United States Patent

Barrows, Jr.

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[45] **Feb. 29, 1972**

[54] CABLE TENSIONING STRUCTURE FOR CENTRIFUGAL COMPRESSOR CONTROL

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[73] Assignee: **Carrier Corporation**, Syracuse, N.Y.

[22] Filed: **June 22, 1970**

[21] Appl. No.: **48,226**

[52] **U.S. Cl.** **74/89.2**

[51] **Int. Cl.** **F16h 27/02**

[58] **Field of Search** 74/89.2; 151/38; 415/147, 148, 415/149, 160

[56] **References Cited**

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[57] **ABSTRACT**

An arrangement to provide proper tension on the cable for operating the capacity control mechanism of a centrifugal compressor. One end of the cable is wrapped about a pulley member and fixed thereto. The opposite end of the cable is wrapped in opposite direction about the pulley member and has a threaded terminal piece extending through a lug formed on the pulley. A compression spring means is positioned on the extending portion of the terminal between the lug and a nut threaded on the terminal. As the nut is threaded on the terminal, tension is applied to the cable. The arrangement includes means indicating the extent of the applied tension and to limit the tension to a maximum amount.

2 Claims, 3 Drawing Figures

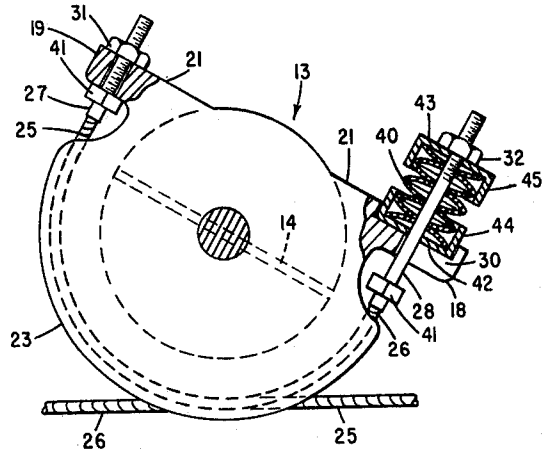


FIG. 3

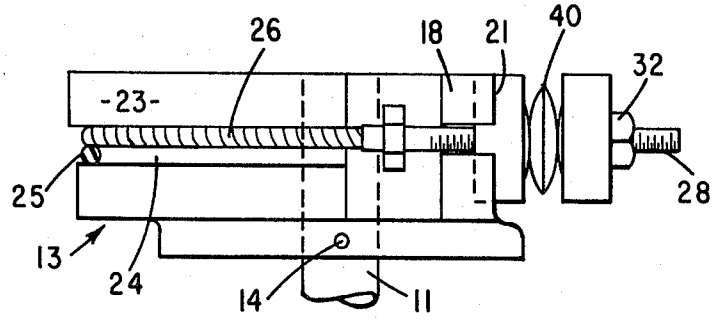
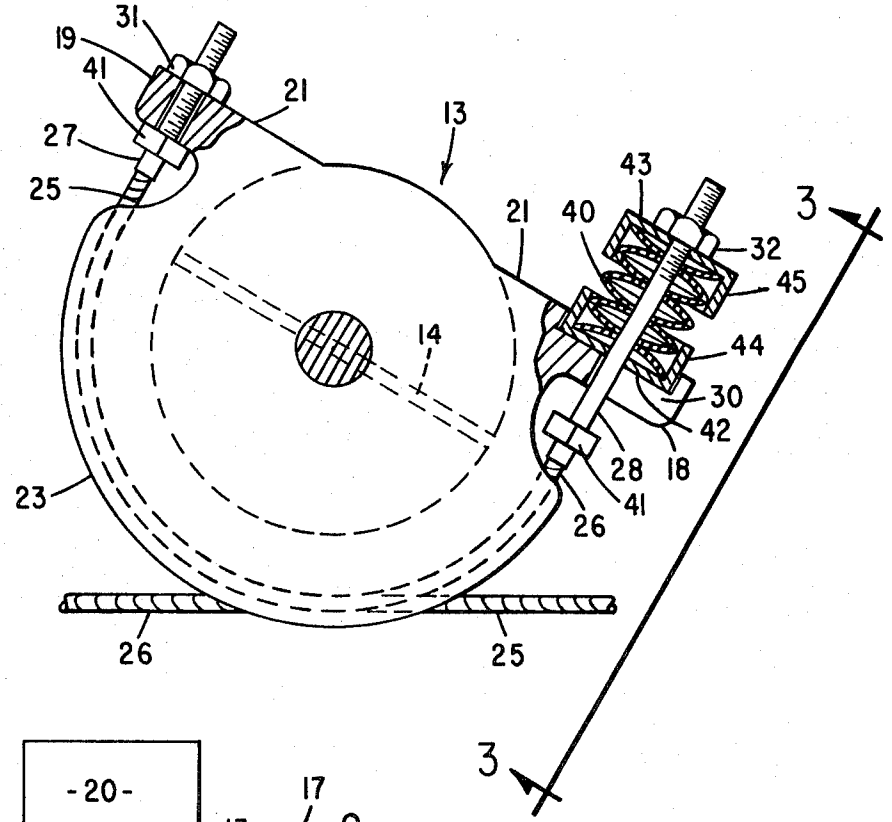


