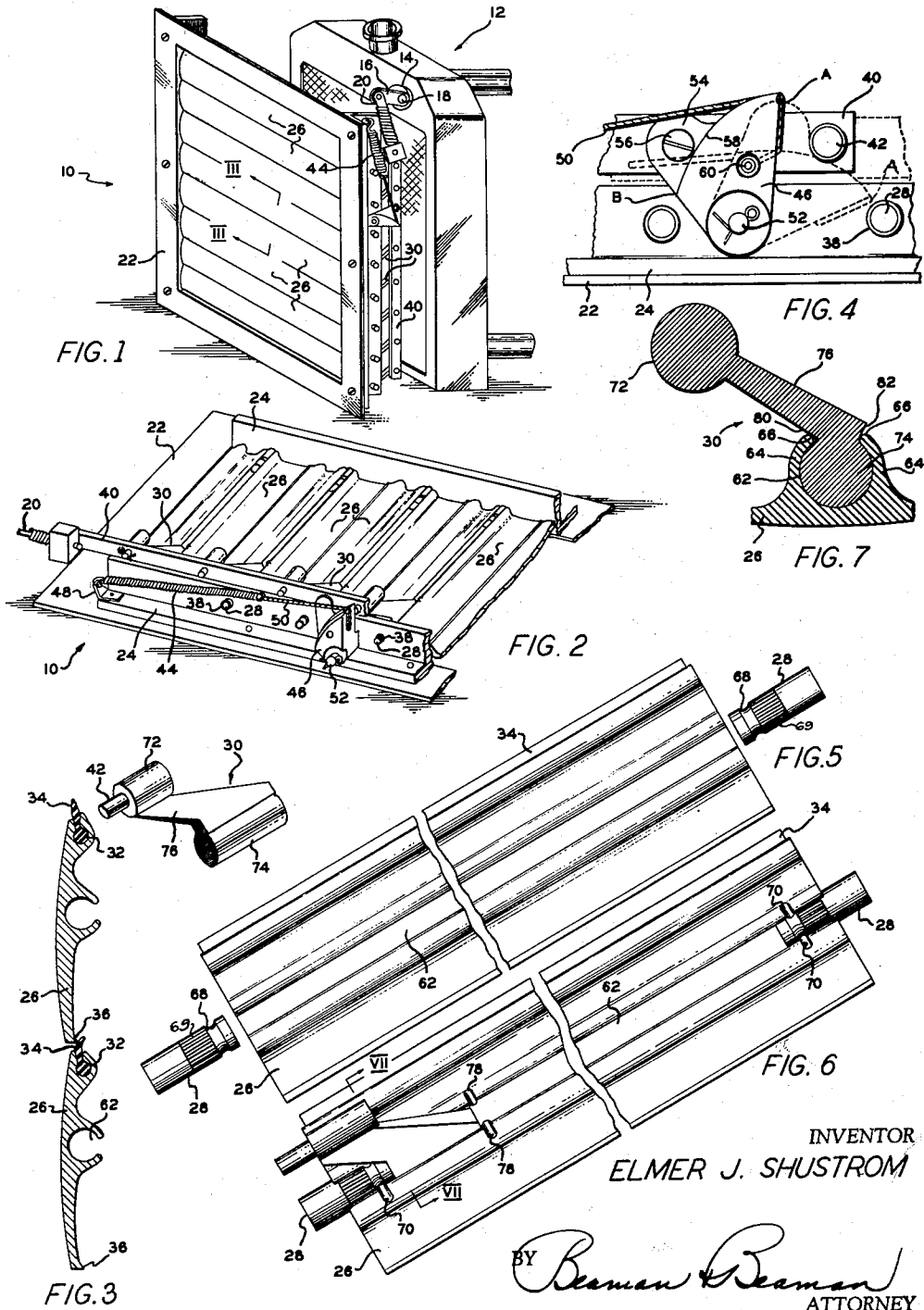


Dec. 24, 1963

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SHUTTER CONSTRUCTION
Filed July 18, 1960

3,115,223



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3,115,223

SHUTTER CONSTRUCTION

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Filed July 18, 1960, Ser. No. 43,413

4 Claims. (Cl. 189-62)

The invention relates to a shutter construction and particularly pertains to a shutter apparatus such as may be employed with shutters regulating air flow in response to a temperature sensitive control.

