Jan. 27, 1948. H. A. MEYER 2,435,091

INLET VANE CONTROL APPARATUS USING LEVERS

Filed Nov. 1, 1944 3 Sheets-Sheet 1

FIG-1

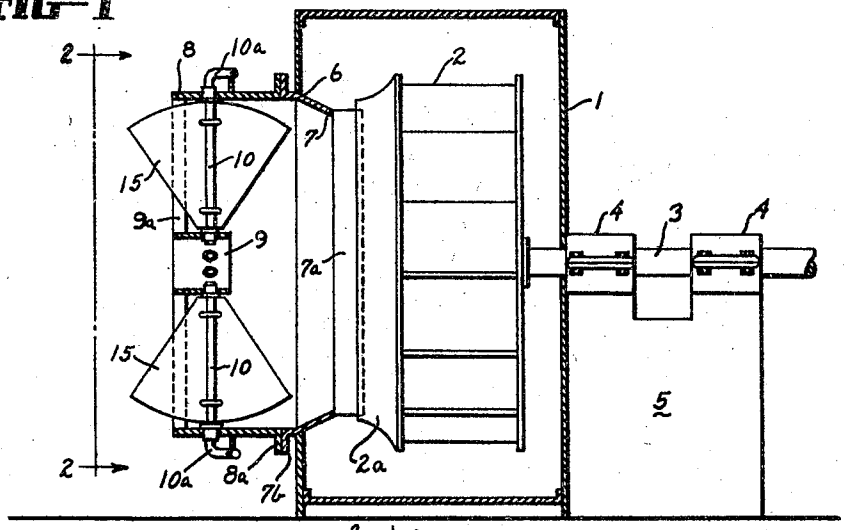
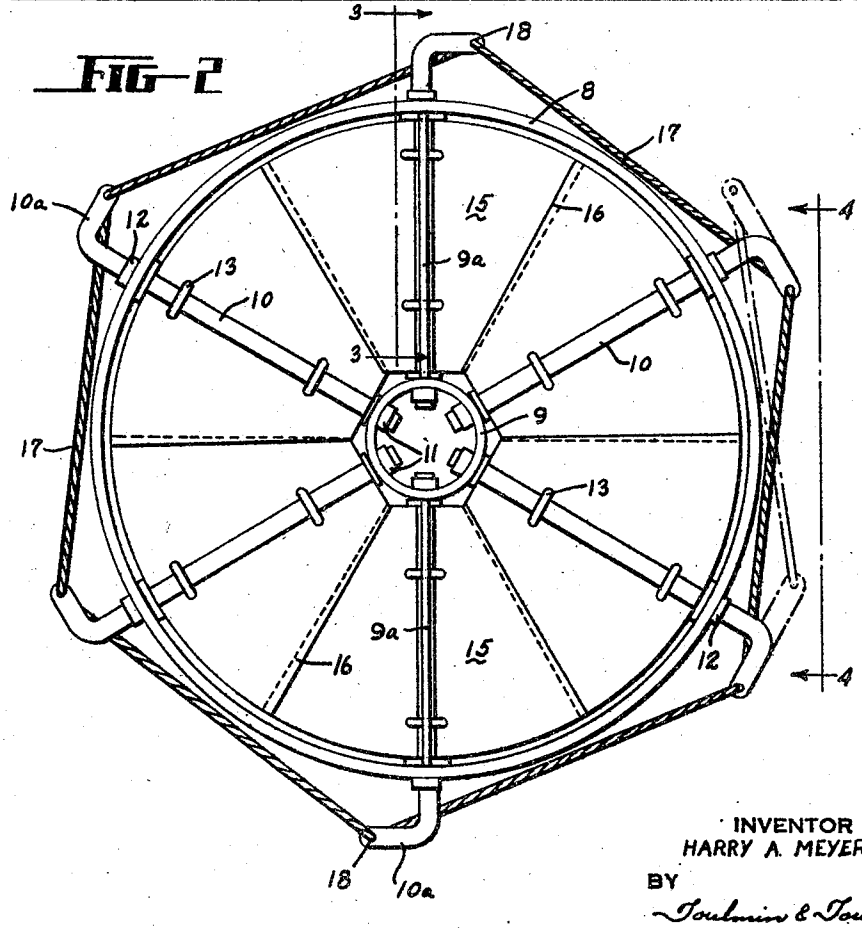


