May 14, 1940.

W. C. AGERELL ET AL

2,200,733

RADIATOR SHUTTER UNIT

Original Filed Jan. 15, 1937

4 Sheets-Sheet 1

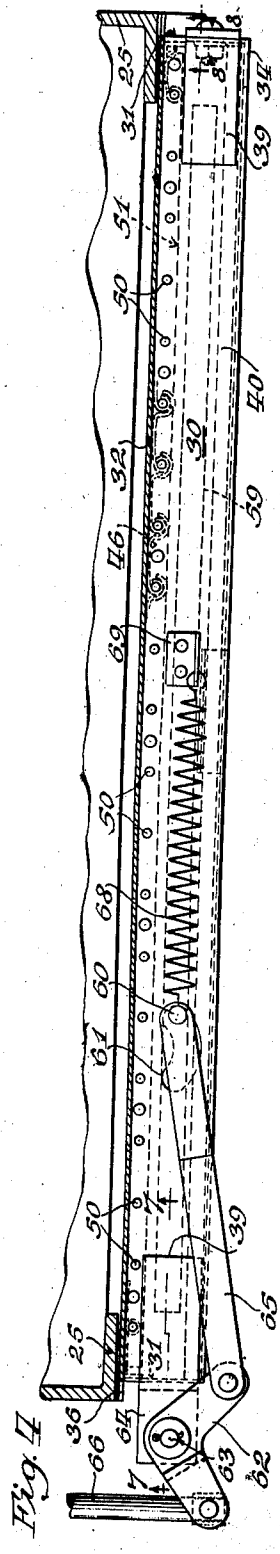