It is known to regulate ventilation control devices, such as shutter devices, by thermostatic means wherein the means will open and close the shutters in response to the temperature of the air flowing therethrough or the temperature of a heat exchanger affected by the air flowing through the shutter. In the internal combustion engine art, shutters are often employed to regulate the flow of air being drawn through the engine radiator and thermostatically controlled shutter apparatus of this type may employ a thermostat control sensing the temperature of the water within the radiator which controls the shutter to regulate the amount of air passing through the radiator and, hence, the temperature of the water within the same.

In the interest of economy, it is desirable that the thermostat control means directly control the shutter and eliminate the use of servomotor or amplifying means interposed between the thermostat and the shutter actuation apparatus. One of the difficulties with the attainment of this object lies in the fact that known thermostatically operated actuators are often incapable of producing the force necessary to accurately control the shutter or the thermostatic control is unable to operate the shutter equally well between the fully closed and the fully open shutter positions due to the wide range of forces necessary with conventional shutter constructions employing spring biasing means.

It is, thus, an object of the invention to provide a shutter construction which may be very accurately controlled by conventional thermostatically operated actuating means wherein the forces required to actuate the shutter between the maximum open and closed positions is substantially constant and well within the operating range of the actuator.

Another object of the invention is to provide a shutter construction employing a spring biasing the shutter vanes to the closed position wherein the force necessary to open the vanes is substantially constant throughout the movement of the vanes.

Yet another object of the invention is to provide an extruded shutter construction wherein the vane and vane components may be readily constructed of corrosive resistant materials and the components of the vane may be readily assembled thereto.

Yet a further object of the invention is to provide an extruded vane construction wherein economical means are employed to assemble the components of the vane and maintain the same in their proper positions and wherein the mechanical configuration of the vane permits a crank arm to be readily affixed thereto in a positive manner.

These and other objects of the invention arising from the details and structural relationships of an embodiment

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thereof will be apparent from the following description and accompanying drawing wherein:

FIG. 1 is a perspective elevational view of a shutter, in accord with the invention, as related to an internal combustion engine radiator,

FIG. 2 is a perspective view of the back side of the upper portion of the shutter employed in FIG. 1,

FIG. 3 is an elevational sectional view of a pair of vanes in the closed position as taken along section III-III of FIG. 1,

FIG. 4 is a detailed elevational enlarged view of the compensating spring anchor employed with the invention,

FIG. 5 is a plan view of the back side of a shutter vane and the components thereof shown in exploded relationship, in accord with the invention,

FIG. 6 is a plan view of the back side of a vane construction, in accord with the invention, with the components thereof in the assembled relationship, and

FIG. 7 is an enlarged detail elevational view of the crank member employed with the vane as taken along section VII-VII of FIG. 6.

A typical manner in which the shutter construction of the invention may be employed is shown in FIG. 1 wherein the shutter 10 is located adjacent and in front of an internal combustion engine radiator 12 of the type which is normally filled with water. A fan, not shown, is usually employed behind the radiator to draw the air therethrough and by regulating the opening and closing of the vanes of the shutter, the amount of air flowing through the radiator may be accurately controlled to regulate the temperature of the water within the radiator.

A thermostatic unit 14, which may be similar to the type disclosed in U.S. Patent No. 2,368,182, is mounted on the radiator 12, and in the illustrated embodiment the thermostatic unit is located in the upper region of the radiator although it may be located at any desired radiator location. The thermostatic control unit 14 is provided with an arm or lever 16 which will rotate in a counterclockwise direction, FIG. 1, about the axis 18, as the temperature of the water within the radiator 12 rises. The lever 16 is connected to a compensation actuating rod 20 which may employ a spring such that upon the tension or compression forces within the rod exceeding a given value the spring will expand or compress and provide a safety feature to prevent injury to the thermostatic unit. The unit 14, lever 16 and rod 20 form no part of the present invention and may be of any conventional type.

The shutter construction employed in the invention is best illustrated in FIGS. 1 and 2 and consists basically of a frame 22 on which may be located a pair of spaced parallel angle members 24 upon the back side of the frame. The vanes 26 are of elongated configuration and are preferably constructed of an extruded member having a cross-section as shown in FIG. 3. The vanes are provided with a bearing shaft 28 at each end and a crank member 30 having a crank axis offset with respect to the axis of the bearing shafts is affixed to the vanes in a manner later described. An elongated projection defining a recess 32 is formed adjacent one of the edges of the vanes to receive a flexible sealing lip 34, of rubber, neoprene or the like, and the other longitudinal edge of the vane is provided with a flange 36 which engages the seal-

ing lip of the adjacent vane, FIG. 3. Preferably, the vane and the crank member are constructed of aluminum or similar material and the bearing shafts are of stainless steel to resist corrosion.

