No. 804,413. PATENTED NOV. 14, 1905.

C. G. Y. KING.

STEAM TURBINE.

APPLICATION FILED FEB. 19, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

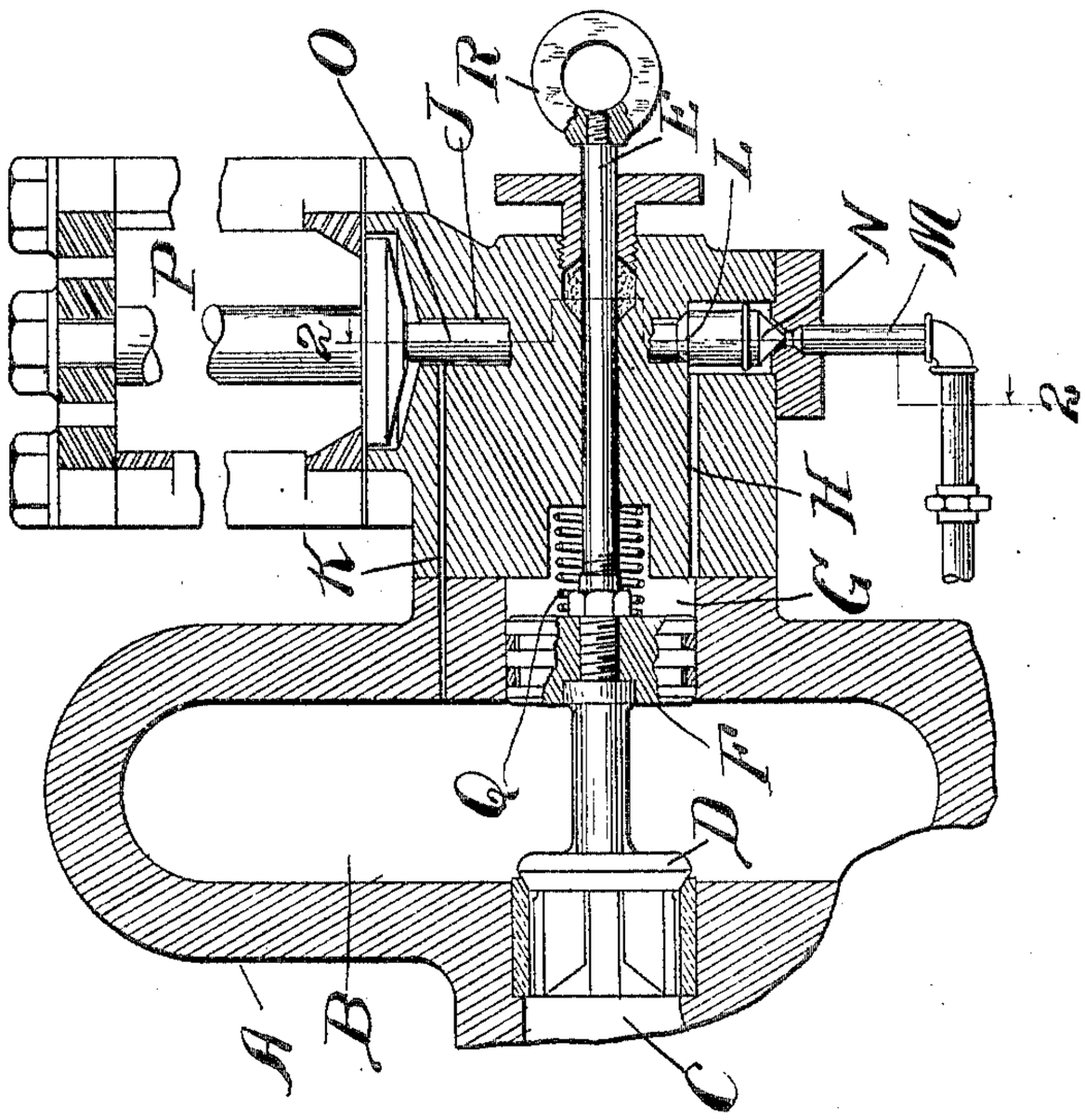
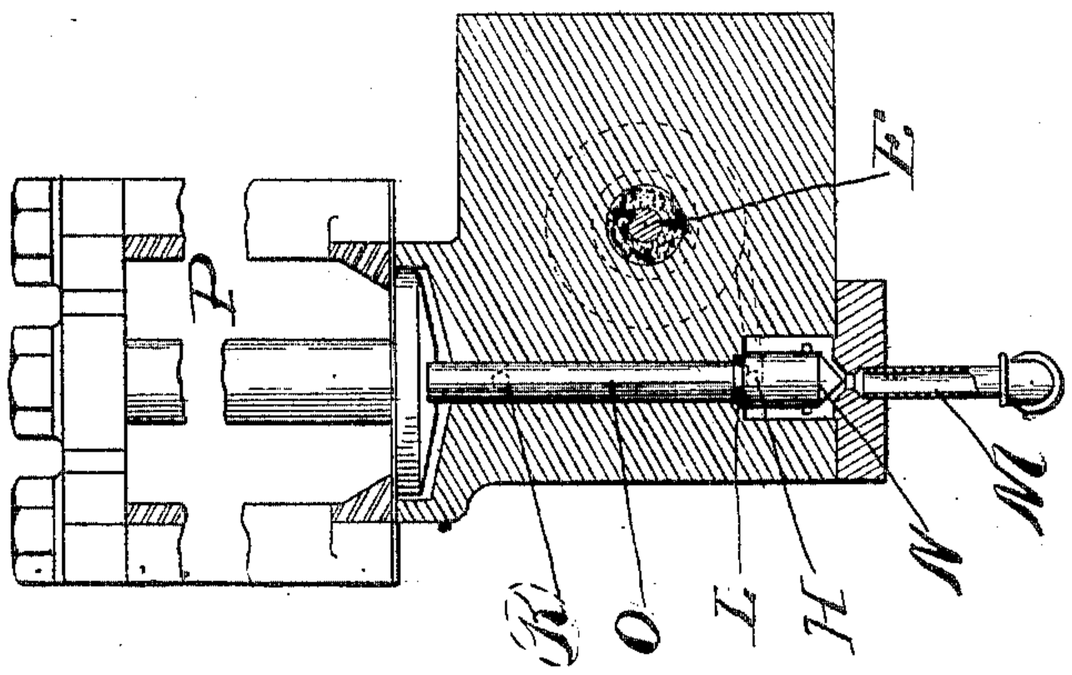


