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FLUID FLOW CONTROL APPARATUS

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FIG. 2.

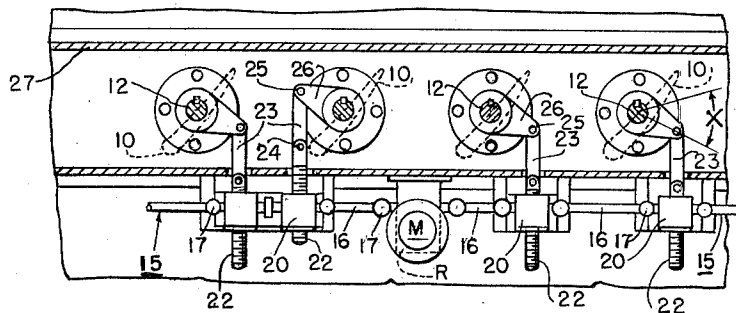


FIG. 3.

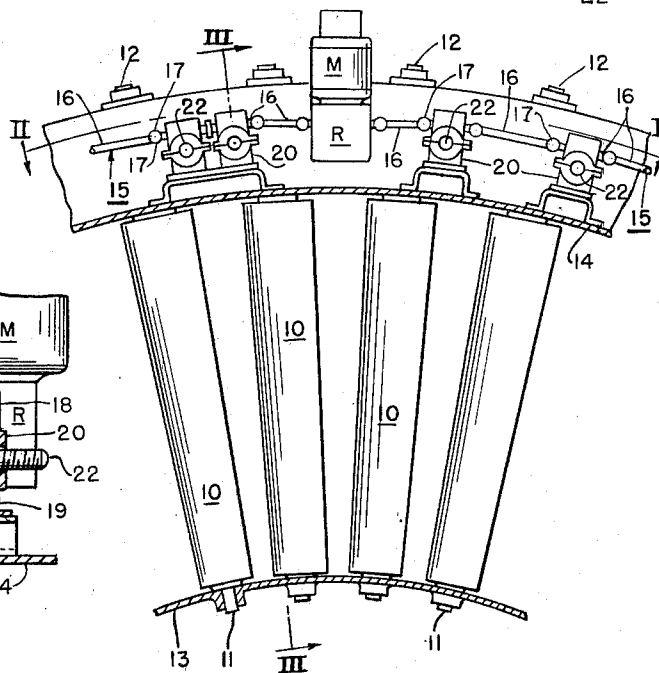
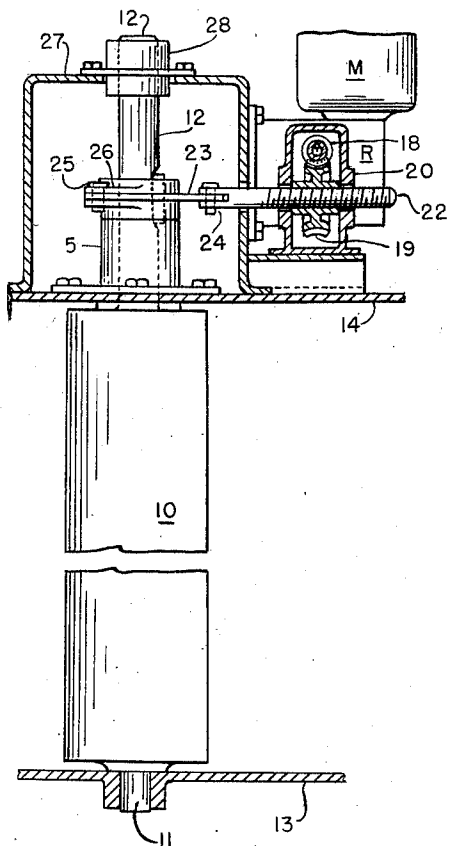


FIG. 1.

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1

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FLUID FLOW CONTROL APPARATUS

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3 Claims. (Cl. 138—46)

This invention relates to axial flow compressors, turbines and like fluid flow machines in which rotating blades operate in conjunction with stationary, guide or stator blades, and has for an object to improve the efficiency of operation of such machines, and is concerned in particular with control or adjustment of the position of the stator blading of single or multi-stage machines of this type.

