R. H. RICE.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED JUNE 2, 1911.

1,041,513.

Patented Oct. 15, 1912.

3 SHEETS—SHEET 1.

Fig. 1.

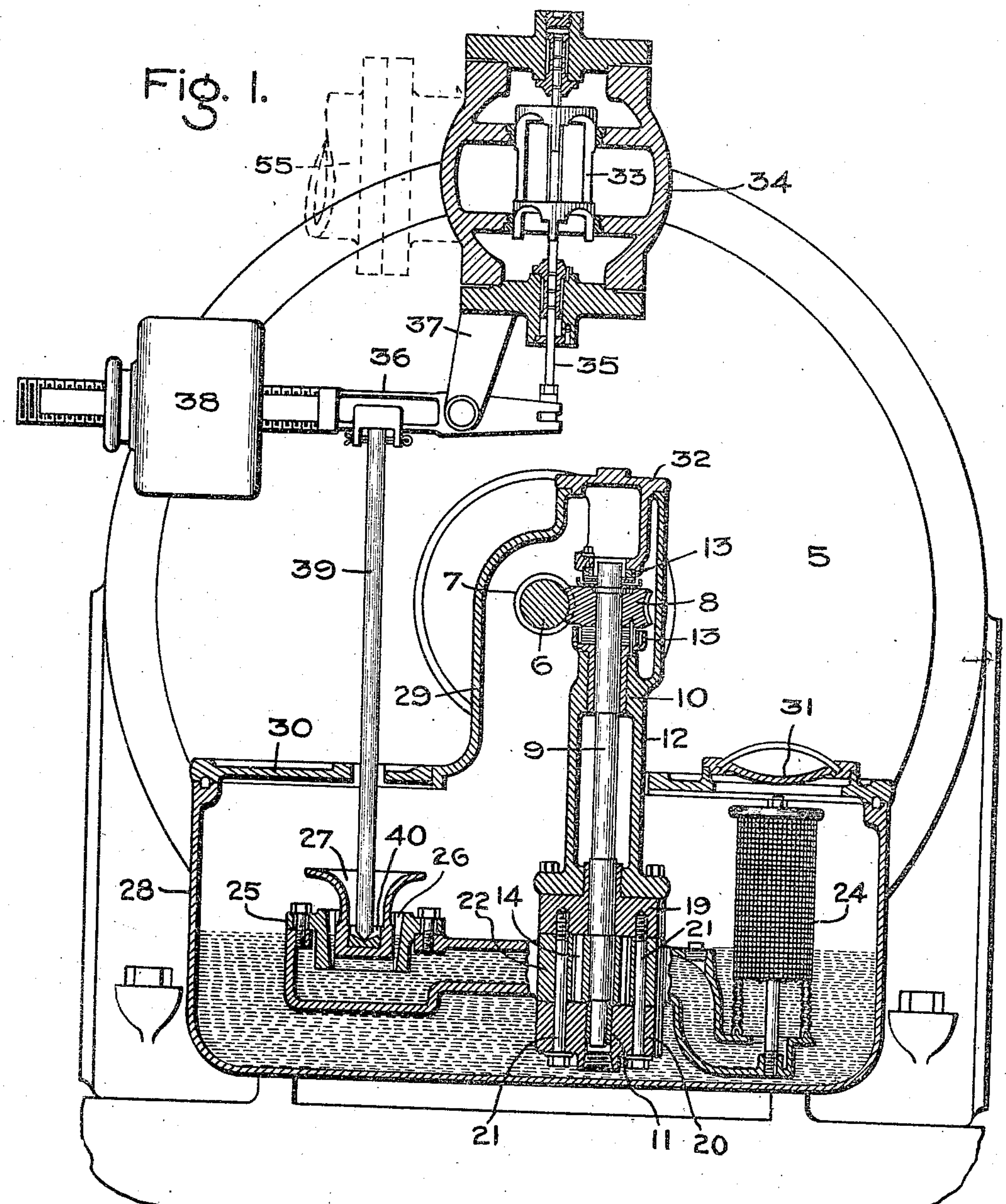

