Aug. 2, 1966 E. F. WARD 3,263,906

STATOR VANE CHECK VALVE

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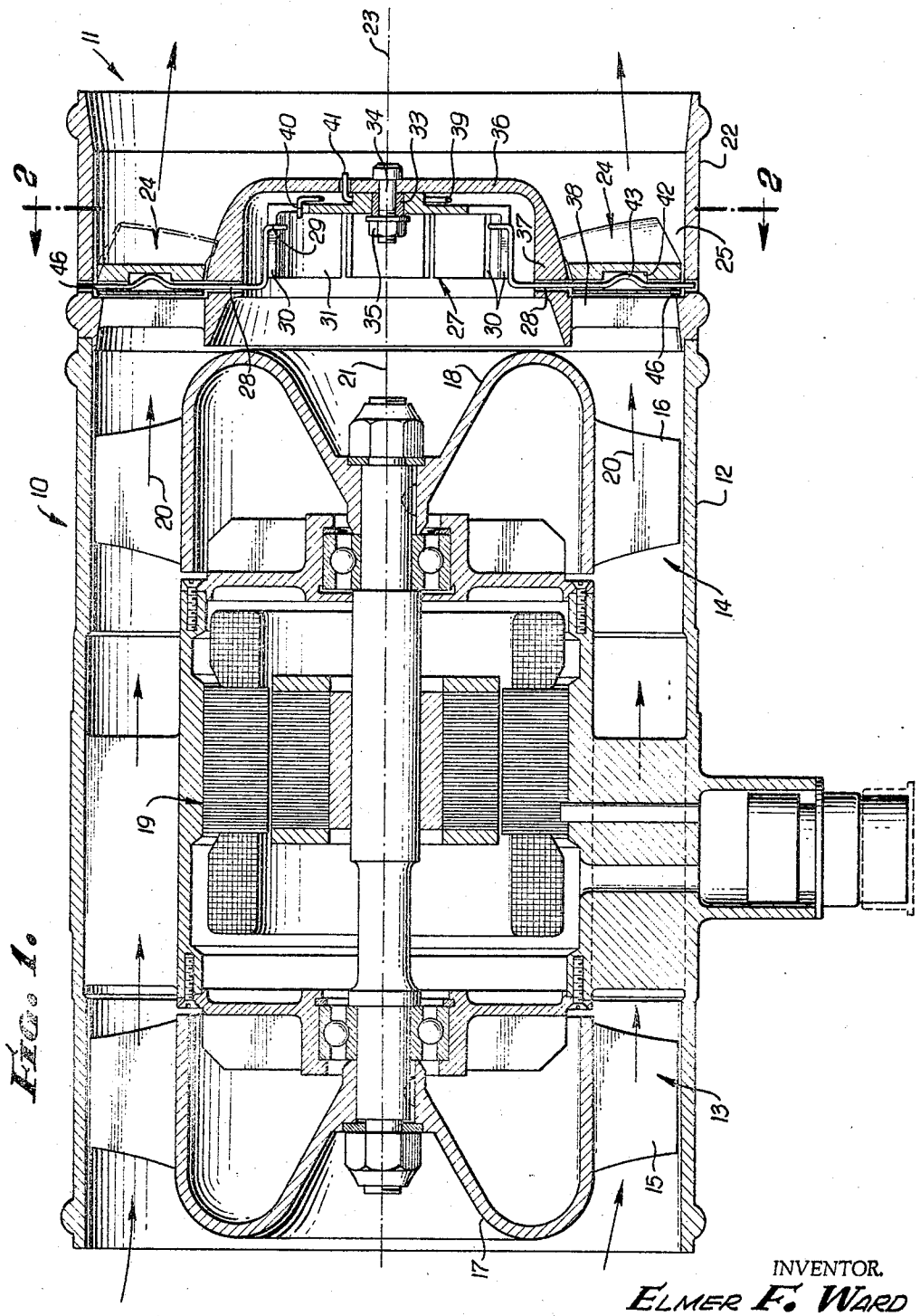


FIG. 1.

