

No. 666,043.

Patented Jan. 15, 1901.

H. ZOELLY.

CONVERSION OF HEAT INTO MECHANICAL ENERGY.

(Application filed Sept. 24, 1900.)

(No Model.)

2 Sheets—Sheet 1.

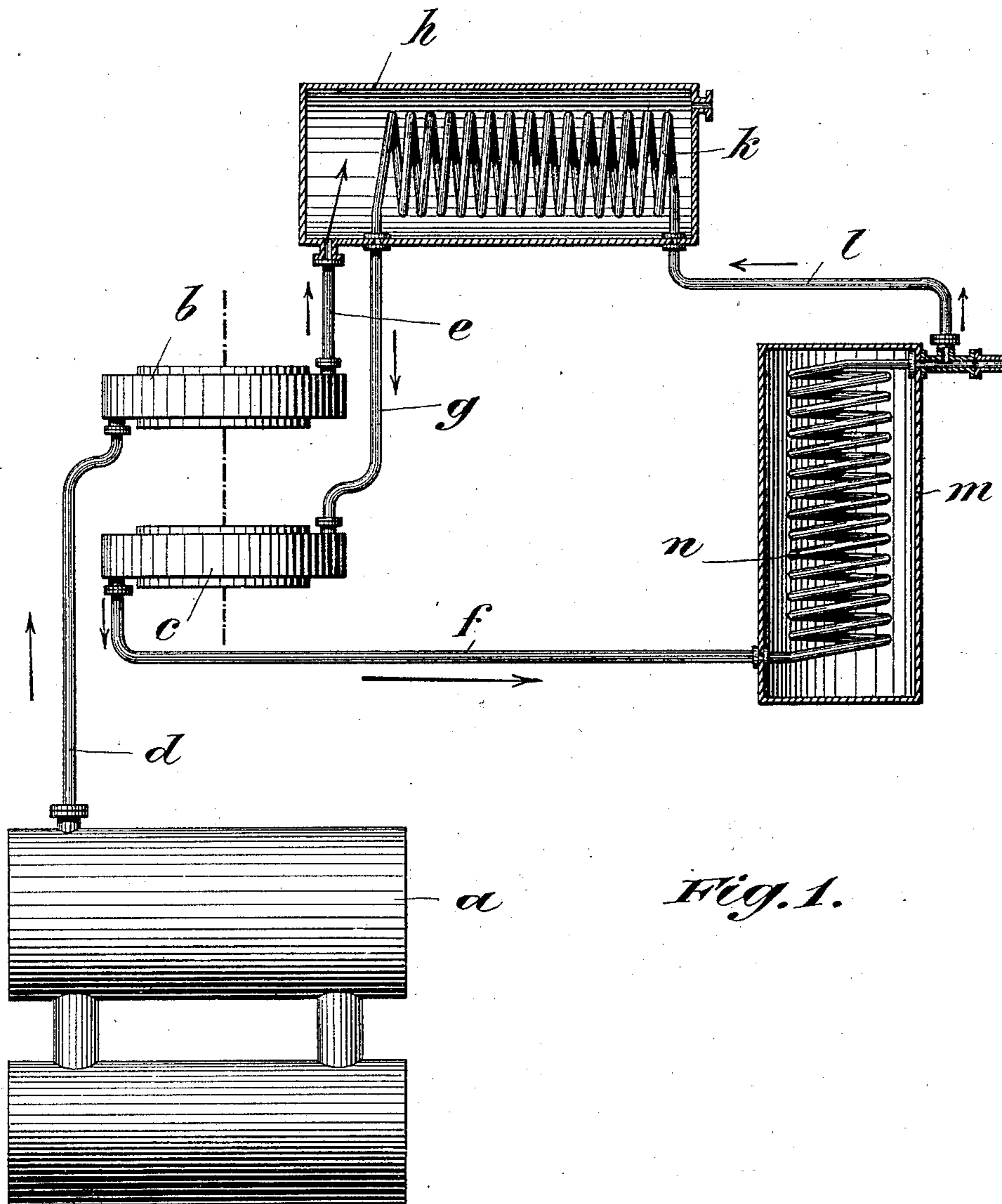


Fig. 1.

