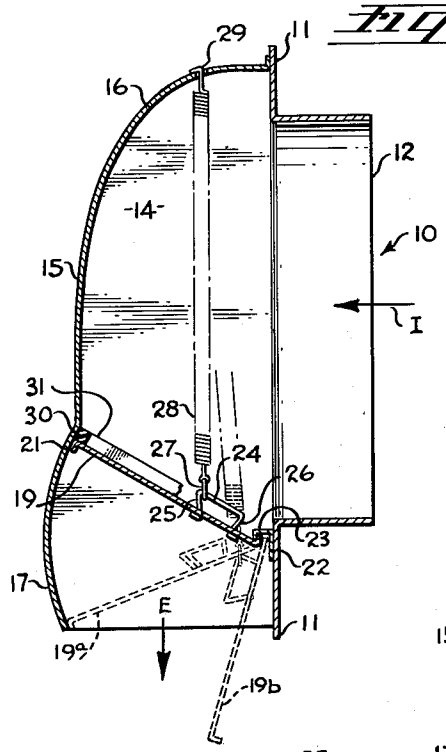
Oct. 9, 1962 R. A. PAPSDORF 3,057,288

SHUTTER ASSEMBLY FOR EXHAUST DUCT WALL CAP

Filed May 5, 1959

Fig. 1



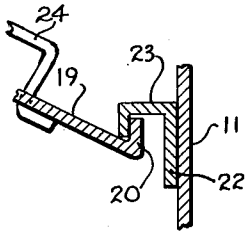


Fig. 4

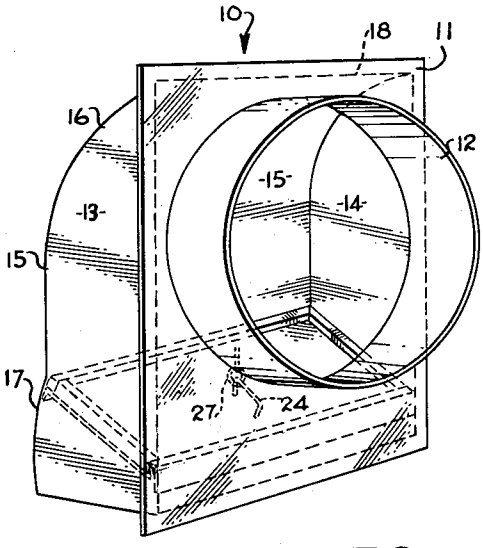


Fig. 2

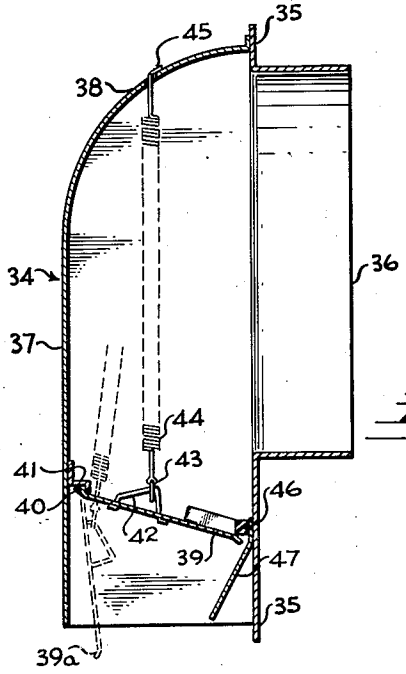


Fig. 3

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SHUTTER ASSEMBLY FOR EXHAUST DUCT WALL CAP

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The present invention relates to exterior wall caps for vent fan exhaust systems and the shutter means employed therein for excluding wind and outside air from the exhaust duct, and more particularly to a variable-leverage closing mechanism for a shutter conformed and adapted to interfit with the housing in a manner which utilizes the force of the air stream on the shutter in a novel way to assist in opening the shutter.