Fig. 4

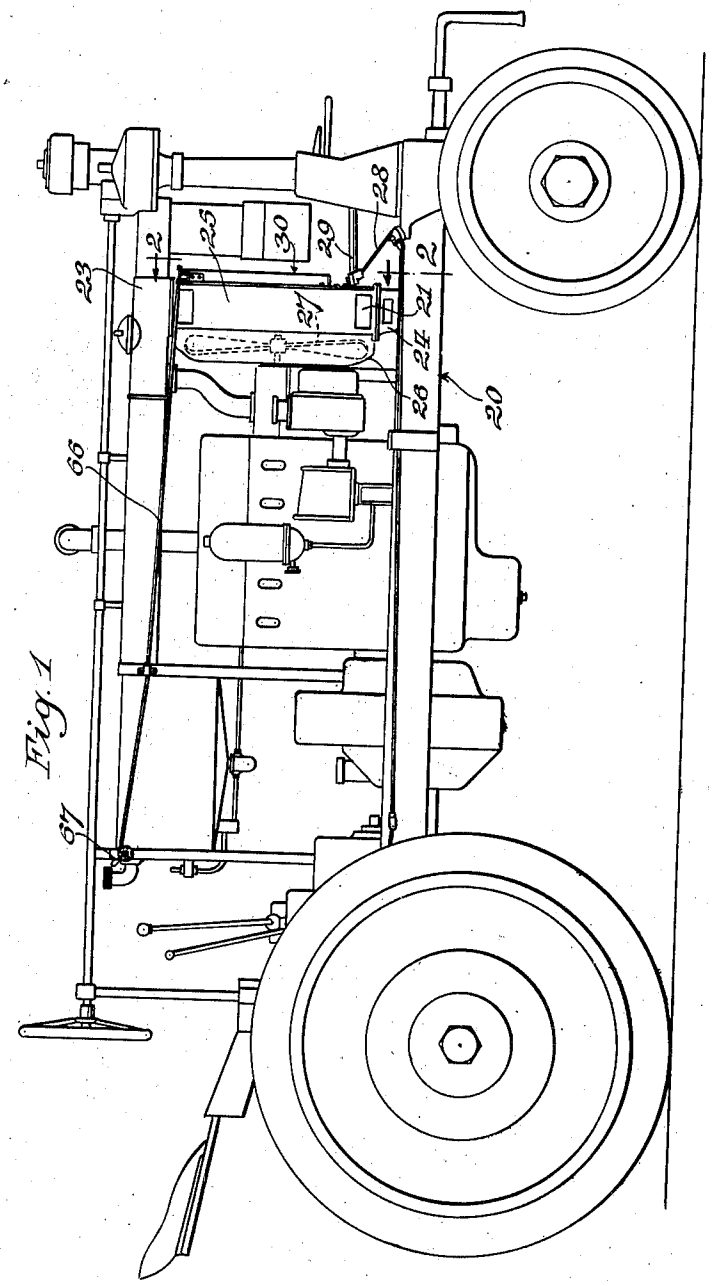


Fig. 1

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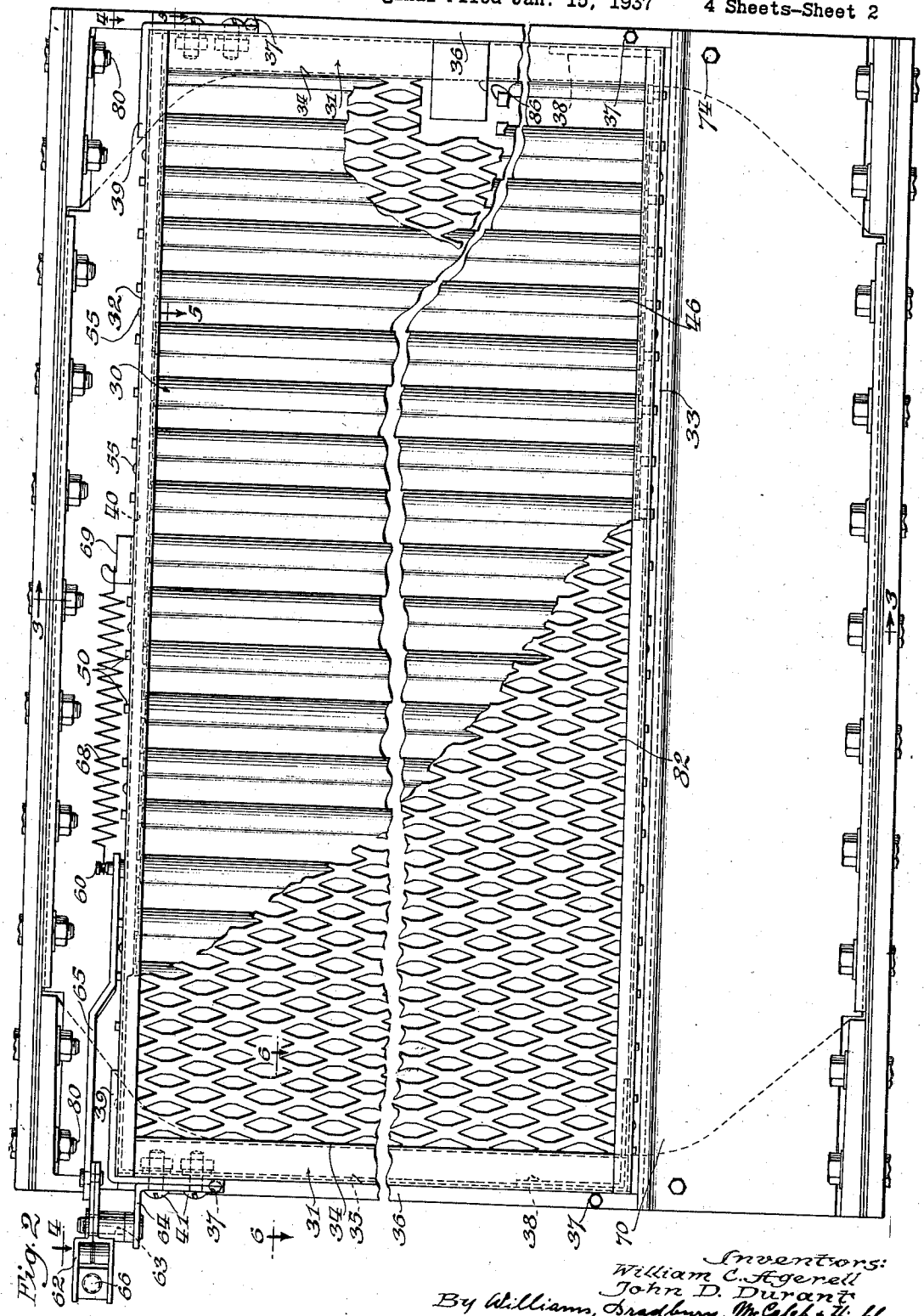