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FIG. 2.

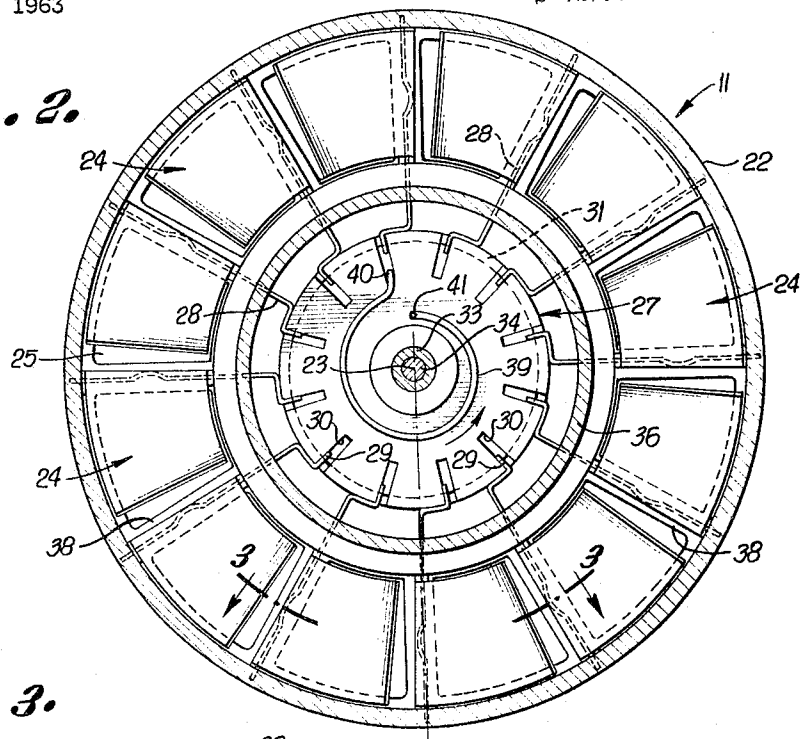


FIG. 3.

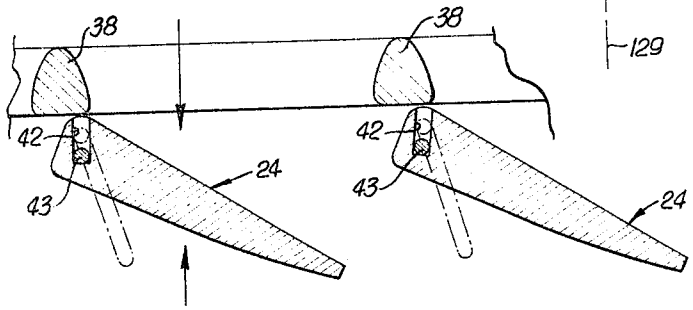
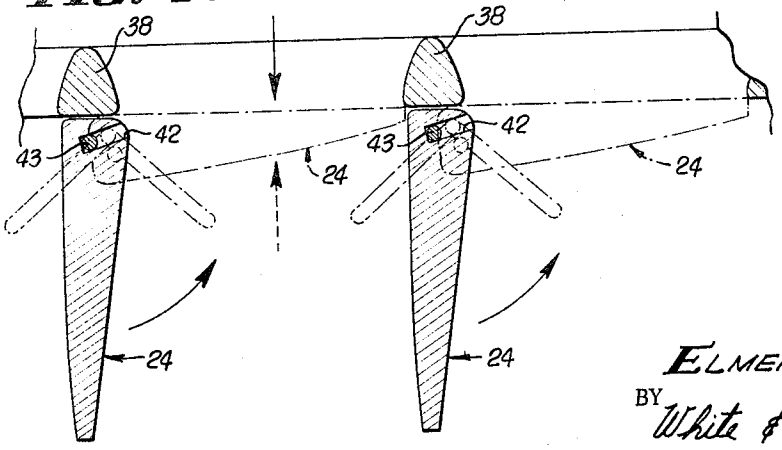


FIG. 4.



