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D. C. DAVIS

1,634,897

TURBINE

Filed Nov. 11, 1924

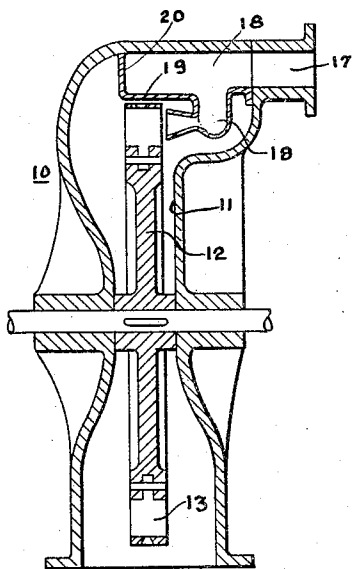


Fig. 1.

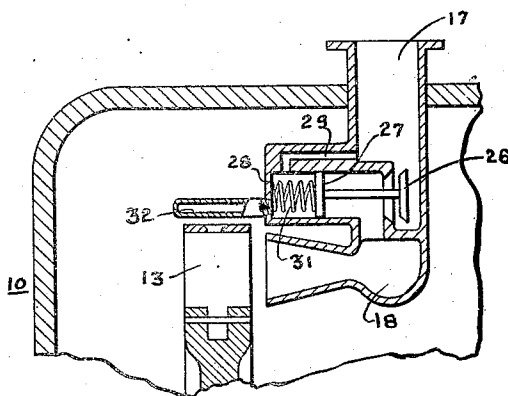


Fig. 4.

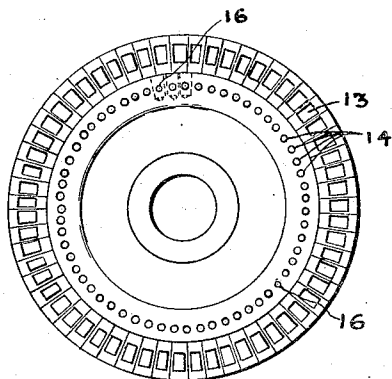


Fig. 2.

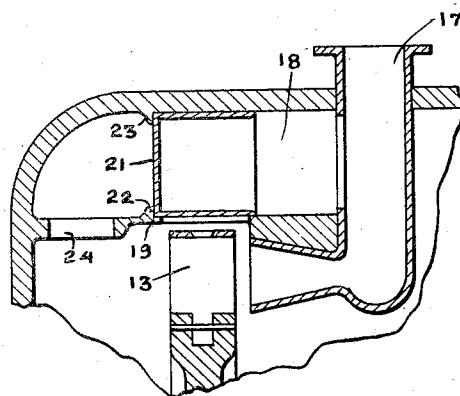


Fig. 3.

WITNESSES:

W. B. Mahaffey

David C. Davis
INVENTOR

UNITED STATES PATENT OFFICE.

DAVID C. DAVIS, OF CHESTER, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TURBINE.

Application filed November 11, 1924. Serial No. 749,300.

My invention relates to safety devices for high-speed rotors, especially the rotors of elastic-fluid turbines, and has for its object to provide apparatus of the character designated which shall prevent motive fluid from being directed against the blading of the rotor should the speed of the rotor, for any reason, get beyond control of the governing or regulating means usually provided therefor.

Apparatus embodying features of my invention is illustrated in the accompanying drawing in which Fig. 1 is a sectional view of a turbine having my improved safety device applied thereto; Fig. 2 is a view of a turbine rotor showing a method of attaching the blades thereto; Figs. 3 and 4 illustrate modifications of my invention.

In the patent to J. A. MacMurchy, No. 1,469,045, issued September 25, 1923, and assigned to the Westinghouse Electric and Manufacturing Company, there is shown and described a safety device for a high-speed rotor of an elastic-fluid turbine, wherein at least one of the rotor blades has a weakened fastening adapted to give away upon the attainment of an excessive speed, resulting in unbalancing the rotor, whereupon the unbalanced rotor rubs against a closely adjacent stationary element establishing a braking action.

It has been found with such apparatus that while the braking action described in the patent aforesaid is obtained, and the turbine is slowed down preventing its further rupture due to centrifugal force, unless an attendant promptly closes off the supply of motive fluid to the turbine, considerable damage may yet be done due to rubbing of the parts.

I accordingly provide, in a turbine, an element adapted to be ruptured by a loosened blade thereof upon the attainment of an excessive speed, and effective to prevent the incoming motive fluid from being directed against the rotor blades, whereupon it ceases rotating altogether or at least rotates at a greatly reduced speed, thus entirely preventing further damage.

Referring now to the drawing, I show in Fig. 1, at 10, an elastic-fluid turbine embodying a casing 11, and a rotor 12. The rotor

12 has a row of blades 13 mounted thereon. Upon the attainment of an excessive speed of the rotor 12 the blades 13 thereof are usually the first to rupture and fly outwardly, due to centrifugal stresses. In order to insure that the blades will be the first to rupture, it is preferable to have at least one of the blades provided with a weakened root fastening, whereby it is adapted to become loosened upon the attainment of an excessive speed of the rotor. In Fig. 2, I show the blades 13 secured to the rotor 12 by means of pins 14, and show certain of the blades secured with pins 16 smaller in diameter than the pins securing the other blades, said pins 16 being of such strength that they are adapted to shear due to centrifugal force upon the rotors attaining an excessive speed. It is to be understood, however, that this method of securing the blades is for the purpose of illustration only and that any method known in the art whereby at least one of the blades of a rotor may become loosened upon the attainment of excessive speed may be employed.