Fig. 2

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RADIATOR SHUTTER UNIT

Original Filed Jan. 15, 1937 4 Sheets-Sheet 3

Fig. 3

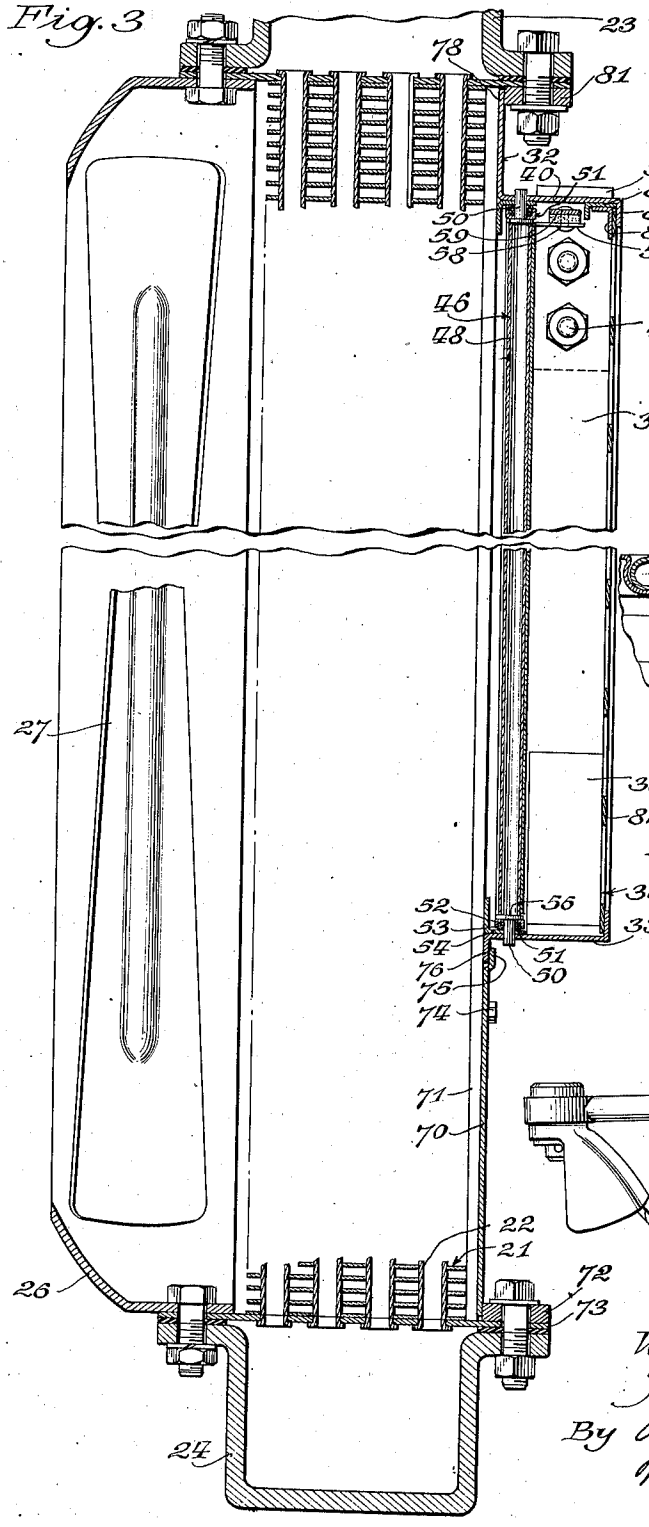
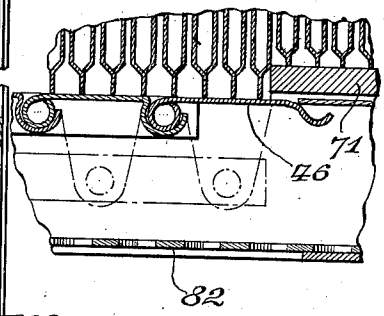


Fig. 9



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May 14, 1940. W. C. AGERELL ET AL 2,200,733

