O. BANNER.

APPARATUS FOR REGULATING TURBINES DRIVEN BY LIVE AND EXHAUST STEAM.

APPLICATION FILED NOV. 29, 1910.

1,015,415.

Patented Jan. 23, 1912.

3 SHEETS—SHEET 1.

Fig. 1

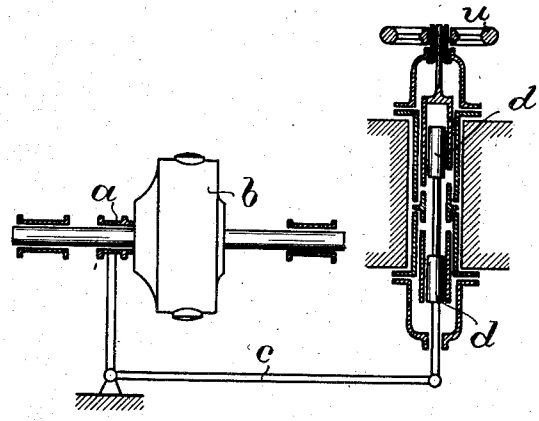


Fig. 2

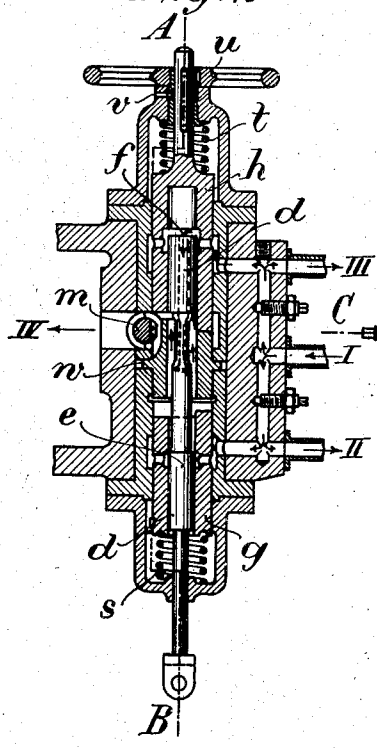
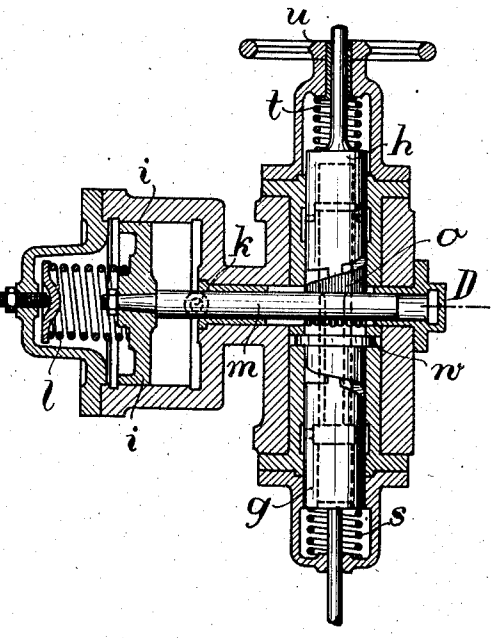


Fig. 3



Witnesses:
Olive D. White
Helen S. Morris.

