R. H. RICE.

GOVERNING MECHANISM FOR TURBINES.

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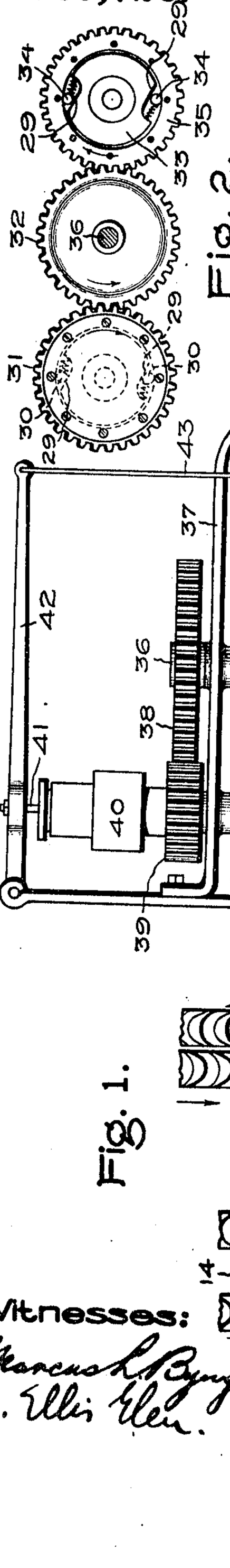

Fig. 2.

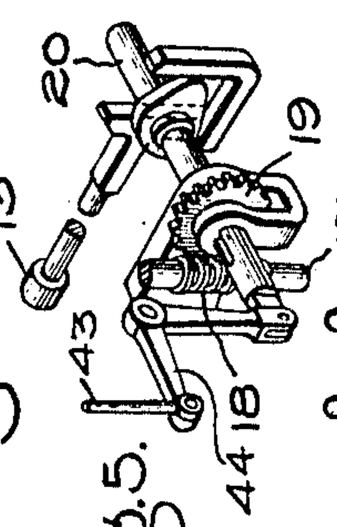

Fig. 5.

Fig. 1.

Fig. 4.

Fig. 3.

Witnesses:

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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR TURBINES.

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Application filed March 6, 1908. Serial No. 419,442.

To all whom it may concern:

Be it known that I, RICHARD H. RICE, a citizen of the United States, residing at Lynn, 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 mechanisms for that type of turbine wherein oppositely rotating wheels are provided, each mounted on and driving a shaft which is mechanically independent of the other, the said shafts driving separate loads, such for example, as the rotors of electric generators.

With such an arrangement, it may happen that the load conditions will be such as to prevent the bucket wheels from running at their designed speeds. For example, suppose the load on the bucket wheel that first receives steam is increased, the said wheel will slow down and more steam will be admitted by the controlling valve or valves while the other wheel owing to the additional supply of steam will abnormally increase in speed, resulting in excessive voltage of the generator driven thereby, and possibly in wrecking the wheel due to abnormal centrifugal strains. On the other hand, the load on the second bucket wheel may be greatly decreased or entirely removed and if the steam supply is maintained constant, the voltage of the generator driven thereby will in the first instance be increased above normal and in the second instance the wheel may be wrecked due to excessive centrifugal strain.

My invention has for its object to provide an improved governing mechanism for turbines having independently movable wheels, each driving its own load, which is so arranged that an increase in speed of either wheel above the predetermined limit will decrease the steam supplied to the turbine as a whole, thereby preventing injury to either of the bucket wheels. In other words the object of my invention is to provide an improved governing mechanism for a turbine of the type described wherein a single speed governor for controlling the mechanism is normally driven by both wheels but which is driven by the wheel having the greater speed to the exclusion of the other when the conditions become abnormal.

In the accompanying drawing illustrating one of the embodiments of my invention, Figure 1 shows a turbine having oppositely rotating bucket wheels equipped with my improved governing mechanism; Fig. 2 is a sectional view taken on line 2—2 of Fig. 1, looking downward; Fig. 3 is a detail view showing intermediate buckets between the wheel buckets; Fig. 4 is a detail view showing oppositely rotating bucket wheels placed close together so that the steam passes directly from one to the other; and Fig. 5 is a detail view of the valve operating mechanism.

1 indicates the bedplate and mounted thereon is a turbine casing 2 having an exhaust chamber 3 which communicates by the conduit 4 with a condenser or other exhaust. The turbine is provided with two oppositely rotating bucket wheels 5 and 6. The wheel 5 is mounted on a shaft 7 and the wheel 6 on the shaft 8. Each of these shafts is provided with its own bearings and the shaft 7 drives the rotor of the generator 9 and shaft 8 drives the rotor of the generator 10. Steam is admitted to the turbine from the valve chest 11, through one, two or more nozzles 12. These nozzles are controlled by valves and said nozzles direct steam against the buckets of wheel 5. The steam issuing from this wheel passes through the passages between the intermediate buckets 14 and thence through the passages in the wheel 6 and acts on the buckets.

The right hand main shaft 7 is provided with a worm 15 that meshes with a worm wheel 16 mounted on the lower end of the vertical shaft 17. Mounted on this shaft in line with the valve chest is a worm 18 which meshes with a worm wheel 19 on the valve-actuating shaft 20. This shaft drives cams which in turn act on forked members for opening and closing the valves successively as the load conditions change. The shaft and cams are movable in an axial direction by the speed governor as the load changes.