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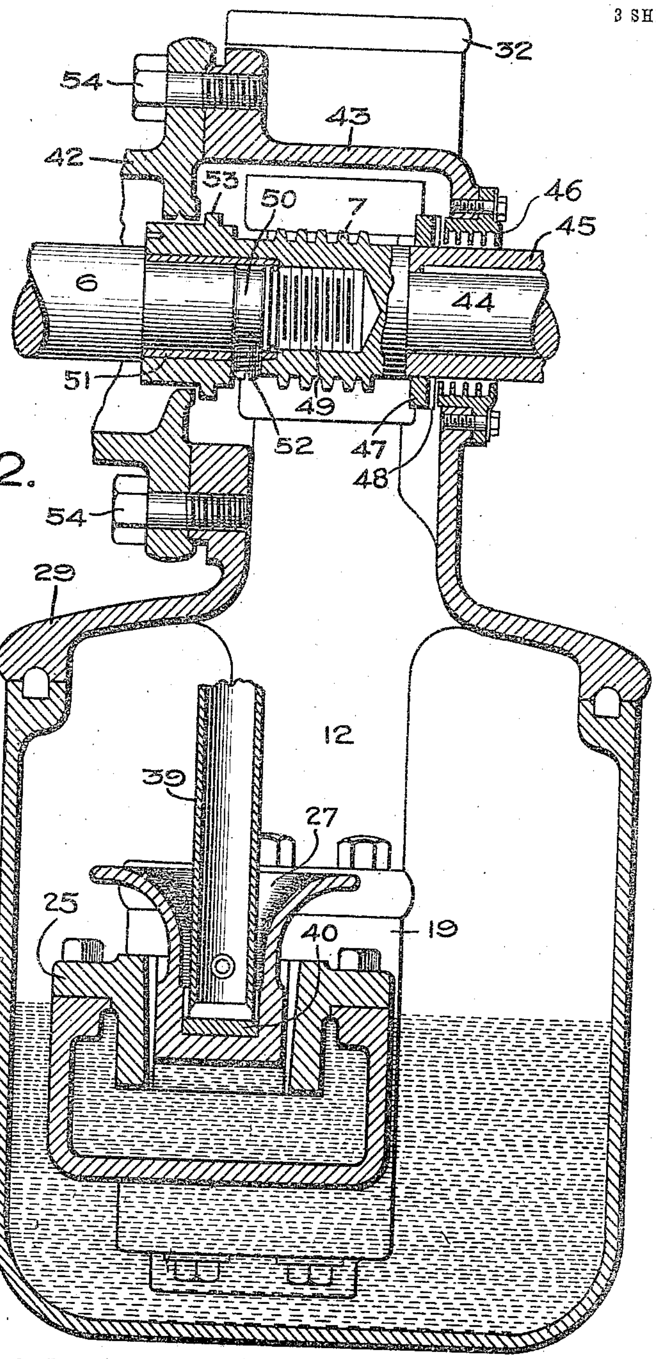
Fig. 2.



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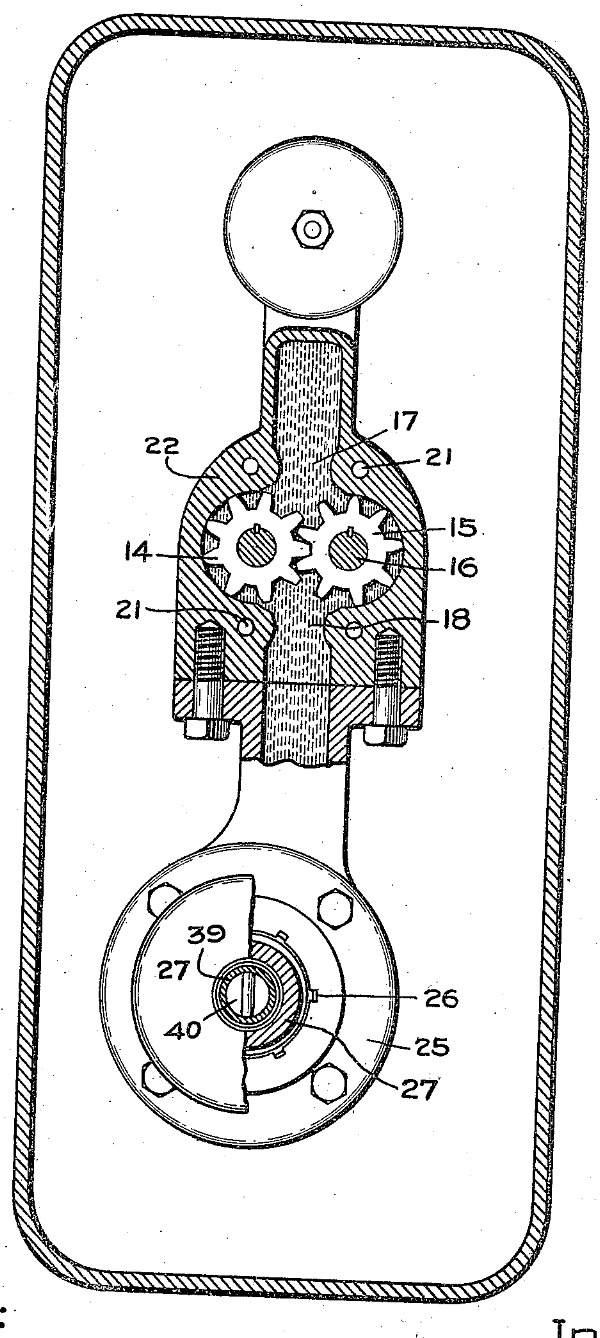
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