A plurality of holes are formed in the angle members 24 in opposed relation which serve as the bearings for the bearing shafts 28. To insure long wear and corrosion resistant operation, the holes are lined by an annular nylon bushing 38 and the bearing shaft is rotatably received within the nylon bushing.

The crank arms 30 of the vanes comprising the shutter are interconnected by a rigid control rod 40 having holes therein to receive the bearing pivot 42 of the cranks and a cotter pin or similar device may be used to maintain the control rod upon the bearing 42. The compensating rod 20 of the thermostatic unit 14 is affixed to the control rod 40 and it will be appreciated that upon a longitudinal force being applied to the control rod the vanes will rotate in unison about their respective axes and, hence, simultaneously open and close in the known manner.

To close the shutter, e.g., the vanes rotated to the position such that their relative relationships will be as in FIG. 3 that no air may pass therethrough, a spring 44 is employed to bias the vanes toward the closed position. To insure that all of the vanes rotate toward the closed position simultaneously, the action of the spring 44 is imposed on the control rod 40 and the force of the spring is applied to the control rod through a spring compensating member 46, FIGS. 2 and 4. One end of the spring 44 is affixed to a spring anchor 48 attached to one of the angle members 24 and a cable, or similar tension transmitting member 50, is attached to the other spring end. The spring compensating member 46 is pivotably affixed to the angle member 24, to which the spring anchor 48 is attached, by a pivot shaft 52 and a boss 54 formed on the member 46 has a hole defined therein whereby a screw 56 may pivotably attach the member 46 to the control rod 40. To insure that pivoting of the member 46 is uninhibited, it will be appreciated that the distance between the axes of the pivot 52 and the screw 56 and the axes of the vane bearing shafts 28 and crank bearing pivot 42 are equal and it will be also noted, FIG. 4, that lines connecting these respective pairs of axes are parallel. Thus, rotation of the spring compensation member 46 about pivot 52 will longitudinally move the control rod 40 and, hence, adjust the vanes in the desired angular relationship.

The spring compensation member 46 is provided with a curved surface 58 which is eccentrically related to the axis of the pivot 52. It will be appreciated that the portion of the surface 58 which is the greatest distance from the axis of the pivot 52 is located at the point A, FIG. 4 and the portion of the surface 58 which is closest to the pivot axis 52 will be at point B. The cable 50 is attached to the member 46 by a set screw 60 cooperating with a hole formed in the member through which the cable is passed and tightening of the set screw will compress and thereby attach the cable to the member. The cable 50 is passed over the portion A of the surface 58 as shown in FIG. 4 and will be tensioned to a linear form by the spring 44.

When the vanes are in the fully closed position, the spring compensation member 46 will be in that position shown in FIGS. 2 and 4 and it will be appreciated that as the distance from the point A to the pivot 52 is at a maximum the torque force exerted upon the member 46 will be at a value determined by the force within the cable 50 and this maximum distance. When the control rod 40 is moved to the right, FIG. 4, to the position which opens the vanes to the maximum open relation, the member 46 will have pivoted to the dotted line position and the cable 50 will be related to the surface 58, as illustrated. In the open position, it will be appreciated that the cable leaves the surface 58 at the point B which is a minimum

distance from the pivot 52. When the spring compensation member 46 is pivoted to the dotted line position of FIG. 4, the effective torque arm exerted by the spring 44 upon the member 46 will be considerably less than the effective torque arm with the member 46 in the full line position and while the minimum effective torque arm will not be equal to the minimum distance between the surface 58 and the pivot 52 the minimum effective torque arm will approach this minimum distance due to the frictional engagement of the cable with the surface. Therefore, upon the actuation of the control rod 40 in the direction to open the vanes the resultant pivoting of the spring compensation member 46 will cause the tension spring 44 to longitudinally expand and although the resultant expansion of the spring requires an increasingly greater force for each unit of longitudinal expansion the fact that the effective torque arm through which the spring force is being applied to the compensation member decreases in length compensates for the increased force necessary to expand the spring and, hence, a substantially uniform force is required to move the control rod from the fully closed position to the fully open position. It will be appreciated that if the spring 44 were directly connected to the control rod 40 and, for instance, one pound of force were required to move the control rod one inch to the right, two pounds of force would be required to move the control rod an additional inch and, hence, the force required to move the rod will become increasingly greater as the vanes approach the open position. By the use of the compensating member 46 the applicant eliminates the problem of an increased force necessary to actuate the control rod and by properly relating the configuration of the surface 58 to the characteristics of the spring, it is possible to produce a biasing action upon the vanes which may be overcome by a substantially uniform force applied to the control rod 40 by the thermostatic unit 14.