Of the various exhaust duct wall cap assemblies that have come within applicant's scope of observation in the prior art, most have employed shutter arrangements of some type to prevent back drafts in the exhaust duct. Many of these shutters were gravity actuated with the shutters designed to assume generally vertical normally closed positions of repose. Others have employed conventional spring loading to urge the shutters to the closed position, with the spring attached at a fixed position on the shutter such that the force of the spring is a minimum when the shutter is closed whereas the maximum force is then needed.

It is observed, moreover, that the efficiency of the operation of these devices is often impaired as a result of corrosion at the hinge or pivot points and also by a gradual lessening or variation in the effective closing spring tension in those employing conventional spring means.

It is scarcely necessary to point out the importance of having a tight closure in the wall cap to prevent the possibility of back drafts particularly in the case of domestic or residential kitchen exhaust systems in which the interior opening of the duct is generally relatively close to the exhaust point. Because of their intermittent use, an exhausting flow of air is not continuously maintained and so these systems are especially subject to back drafts as a result of wind outside.

The present invention has been made with the foregoing considerations in mind and can be said to have a plurality of important objectives.

One important object of the present invention is the provision of an exhaust air duct exterior wall cap assembly having a closure shutter disposed therein in a manner adapted to prevent the ingress of outside air and at the same time imposing minimal resistance to the flow of exhaust air.

A further important object of my invention is the provision of a device of the character described in which the force effective to move the shutter to the closed position is applied variably according to the position of the shutter in its arc of rotation, the closing force being reduced rather than increased as the shutter moves to a fully open position.

Another object of the present invention is the provision of a device of the character described having a closure shutter adapted to interfit with elements interiorly of the wall cap housing and to be rotatably supported therein without the use of conventional hinge or pivot means.

An additional object of the present invention is the provision of a device of the character described in which the tension means effective to urge the shutter to the normally closed position is also effective to maintain the position of the shutter relative to its axis of rotation interiorly of the wall cap housing.

In brief, the exterior wall cap and shutter assembly of

my invention includes a housing having an inlet aperture lying in a vertical plane and a downwardly directed exhaust aperture at the bottom thereof lying in a plane that is horizontal or generally so. The housing has a substantially clear vertically extending passageway therebetween. An angular member having a downwardly extending flange is horizontally disposed and affixed to the inner surface of one housing wall. Said one wall and the flange cooperate to provide an inverted channel. Felt stop strips are affixed in coplanar alignment with the shutter on the other walls to engage the shutter in closed position.

The shutter member is planar in form and has an edge portion turned upwardly along one side and adapted to be received longitudinally in the inverted channel. A slide rod is spaced upwardly from the upper surface of the shutter. The axis of the rod is disposed transversely of the shutter and at right angles to the upturned edge in the channel. The slide rod is slidably engaged by a ring attached to the lower end of a coil spring which depends centrally of the passageway from the top of the housing, the spring being effective to draw the shutter upwardly in the housing against the undersurfaces of the stop strips and to maintain the engagement of the edge portion thereof within the channel.

In the preferred form of my invention the channel is located interiorly of the wall cap housing immediately below the air inlet aperture. When in the normally closed position the shutter is inclined diagonally upward from the channel, and the side of the housing opposite the channel is arcuately shaped to conform closely to the rotational arc of the adjacent edge of the shutter, thus enabling the shutter to extend across the entire sectional area of the housing. The edge of the shutter remains close to the housing wall at said arcuate enlargement for a large part of the travel of the shutter from a closed position to a fully open position.

The upward tension of the coil spring holds the upturned edge of the shutter in constant engagement within the channel recess, eliminating the need for conventional hinges. Since the slide rod is inclined upwardly away from its rotational axis when the shutter is closed, the traveler ring slides to the higher end of the rod, which also is the end farther from the pivotal axis, and holds the shutter tightly closed. However, when the internal air pressure within the system causes the shutter to rotate downwardly, the inclination of the slide rod relative to the horizontal reverses and the traveler ring slides to the other end of the slide rod nearer the pivot, thereby greatly reducing the leverage of the retaining spring and enabling the exhaust air stream to swing the shutter downwardly more easily to the fully open position.