RICHARD H. RICE, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR TURBINES.

1,041,513. Specification of Letters Patent. Patented Oct. 15, 1912.

Application filed June 2, 1911. Serial No. 630,823.

To all whom it may concern:

Be it known that I, Richard H. Rice, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Governing Mechanism for Turbines, of which the following is a specification.

The present invention relates to governing mechanism for elastic fluid turbines and has for its object to provide a simple, reliable governing mechanism of improved construction for varying the amount of steam admitted to a turbine in accordance with the variations in load thereon.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is an end view of a turbine fitted with my improved governing mechanism, the latter being shown in vertical section; Fig. 2 is a sectional view showing a float whose position is responsive to the amount of fluid discharged by a pump that in turn is driven by the turbine shaft, and Fig. 3 is a detail plan view of the pump and the float.

5 indicates a steam turbine of any suitable construction. In the present instance it illustrates a turbine of the well known Curtis type.

6 indicates the turbine shaft that is driven by the bucket wheel or rotor. Mounted on the shaft and driven thereby is a worm 7 that in turn meshes with a worm wheel 8 mounted on one end of an upright shaft 9. This shaft is provided with suitable bearings 10 and 11 that are carried by a tubular support 12. Situated one above and another below the worm wheel are thrust collars 13. On the lower end of the upright shaft is a spur gear 14 which meshes with the spur gear 15 carried by an auxiliary shaft 16. The gears 14 and 15 form a gear pump of which 17 is the suction chamber and 18 the discharge chamber. The gears are located between an upper plate 19 and a lower plate 20, which plates are united by bolts 21 that pass through the horizontal casting 22 forming the casing of the pump. The casting is cored out to form a continuation of the suction chamber 17. Supported by the right-hand end of the casting and feeding oil to the chamber is a wire screen or strainer 24 that serves to prevent foreign matter from passing with the oil into the pump. The left-hand end of the casting 22 is also cored out to form a chamber and has an orifice in its upper wall in which is seated a nozzle 25 having a central bore. This bore may be made cylindrical with longitudinal diverging passages 26 or the bore as a whole may be conical in shape with the section of greatest area at the top. Seated within said bore is a float 27 that makes a loose fit therein. The upper end of the float is flanged outwardly so that the oil flowing through the bore of the nozzle 25 will act on the bottom of the float and also on said flanged portion, thereby increasing the effective lifting power of the oil for a given pressure. A further advantage of this construction resides in the fact that oil cannot shoot out from the nozzle and follow the rod connected with the float where it passes through the cover of the reservoir. The pump and its associated parts are located within an oil containing reservoir 28, the latter being supported by the turbine base and provided with a removable top portion 29 that carries the tubular support 12. The reservoir has a removable cover 30. The cover is provided with a hand hole and a small cover 31 therefor by means of which access can be had to the strainer 24. Situated above the upright shaft 9 is a cover 32 that carries the upper thrust bearing 13. By removing this cover access may be had to the worm and worm wheel.

