March 19, 1940. H. C. EGLOFF 2,193,863

STEAM DRIVE PLANT FOR VEHICLES

Filed June 23, 1936

Fig. 1.

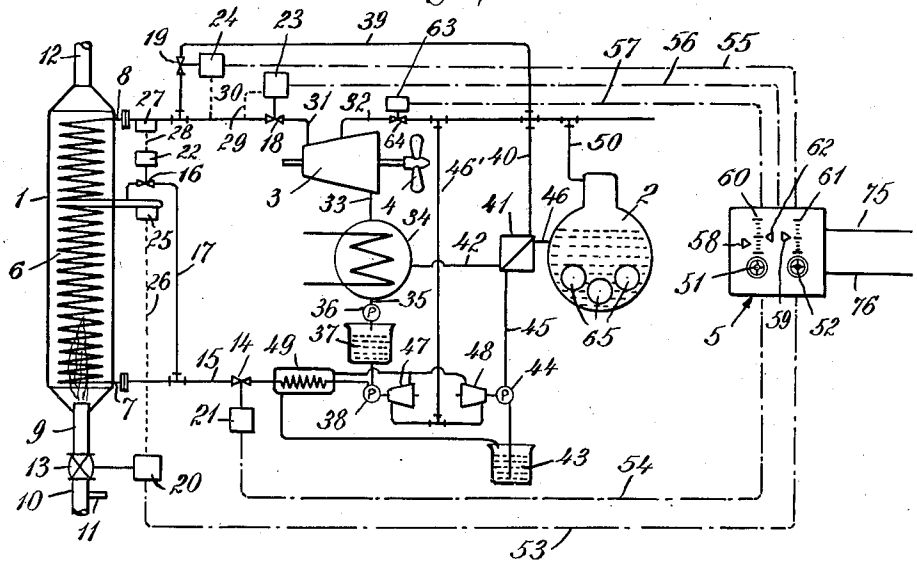


Fig. 2.

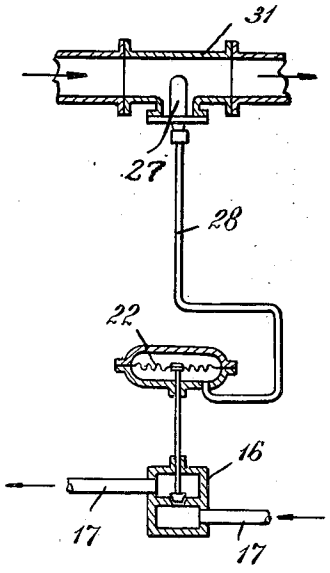
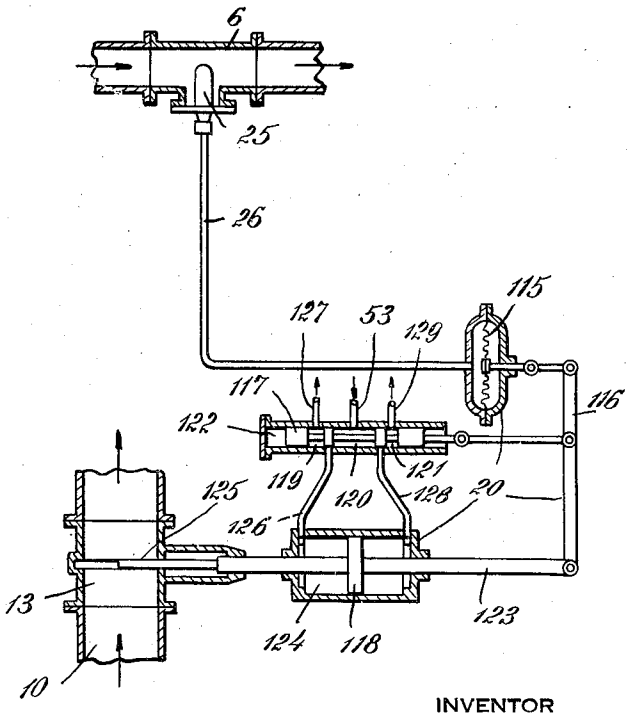


Fig. 3.



