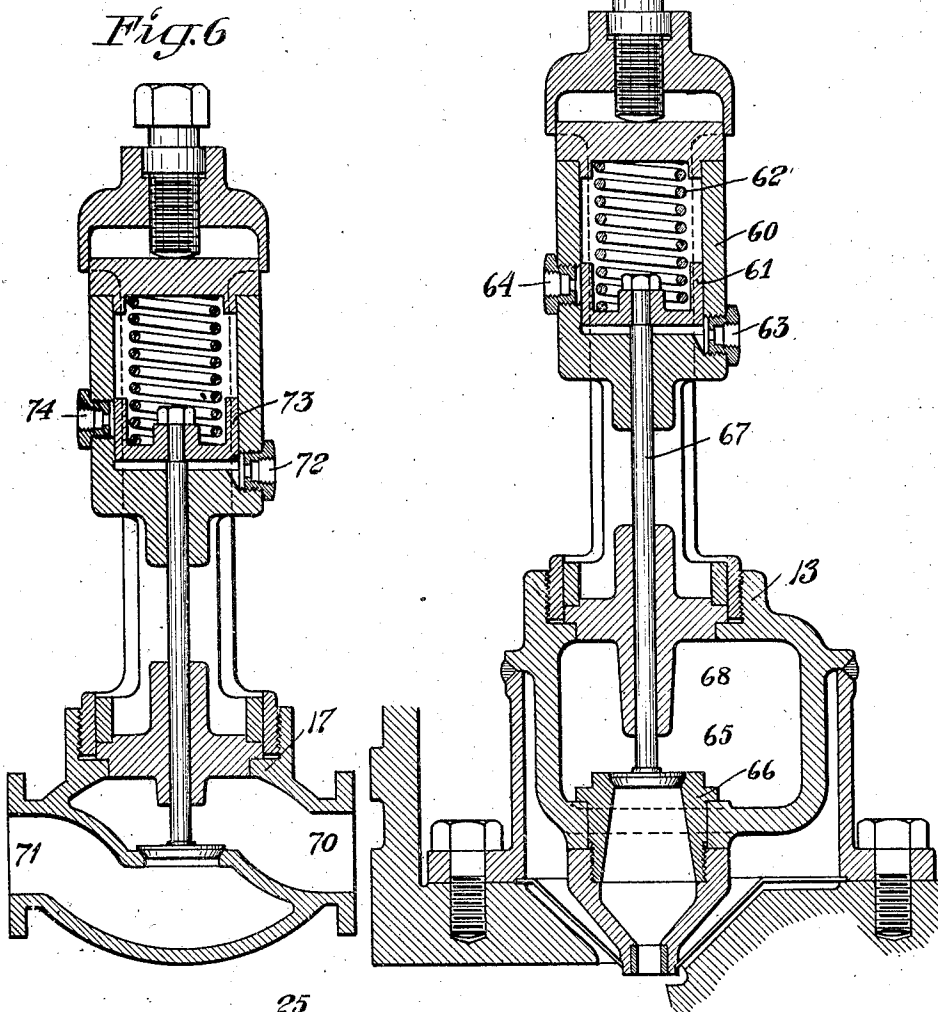
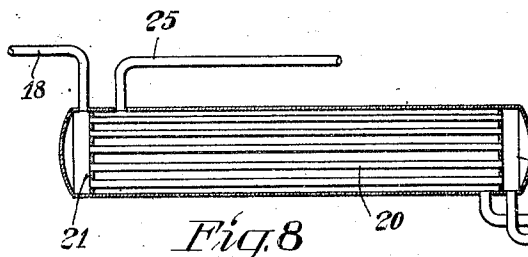


Fig. 8

Inventors
F. Ljungström
I. Broberg
By Marks & O'Neil
Attys.

UNITED STATES PATENT OFFICE.

FREDRIK LJUNGSTRÖM, OF LIDINGO-BREVIK, AND ISIDOR BROBERG, OF LIDINGON, SWEDEN, ASSIGNORS TO AKTIEBOLAGET LJUNGSTRÖMS ÅNGTURBIN, OF STOCKHOLM, SWEDEN, A CORPORATION.

TURBINE-DRIVEN LOCOMOTIVE.

Application filed April 13, 1922, Serial No. 552,411, and in Sweden November 10, 1921.

In turbine-driven locomotives in which the furnace draught is produced by means of a special fan or blower device driven by a turbine, difficulties have always arisen with regard to the regulation of the turbine for the most suitable furnace draught. By reason of its object, the turbine which drives the fan is an auxiliary engine which usually has to be started first, and therefore it must be driven by live steam from the boiler. As nowadays very high steam pressure is often used in the boiler, the operation of small turbines without back pressure is a disadvantage. However, in an auxiliary engine operating with back pressure, there are difficulties in utilizing the exhaust steam from the turbine in an expedient manner, in that disadvantageous variations may occur in the back pressure owing to the use of exhaust steam. With a lower back pressure the speed of the fan turbine is evidently increased and consequently a lower back pressure should preferably be available when a greater draught is desired in the furnace.