The left hand main shaft 8 is provided with a worm 25 which meshes with a worm wheel 26 carried by the upright low speed shaft 27. On the upper end of this shaft is a disk 28 that contains one, two or more recesses having inclined walls 29 as shown in Fig. 2. Located in the recesses are rollers 30 that are spring pressed in one direction and which are so arranged that when the

disk 28 is rotated in a clockwise direction, the rollers will engage the inner surface or bore of the ring 31, but when the ring tends to travel faster than the shaft 27 and disk 28, the rollers will permit the parts to slip. In other words, under certain conditions, the ring can overrun the disk. On the periphery of the ring are gear teeth which mesh with those of the intermediate gear 32, the latter being driven in the direction indicated by the arrow. On the right hand low speed shaft 17 a similar arrangement is provided wherein 33 is a disk containing recesses in which the spring pressed rollers 34 are located that normally serve as driving elements. 35 is the surrounding ring the bore of which coöperates with the rollers and its periphery is provided with gear teeth that mesh with the teeth of the gear 32. The intermediate gear 32 is mounted on a short vertical shaft 36 that is supported by a bearing in the frame 37, the latter being carried by the turbine casing or other suitable support. Mounted on the shaft 36 and above the frame is a spur gear 38 meshing with a gear 39 mounted on the shaft of governor 40, said shaft being located in a bearing in the frame 37. The governor may be of any suitable construction. In the present case the movable element is connected by rod 41 with the governor lever 42. The lever is pivoted at one side of the governor and on the free end is connected by the rod 43 with one arm of the bell crank lever 44, which shifts the cams carrying shaft 20 back and forth in an axial direction as the load of the turbine varies.

The action of my improved governing mechanism is as follows: Assuming that the speed of the main shafts 7 and 8 remains constant, the low speed secondary shafts 17 and 27 rotate at a constant speed and drive the gear 32 at a certain constant speed. The shaft 36 drives the governor 40, and if the speed of the main shafts 7 and 8 increase or decrease simultaneously the governor will act to decrease or increase the amount of steam admitted to the turbine as the case may be. On the other hand, assuming that the load on the right hand generator 9 increases, that on the left hand generator remaining constant or even decreasing, this will cause a decrease in speed of the bucket wheel 5 and an additional steam supply accompanied by an increase in speed of the bucket wheel 6 and its generator. Any increase in speed of the shaft 8 is accompanied by a corresponding increase in speed of the upright shaft 27 and the disk driven thereby. Since the arrangement of the recesses and the rollers therein is such as to form a clutch which grips when moved in one direction but not in the other, it follows that since the speed of the shaft 27 is higher than that of the shaft 17, the gear 31 will drive the gear 32 at a speed slightly in excess of that, due to the rotation of the shaft 17. Since the rollers form a clutch that acts one way only, the shaft 27 will assume control and do the driving while the clutch between the low speed shaft 17 and the gear 32 will overrun. This means that the governor will act on the valve mechanism in a manner to decrease the supply of the motive fluid to the turbine. On the other hand, if the bucket wheel 6 decreases its speed due to load and the wheel 5 increases its speed, the reverse of the above will take place and the driving of the governor will be done by the gear 35, the clutch rollers in the gear 31 automatically releasing the parts and permitting the gear to overrun. In other words the bucket wheel 5 will assume control to the exclusion of the wheel 6.

In describing my invention I have for the purpose of illustration assumed that both the bucket wheel shafts have the same speed but the invention is not necessarily limited thereto in all respects since it would be possible to so modify the gearing that different shaft speeds would tend to drive the governor at the same predetermined speed.

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 combination, turbine elements, regulating means controlling the admission of motive fluid thereto, shafts for said elements, gearing between said shafts including an intermediate gear, a single speed-responsive device driven by said intermediate gear which modifies the position of the regulating means, and automatic clutches controlling the transmission of motion from said shafts to the intermediate gear so that said device can be driven normally by all of the elements and under abnormal conditions by the element having the greatest speed to the exclusion of the others.

2. In combination, turbine elements, a regulator controlling the supply of elastic fluid thereto, a governor for actuating the regulator which is driven by the turbine elements, and means including a clutch mechanism for permitting one of the elements to drive the governor to the exclusion of the remainder under certain conditions.

3. In combination, turbine elements, a regulator controlling the supply of elastic fluid thereto, a governor for actuating the regulator which is driven by the turbine

elements, and means including a clutch mechanism interposed between the elements and the governor which permit the element rotating at the highest speed to assume control to the exclusion of the remainder.

4. In combination, turbine elements, separate shafts therefor, a regulator controlling the supply of motive fluid to said elements, a speed governor, a connection between each element and the governor whereby the elements normally coöperate to drive the governor, and a clutch device in each connection which permits the one having the lesser speed to run idly while the other drives the governor.

5. In combination, turbine elements, separate shafts therefor, a regulator controlling the supply of motive fluid to said elements, a speed governor, a driving connection between each element and the governor, gearing in said connections, and clutches in said gearing which slip in one direction and not in the other.

6. In combination, turbine elements, separate shafts therefor, a regulator controlling the supply of motive fluid to said elements, a speed governor, low-speed shafts driven by the main shafts, gearing between the low-speed shafts and the governor for driving the latter, and clutches for transmitting power from the low-speed shafts to the governor which normally are in operation and which permit the low-speed shaft having the greatest speed to drive the governor to the exclusion of the others.

7. In combination, turbine elements, separate shafts therefor, a speed governor driven by said shafts, and clutches which normally transmit power from the shafts to the governor, one of which becomes inactive when the normal speed relation between the shafts is disturbed.

8. In combination, turbine elements, separate shafts therefor, a speed governor that is common to said elements, gearing for driving the governor at a speed less than that of the shafts, and clutches interposed between the shafts and the governor which act in one way only.

In witness whereof, I have hereunto set my hand this second day of March, 1908.

RICHARD H. RICE.

Witnesses:

JOHN A. MCMANUS, Jr.,

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