FIG-2



INVENTOR
HARRY A. MEYER
BY
Toulmin & Toulmin
ATTORNEYS

Jan. 27, 1948. H. A. MEYER 2,435,091

INLET VANE CONTROL APPARATUS USING LEVERS

Filed Nov. 1, 1944 3 Sheets-Sheet 2

FIG 3

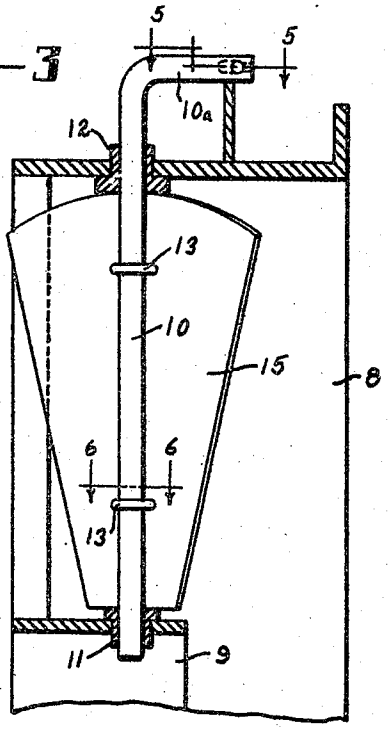


FIG 5

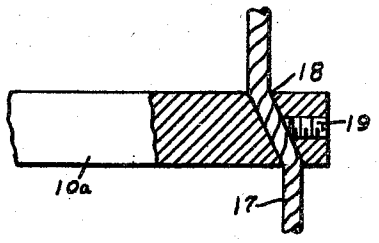


FIG 6

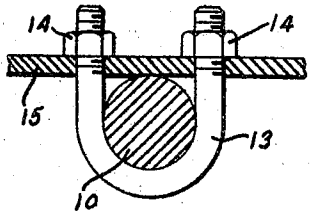
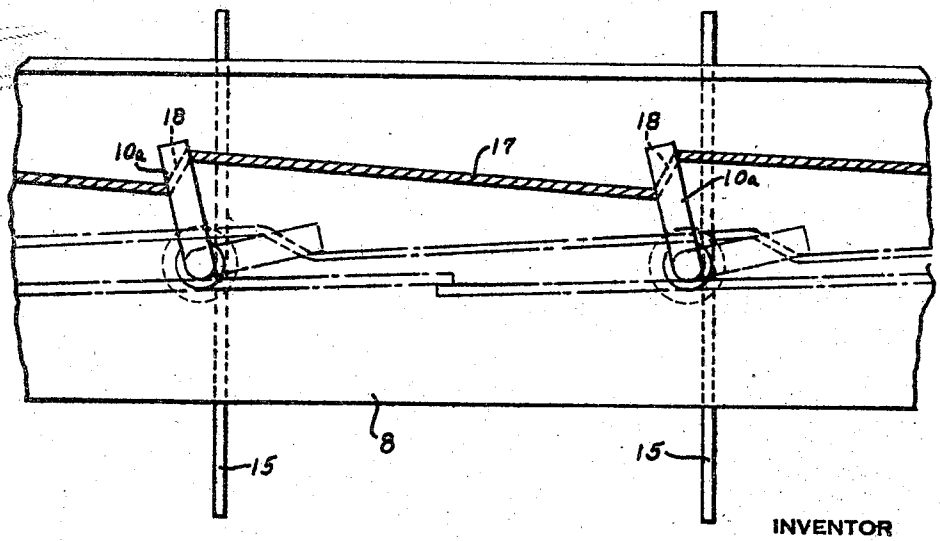