Possible variations of the above embodiment and additional objects of the invention will become apparent upon examination of the following detailed specification together with the references made therein to the accompanying drawings, of which:

FIG. 1 is a vertical sectional view taken centrally of a wall cap housing and shutter assembly constructed in accordance with my invention and shows the shutter in the normally closed position intermediate and fully open positions of the shutter being shown in broken lines.

FIG. 2 is a front perspective view of the assembly seen in FIG. 1.

FIG. 3 is a vertical sectional view taken centrally of an assembly embodying a variational form of my invention.

FIG. 4 is an enlarged fragmentary section like FIG. 1 through the hinge arrangement for the shutter.

Reference is made to FIGS. 1 and 2 which show the preferred form of a wall cap and shutter assembly constructed in accordance with my invention and indicated

generally by the numeral 10. The cap is illustrated in the typical position occupied when mounted on the face of a vertical wall and will be described in that aspect; but it will be realized that it may be in other positions. The wall cap housing structure is seen to include a front vertical plate member 11 which serves as a mounting panel for attaching the assembly to the side wall of a building. A circular aperture is disposed in the plate 11 interiorly of a cylindrical sleeve portion 12 extended forwardly from the plate, the sleeve 12 being adapted to interfit and communicate with an air duct (not shown) interiorly of the building.

Extended rearwardly from the plate 11, on the side opposite from the sleeve 12, are the end walls 13 and 14 and the rear wall 15, the ends being contoured and the rear wall being arcuately conformed at the top, as indicated at 16, for the purpose of directing the exhaust air downwardly. Adjacent the bottom, rear housing wall 15 is arcuately shaped at 17 to provide space for rotation of the shutter as will be more fully explained hereinafter. As is best seen in FIG. 2 the plate 11 is preferably extended both laterally and vertically beyond the rest of the housing as indicated by the broken line 18 to provide a flashing and assure water tightness interiorly of the housing.

The shutter construction will be readily understood by reference to the sectional views of FIGS. 1 and 4. The shutter 19 is generally planar and rectangular in outline, and is provided with a narrow edge portion 20 turned upwardly along one long side, and an opposite edge portion 21 turned downwardly along the other side. The latter is provided principally as a reinforcing flange for stiffening the shutter member since it is made of light gauge material. A longitudinal stringer 22 is attached to the inner surface of the plate 11, being disposed horizontally immediately below the air inlet aperture interiorly of the sleeve 12. The stringer 22 is angular in cross section so as to provide an inverted channel 23 in which the upturned edge flange 20 of the shutter 19 is received, thus providing a fixed horizontal axis of rotation for the shutter. Stringer 22 alone or in cooperation with the housing wall, depending on the shape of the stringer, defines the channel receiving flange 20.

A slide rod 24 is disposed inwardly of and generally parallel to the upper surface of the shutter 19 and is attached thereto in any suitable way, as by means of oppositely extended L-shaped legs 25 and 26 passing through spaced apertures in the shutter. A traveler ring 27, best seen in FIG. 2 is slidably mounted on the slide rod 24, and is attached to the lower end of a coil spring 28 which depends centrally and interiorly of the housing from its point of attachment 29 at the top thereof. The force imposed in this manner on the shutter by the spring 28 is effective to hold the upturned edge 20 of the shutter 19 engaged in the recess of channel 23, and the other edges of the shutter 19 in tight contact with the undersurfaces of felt stop strips, such as 30 and 31 which are affixed to the inner surfaces of the end walls 13 and 14 and the rear wall 15 in coplanar alignment with the channel portion 23 of the stringer 22.

