

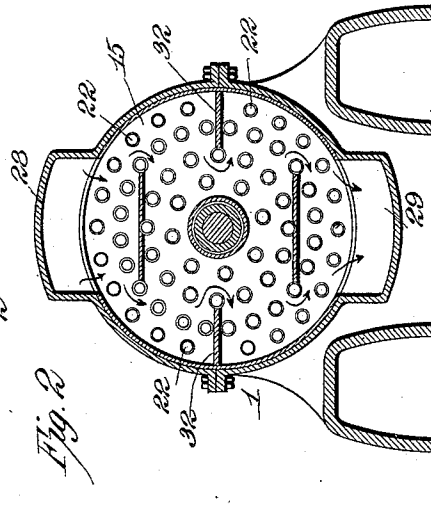
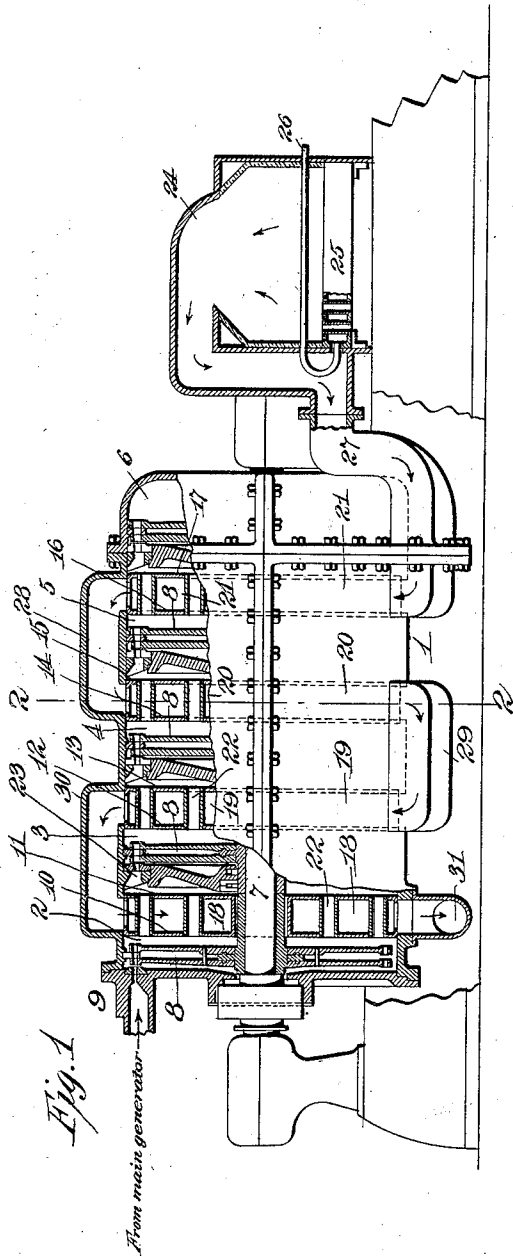
L. C. LOEWENSTEIN & L. H. DYER.
ELASTIC FLUID TURBINE.

APPLICATION FILED SEPT. 28, 1909.

1,041,714.

Patented Oct. 15, 1912.

2 SHEETS—SHEET 1.



Witnesses:

John F. Hatch.
Henry F. Conrad

Inventors.
Louis C. Loewenstein
Leonard H. Dyer
By Dyer & Dyer
Attorneys.