FIG 4



INVENTOR
HARRY A. MEYER

BY

Toulmin & Toulmin

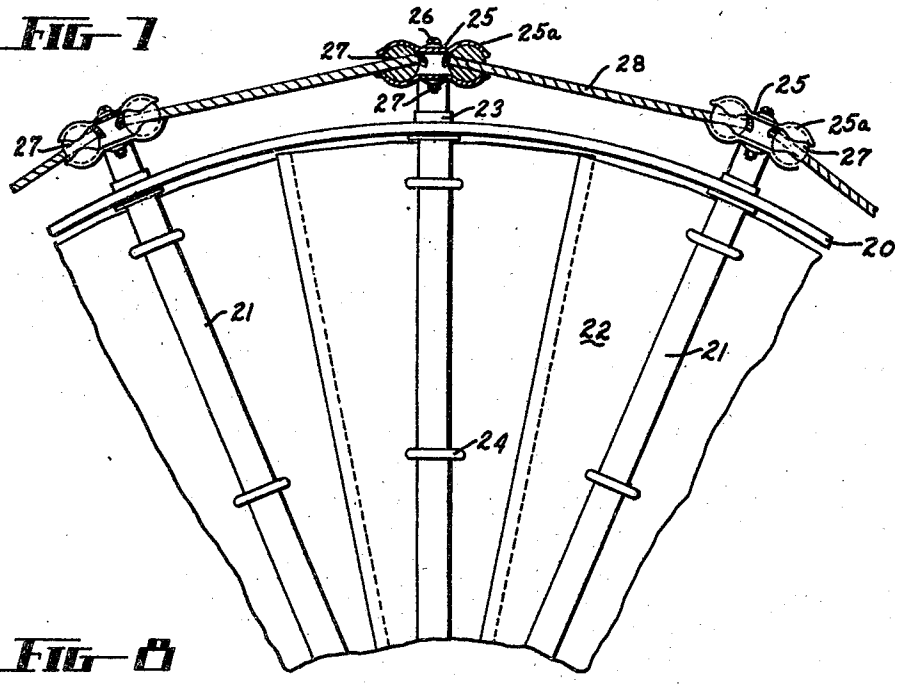
ATTORNEYS

Jan. 27, 1948. H. A. MEYER 2,435,091

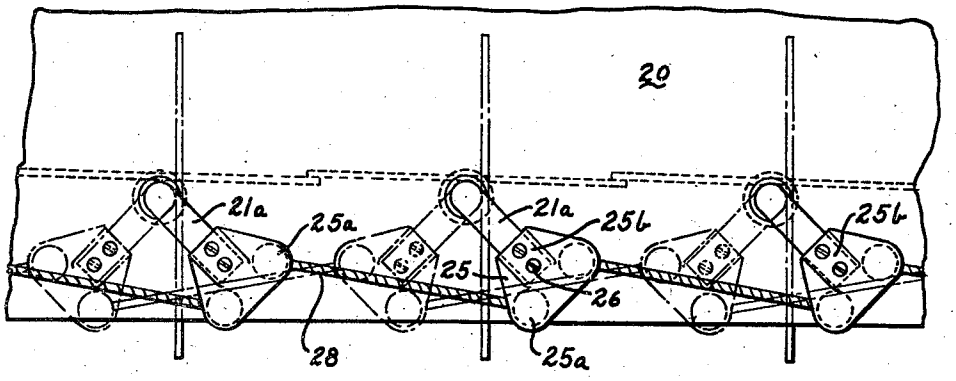
INLET VANE CONTROL APPARATUS USING LEVERS

Filed Nov. 1, 1944 3 Sheets-Sheet 3

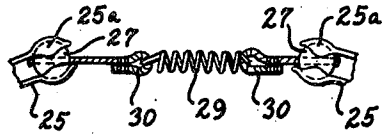
FIG—7



FIG—8



FIG—9



INVENTOR
HARRY A. MEYER
BY
Toulmin & Toulmin
ATTORNEYS

Patented Jan. 27, 1948

2,435,091

UNITED STATES PATENT OFFICE

2,435,091

INLET VANE CONTROL APPARATUS USING LEVERS

Harry A. Meyer, Detroit, Mich., assignor to American Blower Corporation, Detroit, Mich., a corporation of Delaware

Application November 1, 1944, Serial No. 561,407

11 Claims. (Cl. 230—114)

1

This invention relates to vane controls wherein a plurality of vanes are pivoted upon fixed axes and movable between one limiting position in which the vanes coact to close an opening and a second limiting position in which the opening is substantially unobstructed.

It is an object to provide a control as aforesaid in which the vanes are connected for movement in unison by a combination of levers interconnected by flexible elements such as cord, rope, cable, chain or metal strips.

It is a further object to provide, a vane control in which all vanes are, connected for movement in unison by a single flexible element or number of such elements, wherein the said element or elements are maintained taut in all positions of vane adjustment.

Another object is to provide a vane control inlet for centrifugal fans in which the vanes are actuated in synchonous pivoted movement by a series of levers or arms interconnected by a single flexible element secured to said levers so that the total length of its projection onto the plane of the pivot axes of the vanes, remains substantially constant for all positions of vane adjustment.

A still further object is to provide a vane control in which the vane levers are provided with ball and socket joints sequentially interconnected by lengths of cable or other flexible elements, together with a tension element inserted in one or more of said lengths whereby the lengths are maintained taut and all vanes are under positive control in all positions of adjusment.