The operation of the shutter and the manner in which it is adapted to vary the leverage of the closing spring 28 is clearly shown in FIG. 1. Exhaust air, upon initiation of flow within the duct system, enters the wall cap housing 10 through the inlet aperture interiorly of the sleeve 12 in the direction indicated by the arrow I. When sufficient air pressure has built up behind the shutter 19 it begins to rotate downwardly about the fixed horizontal axis defined by the channel 23. It will be observed, however, that during an initial portion of shutter rotation the moving edge 21 of shutter 19 remains closely adjacent the inner surface of the arcuately shaped section 17 of the wall 15 while the shutter moves from closed position to dotted position 19*a*. Hence air pressure is maintained behind the shutter during initial opening movement, substantially without diminution. Full force of the air pressure continues to rotate the shutter downwardly against the slightly increasing opposing force exerted by the increasing extension of the spring 28.

It might be interpolated at this point that if the spring tensioning were applied in the conventional manner wherein the spring is attached to the shutter at a single fixed point, the shutter would of course rotate downwardly to a partially open position but it could hover uncertainly while seeking an angle of equilibrium compatible with both the internal air pressure and the varying effective tension of the spring, and it would continue to offer substantial resistance to the exhaust air stream.

However, when the shutter 19 has rotated downwardly to the position indicated in phantom at 19*a* the shutter and rod 24 have passed through a horizontal position and now the inclination of the rod is reversed relative to the horizontal. The end closer to the pivotal axis is the higher end. Consequently the pull of spring 28 exerts a component parallel to rod 24 that moves the traveler ring 27 now along the slide rod 24 toward the axis of rotation in the channel 23 until restrained by downwardly extended leg 26, thus substantially reducing the leverage exerted by the spring 28. The effective lever arm is reduced by the length of rod 24. Moreover, since the traveler ring 27 must of necessity slide upwardly during its movement toward the axis, it thereby permits a slight contraction of the coil spring thus further reducing the effective pull imposed upon the shutter. The shorter lever arm and reduced spring pull combine to permit the shutter to swing downwardly more easily and to be held at or near the normal open position indicated at 19*b* by an air stream of comparatively low pressure.

In the closed position of shutter 19 as illustrated in FIG. 1, rod 24 is inclined upwardly away from the axis of shutter rotation at channel 23. As the shutter opens, this rod passes through a horizontal position and its inclination is reversed, becoming inclined upwardly toward the axis of shutter rotation. The minimum angle that rod 24 makes with the horizontal when in closed position is determined by the coefficient of friction between rod 24 and ring 27. This friction can be reduced in various ways, as by a choice of suitable materials and by having smooth, polished surfaces on the rod and on the ring so that the two members slide with respect to each other more easily. Friction is also reduced to a minimum by limiting the areas of the surfaces in contact on these members. Of course other types of members can be provided to engage the rod, for example a roller or grooved wheel riding against the underside of rod 24.

The length of the arcuate section 17 of the housing is such that ring 27 slides to the upper end of rod 24 just before the outer end of the shutter passes the lower end of housing wall 17. The air pressure opening the shutter is maintained at a high value until the shutter clears the end of the housing wall and after this is reduced. Consequently the opposing force of spring 28 is preferably reduced just prior to the reduction in the air pressure opening the shutter. After the spring moves ring 27 to the inner and upper end of rod 24 as with the shutter in the position 19*a* the reduction in force tending to close the shutter allows the air pressure to move the shutter easily to a fully open position as at 19*b*.

Obviously, the length of rod 24 and the positions of its ends relative to the axis of shutter rotation determine the change in leverage applied by spring 28. These factors can be varied as desired to produce optimum operation of the shutter. It will be seen that with the dimensions shown in FIG. 1 the leverage in the open position is reduced to about one-half that applied in the closed position. Also, spring 28 is preferably made relatively long. It may be a comparatively soft spring

and because of its relatively small percentage of elongation between the closed and open positions it exerts only a slightly greater pull when elongated. For example, the spring may be designed to elongate only about 20% at the most. Consequently the reduction in leverage far more than offsets the increased spring pull due to elongation with the result that the net force acting on the shutter to close it is considerably reduced when in the fully open position as compared with the force exerted on the shutter when in the fully closed position. Advantage may be taken of this to apply a force sufficient to insure a full closure of the shutter whenever no air is flowing through the wall cap from inlet I to exhaust E.