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STATOR VANE CHECK VALVE

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7 Claims. (Cl. 230—114)

This invention relates generally to check valve assemblies, and more particularly concerns a novel valve of this type characterized in the provision of flow control vanes having multiple modes of operation including guiding the flow in valve open position and blocking the reverse flow in vane closed position.

It is a major object of the invention to provide a compact and highly useful assembly adapted for combination with an axial blower to straighten the blower induced swirling flow of gas when the valve flow control vanes are open, and also to block reverse flow of gas to the blower when the straightening vanes have been moved to flow-blocking position. As will be brought out, the vanes are movable to blocking position in response to reverse flow of fluid thereagainst, the vanes typically have intermediate position under no-flow conditions characterized in that they present sufficient pressure responsive surface area to the downstream side of the assembly that reverse flow against the vanes effects movement thereof to blocking position.

It is another object of the invention to provide novel means for transmitting force to secure vane movement to blocking position in response to reverse flow of fluid thereagainst, such means typically including a yieldable part acting to urge the vanes to said intermediate position under no-flow conditions. Such means also includes what may be characterized as a synchronizer for effecting simultaneous vane movement between open, intermediate and closed positions. As will appear, the synchronizer is rotatable generally about the axis of the flow conduit, and has connection with vane pivots rotatable about generally radial axes under the control of the synchronizer. Pivots in turn aid in securing generally simultaneous pivotal movement of the vanes which are typically located within an annular zone in the conduit and outwardly of the synchronizer. As a result, it is found that the vanes may be made unusually and efficiently responsive to flow conditions in the conduit so as to serve their dual functions of straightening the downstream flow and blocking the upstream flow over a wide range of flow rates.

These and other objects and advantages of the present invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawings, in which:

FIG. 1 is an elevation partly in section showing the combination including a check valve assembly embodying the invention at the downstream side of an axial blower;

FIG. 2 is a view taken on line 2—2 of FIG. 1;

FIGS. 3 and 4 show the vanes in different positions as used in the FIG. 1 and FIG. 2 assemblies.

Referring first to FIG. 1, a blower unit of axial flow type is generally indicated at **10**, and a valve assembly incorporating the invention is shown at **11** at the downstream side of the blower unit. The latter includes a flow conduit **12** containing first and second blower stages **13** and **14** having vanes **15** and **16** carried by hubs **17** and **18**. The latter are rotatable by an electrical motor generally designated at **19** positioned axially between the motor driven hubs, such rotation acting to displace gas in the general direction of the arrow **20** and at increased pressure and velocity, the gas also swirling about the blower axis **21**.

The check valve assembly **11** includes a flow conduit **22** having an axis **23**, and a series of flow control vanes **24** located within an annular zone **25** in the conduit. The

vanes are characterized as having forward flow guiding open position as seen in FIG. 4, and reverse flow blocking position as illustrated in FIG. 4 in dotted lines, and it will be understood that the vanes are movable to blocking position in response to reverse or upstream flow of fluid thereagainst. Furthermore, the vanes also have intermediate position, as in FIG. 3 under no-flow conditions, characterized in that they then present sufficient pressure responsive surface area to the downstream side of the assembly that reverse flow against the vanes effects movement thereof to blocking position. It may also be stated that the vanes in intermediate position present sufficient pressure responsive surface area to the upstream side of the vane assembly that forward or downstream flow against the vanes effects movement thereof to open position.