Other objects and advantages of my invention will be apparent from the following description.

In the drawings:

Figure 1 is a vertical central cross-section through a centrifugal fan equipped with a vane inlet control constructed in accordance with one form of my invention,

Figure 2 is an elevation of the vane control, taken on line 2—2 of Figure 1, looking along the central axis of the vanes,

Figure 3 is a cross section taken substantially upon the line 3—3, Figure 2 and showing the vane at about 45° to the central axis of the vane ring,

Figure 4 is an edge view of the vane ring and vane control mechanism, taken substantially upon line 4—4, Figure 2, and showing in solid lines, the vanes and control mechanism in fully open position, and in dotted lines, in fully closed position,

Figure 5 is a section taken on line 5—5, Figure 3, showing the manner in which the control cable is

2

associated with, and connected to, each radial vane-control arm,

Figure 6 is a section taken on line 6—6, Figure 3, showing one U-bolt connection between a vane and its radial control rod,

Figure 7 is a detail view, partly in section, of a portion of a second form of my invention,

Figure 8 is an edge view of a portion of the vane control ring and vane-actuating mechanism of Figure 7 showing the vanes and control means in solid lines in fully open position and in dotted lines in fully closed position, and,

Figure 9 is a detail of the spring take-up connection between cable ends. used in the form of the invention disclosed at Figures 7 and 8.

Referring to the drawings wherein like reference characters identify corresponding parts throughout, I have shown my vane control at Figure 1 as applied to the inlet opening of a centrifugal fan or blower. It will be understood that this illustration is purely by way of example, and that the invention is adapable to any installation where variation of an opening from full open to full closed, is desired. In Figure 1, 1 indicates the fan casing having a bladed rotor 2 supported on a shaft 3. Said shaft is journaled in bearings 4 supported by a block 5. Shaft 3 is adapted to be coupled to a source of driving power, not shown. In accordance with standard construction, the casing 1 has a central axial opening 6 within which fits a shroud ring 7 having a cylindrical section 7a fitting within and having a slight clearance from, an adjacent ring 2a of rotor 2. Shroud ring 7 is flanged at 7b exteriorly of casing 1. A vane ring or frame 8 is formed with a flange 8a mating with flange 7b, the two being secured together in any desired manner, for example, by bolts.

A hub or ring 9, which may consist of a section of pipe of proper diameter, is positioned within and coaxial with ring 8 by spacer rods 9a and a desired number of vane rods 10 each extending radially of ring 8 and hub 9. While the rods are shown as six in number upon Figure 2, and as equally spaced, it will be clear that the number and spacing may be varied within limits set by sound engineering practice.

As shown more particularly in Figures 2 and 3, each rod 10 is mounted at its radially inward end in a plain bearing 11 which may have a press fit in hub 9; and at its radially outward end in a bearing 12 pressed into an aperture in vane ring 8. These bearings are preferably of the "oilet" type. Each rod 10 has fixed thereon, as by means of U-bolts 13 and nuts 14, Figure 6, a

sector-shaped vane 15, so dimensioned as to slightly overlap the edges of its adjoining vanes when all vanes are in closed position, as indicated at 16, Figure 2.

As indicated in Figures 1 to 4, each rod projects radially outward beyond vane ring 8 and has its end bent at an angle to form a crank arm 10*a*. The free end of each arm 10*a* has a transverse hole 18 whose axis is substantially parallel to a tangent to vane ring 8 but which makes a predetermined angle of less than 90° with the axis of its arm. A flexible element 17 which may be a cable or chain, is threaded between arms 10*a* and through the holes 18. A set screw 19, Figure 5, is provided in each arm 10*a* to engage and secure the flexible element with respect to the corresponding hole. By this construction, when one rod 10 is turned, as by application thereto of a wrench or manual actuation of an arm 10*a*, all other rods are equally and simultaneously turned whereby the corresponding movements of the vanes operates to vary the effective opening of the vane ring and, in the association shown at Figure 1, to vary the delivery of the fan.