The admission of steam to the turbine is controlled by a throttle valve 33 located in the casing 34 which in turn is supported by the casing of the turbine. The valve is provided with a stem 35 the lower end of which is seated in a fork formed in the right-hand end of the governor lever 36, the latter being pivotally secured to a bracket 37 depending from the valve casing or the turbine, as is most convenient. On the lever is an adjustable counterweight 38 which may be moved toward and away from the pivot of the lever to adjust the effective action of the governing mechanism. To the governor lever is pivotally attached a rod 39, the lower end of which is provided with a knife edge that rests in the seat 40, the latter being located within a recess in the float 27. Both the knife edge and the seat are hardened to reduce wear.

In order to facilitate the assembly and removal of the governing mechanism from the turbine proper, the arrangement shown in Fig. 2 is provided, wherein 42 indicates a flanged neck or support that is secured to the turbine casing or to some other suitable support. To the flange of the neck is bolted the top portion 29 of the reservoir containing an orifice through which the shaft 44 extends. This shaft is provided with a sleeve 45 keyed thereto. Surrounding the sleeve is a labyrinth packing ring 46. Mounted on the sleeve and adjacent to the packing is an oil thrower 47 to prevent the escape of oil through the packing. This thrower is provided with radially extending vanes 48 that serve to prevent oil from passing through the clearance. 6 indicates the turbine shaft having on its end a screw-threaded portion 49 of reduced cross-section and also a groove 50. Surrounding the shaft is a sleeve 51 that is held in place on the shaft by a set screw 52. The worm 7 is provided with a hub-like extension that is snugly fitted over the sleeve 51, the set-screw 52 serving to prevent the worm from moving axially on the turbine shaft and also to prevent the shaft from turning independently of the worm. The hub of the worm is provided with an oil thrower 53 to prevent oil from working through the orifice in the annular flanged neck 42.

It is to be noted that the lower part of the reservoir 28 is supported by the turbine base and that the upper part 29 of the reservoir, or more strictly the cover therefor, is bolted to the flanged neck 42 as shown best in Fig. 2. Depending from said part 29 is the tubular support 12 of the upright shaft 9. To the lower end of the support is attached the cross piece containing the pump chambers and carrying the strainer and the discharge nozzle. By reason of this construction after the rod 39 is detached from the governor lever the portion 29, support 12, cross piece 22 etc. can all be removed as a unit by taking out the bolts 54 in the flanged neck. Obviously such a mechanism can be easily and quickly assembled.

The action of my improved governing mechanism is as follows:—Steam is admitted to the valve chest by the conduit 55 shown in dotted lines, and passes through the valve to the nozzles or other fluid discharging devices of the turbine. As the rotor revolves due to the action of the steam on its buckets it causes the turbine shaft and worm 7 thereon to revolve. Motion is thereby transmitted to the worm wheel 8 and the shaft 9, the latter revolving at a speed which is proportional to the speed of the turbine shaft. The pump at the lower end of the upright shaft 9 receives oil from its suction chamber and after imparting pressure thereto delivers it to the discharge or pressure chamber 18. The fluid in said chamber acts on the under side of the float 27 and raises it by an amount depending upon said pressure. The float is raised by the body of oil underneath it until a balance is effected between the pressure of the oil acting thereon and the weight of the governor lever 36, counterweight 38 and associated parts. To state the matter in another way, there is a force tending to lift the float 27 which is opposed by another force and when these two forces are equal and opposite the float will remain stationary. Since the throttle valve 33 is attached to the governor lever 36 it follows that the valve will take a position which is determined by the positions of the float and the governor lever and its counterweight. Assuming now that the turbine increases in speed due to the decrease in load or other cause the pressure in the discharge chamber of the pump increases and in so doing raises the float by a certain predetermined amount which causes the valve 33 to close by such an amount as will decrease the supply of steam to the turbine, thereby reducing its speed until the speed of the turbine has been restored to the normal. This action will slightly decrease the pressure in the discharge chamber of the pump and the float 27 will take a position corresponding to said pressure. On the other hand, if the speed of the turbine decreases the volume of oil discharged by the pump will be reduced by a corresponding amount, the float 27 will move downward slightly due to the action of the counterweight 38 and the throttle valve 33 will increase its opening and hence the steam supply by an amount sufficient to restore the speed of the turbine shaft to normal operating conditions. It is to be especially noted that the effective obstruction offered to the liquid by the float is decreased proportionately as the speed of the current of oil from the pump is increased thereby affording an increased outlet for the additional amount of oil delivered by the pump. This arrangement of parts is conducive to smooth, steady operation and prevents choking which would result in vibrations and unsatisfactory governing operation.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