FIG. 2



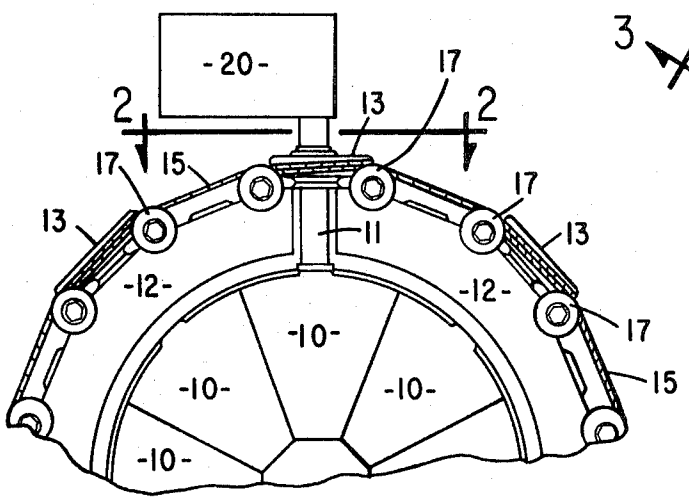


FIG. 1

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CABLE TENSIONING STRUCTURE FOR CENTRIFUGAL COMPRESSOR CONTROL

BACKGROUND OF THE INVENTION

The capacity of centrifugal gas compressors is conventionally regulated by adjusting guide vanes mounted in the intake passage of the compressor or by a diffuser valve member movable transversely across the diffuser outlet passage. In one arrangement, the guide vanes and diffuser valve are operated by mechanism including a circular series of shafts, disposed radially about the axis of the impeller, and which are operatively connected together by a tensioned cable, whereby the shafts operating the inlet guide vanes, or diffuser valve, are moved in unison to vary the flow of gas through the compressor and accordingly control its capacity output. It is important that the actuating cable be maintained under tension in order to effect uniform movement of the guide vanes or the diffuser valve.

The operating shafts are provided with pulleys about which the cable is wrapped; and at one or more places in the cable, a turnbuckle or the equivalent is used to tension the cable. With such an arrangement, it is difficult for the mechanic to know the amount of tension being placed on the cable; and often the cable is overtensioned, and such initial strain on the cable results in the cable being broken during operation of the machine.

My invention embodies a cable tensioning structure which serves to prevent the cable from being overtensioned.

SUMMARY OF THE INVENTION

One of the shaft pulleys is formed with an arcuate peripheral surface and has outwardly extending projections at the ends of the arcuate surface. The projections are formed with openings to receive the end terminals on the cable ends. Nuts are threaded on the cable terminals to pull the wrapped cable ends about the arcuate surface to place the cable under tension. Spring means is positioned on at least one cable terminal between the nut and the projection which, upon tightening of the nut, yieldingly tensions the cable. A washer or the like may be positioned at one or both ends of the spring for conveniently indicating the space between the tightened nut and the projection, such spacing being indicative of the amount of tension placed upon the cable. Stop means is provided to limit the extent the nut can be threaded on the cable terminal and accordingly to limit the tension placed on the cable.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial elevational view of a capacity control structure in which my invention is employed;

FIG. 2 is a top plan view of one of the shaft pulley members, with parts broken away and parts in section, illustrating the structural arrangement embodying my invention;

FIG. 3 is a view taken on line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, 10 designates inlet guide vanes arranged in a circular series about the axis of the compressor inlet passage for controlling the flow of gas to a centrifugal compressor. Each guide vane 10 is fixed to a shaft 11 disposed radially in an annular member 12. The shafts are journaled in the member 12 and have fixed to their outer ends pulleys 13, as by pins 14. A cable 15 is wrapped about each of the pulleys 13, the cable being guided from one pulley to the next by guide rolls 17. The power actuator 20 is connected to one of the shafts 11. A turnbuckle structure inserted in a run of the cable between adjacent guide pulleys 17 may be used to tension the cable. With the cable 15 under tension, all of the shafts 11 in the circular series are rotated in unison by the actuator 20. That guide vane arrangement is conventional.

In the embodiment of my invention, shown in FIGS. 2 and 3, one of the pulleys 13, such as the pulley connected to the actuator 20, is shown. This pulley has circumferentially spaced-apart surfaces 21 formed on outwardly extending lugs 18 and 19. The pulley is formed with an arcuate peripheral surface 23. This surface is preferably formed with a circumferentially extending groove 24 to receive the end portions 25,26 of the cable 15. The end portions of the cable are disposed tangentially to the pulley and are wrapped about the surface 23 in opposite directions. The cable ends have affixed thereto rigid terminals 27,28. The pulley is formed with openings extending through the lugs 18,19 at the ends of the arcuate peripheral portion 23. In the lug 19, the opening is in the form of an aperture through which the cable terminal 27 extends. The lug 18 is formed with an inwardly extending slot 30 in which the cable end 28 is positioned.