Elastic fluid for driving the rotor is admitted to the turbine from an inlet 17 from whence it passes through a nozzle 18 wherein it is expanded and directed against the blades 13 of the rotor causing it to rotate in a manner well known in the art.

In accordance with the method of carrying out my invention illustrated in Fig. 1, I provide the fluid inlet with a widened portion 18 having a wall 19, said widened portion being secured to the turbine casing at 20. The wall 19 overhangs and is closely spaced with respect to the blading 13. The wall 19 is of sufficient strength to withstand the pressure of the incoming motive fluid but is adapted to be ruptured by a loosened blade of the rotor. Thus, should the rotor 12 attain an excessive speed, one or more of the pins 16 shear permitting its associated blades to become loosened from the rotor whereupon it strikes and ruptures the wall 19 of the fluid inlet and the incoming motive fluid instead of passing through the nozzle 18 is by-passed across the top of the blade row to the exhaust.

In accordance with the structure illustrated in Fig. 3, I provide the fluid inlet 17

with a widened out portion 18 as before and an overhanging portion 19. Fitted into the widened portion 18, immediately above the blading 13, is a thimble of some brittle material 21 which is held in place in the portion 18 by means of lugs 22 and 23. The thimble 21 is of adequate strength to withstand the pressure of the incoming motive fluid and normally closes off communication between the inlet 17 and the opposite side of the turbine rotor 12 leading to the exhaust. In this instance the overhanging portion 19 is secured to the casing 11 by a web member 24. In apparatus made in accordance with this modification, a loosened blade strikes the thimble 21, breaking it and permitting the incoming motive fluid to by-pass to the exhaust as before. The thimble 21 may then be replaced at slight expense and with but little work.

In accordance with Fig. 4, I show means for closing off the supply of motive fluid to the nozzle 18 upon the loosening or rupture of a blade. Within the inlet passage 17 is a valve 26 controlled by a piston 27 disposed within a cylinder-like portion 28 of the inlet 17. The piston 27 is normally subjected on both sides to the pressure of the incoming motive fluid, pressure being conveyed to the left hand side, as shown in the drawings, through a restricted passage 29 and the right hand side being at all times exposed to the pressure existing in the inlet 17. The piston 27 is normally held in its extreme right hand position, with the valve 26 open, by a spring 31 which is of sufficient strength to normally hold the piston 27 to the position shown with pressures equalized on each side thereof. At 32 is shown a hollow plug or other suitable hollow closure member which overhangs the blading 13 and is screwed or otherwise attached to the cylinder 28 closing the left hand end thereof. The member 32 is adapted to be broken off by a loosened blade as heretofore described, whereupon the motive fluid escapes from the left hand end of the cylinder 28, the incoming motive fluid in the inlet 17 acting against the piston 27, moves it to the left and closes the valve 26, entirely shutting off the supply of motive fluid to the turbine.

From the foregoing, it will be apparent that I have invented an improved safety device for turbines embodying means made effective by a loosened blade of the turbine rotor to prevent the motive fluid from being directed against the rotor blades.

While I have shown my invention in three forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art

or as are specifically set forth in the appended claims.

What I claim is:

1. In a turbine, a rotor, a row of blades mounted on the rotor and adapted to be loosened upon the attainment of an excessive speed, means for admitting motive fluid to the turbine and directing it against the rotor, and means made effective by a loosened blade for rendering the incoming motive fluid ineffective for driving the rotor but permitting said motive fluid to pass through the turbine.
2. In a turbine, a rotor, a row of blades mounted on the rotor and being adapted to become loosened upon the attainment of an excessive speed, means for admitting motive fluid to the turbine and directing it against the rotor, and means made effective by a loosened blade for diverting the motive fluid away from the blade row but permitting said motive fluid to pass through the turbine.
3. In a turbine, a rotor, a row of blades mounted on the rotor and having at least one blade so secured that it becomes loosened upon the attainment of an excessive speed, a nozzle for expanding and directing motive fluid against the row of blades and having a fluid inlet leading thereto, and an element associated with the nozzle and adapted to be ruptured by a loosened blade and effective upon rupture to prevent the motive fluid from being directed against the blades.
4. In a turbine, a rotor, a row of blades mounted on the rotor and having at least one blade so secured that it becomes loosened upon the attainment of an excessive speed, a nozzle for expanding and directing motive fluid against the row of blades and having a fluid inlet leading thereto, a relatively thin wall for the fluid inlet overhanging the rotor and adapted to be ruptured by a loosened blade, whereby the incoming fluid is diverted away from the rotor.
5. In a turbine, a rotor, a row of blades mounted on the rotor and having at least one blade so secured that it becomes loosened upon the attainment of an excessive speed, a nozzle for expanding and directing motive fluid against the row of blades and having a fluid inlet leading thereto, a relatively thin wall for the fluid inlet overhanging the rotor dividing the fluid inlet from the exhaust and adapted to be ruptured by a loosened blade, whereby the incoming motive fluid is by-passed to the exhaust.
6. In a turbine, having a rotor with blading mounted thereon, at least one of said blades being so secured that its fastening gives way and the blade becomes detached upon the attainment of an excessive speed,

a nozzle for directing the motive fluid against the row of blades, and means associated with the nozzle adapted to be ruptured by a loosened blade, whereupon said means are effective for by-passing the motive fluid to the exhaust.

5
10 7. In a turbine, a rotor, a row of blades mounted upon the rotor, a nozzle for expanding and directing motive fluid against the rotor blades and having a fluid inlet

leading thereto, and an element carried by the nozzle and adapted to be ruptured by contact with a rotor part and effective upon rupture to prevent the motive fluid from being directed against the blades.

In testimony whereof, I have hereunto subscribed my name this 21st day of Oct., 1924.

15

DAVID C. DAVIS