It is noteworthy, in connection with the foregoing, that the edge portion **20** of the shutter **19** is of such size and angular disposition that the edge **20** interfits between the vertical sides of the U-shaped channel and upwardly and interiorly against the inner surface of the horizontal portion thereof. The upward pull of spring holds edge portion **20** seated in the channel for all rotational positions of the shutter making unnecessary the conventional hinge pin.

An alternate arrangement of the shutter assembly constructed in accordance with my invention but adapted for use in a more generally conventional wall cap is shown in FIG. 3 which is a vertical sectional view similar to that of FIG. 1.

The wall cap housing **34** shown in FIG. 3 is seen to include a vertical plate member **35** having a sleeve portion **36** extended outwardly therefrom, but the opposite wall **37**, except for the curved section **38** at the top, is also planar in conformation and parallel to the plate member **35**, having no arcuately shaped area such as that shown at **17** in FIG. 1. The shutter assembly is comprised of elements similar to those employed in the first embodiment including a shutter **39** having an upturned edge portion **40** which is received in the downwardly facing recess of a channel member **41**. Channel forming member is angular in cross-section, but is Z-shaped rather than U-shaped as is member **22**. Consequently a portion of wall **37** cooperates to define the channel receiving and confining the upturned edge flange **40** of the shutter. A slide rod **42** attached to the shutter is slidably engaged by a traveler ring **43** affixed to the lower end of a coil spring **44**, attached at its upper end **45** to the top wall **38** of the housing.

The channel member **41** is affixed to the inner surface of the housing wall **37**. As shown in FIG. 3 the shutter **39** when fully closed has its upturned edge **40** engaged in the channel **41** and its opposite edge bearing against the under-surface of the stop member **46**. It will be noted that the shutter **39** is inclined downwardly from its axis of rotation **41**. A vane member or air deflector **47** is extended diagonally inwardly from the inner surface of the plate **35**, and serves to retard the escape of the exhaust air stream between the outward or moving edge of the shutter **39** and the deflector **47** during the initial period of shutter movement. As previously explained in connection with FIG. 1, it is desired that pressure be maintained behind the shutter until it is forced downwardly to a point where the traveler ring **43** slides toward the axis **41**, thereby reducing the leverage of the spring **44** and permitting the shutter to rotate to the fully open position indicated at **39***a*. Deflector **47** performs a function similar to housing wall **17**.

In the embodiment of FIG. 3, traveler rod **42** makes a substantial angle with the shutter in order that the rod may be inclined upwardly and away from the axis of rotation when the shutter is closed as compared with the reverse inclination when the shutter is open. This permits the ring to slide along the rod as described before. The shutter itself is not necessarily required to move from an upwardly inclined to a downwardly inclined position as in FIG. 1, although this arrangement is advantageous under some circumstances.

A comparison of the embodiment shown in FIG. 1, and the alternate form of the shutter assembly seen in FIG. 3, as adapted for use in a standard wall cap housing, will serve to make the differences in the two and the advantages of the preferred embodiment more completely understood. The arcuate enlargement of the air passageway at **17** makes possible a greater rotational range for the shutter **19** and further provides uniform spacing of the edge **21** of the shutter and the inner surface of the housing; the area of the shutter is substantially the same as the cross sectional area at any point in the air passageway; and operation of the leverage shifting mechanism is smooth and efficient since it is completed during the pre-opening movement of the shutter, the range of pre-opening shutter travel being evenly divided between rotation above and below a generally horizontal plane at which the shutter and the direction of tension are relatively perpendicular.

The most important single superiority of the housing assembly seen in FIG. 1 resides in its freedom from restrictions to the air flow, its sectional area being substantially the same along any horizontal plane and offering no constrictive resistance to exhaust air flowing outwardly thereof in the direction of the arrow E.

From the foregoing it will be observed that I have provided in my invention a wall cap assembly in which the possibility of back drafts is eliminated by virtue of the positive force exerted by the spring holding the shutter fully closed.