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Patented Mar. 19, 1940 2,193,863

UNITED STATES PATENT OFFICE

2,193,863

STEAM DRIVE PLANT FOR VEHICLES

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Application June 23, 1936, Serial No. 86,712
In Switzerland July 3, 1935

1 Claim. (Cl. 60—107)

This invention relates to steam propelled or driven apparatus, particularly for ships, and has for its object certain improvements in apparatus of this type. The apparatus of the invention comprises a high pressure steam generator, a low pressure accumulator, a steam operated power unit or engine, and control means for correlating the fuel supply, the generated steam, and the engine steam requirements for predetermined conditions of operation.

The invention will be better understood from a consideration of the following description, taken in conjunction with the accompanying drawing, in which

Fig. 1 is a schematic or diagrammatic illustration of an arrangement of apparatus according to the invention,

Fig. 2 is an enlarged view, partly in section, of elements 16, 22 and 27, shown in Fig. 1, and

Fig. 3 is an enlarged view, partly in section, of elements 16, 20 and 25, shown in Fig. 1.

The apparatus of the invention comprises a high pressure steam generator 1, preferably of small liquid capacity, a low pressure steam accumulator 2, and a power turbine or engine 3 which drives the propellor 4. The control of the steam generator and the performance of the engine are governed by the control apparatus 5, which will hereinafter be fully described.

The steam generator 1 has a pipe system 6, to one end of which 7 is fed the working medium as a feed liquid and at the other end 8, it is drawn off as superheated steam for use. The firing is effected by a burner 9 to which is fed combustion air through the pipe 10 and the fuel through the pipe 11. The exhaust gases forming during the combustion flow through the pipe 12 to other points of consumption or directly into the open.

For regulating the operation there are provided a regulating element 13 on the burner 9, a feed valve 14 in the feed conduit 15, a supplementary valve 16 in the circuit 17 for additional feed liquid and two steam valves 18 and 19. Each of the regulating elements is controlled by a servomotor 20, 21, 22, 23 or 24. The temperature responsive device 25 which is under the influence of the already partly superheated steam, acts on the servomotor 20, via the conduit 26. A second temperature responsive device 27, influenced by the steam for use, acts on the supplementary valve 16 via the conduit 28. When the temperature rises, the quantity of fuel supply is lessened and the supplementary supply of feed liquid increased, and, conversely, when the temperature falls, the amount of fuel supply is increased and the supplementary amount of feed liquid supply is lessened. The servomotors 23 and 24 of the steam valves 18 and 19 are under the influence of the steam pressure prevailing at the outlet end 8, which is led to the control elements via the conduit 29 or 30. The valves are so adjusted that the valve 18 is first opened, and only when, on full opening of the valve 18, the pressure continues to rise, is the valve 19 also opened.

The supplementary valve 16 and associated operating apparatus are shown in Fig. 2 and the regulating device 13 and associated operating apparatus are shown in Fig. 3. The arrangement and operation of these members will be more fully understood from the following description.

In the steam pipe 31 there is provided a capsule or heat responsive member 27 which is filled with a liquid or gaseous medium. According to the temperature of the steam flowing through the pipe 31 the pressure in the capsule 27 will be high or low. These changes of pressure act through the pipe 28 on the diaphragm of the servomotor 22 which, when the temperature in the pipe 31 or the pressure in the pipe 28 increases, opens the valve 16, and conversely closes it when the temperature falls. Responsive to the changes of temperature in the pipe 31, more or less additional liquid is led into the pipe line 6 of the steam generator through pipe 17.

As shown in Fig. 3, the pipe 6 connects to the heat responsive device 25, and the fluid therein acts through the pipe 26 on the servomotor 20. The servomotor 20 comprises a diaphragm-actuated member 115 connected to the pipe 26. The diaphragm is connected through linkage 116 to the pistons 117 and 118. The piston 117 has three channels 119, 120 and 121 and is reciprocable in the cylinder 122. Pipe 53 connects to the cylinder 122 and thereby provides a source of steam to actuate the servomotor piston 118 which is reciprocably mounted on shaft 123 in cylinder 124. One end of the shaft 123 operates a slide-valve member 125 in the device 13 which controls the flow of gas through pipe 10. When the piston 117 is moved to the right under the action of member 115 and linkage 116, the channel 119 connects the pipe 126 leading into one end of cylinder 124 to the vent 127 and allows the steam to escape to the atmosphere. At the same time pipe 53 is connected through channel 120 and pipe 128, with the cylinder 124. This causes the steam on the right side of piston 118 to move it to the left, thus closing the valve mem-