RADIATOR SHUTTER UNIT

Original Filed Jan. 15, 1937 4 Sheets-Sheet 4

Fig. 5

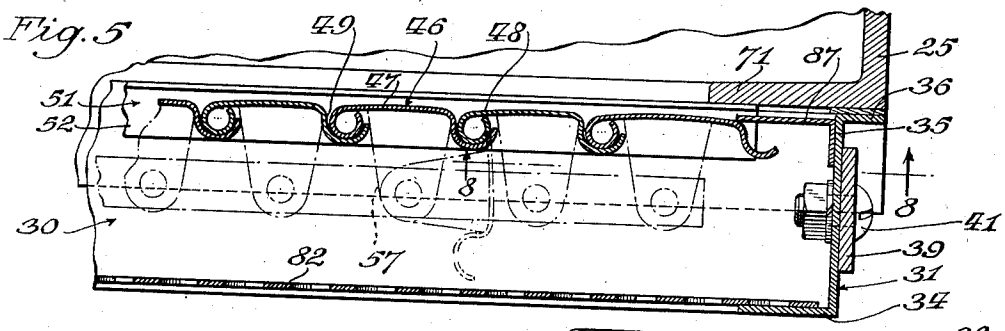


Fig 6

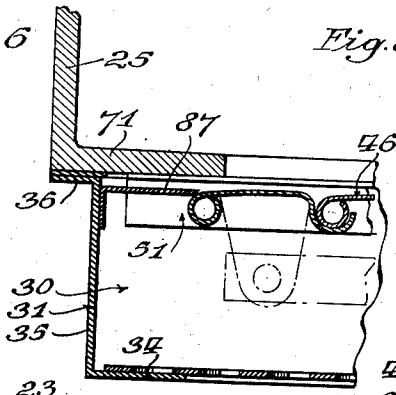


Fig. 8

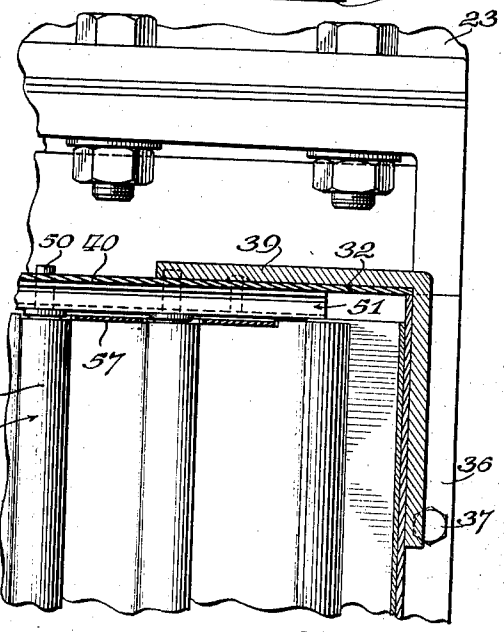
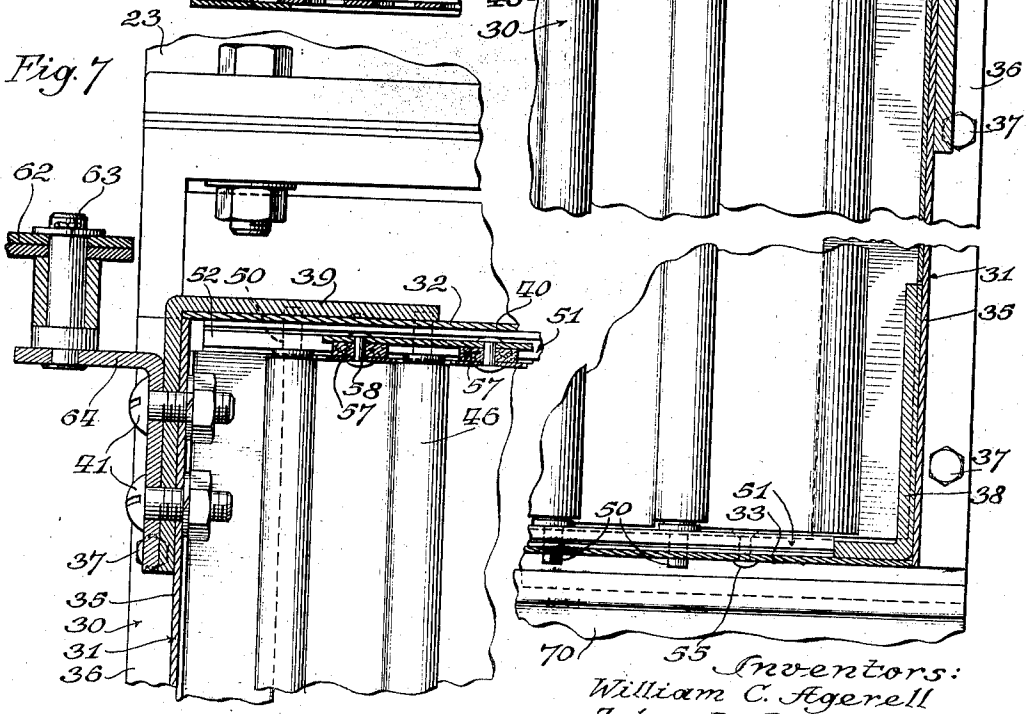