Fig. 2.



Witnesses
J. Bellers
Emil E. Nettmann

Inventor:
Charles G. Y. King
By Brown & Darby
Attys

No. 804,413. PATENTED NOV. 14, 1905.

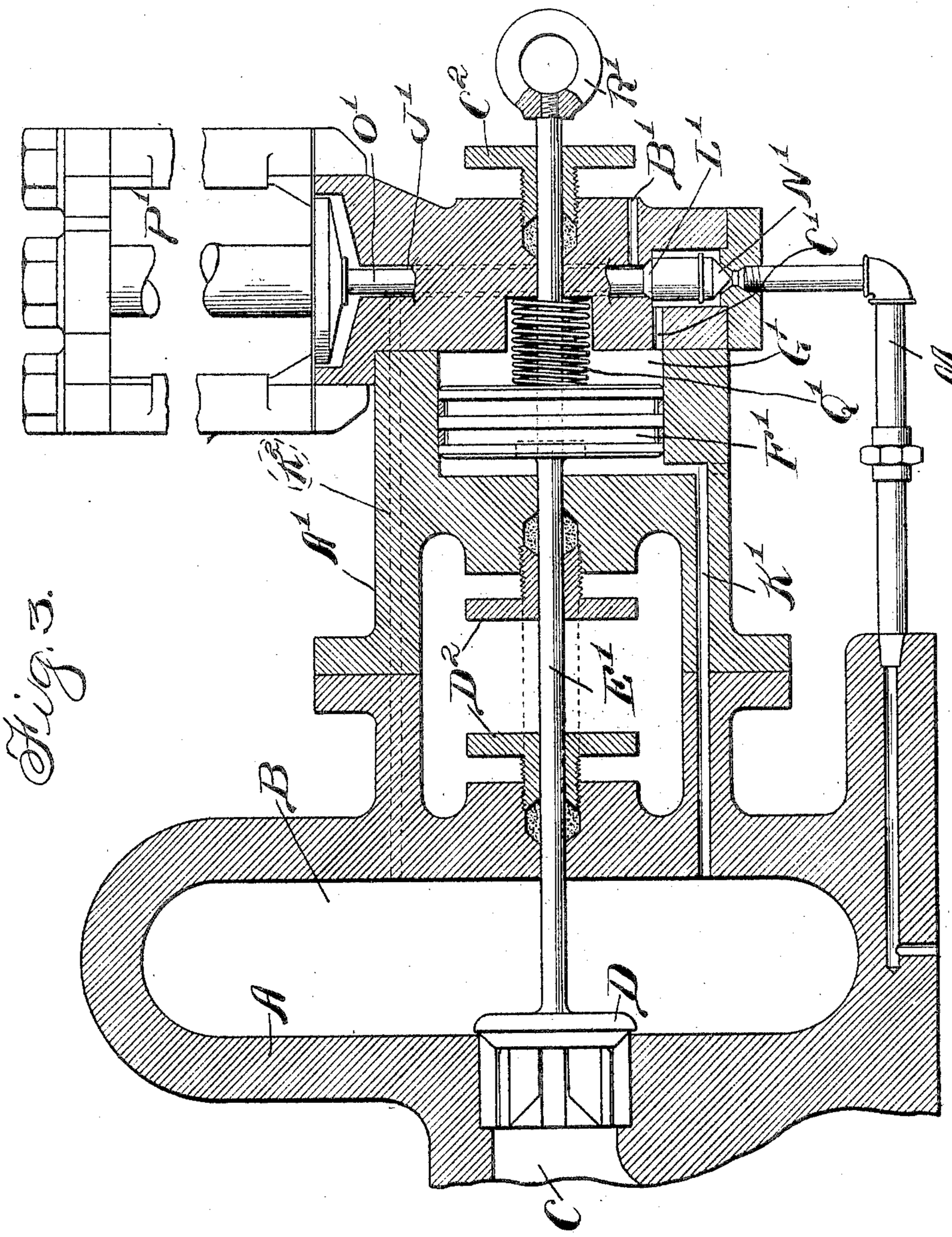
C. G. Y. KING.

STEAM TURBINE.

APPLICATION FILED FEB. 10, 1904.

3 SHEETS—SHEET 2.

Fig. 3.



Witnesses
J. Bell Weir
Emil E. Dettmann

Inventor
Charles G. Y. King
By Brown & Derby
Attys

No. 804,413. PATENTED NOV. 14, 1905.

C. G. Y. KING.

STEAM TURBINE.

APPLICATION FILED FEB. 19, 1904.