The check valve assembly also includes means for transmitting force to secure vane movement to blocking position in response to reverse or upstream flow of fluid against the vanes. In this regard, one such means includes what may be characterized as a synchronizer shown at **27** for effecting simultaneous vane movement between said open, closed and intermediate positions. The synchronizer is rotatable generally about the axis **23** in response to pivotal movement of the vanes and pivots **28** which are rotatable about generally radial axes indicated at **129** in FIG. 2. In this regard, the synchronizer has pivot rotating connection with radially inward extensions **29** of the vane pivots, the form of connection illustrated consisting of axial slots or splits **30** in a skirt portion **31** of the synchronizer, the turned extensions **29** projecting inwardly through the slots. Accordingly, the pivots are cranked during rotation of the synchronizer about axis **23** thereby to assure simultaneous turning of the vanes.

The flow conduit **22** also contains a support for the synchronizer, and typically includes a bearing **33** on a screw fastener **34** at the axis **23**, the bearing being retained by a nut **35** on the screw. The latter also projects through a supporting flow guiding hub **36** having a skirt or annular extent **37** projecting between the vanes and the synchronizer. Finally, the support includes arms **38** projecting at the upstream side of the vanes and outwardly toward the conduit for connection thereto.

The means for transmitting force to secure simultaneous pivotal movement of the vanes also may include a spring acting to urge the synchronizer in a rotary direction carrying the vanes to said intermediate position under no-flow conditions. One highly advantageous form of spring serving this function is shown as a torsion spring **39** having end extents **40** and **41** respectively carried by the synchronizer and the hub, suitable slots in these parts receiving the spring end extents. The main extent of the spring wraps about the axis **23**.

Reference to FIGS. 1 and 3 shows an advantageous form of the vanes to have recesses **42** receiving offset portions **43** of the pivots **28** acting to interlock the pivots and vanes for turning movement.

In operation, when the flow passes forwardly or downstream, the vanes are straightened by the flow as shown in FIG. 4, and in turn straighten the spiraling flow to recover spiral flow energy and convert same to forward flow energy. In this regard, the opposite faces of the vanes in open position extend in generally forwardly directed planes. Should the downstream flow then reduce to a no-flow condition, the vanes will return to FIG. 3 intermediate position under the influence of the spring **39**, and if the flow reverses to impinge against the downstream facing sides of the vanes in intermediate position, they will then respond and close to the positions shown in FIG. 2 and by the dotted lines in FIG. 4, stopping and sealing at ledges **46** and arms or posts **38**.

I claim:

1. In a check valve, a flow conduit having an axis, a

series of flow control vanes arranged within an annular zone in the conduit, the vanes having

(a) forward flow controlling open positions in which the vanes are disposed in generally forwardly and axially extending planes spaced about said axis.

(b) reverse flow blocking closed positions in which the vanes are disposed in a transverse plane extending generally normal to said axis, and

(c) intermediate positions between said open and closed positions,

the vanes being simultaneously rotatable between said positions, and means for controlling said vane rotation so that the vanes must rotate as a group between said positions in response to change in said flow and so that the vanes seek said intermediate positions under no-flow conditions.

2. The check valve of claim **1**, in which said means includes vane pivots rotatable about generally radial axes and a pivot rotation synchronizer rotatable generally about said conduit axis in response to pivotal rotation of said vanes and pivots.

3. The check valve of claim **2**, in which said synchronizer has pivot rotating connection with radially inward extensions of said vane pivots, and a support for said synchronizer carried by and within said flow conduit.

4. The check valve of claim **2**, in which said vanes have recesses receiving offset portions of said pivots acting to interlock the pivots and vanes.

5. The check valve of claim **3**, in which said support has flow guiding annular extent projecting between said vanes and synchronizer, and arms projecting at the upstream side of said vanes and outwardly toward said conduit.

6. The check valve of claim **2**, in which said means includes a spring acting to urge the synchronizer in a rotary direction carrying the vanes to said intermediate positions.

7. The check valve of claim **1** including power driven rotary blower means for effecting and directing forward flow to spiral about said axis and impinge against the vanes.

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