L. C. LOEWENSTEIN & L. H. DYER.

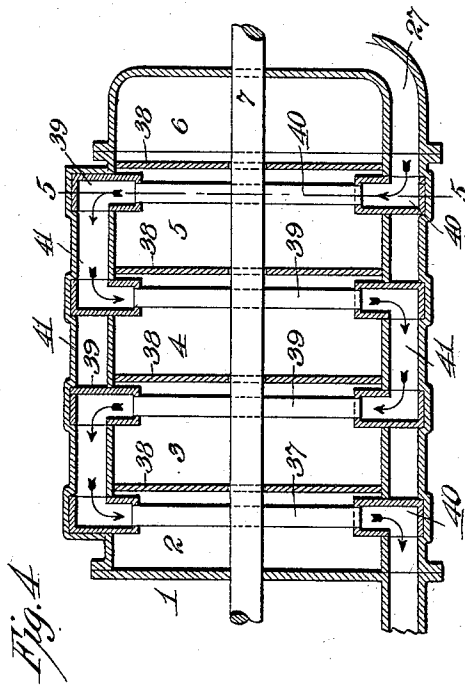
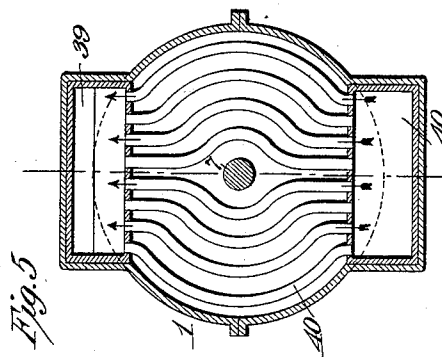
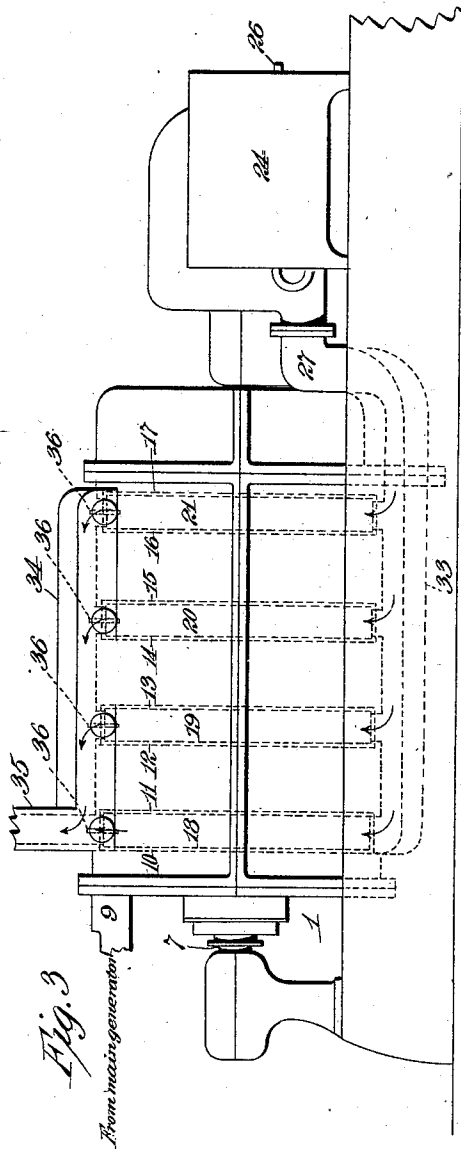
ELASTIC FLUID TURBINE.

APPLICATION FILED SEPT. 28, 1909.

1,041,714.

Patented Oct. 15, 1912.

2 SHEETS—SHEET 2.



Witnesses:

John H. Hetch
Henry F. Conrad

Inventors:

Louis C. Loewenstein
Leonard H. Dyer
Raymond Dyer
Attorneys.

UNITED STATES PATENT OFFICE.

LOUIS C. LOEWENSTEIN, OF LYNN, MASSACHUSETTS, AND LEONARD H. DYER, OF GREENWICH, CONNECTICUT, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELASTIC-FLUID TURBINE.

1,041,714.

Specification of Letters Patent.

Patented Oct. 15, 1912.

Application filed September 28, 1909. Serial No. 520,002.

To all whom it may concern:

Be it known that we, LOUIS C. LOEWENSTEIN, a citizen of the United States, and a resident of the city of Lynn, county of Essex, State of Massachusetts, and LEONARD H. DYER, a citizen of the United States, and a resident of the town of Greenwich, county of Fairfield, State of Connecticut, have invented a new and useful Elastic-Fluid Turbine, of which the following is a specification.

This invention relates to multistage turbines which utilize elastic fluid and is particularly applicable to steam turbines, although it is not so limited.