3 SHEETS—SHEET 3.

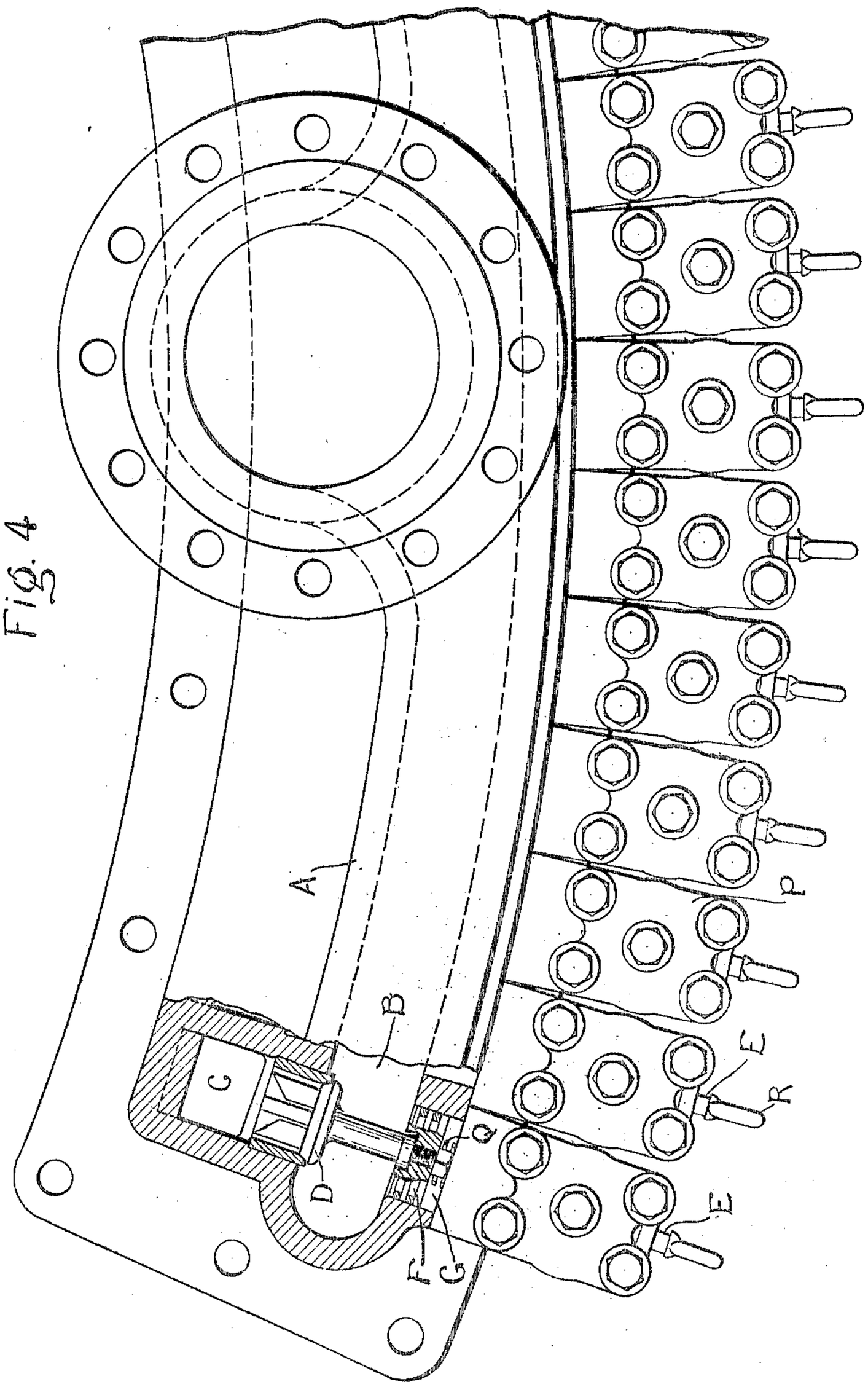


Fig. 4

Witnesses
Lloyd C. Bush
Arlen Alford

Inventor
Charles G.Y. King
By Allen & Davis
Atty.

UNITED STATES PATENT OFFICE.

CHARLES G. Y. KING, OF CHICAGO, ILLINOIS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STEAM-TURBINE.

No. 804,413. Specification of Letters Patent. Patented Nov. 14, 1905.

Application filed February 19, 1904. Serial No. 194,324.

To all whom it may concern:

Be it known that I, CHARLES G. Y. KING, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Steam-Turbine, of which the following is a specification.

This invention relates to steam-turbines, and particularly to the valve mechanism thereof.

The object of the invention is to provide a construction of valve-controlling mechanism for turbines wherein the proper operation of the valves is indicated at a point outside the valve-casing.

A further object of the invention is to provide a construction of valve mechanism for turbines which is simple and efficient, wherein each valve controlling the supply of steam is efficiently balanced and has connected therewith means extending to a point outside of the valve-casing to indicate when the valve is operating properly.

Other objects of the invention will appear more fully hereinafter.

The invention consists, substantially, in the construction, combination, location, and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings, and to the various views and reference-signs appearing thereon, Figure 1 is a broken view in section of a construction of valve mechanism of steam-turbines and embodying the principles of my invention. Fig. 2 is a view in section, parts broken out, on the line 2 2 of Fig. 1 looking in the direction of the arrows. Fig. 3 is a view similar to Fig. 1, illustrating a modified construction of valve mechanism for turbines embraced within the spirit and scope of my invention; and Fig. 4 is a plan view of the chest containing the admission or nozzle valves.

The same part is designated by the same reference-sign wherever it occurs throughout the several views.