Inventor:
Otto Banner
By Emil Bunnelsche
Attorney

O. BANNER.

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Fig. 4

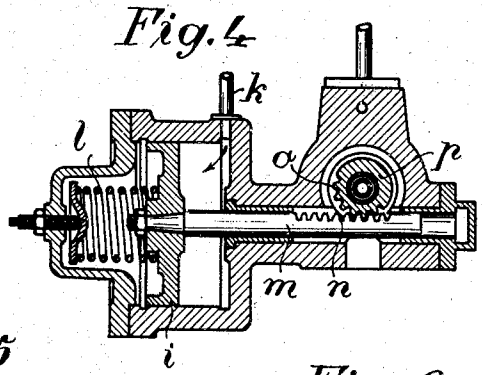


Fig. 5

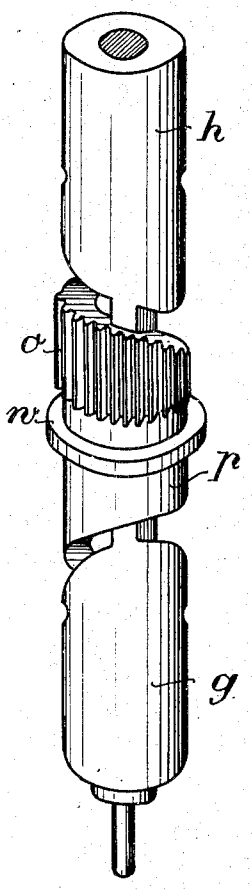


Fig. 6

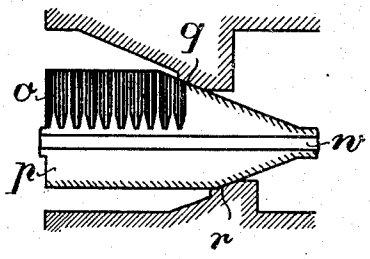
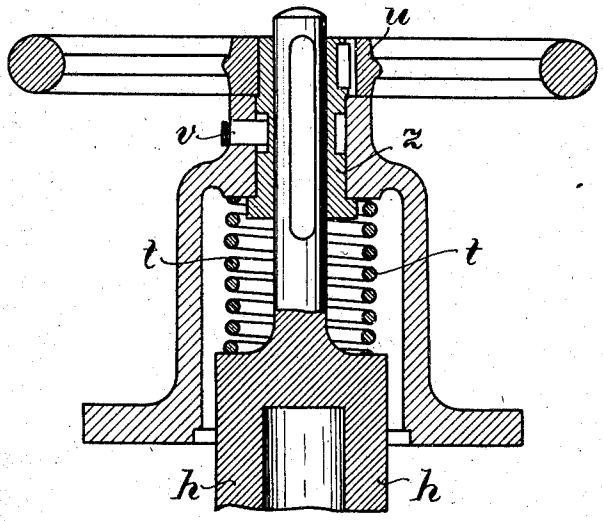


Fig. 7



Witnesses:
Olive D. White
Helen S. Morris

Inventor:
Otto Banner
By Louis Binnelcke
Attorney

O. BANNER.

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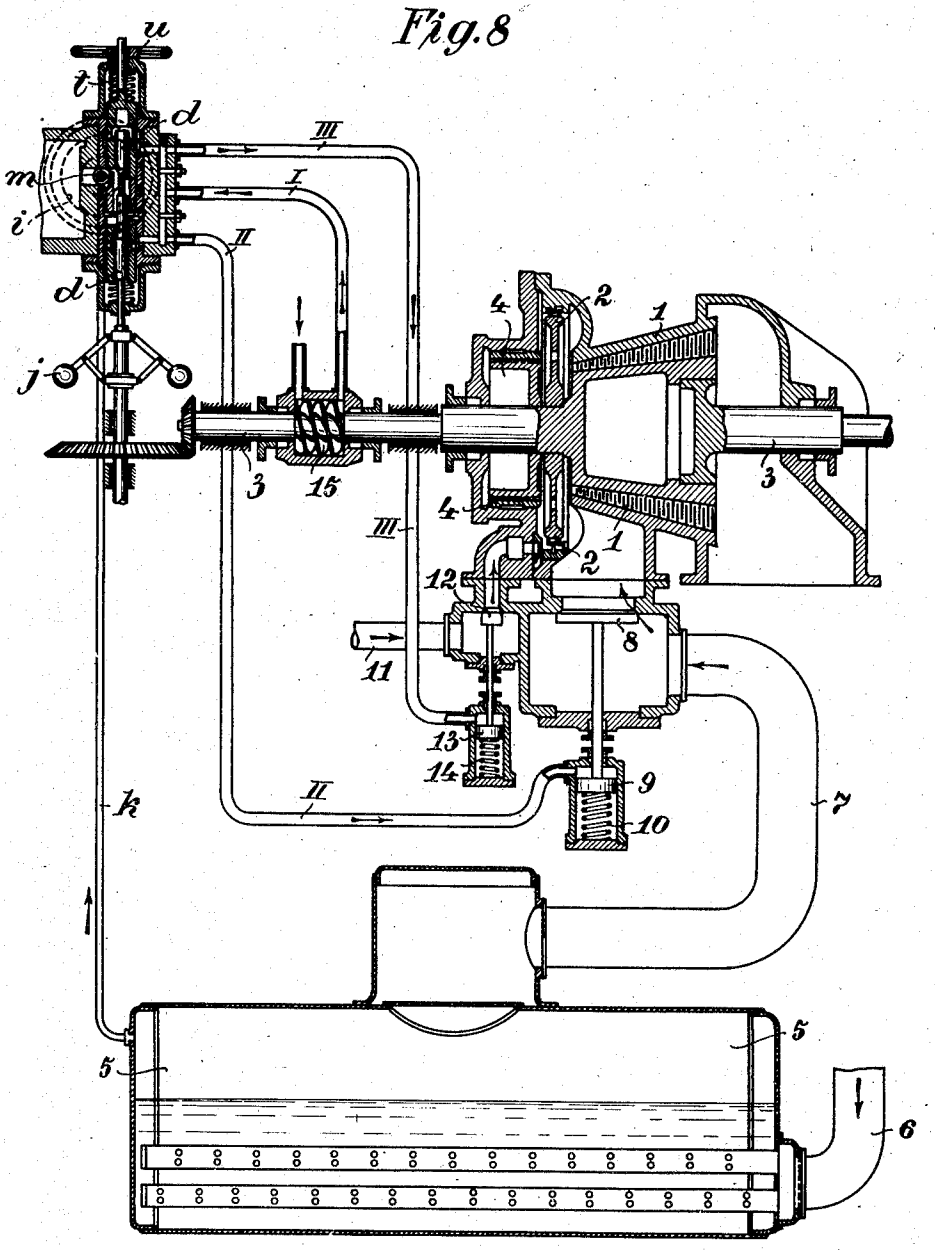
3 SHEETS—SHEET 3.