The present invention is a modification of our invention forming the subject matter of an application for patent filed September 28, 1909, Serial Number 520,001. By this invention we seek to enjoy all of the material advantages incident to our said invention, and at the same time avoid the necessity of having the furnaces located within the shell of the turbine. These and further objects will appear from the following specification and the accompanying drawings, considered together or separately.

In the drawings: Figure 1 is a side elevation partly in section of a multistage elastic fluid turbine, embodying our invention. Fig. 2 is a sectional view thereof on the line 2—2 of Fig. 1. Fig. 3 is a side elevation of a modification of the structure shown in Fig. 1 illustrating parallel flow of the reheating gases. Fig. 4 is a detail sectional view of a modification showing an arrangement for series flow of the reheating gases; and Fig. 5 is a sectional view on the line 5—5 of Fig. 4.

In all the views like parts are designated by the same reference characters.

According to our invention the elastic fluid between stages in a multistage elastic fluid turbine is reheated by a furnace, which is separate from the furnace of the main generator. This furnace is so connected with the turbine that the heating gases will come in contact with the walls of the passages through which the elastic

fluid traverses the several stages of the turbine.

Referring to Figs. 1 and 2, the turbine 1 has its shell divided into a plurality of stages indicated at 2, 3, 4, 5 and 6. The turbine illustrated has a horizontal shaft 7 and rotating elements 8, such elements turning in each stage. The shell is divided by diaphragms 10, 11, 12, 13, 14, 15 and 16, 17 into stages of different pressures. The diaphragms are arranged in pairs as shown. The space between each pair of diaphragms constitutes a passage for the traversal of the hot gases. These passages are indicated at 18, 19, 20, 21. The fluid passage includes a nozzle 9, leading into the stage 2 of highest pressure. The fluid passage continues from one stage to another through tubes 22, such tubes connecting each pair of diaphragms 10 and 11, 12 and 13, 14 and 15, and 16 and 17. The size and number of these tubes should be proportioned so that the fluid can pass from one stage to the next without choking or other loss. In each of the stages succeeding the stage 2 is located a nozzle 23, such nozzle directing the fluid into the rotating element 8 in such stage. Such a form of turbine is similar to those in common use, with the exception of being divided into stages by double diaphragms producing the gas passages 18 and 21, inclusive, with the tubes 22 connecting the diaphragms and lying within the gas passages. In connection with the turbine thus produced we provide a furnace 24, such furnace being separate from the turbine but as close thereto as conveniently possible. The furnace illustrated in Fig. 1 is an ordinary type of liquid fuel burning furnace having a burner 25 and a fuel supply pipe 26. The furnace is connected to the turbine by means of a flue or passage 27. This flue is shown as connected to the bottom of the gas passage 21. An additional passage 28 is provided at the top of the turbine shell, connecting the passages 20 and 21. A second passage 29 is provided at the lower part of the turbine shell connecting the passages 19 and 20, and a third passage

30 is provided at the top connecting the passages 18 and 19. A connection 31 is made at the bottom of the turbine for taking off the hot gases from the passage 18. 5 The direction of flow of the hot gases is indicated in Fig. 1 by the arrows. As so arranged, the hottest gases will come in contact with the tubes through which the steam at lowest pressure traverses. By properly 10 proportioning the size of the tubes and varying their number, the increment of heat may be so proportioned that the desirable results sought for will be attained.

For the purpose of distributing the flow 15 of hot gases among the tubes 22 one or more baffle plates 32 (see Fig. 2) may be arranged in one or more of the passages 18, 19, 20, 21.

The invention may be modified in many ways. In Fig. 3 is shown an arrangement 20 in which the hot gases traverse the turbine by a parallel flow arrangement. The lower ends of the gas passages 18, 19, 20, 21, are connected to a manifold 33, which is coupled up to and is connected with the flue 27 of the furnace 24. The outlet of the passages 25 18, 19, 20, 21, is through another manifold 34 lying on the top of the shell of the turbine, and having a stack 35. For the purpose of controlling the flow of gases through 30 the passages 18, 19, 20 and 21, valves or dampers 36 are provided located in coöperative relation to the passages 18, 19, 20, 21, so as to control the flow of gases through such passages.