Consideration of Figures 2, 3 and 4, will show that the sections of cord 17 between arms 10*a* remain taut throughout a 90° range of pivotal movement of the sectors. When an arm 10*a* moves downwardly from the plane of the sheet in Figure 2, the hold 18 therein moves in a plane normal to the axis of the main portion 10 of said rod. Hence, when the arms 10*a* move through 90° from a position as shown at Figure 2 the radial distance from holes 18 to the center of hub 9 decreases by an amount proportional to the cosine of the angle of rotation and the effective dimensions of the rod itself, that is, the radial distance from the center of hub 11 to arm 10*a*, and the distance of hole 18 from the main portion of rod 10. This decrease shortens the actual distance between consecutive holes 18 and tends to cause slack or looseness in the inter-vane sections of element 17. However, consideration of Figure 4 will show that, while the foregoing motion of arm 10*a* is taking place, the projection of the holes 18 on the plane of the vane ring is shortened by an amount substantially proportional to the diameter of the rod, the angle between the axes of the hole and arm 10*a* and the sine of the angle of rotation. By selecting a proper value for the angle at which holes 18 are drilled and the effective radius of arms 10*a*, the effective length of element 17, that is, the total length of its individual straight sections projected onto the plane of ring 8, may be kept substantially constant so that no looseness develops in any angular position of arms 10*a* and all vanes are at all times under the precise and positive control of element 17. This is true whether said element is a cord, chain, plastic rope, or other element having the desired properties of strength and flexibility. If desired, one or more of the rods 10 may be formed with means to receive a wrench, or turning lever, particularly in the larger sizes of vane rings.

At Figures 7, 8 and 9 I have shown a modified form of my invention in which the vane ring 20, rods 2 and vane sectors 22, are associated by means of bearings 23 and U-bolts 24 in the same manner as in the species of Figures 1 to 6, inclusive.

As in the species of Figures 1 to 6, inclusive, vane rods 21 are bent at their ends exteriorly of ring 20, to form arms 21*a*. A pair of socket plates

25 are attached to the end of each arm 21*a* by means such as machine screws 26 passing through aligned holes in plates 25 and arm 21*a*, and secured in place by nuts 27. Plates 25 may be simple stampings and are formed in the general form of a truncated equilateral triangle having spherically dished portions 25*a* and a cylindrically dished portion 25*b* adapted to fit the ends of arms 21*a*. Thus, when two of these plates are secured to an arm in spaced relation, opposed portions 25*a* conjointly form spherical sockets each adapted to receive and hold a ball 27. These balls are drilled on a diameter thereof to receive the respective ends of a plurality of flexible cord sections 28. Merely by way of example, if 28 is in the form of metallic cable, each end is passed through a hole in a ball 27 and the projecting end broomed and soldered. By this construction, when the parts are assembled as shown at Figures 7 and 8, all vane sectors 22 are positively connected for equal and simultaneous rotation.

Figure 8 shows the relation between each arm 21*a* and the plane of the corresponding vane sector; and it will be noted that when the parts are as shown in solid lines, the vane sectors are in fully closed position, while, when moved to dotted line position, the vanes are in fully open position. As these limiting positions are symmetrical with respect to the plane of ring 20, it is clear that the combined effective length of sections 28 and plates 25, that is their total foreshortened lengths on the plane of ring 20, are the same for both positions. However, in passing from one position to another, the total effective length increases and, unless compensated, would cause slackness or looseness. To compensate for this increase, in positions of adjustment between the two limiting positions, I insert a resilient element such as a tension coil spring 29, Figure 9, in one section 28. For example, the one section may be cut and the ends formed into loops 30, each passing through an eye of the spring. The parts are so proportioned that spring 29 is always under tension, whereby the cord sections 28 are kept taut and the vanes are at all times under precise control. As in the species of Figures 1 to 6, inclusive, rods 21 may be formed with means to effect turning thereof. In the particular installation of Figures 7 and 8, the rod to be adjusted would preferably be located on a rod substantially diametrically opposite to the section 28 in which spring 29 is inserted. Any suitable means may be provided, if desired, for locking or securing one or more of the vane rods in position to thus positively hold all vanes in corresponding positions of adjustment until a different adjustment is desired.

While I have described the invention in the forms now preferred by me, various modifications and substitutions will be apparent to those skilled in the art. Furthermore, numerous uses are apparent apart from the one selected for illustration at Figure 1. It is to be understood that I reserve all modifications, substitutions and uses that fall within the scope of the subjoined claims.

Having now fully described my invention, I claim:

1. In a vane control, a ring, a plurality of rods pivoted on respective, circumferentially spaced axes radial of said ring, a vane secured to pivot with each of said rods from a first position substantially in the plane of said ring, to a second position substantially normal to said plane, a lever arm on each rod at one end thereof, and flexible cord means connecting the end of each

arm with the adjacent arms whereby all rods may be simultaneously actuated between said positions.