The stator blading in such machines is arranged in one or more circumferential rows and each row of blading comprises a stage which is designed to operate in conjunction with the rotor blading in the flow of fluid axially through the machine.

It is appreciated in the industry that provision for the variation of the angular disposition or pitch of the stator blading of axial flow machines, would be desirable in order to satisfy changing conditions of operation. The attainment of this end, however, presents substantial mechanical problems arising primarily from the requirement for the simultaneous and also the accurate adjustment or setting of a multiplicity of blades to a selected value.

Various systems utilizing cables, shafts, rings and endless chains which operate through gearing, cranks and lever arrangements for adjusting pivoted or rotatable vanes, blading, etc., to regulate fluid flow have been proposed heretofore. These arrangements, however, do not provide for the essential simultaneous and accurate adjustment of all of the blades to the same degree of accurate setting accomplished by the instant arrangement.

While the problems in stator blade adjustment exist in fluid flow machines of small capacity, in machines of large physical dimensions, such as compressors suitable for wind tunnel installations, the problems, although similar in kind to those of the small capacity machines, are greater in degree and consequently are more difficult to overcome. This will be more readily appreciated when it is realized that such blades may weigh around nine hundred pounds apiece.

The essential object of the present invention is to provide an arrangement for simultaneously revolving or rotating each of a group of fluid control vanes from one position to another selected position.

Another object is to interconnect a group of revolvable vanes, for simultaneous movement, in a manner to prevent lost motion between adjacent members and provide for substantially the same degree of adjustment of each member.

Another object is to interconnect a ring of revolvable fluid flow control vanes in a manner to provide for their simultaneous actuation from one position to a selected position.

More specific objects will be apparent from the following detailed description of the accompanying drawings in which:

Fig. 1 is a partial front elevational view of a stage of

2

stator blading disclosing a portion of the adjusting mechanism;

Fig. 2 is a developed section along the line II—II of Fig. 1; and

Fig. 3 is a sectional view along the line III—III of Fig. 1.

The elements 10 are representative of a stage of stator blades of a compressor, turbine or other fluid flow machine and each has an inner and outer spindle 11 and 12 respectively, which are received in openings in the inner and outer casings 13 and 14 for rotative movement therebetween.

The outer casing 14 provides a support for the mechanism used in adjusting the position of all of the blades simultaneously. The adjusting mechanism comprises a drive shaft indicated generally at 15 which is disposed about the outer periphery of casing 14 and is constructed of a plurality of links 16 which are interconnected by universal joints 17 forming an endless ring.

Referring to Fig. 3, certain of the links 16 are provided with threaded portions 18 forming gear elements or worms for cooperating with worm gears 19 providing a driving means for rotating the blades or elements 10. Each cooperating worm 18 and gear 19 is disposed within wall structure defining a housing 20 and the housings 20 are positioned about the outer casing 14. A reversible motor M having reduction gearing in gear box R is provided and is arranged to drive shaft 15 for effecting its rotation in either direction to simultaneously operate each of the blades or elements 10. As clearly shown in Fig. 3 each worm gear 19 is threaded internally and receives a threaded rod 22 which is movable transversely of the outer casing 14 in accordance with the direction of rotative movement of the drive shaft 15. Linkage 23 has one end pivoted at 24 to the rod 22 and its other end pivoted at 25 to a lever 26 which is operatively connected to the upper spindle 12 of a blade 10.

For enclosing elements of the adjusting apparatus an annular housing 27 is formed about the outer periphery of the outer casing 14 and bearings 28 are provided in its upper wall for receiving the free ends of the spindles 12 whose inner portions adjacent the blades 10 are supported in journals 5 secured to the outer casing 14. The motor M and associated gear box R may then be supported on one side wall of the housing as shown, with the gear housings 20 positioned to provide for reciprocation of the rods 22 through the side wall.