35 Another modification of the invention consists in passing the hot gases through tubes while the elastic fluid passes around the tubes, a construction the opposite of that already described. Such an arrangement is 40 shown diagrammatically in Figs. 4 and 5. In lieu of the passages 18, 19, 20 and 21, and the tubes 22 passing therethrough, a series of tubes 37, 38, 39 and 40 is provided, such tubes lying respectively within the 45 stages 2, 3, 4, 5, of the turbine. The stages of the latter are formed by single diaphragms 38, 38, in the usual manner. The upper and lower ends of the tubes are connected with boxes 39 and 40, respectively,— 50 such boxes lying within the shell of the turbine. As shown in Fig. 4 the hot gas arrangement is one in which the gas traverses the stages in series, the connections being made by short horizontal pipes 41. 55 The steam passes through the spaces between the tubes 37, 38, 39 and 40, and is heated by contact thereby. It is within the scope of the invention to make this arrangement with a parallel flow, such as that illustrated in Fig. 3. 60

We have illustrated our invention by means of a multistage steam turbine, but we desire it understood that the invention is not so limited. Any other form of engine

may be used, operated by any form of elastic 65 fluid. The stages may be located within a single shell or not, and any form of furnace may be employed.

It is apparent from the foregoing description that by reheating between the stages 70 we are able to secure a more advantageous steam expansion throughout the turbine; as, for instance, a closer approach to true adiabatic expansion, or perhaps an isothermal expansion, as the necessities of any certain 75 problem may demand. In other words, by regulating the reheating at the various stages, it is possible to secure any theoretical expansion that may be desired, independently of any initial superheat. This we regard as a great advantage because the heat 80 is applied in just the stage where wanted and in the correct quantity, which can be closely regulated by the means described and cannot be obtained by reheating by flue 85 gases.

Certain broad features herein disclosed are not claimed herein, but are claimed in our co-pending application for patent, filed September 28, 1909, Serial No. 520,001. 90

In accordance with the provisions of the patent statutes, we have described the principle of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we 95 desire to have it understood that the apparatus shown is merely illustrative and that the invention can be carried out in other ways.

Having now described our invention, 100 what we claim as new and desire to secure by Letters Patent, is:—

1. A multistage elastic fluid turbine, having a furnace separate from the main generator furnace for reheating fluid between 105 stages, such furnace being outside of the turbine shell.

2. A multistage elastic fluid turbine, having a shell with the reheaters within the shell, and a furnace connected thereto and 110 outside of the shell, and means for passing gases from the furnace through all of the stages of the turbine.

3. A multistage elastic fluid turbine having a furnace separate from the main generator furnace and outside of the casing of the turbine, and means for passing gases 115 from the furnace through all of the stages of the turbine.

4. A multistage elastic fluid turbine having a separate furnace, flues between stages, connections between the flues and furnace, and means for passing elastic fluid outside 120 of the flues.

5. A multi-stage elastic fluid turbine, 125 having a main boiler furnace and an additional furnace outside of the casing of the turbine, flues connecting the furnace and

turbine, and means for controlling the passage of heating gases through the different stages.

6. A multi-stage elastic fluid turbine, 5 having a furnace outside of the turbine casing, connections between the furnace and the turbine, and means for controlling the passage of heating gases through the different stages.

10 7. A multi-stage elastic fluid turbine, having a casing, a single heating furnace outside of the casing, flues connecting the casing and furnace, and dampers for controlling the flow of gases through the flues.

This specification signed and witnessed 15 this 23rd day of Sept., 1909, and 30th day August 1909, respectively.

LOUIS C. LOEWENSTEIN.

LEONARD H. DYER.

Witnesses to signature of Louis C. Loewenstein:

JOHN A. McMANUS, Jr.,

HENRY O. WESTENDARP.

Witnesses to signature of Leonard H. Dyer:

JOHN L. LOTSCH,

ANNA L. TERRELL.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."