ber 125 of the regulating device 13. If piston 117 is moved to the left under the action of the diaphragm 115 and linkage 116, the channel 121 connects cylinder 124 through pipe 128 with the vent 129 and permits the steam to escape to the atmosphere. At the same time, steam is admitted to the other side of piston 118 through pipe 53, channel 120 and pipe 126, thereby moving piston 118 and shaft 123 to the right and opening valve member 125 of the regulating device 13. Variations in the steam temperature in the pipe 6 cause the temperature operated device 25 to actuate, through the servomotor 20, the fuel regulating device 13.

Each of the servomotors 21, 23 and 24 is preferably constructed similarly to servomotor 20 shown in Fig. 2, and are operated in accordance with the principles there illustrated.

The steam flows through the conduit 31 into the turbine 3 and is here expanded to the condenser pressure while delivering work. If necessary, a portion of the steam can be drawn off from an intermediate stage of the power engine and carried away through the conduit 32. The completely expanded steam flows through the conduit 33 into the condenser 34. The condensate is pumped through the conduit 35 by the condensate pump 36 into the feed tank 37 and then is again introduced into the steam generator for further evaporation by means of the feed pump 38 through the feed pipe 15.

The steam evolving directly from the steam generator through the conduit 39 flows through the conduit 40 into the heat exchanger 41. The condensate or mixture of condensate and steam then formed flows through the conduit 42 and into the condenser 34.

A pump 44 draws liquid from a tank 43 and pumps it through the conduit 45 into the heat exchanger 41 and further in pre-heated state through the conduit 46 into the accumulator 2.

The discharge of the accumulator takes place through the conduit 50 from which the steam can be led via the conduit 32 to increase the output of the power engine 3. If necessary, the increase of output can be still further enhanced by heating the steam accumulator 2 by means of special furnaces 65 and utilizing this accumulator itself for the generation of steam. Another portion of the accumulated steam is led via the conduit 46' to the auxiliary power engines 47 and 48 of the feed pumps for the high pressure steam generator 1 and the low pressure accumulator 2. From the auxiliary power engines 47 and 48 the steam flows into a preheater 49, from which the condensate passes into the tank 43.

For controlling the steam generator and for carrying out the travel maneuvers, the control apparatus 5 can be influenced by two hand wheels 51 and 52. By means of the hand wheel 51, via the impulse conduits 53, 54 and 55, the operation of the steam generator is influenced, and by means of the hand wheel 52 first the power engine is set to the desired travel output via the conduits 56 and 57 and simultaneously, via the conduits 53—55, the operation of the steam generator is automatically adapted to the output set for the power engine. Both the output set for the steam generator by the hand wheel 51 and the output set for the power engine by the hand wheel 52 can be read, by means of the pointers 58 or 59, on the scales 60 or 61. An additional pointer 62 serves to verify whether by means of the control apparatus the operation of the steam generator is adapted to the travel output required from the engine. Via the conduit 57, with the aid of the servomotor 63, the valve 64 inserted in the conduit 32 is influenced in such a way that during the operation a definite quantity of steam flows from the low pressure accumulator 2 into the power engine 3 in order to replace the losses resulting in the high pressure cycle of the working medium or, in certain cases, to bring about a withdrawal of steam from the power engine 3.