Fig. 8



Witnesses:
Olive D. White
Helen S. Morris

Inventor:
Otto Banner
By Emil Baumgarten
Attorney.

UNITED STATES PATENT OFFICE.

OTTO BANNER, OF STERHRADE, GERMANY.

APPARATUS FOR REGULATING TURBINES DRIVEN BY LIVE AND EXHAUST STEAM.

1,015,415. Specification of Letters Patent. Patented Jan. 23, 1912.

Application filed November 29, 1910. Serial No. 594,664.

To all whom it may concern:

Be it known that I, OTTO BANNER, engineer, a citizen of the German Empire, residing at Sterhrade, Germany, have invented new and useful Improvements in Apparatus for Regulating Turbines Driven by Live and Exhaust Steam, of which the following is a specification.

The invention relates to means for regulating the speed of an exhaust steam turbine having a part operated by live steam.

According to the invention the steam inlet organs are controlled by an oil relay, the valve-face of which is divided so that both parts thereof can be adjusted independent of each other according to the variations of pressure in the exhaust steam pipe.

The objects of the invention are to render the stresses on the governor gear independent of the variations of pressure of the exhaust steam, to cause more or less live steam to come into action according as the pressure in the exhaust steam pipe alters and to simultaneously close the exhaust steam valve in order thus to regulate the amount of energy supplied to the engine.

In the drawing one construction of the new oil relay valve gearing is shown by way of example, Figure 1 representing the connection between the oil relay and the governor of the turbine in side elevation, Fig. 2 the oil relay itself in the vertical section on a larger scale, Fig. 3 is a sectional view through the oil-relay on line A—B of Fig. 2. Fig. 4 is a section through the device taken on line C—D of Fig. 3, showing the adjusting device for the slide-valve sections of the oil-relay and its connection with the regulating piston of the heat accumulator. Fig. 5 is a perspective view on an enlarged scale of the adjusting-cone for the slide-valves with the sections of the valve in operative position. Fig. 6 is a detail sectional view of a portion of the adjusting-cone and adjoining portions of the valve-sections shown in Fig. 5 in position. Fig. 7 is a section through the head of the oil-relay, showing the mechanism for regulating the valves to admit steam under different pressures. Fig. 8 is a diagrammatic view partly in section of the device in use with a steam turbine, with its various connections.

Referring more particularly to Fig. 8, 1 is the auxiliary low-pressure turbine, and 2 is the adjacently disposed high-pressure steam turbine. 3 indicates the turbine shaft, upon which, in front of the two turbines, is fastened a piston 4 to relieve the turbines of the end thrust of the shaft. At 5 is shown a heat accumulator of the well known Rateau type, which has the form of a boiler. Into this heat accumulator the exhaust steam issuing from a steam engine (not shown) which is used to perform any kind of work, is conducted through the conduit 6, and from thence passes through outlet-pipe 7 and valve 8 into the low-pressure turbine 1. The inlet-valve 8 for the exhaust steam is connected to the piston 9, which is subjected on one side to the action of a spring 10, and on the other to the action of oil-pressure, which is conducted thereto through the channel II. At 11 is indicated the inlet pipe for the boiler-steam, through which the latter is conducted to the high-pressure turbine through the valve 12. The valve 12 is connected to a piston 13, which, in the same manner as shown in connection with the piston 9, is subjected to the action of a spring 14 on one side, and on the other side to the action of oil pressure, which is fed through the channel III. Upon the shaft 3 is secured in any suitable manner, a spiral pump 15, by means of which the pressure in the oil is generated for the oil-relay. The oil is kept in circulation, and passes through the channel I from the pressure-pump 15 to the oil-relay, which is shown on an enlarged scale in Fig. 2. A governor *j* which controls the valve *d* of the oil-relay is driven by the turbine-shaft 3 by means of bevel gear connections. The channel *k* is a connection between the heat accumulator and the regulator which is best shown in Figs. 3 and 4, and by means of which the pressure in the heat accumulator is communicated to the piston *i*.