In the operation of steam-turbines, wherein the supply of steam to the turbine is controlled by valves, it has been a common practice to arrange the valves within a casing to operate automatically. It frequently happens that by reason of the expansion of the parts associated in the valve mechanism, due to the heat to which such parts are subjected or from other cause, the valves fail to operate properly, the guides therefor sticking or binding in their guideways, and hence resulting in a failure of the turbine to operate in the desired manner. By reason of the location of the valve mechanism controlling the admission of steam to the turbine within the valve-casing it is difficult, if not impossible, to ascertain or to remove the cause of this interruption in the proper operation thereof. This objection especially arises where the supply of steam to the turbine is controlled by a plurality of valves arranged in sets within valve-casings, and frequently the failure of a set of valves or of particular valves in a set to properly operate in the performance of their duty is revealed only by the effects produced in the turbine. The difficulty of ascertaining whether or not a valve is closed or opened is further enhanced by the fact that in normal operation some of the valves will be open, some will be closed, and at least one will be opening and closing at frequent intervals for regulating those loads not satisfied by a given number of continuously-open ports and valves. In order to overcome the sticking or binding of the valves or of their balancing or guiding means or their failure to properly operate in the performance of their functions, it has been a common expedient to tap the casing in which the valves are placed at intervals, so as to jar loose the valve or to overcome the sticking or binding. This expedient, however, is not always satisfactory or efficient, and even in the case where such expedient is resorted to it is impossible to determine which particular valve of a set is not properly operating.

It is among the special purposes of my present invention to overcome these objections and to provide an arrangement wherein means are connected to move with each valve and arranged to extend to a point outside of the casing to afford means for readily indicating visually or otherwise whether or not the valve to which such means are connected is operating properly or properly performing its desired function.

It is also among the special purposes of my invention to provide means which are connected to move with each valve to indicate whether or not it is properly operating and which will also afford means through which

any binding or sticking of the valves during their operation may be overcome and the valve caused to resume its normal and proper automatic operation, thereby enabling an attendant not only to observe whether or not all the valves are properly operating, but to note any failure of any particular valve to operate properly and to cause any particular valve which may fail to operate properly to resume its proper operation.

Many specifically different constructions and arrangements may be devised for accomplishing these objects without departure from the spirit and scope of my invention. While therefore I have shown and will now describe various constructions and arrangements embodying the principles of my invention, I do not desire to be limited or restricted to the exact details of construction now to be described.

Referring to the construction shown in Figs. 1 and 2, reference-sign A designates a valve-casing inclosing the valve-chest B, to which steam is supplied from any suitable or convenient source. C designates a port delivering from the steam-chest B to the turbine. D designates a valve controlling this port, and E designates a stem or rod or other suitable connection connected to move with the valve D in the operation thereof and extending to a point outside of the valve-casing to afford means for indicating whether or not the valve D is performing its proper functions and in the proper manner and for permitting or enabling any sticking or binding of the valve or its associated mechanism to be overcome and removed. In order that the valve D may be automatic in its operation and suitably and properly balanced, a piston F is connected to the valve-stem or suitably mounted and secured thereon, so as to move with the valve D. This piston is arranged to operate within a cylinder G, and in the construction shown in Figs. 1 and 2 this piston is exposed on both faces thereof to the steam-pressure of the chest B, one face of said piston being exposed directly to the steam in chest B and the cylinder G on the opposite side of piston F communicating with chest B in any suitable or convenient manner or with a convenient source of steam-pressure. For instance, I have shown a passage or channel H delivering into the cylinder G and forming a communication between said cylinder and a passage J, into which steam-pressure is supplied from valve-chest B through a passage K. A valve L, operating in passage J, affords means for opening and closing the supply of steam through the passages J, K, and H to the cylinder G. Communicating with passage J is an exhaust or drain pipe M, preferably located at the lowermost point of said passage J and at a point below the point of communication therewith of passage H, and, as shown and preferably, the passage H communicates with cylinder G at its lowermost point in order to afford means for escape from cylinder G of any condensation which may take place within said cylinder. The drain or exhaust pipe M or the communication between such pipe and passage J may be controlled in any convenient manner—as, for instance, by means of a needle-valve N, connected to move with valve L—the relative arrangement of said valves L and N being such that when one is closed the other is open. Of course it is obvious that the drain or exhaust pipe M may be arranged to deliver to a condenser or vaccum pump or other means, as may be desired, whereby steam-pressure may be quickly and readily exhausted from cylinder G and hence from one side or face of piston F. The valves L and N may be operated in any suitable or convenient manner—as, for instance, by being connected to or carried by a stem O, extending through passage J, but of smaller diameter than that of said passage and operated by a magnet or other suitable means, (indicated generally at P.)