The disclosed embodiment shows the surface 58 as having a groove therein to receive the cable 50 and the use of such a groove will increase the frictional contact between the cable and member. It is also appreciated that by replacing the cable 44 with a chain and forming sprockets cooperating with the lengths of the chain on the surface 58 that a positive connection between the spring and the member may be obtained throughout the entire pivoting action of the compensating member and a positive connection will be achieved between the tension member, chain in this case, and the compensating member at all pivotable positions of the member whereby the axial torque arm exerted by a spring upon the member will be equal to the minimum distance between the point of contact of the chain with the surface 58 in respect to the axis of the pivot 52.

The vanes 26 employed with the invention are preferably of the above described type and referring to FIG. 5, it will be additionally noted that the extruded configuration of the vanes includes projections defining central cylindrical chamber 62 extending the length of the vanes. The chamber 62 being defined by upstanding arcuate finger portions 64, FIG. 7, which terminate in longitudinal edges 66. The stainless steel bearing shafts 28 may be machined from stainless steel stock and are provided with an annular groove 68 and a knurled portion 69, FIG. 5. Upon inserting the bearing shafts 28 into the cylindrical chamber 62 and upsetting portions 70 of the fingers 64 to force vane metal of the fingers into the grooves 68 the bearings will be firmly affixed to the vanes and the knurled portions 69 will resist rotation of the shafts within the chamber 62. The upsetting of the portions 70 may be done by a punch press operation and provides a positive mechanical connection between the bearing shafts and the vanes.

The crank member 30 may be formed from an extrusion consisting of a pair of cylindrical portions 72 and 74 interconnected by a web 76. By a simple sawing operation, the extrusion may be formed as shown in FIG.

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5 after the bearing pivot 42 has been turned upon the portion 72. In assembling the crank portion 30 to the vane, the cylindrical portion 74 is inserted into the chamber 62 and the left bearing stud, FIGS. 5 and 6, is inserted after the crank bearing portion. Thereupon, the finger portions 64 may be upset at 78 to prevent axial movement of the crank portion to the right and upon upsetting the finger portions into the groove 68 of the left bearing stud movement of the crank member and bearing shaft to the right is prevented. Thus, it will be appreciated that riveting, welding or threaded fasteners are not employed in the assembly of the vane components and that merely the upsetting of portions 70 and 78 of the vanes are necessary to establish a positive assembly. It will also be appreciated that the construction of the invention provides an unobstructed and attractive front vane surface, FIGS. 1 and 3, and the usual rivets or such which are a part of conventional vane construction are not required.

The configuration of the crank member 30 is best seen in FIG. 7 and it will be noted that the web 76 is attached to the cylindrical portion 74 in a somewhat tangential manner whereby a surface 80 and a shoulder 82 are formed on the web adjacent the cylindrical portion 74. The dimension and relationship of the surface 80 and shoulder 82 is related to the dimension separating the edges 66 of the fingers such that the finger edges 66 engage the surface 80 and shoulder 82 as shown to prevent angular movement of the crank member relative to the vane.

It will therefore be appreciated that the invention discloses a shutter construction which is of economical, dependable construction and the use of the spring compensation member provides control characteristics which, when used with a thermostatic control of the known type, which are highly accurate and lie within the capabilities of the thermostatic control. Prior shutter construction employing self powered thermostatic control are inconsistent in their operation, particularly in the area approaching the fully opened position and sufficient force was not produced to effectively close the shutters to obtain a relatively airtight seal. The invention overcomes the above disadvantages of prior constructions, yet produces a purely mechanical and dependable apparatus of economical cost.

It is understood that various embodiments to the invention may be apparent to those skilled in the art without departing from the spirit and scope thereof and it is intended that the invention be defined only by the following claims.