The valve —*d*— of the oil relay is adjusted in the usual manner from the collar —*a*— of the governor —*b*— through the lever —*c*— according to the load on the tur-

bine. Said valve —*d*— has two operating edges —*e*— and —*f*— of which —*e*— governs the passage of the oil under pressure to the auxiliary engine for operating the exhaust steam valve, while the edge —*f*— governs the supply of oil to the engine of the live steam valve. The oil under pressure passes to the relay through the channel I and flows — being suitably throttled by set-screws — toward both edges —*e*— and —*f*—. When these edges are open the oil under pressure flows in the direction of the arrows through the channel IV. If on the other hand the edge for example —*e*— of the valve —*d*— cuts off the pressure of the oil, the pressure of oil in the channel II will increase and the exhaust steam valve will be raised. When the oil is throttled by the edge —*f*— the oil pressure will increase in the channel III, whereupon the live steam valve will rise. Now in order to adapt this operation of the oil relay for turbines having two pressure stages, the valve-face is divided into two movable parts —*g*— —*h*—. Each part is adjustably independent of the other and the adjustment of both parts is rendered dependent from the variations of pressure in the exhaust steam pipe, which can be done in various ways.

In Fig. 3 the device for independently adjusting the two parts of the valve-face is shown in horizontal section. This however is only one construction chosen as an example. The top of the piston —*i*— is exposed to the pressure of the exhaust steam from the heat-accumulator with which its cylinder is connected by means of the pipe —*k*—. A spring —*l*— acts on the underside of this piston —*i*— so that the pressure of the heat accumulator is balanced by the tension of the spring in every position of the piston. The upper part of the piston-rod —*m*— is provided with teeth —*n*— in which engage the teeth —*o*— on the circumference of the adjusting cone —*p*—. The said adjusting cone —*p*— has two screw-shaped surfaces —*q*— and —*r*— on which slide the correspondingly shaped surfaces of the parts —*g*— and —*h*— of the valve-face, which are prevented from rotating and can only move longitudinally. The adjusting cone is prevented from moving longitudinally by an annular rib —*w*—. The springs —*s*— and —*t*— serve to press the parts —*g*— and —*h*— of the valve-face on the screw-surfaces —*q*— and —*r*— of the adjusting cone —*p*—. As soon as there is insufficient exhaust steam, the pressure in the pipe —*k*— and over the piston —*i*— will sink. The spring —*l*— will therefore raise the piston —*i*— and by the teeth —*m*— of the rod —*n*— and the teeth —*o*— of the adjusting cone, said cone will be so turned that the parts —*g*— and —*h*— of the valve-face sliding thereon will approach each other. As a consequence the edge —*e*— which does not alter its position, will uncover the opening in the part —*g*— so that oil under pressure will escape at that point and consequently the exhaust steam valve will close. The edge —*f*— in the part —*h*— on the other hand will close the opening in the latter, thus throttle the passage of the oil and cause the live steam valve to open. In order to provide for the admission of live steam at different pressures of the exhaust steam (for example at 1.0, 1.05 or 1.1 atmospheres), the part —*h*— of the valve-face is adapted to be moved up and down by a hand-wheel —*u*— on the upper. The hand-wheel *u* is secured to the boxing *z* by means of a groove and feather, and said boxing surrounds the spindle of the valve section *h*. The spindle is secured to the boxing *z* by means of a spline, so that by turning the hand-wheel *u*, the boxing *z* and with it, the slide-valve section *h* will be rotated. In the boxing *z* is located at regular intervals a series of recesses in which the catch-bolt engages, so that the slide-valve section *h*, may be set at different positions.

In constructing the apparatus it is immaterial whether a single valve is used and this valve is provided with both operative edges —*e*— and —*f*— as in the example chosen, or whether the said operative edges are provided on two or more different valves. The essential feature of the oil-relay is the division of the valve-face and the adjustment of the same by the pressure in the heat-accumulator independent of the gear of the governor.

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

1. The described apparatus for regulating exhaust steam turbines having a part operated by live steam, comprising in combination a governor, an oil valve adapted to be adjusted by said governor and having a valve-face divided into two separate parts and means to adjust said parts in accordance with the pressure of the exhaust steam in the heat-accumulator, substantially as and for the purpose set forth.

2. In combination with an apparatus for regulating the speed of a turbine operated by both live and exhaust steam, of an oil valve having two operative edges and a separate slide as valve-face for each operative edge of said valve, substantially as and for the purpose set forth.

3. In an apparatus for regulating the speed of a turbine operated by both live and exhaust steam, the combination of an oil valve having a valve-face divided into two parts; a cone adapted to be rotated without moving longitudinally and having two screw surfaces adapted to act on the parts of

said valve-face so as to cause them to approach or recede from each other simultaneously, a piston regulator, a heat accumulator adapted to operate said piston regulator, and mechanism connecting said piston regulator with said valve, substantially as and for the purpose set forth.

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

OTTO BANNER.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.