It will also be observed that the shutter assembly of my invention provides support means for the shutter without the use of conventional hinges or pivot members.

It has also been pointed out that the shutter assembly includes variable leverage means whereby the shutter closing force is reduced, rather than increased, during the final portion of its travel to fully open the passageway, and is restored to a maximum during the final closing movement, thus insuring a tight closure.

It will be further noted that, as a result of my invention, the shutter and housing elements are relatively dimensioned and conformed in a manner effective to provide an exhaust air passageway being of constant area and undiminished capacity throughout.

Although in order to comply with the statute the device of my invention has been shown and described in considerable detail in the particular form of a preferred embodiment, it will be understood that the details are subject to change and substitution and the embodiment to substantial variation, and the invention itself is amenable to adaptation into a plurality of embodiments and therefore is not to be considered as limited or restricted except as may be indicated by the following claims.

I claim:

1. In an exhaust air wall cap assembly including a housing having an air passageway therethrough, the combination with a pressure-responsive shutter mounted rotatably within said passageway to swing about a horizontal axis, spring means connected to the shutter adapted to impose a force on said shutter effective to rotate it to a closed position upwardly of said passageway, and wall means providing an arcuate surface concentric with said axis and closely spaced from the moving edge of the shutter which extends parallel to and is spaced from said axis substantially to prevent air flow past the shutter during the initial portion of the movement from closed to fully open positions while said moving edge is closely spaced from said arcuate surface, the range of movement of the shutter being sufficient to swing the shutter past said arcuate surface to an open position.

2. The invention in accordance with claim 1 that also includes means connecting the spring to the shutter adapted to move the position of application of said force to said shutter in a direction transversely of said axis, said connecting means including a rod rigidly mounted on the shutter and lying in a plane substantially perpendicu-

lar to said horizontal axis, said rod reversing its inclination with respect to the horizontal as the moving edge of the shutter traverses the arcuate surface of the wall means, and means slidably connecting the spring to the rod.

3. A wall cap assembly as in claim 2 in which the means connecting the spring to the shutter moves the position of application of said force to said shutter between two fixed points lying on a line in the plane of the shutter.

4. In an exhaust air wall cap assembly including a housing having a vertically extending air passageway therethrough, the combination of:

a pressure-responsive shutter interfitting with said passageway;

means rotatably mounting the shutter on the housing to swing about a horizontal axis at one edge of the shutter and within said passageway;

spring means connected at one end to the housing,

and means connecting the spring at the other end thereof to the shutter to provide an automatically changing location of application of a force to the shutter relative to said axis, which force is effective to rotate the shutter to a closed position, said connecting means including a member on the shutter spaced from and extending transversely to said axis and inclined upwardly and away from the axis when the shutter is in closed position and reversing its inclination relative to the axis when the shutter is rotated through an acute angle from the closed position toward an open position.

5. A wall cap assembly for an air exhaust system, comprising the combination of:

a housing having air inlet and exhaust apertures therein and defining a passageway therebetween;

a variably-tensioned shutter assembly including a channel member defining a recess opening downwardly and affixed horizontally to an inner surface of said passageway;

a spring member depending centrally of said housing from the top thereof and having a traveler attached to the lower end thereof;

a shutter member having an upturned edge portion adapted to be rotatably received within said recess in said channel to establish a pivotal connection between the shutter and channel about a horizontal axis, the shutter being movable about said axis between a closed position and an open position,

and slide rod means attached to and located above said shutter and engaged slidably by said traveler, said rod extending transversely of said channel and being inclined upwardly toward said axis when the shutter is in the open position and inclined upwardly away from said axis when the shutter is in the closed position.