From the foregoing description it will be readily seen that when valve L is opened or unseated both sides or faces of piston F are exposed to the same steam-pressure, thereby efficiently balancing said piston; but when valve L is seated or closed by reason of its being raised by the magnet or other suitable means P and valve N is unseated or opened the supply of steam to one side or face of piston F is cut off and cylinder G on that side or face of said piston is open to exhaust, thereby causing said piston F to become overbalanced and enabling the steam-pressure from the chest B operating against the inner face of the piston to move the same into cylinders G, thereby unseating nozzle-valve D. If desired, a spring Q may be arranged to oppose the opening movement of valve D, the tension of said spring being normally exerted in a direction to yieldingly maintain valve D closed or seated, and when valve N is again seated and valve L accordingly unseated steam-pressure is again admitted to the inner end of cylinder G to reëstablish a balance of piston F, hence permitting the tension of spring Q to be applied in a direction to seat said valve D. Therefore by suitably operating the magnet or other means P employed for operating valves L and N the operation of the main valve D is made automatic. The heating of the valve-casing A, and the consequent expansion of valve D or its associated piston F, frequently causes a binding or sticking of these parts, and hence a failure of the same to properly operate to perform their functions. Where these parts are located entirely within the casing, as is customarily the case, it is impossible to determine either from the sound or in any other manner, except in the effects noted in the operation of the turbine to which the steam is supplied, whether or not the

valves or any particular valve is properly performing its function. Therefore, in accordance with the principles of my invention and in order to overcome this objection and to provide means whereby the operation of each valve may be indicated upon inspection I connect a rod E to the stem of each valve D in any convenient manner, or the stem of any of such valves may be prolonged or extended so as to project outside of the valve-casing and into position to be conveniently examined or inspected to indicate whether or not the valve with which it is connected is properly operating and affording means by which by delivering taps or blows thereon the valve connected therewith may be caused to resume its proper operation in case it or its associated parts should bind or should stick sufficiently to prevent its automatic operation. In the particular form shown, to which I do not desire to be limited or restricted, I mount a projection R upon the projecting end of rod E, and which by the extension of its projection beyond the casing and the movements thereof will indicate immediately upon inspection whether or not the valve associated therewith is properly performing its function.

From the foregoing description it will be seen that I provide an exceedingly simple and efficient construction and arrangement for indicating whether or not the valve mechanism of the turbine is properly operating, and also whereby, in case a particular valve should fail to operate properly, the operation thereof may be caused to resume without disturbing or interfering with the action of any of the other valves.

The particular construction and arrangement of electromagnet or other mechanism indicated at P for operating the valves L and N in the specific details thereof forms no part of my present invention, and therefore is indicated merely in outline.

In Fig. 3 I have shown a modified construction and arrangement embraced within the spirit and scope of my invention, but embracing the same principles of operation, wherein the casing A, valve-chest B, opening or port C, and nozzle or admission valve D may be of substantially the same construction and arrangement as that above described with reference to the construction shown in Figs. 1 and 2. In order to remove the balancing-piston, which is associated with the nozzle or admission valve D as far as possible from the influence of the heat, and hence to remove or reduce as much as possible the danger of binding or sticking of the parts associated with the operation of the valve by reason of the expansion and contraction thereof, I arrange the piston F′, in the construction shown in Fig. 3, to operate in a cylinder or chamber G′, formed in a separate casting A′, which is bolted or otherwise secured to the valve-casing A in any suitable or convenient manner, and I form the valve-stem E′ of such length as to pass through the casing A and the casing A′ and to the exterior of the latter, said stem receiving thereon piston F′ and having means for attaching the same to move with the nozzle or admission valve D and of indicating exteriorly of the casing the movements of the valve D. The piston F′, in the form of device shown in Fig. 3, is opened on opposite sides thereof to a pressure medium, by which said piston is balanced, and such pressure medium may be supplied to cylinder or chamber G′ in any suitable or convenient manner—such, for instance, as through a passage K′, delivering from the steam-chest B into cylinder or chamber G′ on one side of the piston, and a passage B′, delivering into said cylinder or chamber G′ from the steam-chest B or other source of pressure on the opposite side or face of said piston. The passage B′ delivers into a passage or channel J′, in which is located a valve L′, which controls the supply of steam-pressure through passage B′ and a passage C′, extending between cylinder or chamber G′ and passage J′. N′ designates a needle or other suitable form of valve which controls the opening from passage J′ into a return exhaust or drain pipe M′, which, if desired, may deliver to a condenser; vacuum-pump, or other drain. The valves L′ and N′ are connected to move together and are so relatively arranged that when valve L′ is seated to cut off communication between supply-passage B′ and cylinder or chamber G′ the valve N′ is unseated to open chamber or cylinder G′ through passage C′ to the exhaust or drain pipe M′, and similarly when valve N′ is closed to shut off communication between cylinder G′, passage C′, and passage J′ to exhaust or drain, valve L′ is unseated to again establish communication between cylinder or chamber G′ and the source of pressure through passages C′, J′, and B′. It is obvious that the pressure medium thus supplied to the cylinder G′ may be supplied direct from the steam-chest B—as, for instance, through a passage K^2 (indicated in dotted lines in Fig. 3) and delivering from the steam-chest B into passage J′. The valves L′ and N′ are connected to move with a stem or rod O′, adapted to be actuated in any suitable manner—as, for instance, by means of an electromagnet P′, the construction of which is indicated only generally. A spring Q′ is arranged to exert its tension upon piston F′ in a direction to move said piston to close or seat valve D. When the pressure on opposite sides or faces of piston F′ is equal—that is, when valve L′ is unseated, thereby opening cylinder or chamber G′ on opposite sides or faces of the piston F′, arranged therein, to the steam-pressure of the steam-chest B—said piston becomes balanced, and hence nozzle or admission valve D will be seated automatically by spring Q′. When, however, valve L′ is seated to cut off the supply of