The present invention relates to means for utilizing the exhaust steam from the fan turbine, so that a reduced back pressure is obtained when a stronger furnace draught is required, the said arrangement consisting in causing the exhaust conduit from the turbine of the ventilator gear to communicate with the main turbine of the locomotive and, preferably, also with a preheater for the feed water.

In the accompanying drawings an embodiment of the invention is illustrated. Fig. 1 shows a turbine-driven locomotive arranged according to the present invention. Fig. 2 shows an end view of the main turbine on an enlarged scale and Fig. 3 a section of said main turbine. Fig. 4 is a cross-section and Fig. 5 a side view, respectively, of an oil distributing device for operating the steam supply. Fig. 6 is a cross-section of the oil pressure valve controlling the supply to the main turbine of exhaust steam from the fan turbine. Fig. 7 is a cross-section of one of the nozzle valves of the main turbine. Fig. 8 is a longitudinal section of the feed water preheater. Figs. 6, 7 and 8 are all drawn to an enlarged scale.

In Fig. 1 the reference numeral 1 designates the boiler and 2 the smoke stack of the locomotive with a fan turbine 3 arranged

therein in known manner. Steam is introduced from the boiler 1 into said turbine 3 through the conduit 30 and the steam discharge conduit 4 from the fan turbine is connected with a preheater 5 for the feed water by means of piping 18 and with the main turbine 7 by means of a branch pipe 6. The preheater which is more clearly shown in Fig. 8 consists in known manner of a nest of tubes 20 communicating with headers 21 and 22. Exhaust steam from the fan turbine 3 enters the header 21 through the pipe 18, passes through the tubes 20 into the header 22 and is conducted to the condenser through the pipe 24. Feed water enters the header 22 through the pipe 23, passes around the tubes 20 and is introduced in the boiler through the pipe 25.

The main turbine 7 which is more clearly shown in Fig. 3 consists in known manner of two parts, viz, an action part 8 and a reaction part 9. 10 designates openings for the steam supply, and the arrows indicate the path of the steam to the outlet 11. Arranged in the opening 10 are preferably one or more nozzles 13 for different variations in the steam supply.

In the turbine shown in Fig. 2, there are mounted five nozzles 13 in the opening 10. The main steam supply to the turbine takes place through the conduit 12 whence the steam is conducted around the nozzle valves 13. These nozzle valves are opened by means of oil pressure, the oil being supplied through the pipes 14. These pipes 14 are connected with a distributing device for the oil, said device consisting, as shown in Figs. 4 and 5, of a closed casing 50 having an adjustable valve body 51, which when turned by means of the hand wheel 52 opens a communication between one or more of the pipes 14 leading to the oil pressure regulated nozzles 13 and the interior of the said casing 50 having an oil supply pipe 53. The oil is led off from the nozzle valves through the pipe 15.

Such a nozzle valve 13 may be constructed in any known manner. According to Fig. 7 the valve comprises an upper cylinder in which moves a piston 61 which is kept in its lowermost position by means of a spring. In the wall of the cylinder there are provided two openings 63 and 64, the inlet opening 63 being connected with one of the

oil supply pipes 14 (see Fig. 2), whereas the outlet opening 64 communicates with the common oil exhaust pipe 15 (see Fig. 2). By means of the valve stem 67 the piston 61 is connected to a valve disc 65 bearing against a valve seat 66.

The operation of this valve is as follows:

Steam is introduced through the conduit 12 (see Fig. 2) into the inlet chamber 68 arranged around the valve stem 67. Oil from the oil distributing device 50, 51 is introduced through a pipe 14 into the inlet opening 63 and lifts the piston 61 upwards against the action of the spring 62, whereby the valve disc 65 is lifted from its seat 66 so that steam may flow through the nozzle 13 into the turbine. When the oil supply is cut off, the disc 65 is again pressed against its seat 66 under the action of the spring 62.

In Fig. 3, 6¹ designates the end of the discharge conduit of the fan turbine, said conduit being a pass-in pipe for the main turbine. The point of this passing-in for the main turbine must be so selected that the pressure at this point corresponds to the desired back pressure for the fan turbine. Preferably, this pressure is lower than the back pressure prevailing in the feed water preheater. When the fan turbine exhaust passes to both the preheater 5 and the main turbine, the back pressure of the fan turbine will be decreased, so that the number of revolutions of the fan turbine, and thus also the draught in the furnace will be increased. In the embodiment shown, the pipe 6 opens into the space between the action and the reaction turbine parts 8 and 9 where a pressure lower than the admission pressure prevails.