Witnesses:  
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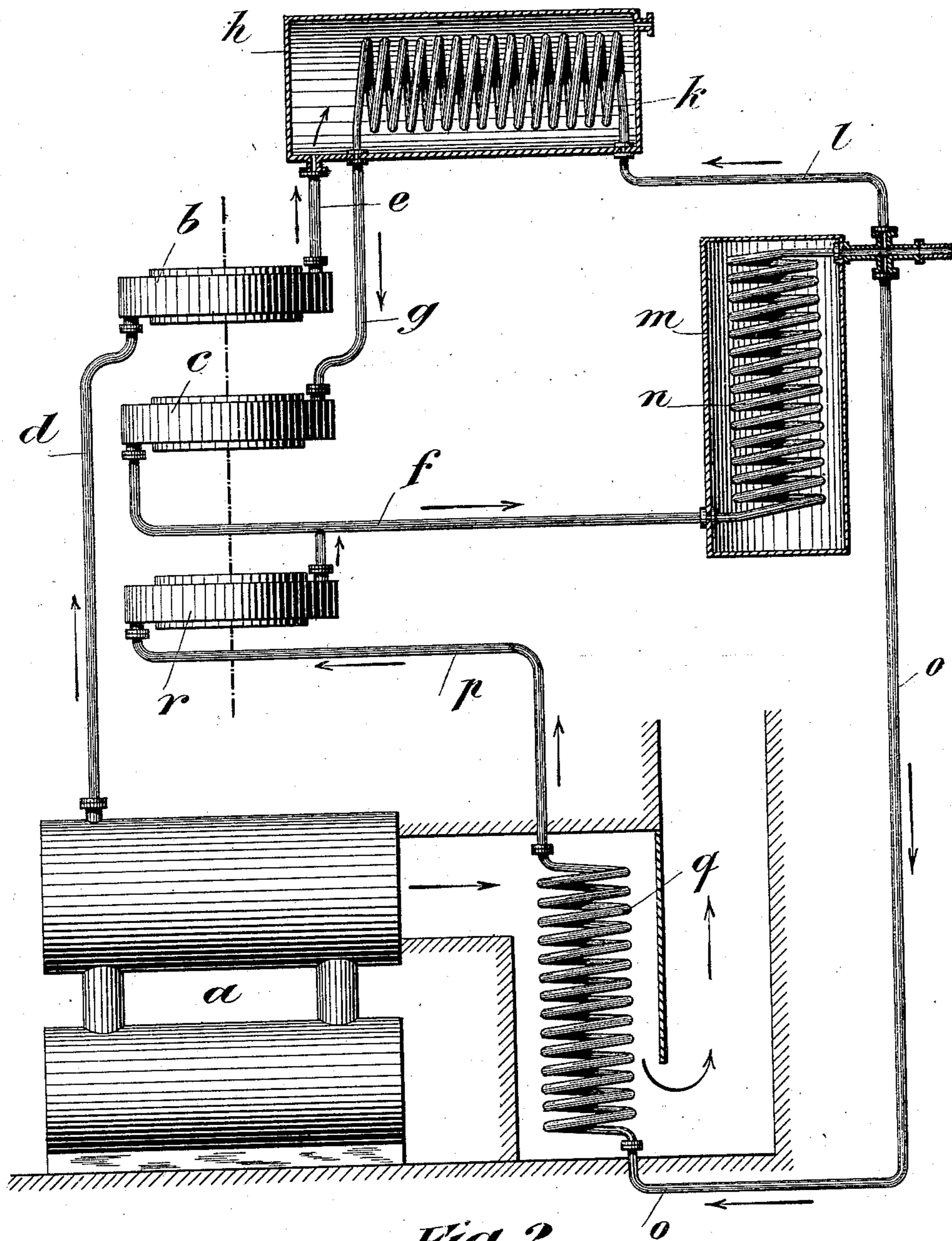


Fig. 2.

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# UNITED STATES PATENT OFFICE.

HEINRICH ZOELLY, OF ZURICH, SWITZERLAND.

## CONVERSION OF HEAT INTO MECHANICAL ENERGY.

SPECIFICATION forming part of Letters Patent No. 666,043, dated January 15, 1901.

Application filed September 24, 1900. Serial No. 30,994. (No model.)

*To all whom it may concern:*

Be it known that I, HEINRICH ZOELLY, a citizen of the Republic of Switzerland, residing at Zurich, Switzerland, have invented new and useful Improvements in and Relating to the Conversion of Heat into Mechanical Energy, (for which I filed applications for patents in Switzerland on the 11th of April 1900, No. 23,688; in Germany on the 28th of April, 1900, No. 14,256 1/14; in France on the 26th of April, 1900, No. 287,940, and in Great Britain on the 4th of May, 1900, No. 8,295,) of which the following is a specification.

This invention relates to apparatus for converting heat into mechanical energy in which the largest possible percentage of the available heat is utilized.