steam or other pressure from chamber or cylinder G′ on one side of the piston therein, the valve N′ will be opened, thereby opening the chamber or cylinder G′ on that side of the piston to exhaust, and hence permitting the pressure on the opposite side of the piston to shift the same against the action of spring Q′ and in a direction to unseat nozzle or admission valve D. As above indicated, the stem or rod E′ extends to a point exteriorly of the casing and may, if desired, be provided with any suitable device (indicated at R′) the movements of which may be readily observed upon inspection by an attendant, thereby revealing whether or not the particular valve to which said device R′ is connected is operating properly. In this construction it will be obvious that the rod E′ should be suitably packed at the points where it passes through the casing A or the casing A′, as indicated at D^2 C^2, although I do not desire to be limited or restricted in this respect nor to the specific details of the packing employed.

It will be observed that in the construction shown in Fig. 3 the piston F′ is removed from the casing A of the steam-chest, and hence is not as liable to become warped or unduly expanded by the heat of such casing, thereby reducing the danger and objection of binding or sticking of the same during the operation thereof. It will also be observed that in case any particular valve of any set should be interrupted the fact would become readily apparent by an attendant observing the failure of the projecting end of the rod E′, connected to such valve, to move properly or to the desired extent, and hence enabling such attendant by slightly tapping such rod or the device R′, carried on the projecting end thereof, to cause the valve to resume its normal operation.

I have above described the pistons F and F′ as being operated through steam-pressure admitted to the chamber or cylinder in which such pistons operate from the steam-chest. It is obvious that this piston in either case may be balanced and unbalanced by any other suitable or convenient pressure medium admitted to opposite sides or faces of the piston in any convenient manner. I do not desire, therefore, to be limited or restricted to the particular means employed for securing a balancing or overbalancing effect upon this piston, and the particular method employed for admitting and exhausting the pressure medium to the respective sides or faces of piston F′ would readily suggest themselves to persons skilled in the art. The constructions shown, however, I have found in practice to be simple and efficient and to well answer the purpose.

In Fig. 4 is shown the arrangement of the parts when viewed in plan. A represents the valve chest or casing containing a plurality of nozzle-valves D in chamber B, each valve controlling the admission of motive fluid to the port C, the latter being arranged to discharge fluid to the turbine. Each valve is actuated by a piston F, located in the cylinder G, and normally urged toward the closed position by a coiled compression-spring Q. Connected with each of the nozzle-valves and extending through the wall of the casing or chest is the stem or rod E, which affords means for indicating whether or not the valve D is performing its proper functions and in the proper manner. On the end of each of the stems E is mounted a ring or projection R, which serves in addition to acting as an indicator to enable the attendant to open or close the valve by suitable means in the event of its sticking.