From Fig. 2 it will be seen how the discharge pipe of the fan turbine serves as a pass-in pipe for the main turbine only when the steam consumption in the main turbine is larger. When the third nozzle 13^a is opened, the supply to the main turbine is also opened to the discharge steam from the fan turbine by a branch conduit 19 extending from the oil supply conduit 14 of the nozzle valve 13^a to the oil pressure valve 17 in conduit 6, so that the valves 13^a and 17 are simultaneously opened. By this arrangement the discharge steam from the fan turbine is introduced into the main turbine only when three nozzles are open for the admission of steam to the main turbine, it being thus provided that the furnace draught is increased at times when the steam consumption in the main turbine is large.

An example of the construction of the valve 17 is shown in Fig. 6. As seen from the figure, the valve 17 is constructed in the same manner as one of the nozzle valves as

shown in Fig. 7. The inlet 70 of the valve 17 communicates with the pipe 6 conducting exhaust steam from the fan turbine 3, and the outlet 71 is connected to the pipe 6¹ serving as pass-in pipe for the main turbine. Oil from the pipe 19 (see Fig. 2) enters the inlet 72, lifts the piston 73 and exhausts through the outlet 74 and the pipe 19¹ (see Fig. 2) into the oil exhaust pipe 15.

The arrangement above described is only an embodiment of the invention and may be subjected to numerous modifications without changing the principle of the invention.

We claim:

1. In a steam-driven locomotive, a boiler, a main turbine for driving the locomotive, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a steam consuming apparatus, means to connect the inlet part of both said turbines with the boiler, means to connect the exhaust part of said fan turbine with the steam consuming apparatus, means to connect said exhaust part also with a low pressure stage of the main turbine, and a valve for controlling said last-mentioned means.
2. In a steam-driven locomotive, a boiler, a main turbine for driving the locomotive, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a preheater for the feed water to the boiler, means to connect the inlet part of both said turbines with said boiler means to connect the exhaust part of said fan turbine with said feed water preheater, means to connect the exhaust part also with a low pressure stage of the main turbine, and a valve for controlling said last-mentioned means.
3. In a steam-driven locomotive, a boiler, a main turbine for driving the locomotive, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a steam consuming apparatus, means to connect the inlet part of both said turbines with the boiler, means to connect the exhaust part of said fan turbine with the steam consuming apparatus, means to connect said exhaust part also with the main turbine at a point where the pressure is lower than the admission pressure of the steam consuming apparatus, and a valve for controlling said last-mentioned means.
4. In a steam-driven locomotive, a boiler, a main turbine for driving the locomotive, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a preheater for the feed water to the boiler, means to connect the inlet part of both said

turbines with said boiler, means to connect the exhaust part of said fan turbine with said feed water preheater, means to connect said exhaust part also with the
 5 main turbine at a point where the pressure is lower than the admission pressure of the feed water preheater, and a valve for controlling said last-mentioned means.

5. In a steam-driven locomotive, a boiler,
 10 a main turbine for driving the locomotive, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a
 15 steam consuming apparatus, means to connect the inlet part of both said turbines with the boiler, means to connect the exhaust part of said fan turbine with the
 20 steam consuming apparatus, means to connect said exhaust part also with a low pressure stage of the main turbine, and a valve for controlling said last-mentioned means, said valve being controlled by the steam
 supply device of said main turbine.

6. In a steam-driven locomotive, a boiler,
 25 a main turbine for driving the locomotive, a plurality of nozzles for supplying steam to said turbine, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said
 30 fan device, a steam consuming apparatus, means to connect the inlet part of both said

turbines with the boiler, means to connect the exhaust part of said fan turbine with the steam consuming apparatus, means to connect said exhaust part also with a low
 35 pressure stage of the main turbine, and a valve for controlling said last-mentioned means, said valve being operatively connected with one of the inlet nozzles of the main turbine so that said valve and said
 40 nozzle open simultaneously.

7. In a steam-driven locomotive, a boiler, a main turbine for driving the locomotive, consisting of an action part and a reaction
 45 part, a fan device for producing furnace draught, an auxiliary turbine operating with back pressure for driving said fan device, a steam consuming apparatus, means to connect the inlet part of both said turbines with the boiler, means to connect the
 50 exhaust part of said fan turbine with the steam consuming apparatus, means to connect said exhaust part also with the main turbine at the space between said action turbine part and said reaction turbine part,
 55 and a valve for controlling said last-mentioned means.

In testimony whereof we affix our signatures.

FREDRIK LJUNGSTRÖM.
 ISIDOR BROBERG.