It will be understood that the above-described elements of the adjusting apparatus will be arranged about the outer casing 14 to provide an efficiently operating structure. The gear elements 18 and 19 which form the driving means for actuating the blades 10, as well as the universal connections or joints 17 which form the annular drive shaft 15, will be selected with a view to minimizing lost motion between the elements and provide for adjustment of all the blades 10 substantially simultaneously upon energization of the motor M. The universal connections 17 thus will provide for practically instantaneous rotation of all the gear elements 18 and the teeth of the gear elements 18 and 19 will have a high degree of surface contact or mesh therebetween.

The actuating mechanism for the blades 10 is arranged to adjust the blades through a preselected angle or arc of movement and the motor M is reversible and provided with suitable self actuating braking mechanism (not shown) to prevent any substantial overrunning. Suitable means may be provided, if desired, for indicating the angular position of the blades after an adjustment of the setting of the blades has been effected.

While the invention has been shown in but one form,

3

it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. In an air flow control device of the class wherein a plurality of vanes are mounted for rotative movement between concentrically disposed inner and outer cylindrical casings and each vane has a spindle end disposed outwardly of the outer casing; means for simultaneously adjusting said vanes, said means comprising a plurality of levers, said levers having one end secured to said spindles and their other ends extending laterally therefrom, a plurality of rods extending transversely of said outer casing, said rods being pivotally connected to the ends of said levers farthest from said spindle, each said rod having a worm gear screw threaded thereon adjacent the end farthest removed from said pivotal connection, said worm gears being adapted to move said rods in either direction across said outer casing to actuate said levers, an annular drive shaft disposed about said outer casing and having worm portions thereon which are positioned in coacting relation with said worm gears and driving means for rotating said shaft in either direction.

2. In an air flow control device of the character described having a plurality of circumferentially-spaced vanes extending radially between concentrically disposed inner and outer casings which define an annular flow path and having means for mounting each of said vanes for limited rotational radial movement including a spindle for each said vane extending radially outwardly through and beyond the outer casing; mechanism for simultaneously adjusting said vanes comprising an endless drive shaft surrounding the outer casing adjacent said spindles and comprising a plurality of links disposed in end-to-end relation and a plurality of universal joints drivingly connecting said links at adjacent ends, a plurality of worms secured on said drive shaft at spaced locations therealong, a plurality of worm gears each meshing with one of said worms and having internally-threaded axial bores, a housing structure including spaced parallel side walls enclosing said worms and worm gears and maintaining the latter aligned with the former, a plurality of externally-threaded rods extending transversely through and supported by the side walls of said housing structure, said rods extending through and threadedly engaging the internally-threaded bore of said worm gears, whereby rotation of said worm gears by said worms effects axial movement of said rods relative to said housing structure, a plurality of levers secured at one end

4

to said spindles of said vanes and movable therewith, a plurality of links joining the ends of said levers farthest removed from said spindle with an end of said rods, whereby movement of each of said rods through said gearing effects rotative movement of said vanes, and means drivingly associated with said endless drive shaft to operate said gearing, thereby rotating said vanes.

3. In an air flow control device of the character described having a plurality of circumferentially-spaced vanes extending radially between concentrically disposed inner and outer casings which define an annular flow path and having means for mounting each of said vanes for limited rotational radial movement including a spindle for each said vane extending radially outwardly through and beyond the outer casing; mechanism for simultaneously adjusting said vanes comprising an endless drive shaft surrounding the outer casing adjacent said spindles and comprising a plurality of links disposed in end-to-end relation and a plurality of universal joints drivingly connecting said links at adjacent ends, a plurality of worms secured on said drive shaft at spaced locations therealong, a plurality of worm gears each meshing with one of said worms and having internally-threaded axial bores, a wall structure, a plurality of externally-threaded rods extending transversely through said wall structure, said rods extending through and threadedly engaging the internally-threaded bores of said worm gears whereby rotation of said worm gears by said worms effects axial movement of said rods relative to said wall structure, a plurality of levers secured at one end portion to said spindles of said vanes and movable therewith, said levers being pivotally connected to the end portions of said rods whereby movement of each of said rods through said gearing effects rotative movement of said vanes, and means drivingly associated with said endless drive shaft to operate said gearing, thereby rotating said vanes.

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