Having now set forth the object and nature of my invention and various constructions embodying the principles thereof, what I claim as new and useful and of my own invention, and desire to secure by Letters Patent, is—

1. In an elastic-fluid turbine, the combination of a plurality of entirely-inclosed individual valves which have an open and a closed position but no intermediate for controlling the admission of fluid to the turbine, some of the valves being normally open and others normally closed, actuators for the valves which are also inclosed and thus hidden from view, controlling devices for the actuators located external to the casing, which do not indicate the position of the valves or actuators, and means connected to move with each of the valves to indicate whether it is open or closed.

2. In an elastic-fluid turbine, the combination of a plurality of entirely-inclosed individual valves which have an open and a closed position but no intermediate, for controlling the passage of motive fluid to the turbine, a casing which is common to the valves and contains a chamber that supplies the ports controlled by the valves, actuators for the valves which are contained in the chest and are hidden from view, controlling devices for the actuators located external to the valve-casing, which do not indicate the position of the valves and actuators, and means connected to move with each of the valves and its actuator to indicate whether the valve is open or closed.

3. In an elastic-fluid turbine, the combination of a plurality of individual valves which have an open and a closed position but no intermediate, for controlling the admission of fluid to the turbine, some of the valves being normally open and the others closed, cylinders, pistons therein attached to the valves for actuating them, relay-valves for controlling the movements of the piston which are hidden from view, and means connected to move with each of the valves to indicate whether it is open or closed.

4. In an elastic-fluid turbine, the combination of a plurality of individual valves for

controlling the admission of motive fluid to the turbine, some of the valves being normally open and others normally closed, individual magnets for controlling the opening and closing of the valves and which of themselves give no indication of the position of the valves, and indicators attached to and movable with each valve which extend through the casing of the valve and into view.

5. In a turbine, a casing having a steam-chest, a plurality of valves arranged therein and operating to control the supply of steam from such chest to the turbine, a rod or stem connected to move with each valve and extending to a point exterior of said casing, a piston connected to each rod or stem, independent means for supplying a pressure medium to opposite sides or faces of each piston, and means for exhausting the pressure-supply from one side or face of each piston to overbalance the same, all combined and arranged as and for the purpose set forth.

6. In a steam-turbine, a valve-casing, a plurality of valves arranged therein and operating to control the supply of pressure medium to the turbine, a rod connected to move with each valve in the opening and closing movements thereof, a cylinder or chamber associated with each valve, a piston operating in each cylinder or chamber and connected to its associated stem or rod, means for supplying a pressure medium to opposite sides or faces of each piston to maintain the same balanced, means for yieldingly maintaining each valve closed when said piston is in balanced condition, independent means for automatically unbalancing each piston to move its connected valve, said rod or stem projecting through the casing to a point exteriorly thereof to afford means for indicating the movements of its connected valve, as and for the purpose set forth.

7. In a turbine, a valve-casing, a plurality of valves arranged therein and operating to control the supply of pressure medium to the turbine, a stem or rod connected to move with each valve and extending to a point exterior of the casing, a piston connected to each valve, a chamber in which each piston operates, independent means for exposing the opposite sides or faces of each piston to a pressure medium to effect a balancing thereof and including a valve-controlled passage, pressure-supply and pressure-exhaust communications with said passage, and means for operating the controlling-valve for each passage, as and for the purpose set forth.

8. In a steam-turbine, a casing, a plurality of valves arranged therein and operating to control the supply of pressure medium to the turbine, a valve stem or rod connected to move with each valve and extending exteriorly of the valve-casing, a piston connected to each valve, a spring arranged to bear against each piston and tending to normally seat its associated valve, independent means for supplying pressure medium to the opposite sides or faces of each piston, said means including a passage, said passage communicating with the chamber in which its associated piston operates and on one side of said piston and also communicating with a drain or exhaust connection, valves to control said supply and exhaust communications, and means for actuating said last-mentioned valves, as and for the purpose set forth.

9. In a steam-turbine, a valve-casing, a plurality of valves arranged therein for controlling the supply of pressure medium to the turbine, a rod connected to move with each valve and extending exteriorly of the valve-casing, a cylinder or chamber associated with each valve, a piston arranged in each cylinder or chamber and connected to its associated valve, passages leading from the valve-chest to opposite ends of each cylinder or chamber, and auxiliary valves controlling the supply and exhaust from one end of each cylinder, all combined and arranged as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 16th day of February, 1904, in the presence of the subscribing witnesses.

CHARLES G. Y. KING.

Witnesses:
C. H. SEEM,
E. C. SEMPLE.