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

1. In a governing mechanism for prime movers, the combination of a pump whose speed varies with that of the prime mover for maintaining a continuous fluid circulation, a nozzle through which the pump discharges a column of fluid, the area of the nozzle increasing in the direction of flow, a float arranged within the nozzle that rides on the fluid column, the position of the float varying with the volume of the discharge and thereby varying the effective flow area of the nozzle, a valve means controlling the admission of motive fluid to the prime mover, and a mechanical connection for transmitting the movements of the float to the valve means.

2. In a governing mechanism for prime movers, the combination of a pump whose speed varies with that of the prime mover for maintaining a continuous fluid circulation, a nozzle through which the pump discharges a column of fluid, the area of the nozzle increasing in the direction of flow, a float arranged within the nozzle that rides on the fluid column, the position of the float varying with the rate of discharge and thereby increasing the effective flow area of the nozzle as the speed of the pump increases and vice versa, a valve controlling the admission of motive fluid to the prime mover, a lever connected to the valve, and a connection for transmitting motion between the lever and float.

3. In a governing mechanism for prime movers, the combination of a pump driven by the prime mover to be governed, a chamber for the pump having a discharge orifice, a float located in the orifice and arranged by its movements to increase and decrease the effective discharge area of the orifice, a valve actuated by the float for controlling the admission of fluid to the prime mover, and a means acting in opposition to the float.

4. In a governing mechanism of the character described, the combination of a pump, a float comprising a body portion and an outwardly extending flange, said body portion and flange both being located in the path of and acted upon by the discharge of the pump, a valve moved by the float to control the passage of motive fluid, and an adjustable means acting in opposition to the float.

5. In a mechanism of the character described, the combination of a pump, a discharge chamber therefor, a nozzle through which the chamber discharges, the cross-sectional area of said nozzle being greater at one end than the other, a float located in the nozzle and moving in a direction to increase the discharge area as the volume of fluid discharged by the pump increases, and a valve means actuated by the float.

6. In a mechanism of the character described, the combination of a pump, a discharge chamber therefor, a nozzle for the chamber that diverges outwardly and through which fluid from the pump flows, a float located in the nozzle and having an outwardly flaring flange, a throttle valve, a lever connected thereto, a means connecting the float and lever, and a counterbalance acting through the lever to oppose certain movements of the float.

7. In combination, a prime mover, a pump, a shaft driven by the prime mover for actuating the pump, a support for the pump shaft that is carried by the prime mover, a casing for the pump carried by said support and having a discharge chamber, a float acted upon by the fluid leaving the discharge chamber, a reservoir in which the pump is suspended, and a valve actuated by the float.

8. In combination, a prime mover, a main shaft therefor, a pump, a pump shaft, gearing between the two shafts, a support for the pump shaft, a casing carried by the lower end of the support and provided with supply and discharge chambers, a discharge nozzle, a float in the nozzle, a reservoir in which the pump is submerged, a valve actuated by the float, and a means also acting on the valve in opposition to the float.

9. In a governing mechanism for prime movers, the combination of a pump driven by the prime mover and at a speed varying therewith, a chamber for the pump having a discharge member, a device that extends into the member and obstructs the flow of fluid therethrough to a certain extent only, said device moving outwardly from said member as the flow from the pump increases to decrease the obstruction to the flow through the member and moving into it as said flow decreases to increase said obstruction, and a regulator for the prime mover, which is controlled in its action by the movements of the device.

10. In a governing mechanism for prime movers, the combination of a pump driven by the prime mover and varying in speed therewith, a float having an outwardly extending flange on its upper end, a means for directing

the fluid discharged by the pump against the under side of the float and its flange and raising it by an amount dependent upon the speed of the pump; the weight of the float acting to oppose the lifting effect of the fluid, a means acting on the float in opposition to the fluid, and a means for controlling the admission of motive fluid to the prime mover whose action is responsive to movements of the float and means.

In witness whereof, I have hereunto set my hand this thirty-first day of May, 1911.

RICHARD H. RICE.

Witnesses:

John A. McManus, Jr.,

Charles A. Barnard.