The adapting of the operation of the steam generator to the output of the power engine can be effected by displacing, by means of the hand wheels 51 and 52, cams which are co-ordinated to one another and which adjust the individual control elements of the steam generator and power engine plants in accordance with a pre-arranged program. With this, there can also be connected couplings of individual control elements or blockings of individual or several control elements in such a way that no displacements of individual elements can be effected which would endanger the operation. The transmission of the impulses can be effected hydraulically, mechanically, pneumatically or electrically. In particular, in hydraulic transmission, there can be inserted individual intermediate control elements, by means of which the control can be brought into a definite function of the course of the impulses, for example, in such a way that the control elements are operated proportionately to the changes of definite operating properties or also proportionately to the speed of the changes of an operating property. There can also be inserted an addition device by means of which different impulse values united together can act on an individual control element. By aid of the automatic receiving devices on the steam generator or power engine plant (for example, temperature and pressure responsive means, speed and output regulators, etc.) the values adjusted on the regulating devices by the control apparatus 5 are subsequently re-corrected in such a way that the condition of the steam either remains invariable or takes a course in accordance with a prescribed program.

The power engine 3 is advantageously constructed as a turbine, with one part equipped for the travel in one direction and other part equipped for the travel in the other direction. However, a separation of the two parts can also be effected in such a way that one housing serves for one direction of travel and the other housing for the other direction of travel. Furthermore, however, reversible engines can also be used, for example, piston steam engines. In this case, the reversing apparatus is likewise influenced by the control device 5. If two different machine parts are present for the two directions of travel, then the regulating device leading the steam into the power engine is to be constructed in such a way that operating steam is fed only either to the one machine or to the other. However, in order to keep warm the portion that is not in operation, a definite quantity of warming-up steam can be conveyed constantly or intermittently to this portion.

At times when the ship, for example, while in port, is ready for a journey, the steam generator 1 is only slightly heated, there being fed to it a quantity of feed liquid commensurate with the firing. The steam then, controlled by the valve 19, flows via the conduits 39 and 40 into the heat exchanger 41, so that its heat is transmitted to the working medium flowing through the conduits 45 and 46 into the low pressure accumulator. Then all auxiliary machines and other

steam consuming points are supplied with steam from the low pressure accumulator 2. To promote the generation of steam, when necessary, the furnaces 65 can be kept in operation. The quantity of steam to be produced during the initial setting is adjusted by means of the hand wheel 51 and with the aid of the valve 14 for the feed quantity, and by means of the element 13 for the amount of heat, and by means of the element 19 for the passage of the steam.

If the ship is ready to start, then by means of the hand wheel 52 via the conduit 56, the valve 18 is opened to an extent which corresponds to the desired starting output. As long as this starting output does not exceed the output set for the steam generator by the hand wheel 51, no change will take place in the control adjusted for the steam generator. If then the output which is set for the power engine 3 exceeds the output set for the steam generator, then by the control apparatus 5 by means of the conduits 53 and 54, the output of the steam generator is automatically raised to such an extent that there will be fed to the turbine the amount of steam necessary for the output demanded. For certain cases however, in which a specially great flexibility of the maneuvering operations seems desirable, the low pressure accumulator 2 can also be utilized for rapid change of the travel output. When the output of the power engine is lowered by turning back the hand wheel 52, the output of the steam generator is likewise lessened correspondingly. If the travel output falls below the output set by the hand wheel 51 for the initial setting, then there will be no further change in the operation of the steam generator, but the heat of the excess steam will be transmitted to the working medium for the low pressure accumulator.

The operating stand for the plant can be arranged as desired. In connection with this there results the advantage of the invention that the control and the command of the entire drive plant including both the steam generator as well as the power engine plant, are combined at one point, which can be arranged either in the engine room or in a command room or in the vicinity of the operating stand of the vessel. This simplifies the carrying out of the traveling instructions and increases the safety of operation.

I claim:

In a steam system having a generator of small liquid capacity, a low pressure steam accumulator, and a power engine connected to the generator and the accumulator by steam pipes, the improvement which comprises a first auxiliary power engine, a first feed water pump, a feed water pipe connecting the first pump to the generator, said pump being driven by the first auxiliary power engine, conduit means connecting the first auxiliary power engine with the low pressure steam accumulator, whereby the first auxiliary power engine may be operated to drive the first feed water pump when the steam is not available from the generator, a second auxiliary power engine connected by a conduit to said accumulator, a second water pump driven by the second auxiliary power engine, and conduit means connecting the second water pump to the accumulator, whereby the second auxiliary power engine may be operated by steam from the low pressure steam accumulator.

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