I claim:

1. In a shutter apparatus, a supporting frame, a plurality of parallel shutter vanes pivotally mounted on said frame selectively pivotable between open and closed positions, an actuating arm defined on each of said vanes having a crank pin in spaced relation to the pivot axis of the vane, a control rod interconnecting the crank pins of said arms providing like and simultaneous operation of said vanes, means selectively positioning said control rod, a tension spring biasingly associated with said control rod tending to bias said rod in a given direction, a lever pivotally mounted on said frame about a support pivot axis and pivotally attached to said control rod, an arcuate spring extension engaging surface defined on said lever eccentrically related to the pivot axis thereof, said arcuate surface having a minimum radial dimension from said lever pivot axis at one end of said surface progressing to a minimum radial dimension at the other end of the surface and a flexible spring extension attached to said spring and fixed to said lever as to frictionally engage said arcuate surface thereof during pivoting of said lever, said spring extension engaging surface being of such configuration and being so related to said lever pivot axis that said spring imposes a substantially equal biasing force on said control rod throughout the operative pivoting range of said lever, said extension engaging the mini-

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imum radial dimensions of said surface at maximum extension of said spring.

2. In a shutter control apparatus comprising, in combination, a thermostatic control member, a shutter including a supporting frame, a plurality of parallel shutter vanes pivotally mounted on said frame selectively pivotable between open and closed positions, an actuating arm defined on each of said vanes having a crank pin in spaced relation to the pivot axis of the vane, a control rod interconnecting the crank pins of said arms providing like and simultaneous operation of said vanes, means connecting said thermostatic control member to said control rod for selectively positioning said control rod by said control member, a spring biasingly associated with said control rod tending to bias said rod in a given direction and compensating means interposed between said spring and said control rod varying the biasing force exerted on said control rod in dependence upon the angular position of said vanes, said compensating means including a lever member pivotally mounted on said frame about a pivot axis, an arcuate spring extension engaging surface defined on said lever eccentrically related to the pivot axis thereof, said arcuate surface having a maximum radial dimension from said lever pivot axis at one end of said surface progressing to a minimum radial dimension at the other end of the surface and a flexible spring extension attached to said spring and fixed to said lever as to frictionally engage said arcuate surface thereof during pivoting of said lever, said spring extension engaging surface being of such configuration and being so related to said lever pivot axis that said spring imposes a substantially equal biasing force on said control rod throughout the operative pivoting range of said lever, said extension engaging the minimum radial dimensions of said surface at maximum extension of said spring.

3. In a shutter vane construction, a vane body having front and rear sides, longitudinal edges and lateral ends, a pair of spaced, parallel, arcuate, longitudinally extending projections integrally formed on the rear side of said body member defining a cylindrical recess, said projections having terminating edge portions defining a longitudinal slot providing access to said recess, cylindrical bearing shafts received within said recess adjacent to and projecting beyond each lateral end, portions of said projections adjacent said shafts being deformed into said recess maintaining said shafts therein, a crank arm affixed to said vane, said crank arm having a cylindrical portion received within said recess and a web portion extending through said slot, abutment shoulders defined on said web portion adjacent said cylindrical portion engaging said projection terminating edge portions preventing rotation of said arm cylindrical portion within said recess and inwardly extending projection portions deformed into said recess adjacent said cylindrical portion preventing longitudinal arm displacement therein.

4. In a shutter vane construction, a vane having front and rear sides and lateral ends, a pair of spaced longitudinally extending arcuate projections defined on the rear side of said vane intersecting the lateral ends thereof, said projections having spaced longitudinally extending terminating edges and including inner cylindrical surfaces defining a cylindrical recess accessible at said vane lateral ends and between said projection edges, the spacing between said projection terminating edges being less than the diameter of said recess, a cylindrical bearing shaft received within said recess adjacent each of said vane lateral ends and projecting therebeyond, a groove defined on the bearing shaft portions received within said recess having shoulder edges transversely disposed to the axis of said shafts and recess, portions of said projection terminating edges being deformed into said bearing shaft grooves preventing axial movement of said shafts relative to said recess, an actuating crank arm affixed to said vane, said crank arm having a cylindrical portion complementary in configuration to said recess and received therein, abut-

ment shoulders defined on said arm cooperating with said projection terminating edges preventing rotation of said crank relative to said vane, said terminating edges being deformed adjacent an end of said cylindrical crank portion forming stop means maintaining said portion within said recess.

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