6. In a wall cap assembly for an air exhaust system, the combination comprising:

a wall cap housing having spaced air inlet and exhaust apertures and defining an exhaust air passageway therebetween;

a shutter assembly including a shutter and hinge means having a normally horizontal axis connecting the shutter at one edge to the inner surface of a wall of said passageway;

stop means carried by the housing and engageable by said shutter;

coil spring means depending centrally of said housing from the top thereof and having a traveler ring affixed to the lower end thereof;

and slide rod means mounted on and above the shutter and having a portion lying substantially in a plane perpendicular to said axis and slidably engaged by said traveler ring, said spring means engaging said slide rod means at one side of the axis to swing the shutter upwardly interiorly of said passageway to a normal closed position in contact with said stop means;

the portion of said slide rod means engaged by said traveler ring being inclined upwardly away from said channel when the shutter is closed and oppositely inclined when the shutter is open so that the highest point thereof, to which said traveler ring is adapted to slide, is spaced furtherest from said axis when said shutter is in said closed position and is closest to the axis when the shutter is in open position, thereby providing said spring means maximum leverage when said shutter is in said closed position and minimum leverage when the shutter is in open position.

7. A wall cap and shutter assembly for an air exhaust system comprising:

a housing including a planar side wall adapted for attachment to a building wall, said planar side wall having an air inlet aperture therein and a sleeve outwardly extended circumferentially of said aperture, spaced end walls extending from said planar side wall oppositely from said sleeve, and an outer side wall curved to join said planar side wall to close the top of said housing and having an arcuate section adjacent the bottom thereof, said housing being open at the bottom to permit egress of exhaust air therethrough;

a rigid channel member having a recess opening downwardly thereof being affixed in a horizontally extending position to the inner surface of said planar wall below the aperture therein;

stop strips disposed in coplanar alignment with said channel at the outer side wall and end walls of said housing;

a coil spring depending centrally of said housing from the top thereof and having a traveler ring affixed to its lower end, said spring being adapted to swing said shutter upwardly and interiorly of said housing to a closed position against the undersurfaces of said stops;

a generally planar shutter member having an upturned edge portion adapted to be rotatably received within said recess in said channel to establish a generally horizontal axis substantially at the center of curvature of the arcuate wall section and about which the shutter swings with one edge thereof closely spaced from said arcuate wall section over an initial portion of the swinging movement of the shutter;

a slide rod angularly conformed and including a section above and extending normally to said channel and disposed generally parallel to the shutter, said slide rod section being engaged by said traveler ring slidably thereon and movable with the shutter between an inclination upwardly and away from said channel when the shutter is in said closed position and an opposite inclination when the shutter is in an open position.

8. The wall cap and shutter assembly in accordance with claim 7 and further characterized by said spring being adapted in tension to enable said shutter to rotate downwardly in response to the normal exhaust air pressure thereon, and to hold said upturned edge of said shutter in engagement within said channel recess during said downward rotation.

9. The wall cap and shutter assembly in accordance with claim 7 and additionally characterized by the plane of said coplanar alignment of said stop strips with said channel being disposed diagonally upwardly from said channel to the upper termination of said arcuate section of said housing, said shutter when in the fully closed position being disposed immediately below and adjacent to said plane of alignment.

10. The wall cap and shutter assembly in accordance with claim 7 in which said channel member is spaced from and co-axial of the concave inner surface of said

arcuate section of said housing whereby the range of pre-opening travel of said shutter between the top and bottom of said arcuate section is substantially evenly divided between rotation above and below a generally horizontal plane of reference containing said horizontal axis and at which the shutter and the direction of effective spring tension are relatively perpendicular.

11. An exhaust air wall cap assembly comprising:

a housing having an air passageway therethrough extending in a generally vertical direction;

an air pressure responsive shutter of light gauge sheet metal rotatably disposed in said passageway;

a horizontally extending angular member defining a downwardly facing recess extending across substantially the full width of the air passageway and attached to an inner wall surface of the passageway;

said shutter having along one side an upturned integral marginal flange adapted to be received in the recess to establish with the channel a horizontal axis of rotation of the shutter;

and spring means above and attached to the housing at a location in the air passageway above the shutter and to one face of the shutter to pull the shutter upwardly to engage the stop means and maintain the flange thereon in said recess against the force of gravity.

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