2. In a vane control, a plurality of vanes, a frame, means mounting said vanes in said frame on circumferentially-spaced, coplanar, angularly-related axes, respectively, said means including a lever arm angularly-related to each axis, and elongated flexible means connecting each lever arm within the adjacent arms to move all vanes in unison between closed and open positions.

3. In a vane control, a plurality of generally sector shaped vanes, means pivoting said vanes on substantially coplanar, radial, angularly-related axes, a control arm fixed to each vane radial of its axis and each arm having its axis making a predetermined angle with the plane of its vane, and elongated flexible means interconnecting said arms, said means being fixed across each arm at a predetermined angle whereby said means remains taut for all positions of angular adjustment of said vanes.

4. In a vane control, a ring, a plurality of substantially coplanar, equally angularly-spaced rods pivoted in said ring radially thereof, a sector-shaped vane secured to each rod, said vanes coacting in one position to substantially close the opening through said ring, each rod projecting through said ring and having a radial arm at its radially outward end, and a single elongated flexible element connecting the free ends of said arms and fixed across each arm at a predetermined angle such that said element is maintained taut for all positions of angular adjustment of said vanes.

5. In a vane control, a ring, a plurality of vanes, means mounting said vanes in said ring for pivotal movement on angularly-related axes extending radially of said ring, an arm connected to each vane with its axis at a predetermined angle to the plane thereof, each arm having an opening extending across its free end at an angle of substantially 45° to the axis of said arm, and cable means secured in each opening and interconnecting said arms for movement in unison.

6. In an inlet vane control, a vane ring, a hub centrally within said ring, a plurality of vanes, means mounting said vanes for pivoting on angularly-related axes extending radially between said hub and ring, said vanes, in one position, being adapted to substantially close said ring, an actuating arm secured to each vane radially of its pivot axis, each arm making the same predetermined angle with its vane, and elongated flexible means interconnecting said arms for moving said vanes in unison, said means being secured across each arm at an acute angle whereby said means remains taut for all positions of adjustment of said vanes.

7. In a vane control, a ring, a plurality of angularly related rods pivoted within said ring on axes extending radially thereof, each rod having an arm secured therewith exteriorly of said ring, each arm extending radially of its rod, universal joint means pivoted on the free end of each arm, and tension elements connecting all of said universal joint means whereby said vanes are connected for positive movement in unison.

8. A vane control including a ring, a plurality of vanes, means mounting said vanes on angularly-spaced axes radial of said ring for pivoting between a first position conjointly closing said ring, and a second open position, an arm secured to each vane radially of the pivot axis thereof, means forming a ball socket secured to each arm, a ball rotatably held in each socket, and flexible tension elements connecting each ball with the next adjacent ball.

9. In a vane assembly, a sector-shaped vane, means pivoting said vane on an axis substantially coplanar and radial of said vane, an arm attached to said vane, a pair of plates secured to said arm and conjointly forming at least one ball-receiving recess therebetween, a ball in each said recess, and an elongated flexible tension element attached to said ball.

10. In a vane control, a plurality of substantially sector-shaped vanes, means pivoting said vanes on respective angularly related axes extending radially from a central axis, an arm secured to each vane and extending radially from its pivot axis, a pair of spaced plates secured to each arm and shaped to conjointly form a pair of ball sockets therebetween, a ball in each said socket, and cable means connecting each ball with the adjacent ball of a next adjoining arm whereby said vanes are connected for positive adjustment in unison.

11. In a vane control, a plurality of generally sector-shaped vanes whose bounding radial edges make an angle substantially equal to 2π radians divided by the number of said vanes, means mounting said vanes on respective radial, coplanar, angularly-related axes, lever arms substantially normal to each said axis respectively, each arm having its radial axis fixed at a predetermined angle to the plane of its vane and a single elongated flexible element connecting the ends of said arms, and fixed to each arm to cross the axis thereof an angle of substantially $\pi/4$ radians whereby said vanes may be rotated in unison.

HARRY A. MEYER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,989,413	Hagen	Jan. 29, 1935
2,037,395	Seelig	Apr. 14, 1936
2,100,481	Howden	Nov. 30, 1937
2,100,489	Richardson	Nov. 30, 1937

FOREIGN PATENTS

Number	Country	Date
500,965	Great Britain	Feb. 20, 1939