Apparatus according to this invention comprises a main vapor-turbine or group of turbines, which is connected to the former and utilizes the heat still contained in the exhaust-vapor issuing therefrom. For this purpose the first-mentioned turbine or group of turbines, which is supplied with warm vapor, is connected with a surface condenser, which is arranged to evaporate a liquid with a low boiling-point by means of the heat still contained in the exhaust-vapor of the main turbine or group of turbines, the vapors thus obtained being used for supplying the secondary turbine or turbines.

Two examples are shown diagrammatically in the accompanying drawings.

Figure 1 represents apparatus having a water-tube boiler *a*, which is connected through a pipe *d* with a main vapor-turbine *b*, from which a pipe *e* passes to a surface condenser *h*, provided with a coiled pipe *k*, that communicates on one hand through a pipe *g* with a secondary turbine *c*, connected to the first turbine *b*, and on the other hand through a pipe *l* with the coiled pipe *n* of a second surface condenser *m*, from the other end of which a pipe *f* passes to the turbine *c*.

The mode of operation is the following: The high-pressure steam generated in the boiler *a* delivers up its energy in the main turbine *b*, from which the exhaust-steam passes into the surface condenser *h* and gives up its heat there to the liquid to be evaporated in the coiled pipe *k*, and the vapor generated by the said evaporation is supplied to

the turbine *c*, from which the exhaust-vapor passes into the coiled pipe *n*, where it is condensed. The liquid thus produced in the coil *n* can be pumped into the coiled pipe *k* in order to be reëvaporated.

The process can be still further extended by using the vapor issuing from the secondary turbine to evaporate another liquid having a lower boiling-point than the first to supply a third vapor-turbine or group of turbines, &c.

Fig. 2 represents an example in which another turbine *r* is connected to the turbines *b* and *c*. The vapor for this third turbine is generated in a coiled pipe *g*, which is in communication through the pipes *o* and *p* with the coiled pipe *n* of the surface condenser *m* and the turbine *r*, respectively. This coiled pipe *g* is heated by the hot gases from the furnace of the boiler *a*.

A separate vapor-turbine or group of turbines and an arrangement for evaporating, by means of the gases from the furnace of the boiler or boilers supplying the main turbine, a liquid suitable for the temperature in question may be also used in conjunction with secondary and other turbines supplied with vapor, as hereinbefore described.

Apparatus according to this invention enables the widest limits of temperature to be attained, and consequently the greatest possible utilization of the available heat. Not only can the lower limit of temperature be considerably lowered as compared with other methods of working, but the upper limit of temperature can be raised much higher than in such methods of working by the use of a high pressure and a very high degree of superheating, which is of practical importance in view of the fact that in contradistinction to the method of utilizing heat in ordinary steam-engines, for example, no packing of moving parts is required.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. Apparatus for converting heat into mechanical energy comprising two vapor-turbines or groups of vapor-turbines of which one, a main vapor-turbine or group of vapor-turbines, using steam, is in communication with a condenser, in which the exhaust-steam of

the said vapor-turbine is used for evaporating a liquid having a low boiling-point, so as to supply the other or secondary vapor-turbine or group of vapor-turbines.

- 5 2. Apparatus for converting heat into mechanical energy comprising two vapor-turbines or groups of vapor-turbines of which one, a main vapor-turbine or group of vapor-turbines, using steam, is in communication  
10 with a condenser, in which the exhaust-steam of the main vapor-turbine or group of turbines is used for evaporating a liquid having a low boiling-point so as to supply another or secondary vapor-turbine or group of vapor-turbines, the secondary vapor-turbine or  
15 group of turbines being, like the main vapor-turbine or group of turbines, in communication with a condenser in which a liquid of still lower boiling-point is evaporating by means  
20 of the exhaust-vapor from the secondary vapor-turbine or group of turbines for the purpose of supplying a third vapor-turbine or group of turbines.

3. Apparatus for converting heat into me-

chanical energy comprising two vapor-tur- 25  
bines or groups of vapor-turbines of which one, a main vapor-turbine or group of vapor-turbines, using steam, is in communication  
30 with a condenser, in which the exhaust-steam of the main vapor-turbine or group of turbines is used for evaporating a liquid with a lower boiling-point so as to supply another  
or secondary vapor-turbine or group of vapor-turbines, in combination with an arrange- 35  
ment for evaporating, by means of the furnace-gases of the boiler installation that supplies the main vapor-turbine or group of turbines a liquid suitable for the temperature  
in question so as to supply a third vapor-turbine connected to the other turbines or 40  
groups of turbines.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HEINRICH ZOELLY.

Witnesses:

MORITZ VEITH,

A. LIEBERKNECHT.