The cable terminals 27,28 are threaded externally to receive nuts 31,32. At least one of the terminals, as terminal 28 (FIG. 2), extends a distance beyond the surface 21; and spring means is interposed between the surface and the nut 32. In FIG. 2, the spring means consists of a stack of Belleville spring washers 40 positioned on the terminal end 28.

The terminal 27 of cable end 25 is inserted through the aperture in the surface 21 and the nut 31 tightened. The cable terminals have affixed thereto noncircular enlargements 42 for the reception of a wrench to restrain the cable terminals from rotation while the nuts 31,32 are tightened. The nut 31 is tightened, drawing the terminal enlargement 41 against the underside of the lug in which the cable terminal 27 is positioned. This construction serves to fixedly secure and position the cable end 25 with respect to the pulley. Thereafter, the nut 32 is tightened, and it will be apparent that the cable end 26 is drawn about the arcuate peripheral portion 23 and the cable placed under tension by the compressed spring means 40.

The ultimate tension that may be applied to the cable is limited by engagement of the enlargement 41 on terminal 28 with the underside of the lug in which the terminal 28 is positioned. However, in practice, tension of such magnitude is not applied to the cable. The enlargement 41 on the terminal 28 serves only to prevent putting the cable under an excessively high tension, that is to limit the tension applied to the cable to a predetermined amount.

In the arrangement shown in FIG. 2, means is provided to indicate the amount of tension imparted to the cable or to permit the tension to be concurrently and accurately determined as nut 32 is threaded on terminal 28. washers 42, 43 positioned on the terminal 28. One of these washers, or preferably both of them, is formed with cylindrical flanges as 44,45. These flanges are arranged in confronting relation. As the nut 32 is tightened, the flange 45 of the outer washer 32 43 moved toward the flange 44 of the inner washer. As the nut 32 is tightened and the flange 45 is moved toward the flange 44, the spacing between these flanges is indicative of the amount of tension placed upon the cable. The maintenance man, by measuring the distance between these flanges, will know the amount of tension placed on the cable; and he can so adjust the tension as to meet the specifications for the particular machine.

It will be appreciated that a coil compression spring or other type of spring arrangement may be used in place of the Belleville springs 40. However, these springs are particularly suitable for the purpose due to the fact that they constitute a high-rate spring. Also, the force exerted by the Belleville washer springs, upon the tightening of the nut 32, is uniform, whereby upon measuring the spacing between the flanges of the washers 42,43 the tension placed upon the cable is accurately determined.

The cable, with the terminals 27,28 affixed thereto, is of a predetermined length. The spring means 40 is selected so that when the nut 32 is tightened to effect a predetermined spacing between the flanges 44,45 of the washers 42,43, the cable is placed under proper tension. The springs 40 serve to maintain the desired tension on the cable, taking into consideration the extent of stretch that may develop in the cable during operation of the machine. In any event, engagement of the enlarge-

ment 41 on terminal 28 with the lug in which the terminal is positioned determines the maximum tension that can be placed upon the cable which is not of such magnitude as to overstress the cable.

I claim:

1. A centrifugal refrigeration compressor including a capacity control mechanism having a circular series of control actuating shafts, and a cable operatively connected to all of said shafts for operating the same in unison, a pulley member fixed to one of said shafts and being formed with an arcuate peripheral surface and having an outwardly extending lug positioned at one end of said peripheral surface, the free end portions of said cable extending tangentially to said peripheral surface, one of said end portions being wrapped about said surface and being fixedly secured to said pulley member, the other end portion of said cable being wrapped about said peripheral surface in opposite direction and having fixedly secured thereto a rigid externally threaded terminal extending outwardly through said lug, spring means positioned on the outwardly extending portion of said terminal between said lug and a nut threaded on said terminal, said nut being operable upon being threaded on said terminal toward said lug to tension said cable, means carried by said terminal for indicating the amount of tension imparted to said cable and stop means fixedly secured to said terminal and being movable into engagement with said lug upon threading said nut on said terminal toward said lug, said stop means being operable upon such engagement to limit said tension to a predetermined maximum.

2. A structure as set forth in claim 1 and including a washer member positioned on said terminal intermediate said spring means and said nut, a second washer member positioned on said terminal intermediate the opposite end of said spring means and said lug, said washer members being formed with cylindrical flanges extending in confronting relation, said flanges normally terminating in spaced-apart relation to indicate the tension imparted to said cable.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,645,144 Dated February 29, 1972

Inventor(s) KENNETH C. BARROWS, JR.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 24, cancel "42" and insert in place thereof --41--.

Column 2, line 45, after "28.", insert --This means consists of--.

Column 2, line 50, cancel "3243" and insert in place thereof --43 is--.

Signed and sealed this 11th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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