Fig. 7



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UNITED STATES PATENT OFFICE

2,200,733

RADIATOR SHUTTER UNIT

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Application January 15, 1937, Serial No. 120,694
Renewed October 12, 1939

10 Claims. (Cl. 257—132)

Our invention relates to radiator shutter units, and especially radiator shutter units for controlling the flow of cooling air through the radiators of internal combustion engines.

Many of the objects and features of the present invention are concerned especially with problems peculiar to radiator shutter units for tractors or for stationary engines of similar type. Tractors seldom achieve any considerable ground speed. At the same time their motors are subject to unusually hard pulls which tend to increase the amount of heat to be dissipated through the radiator. For this reason the radiator fans are of unusual capacity and create a relatively large air pressure against the radiator which must be held back without substantial leakage by the shutter unit during the warming up period. Usual constructions of radiator shutters for automobiles if applied to tractors are found not to operate with the degree of efficacy achieved in automobiles. They do not hold so tightly against the fan pressure

Another problem encountered with tractors is that they normally operate on kerosene or lower grade distillate using gasoline only for starting. As the supply of gasoline for starting is very limited, it is important that the warming up of the motor be completed within a limited time in order that the supply of starting gasoline does not become prematurely exhausted. We have also found that due to the high fan pressures, if there is some substantial space between the radiator core and the closed shutter, a local circulation of air will be set up through the radiator core which will materially cool the radiator and often dangerously so despite the fact that the shutter may be tightly closed. To meet these conditions peculiar to tractors, we have so arranged the shutters that they tend to close under the air flow created by the fan, and we have also arranged the shutters so that when closed they lie substantially close to the core, whereby they substantially preclude the objectionable local circulation referred to above.

Other objects of our invention include an improved mounting for the shutter unit, a framing of the shutter which is rugged and yet permits convenient replacement of shutter blades, a protective grill for the shutters, and provision to allow clearance for working parts of the steering apparatus on certain types of tractors which interfere with the position which would normally be occupied by a conventional shutter unit.

The foregoing together with further objects, features and advantages of our invention are set forth in the following description of specific embodiments thereof, which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation of a tractor to which the shutter unit of our invention has been applied;

Fig. 2 is a front elevation of the shutter unit taken on the line 2—2 of Fig. 1;

Fig. 3 is a medial vertical section longitudinally of the tractor through the radiator and shutter unit taken on the line 3—3 of Fig. 2;

Fig. 4 is a plan section of the radiator unit taken on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary plan section at a slightly lower elevation on the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary plan section through the side frame of the unit taken on the line 6—6 of Fig. 2;

Fig. 7 is a vertical section looking rearwardly of the upper corner of the shutter unit taken on the line 7—7 of Fig. 4;

Fig. 8 is a vertical section, looking rearwardly, of the opposite lateral side of the shutter unit taken on the lines 8—8 of Figs. 4 and 5; and

Fig. 9 is a fragmentary plan section similar to Fig. 5, but showing a modified construction whereby the shutters when closed come still closer to the forward face of the radiator core.

Referring to Fig. 1, the radiator shutter of our invention is here shown as applied to a tractor 20, which has a radiator 21 comprising a core 22 (Fig. 3), an upper header 23, lower header 24 and channel-shaped frame sides 25. On its rearward side the radiator carries a shroud 26 for the radiator fan 27 at the forward end of the engine. The particular type of tractor here illustrated has a central forward vertical post which carries the axle for the front wheels. As an auxiliary steering aid for sharp corners or "square" turns, brakes on the differential are controlled by cables 28 run to a steering arm 29 which extends rearwardly from the post into rather close juxtaposition with the radiator.

It might be explained at this point that, because of the arm 29 in this particular type of tractor, there is not sufficient clearance at the elevation of the arm 29 between the end of the arm and the core for the radiator shutters to extend the entire distance from top to bottom across the front of the radiator core. Therefore, in a tractor shutter unit adapted for use in this particular type of tractor, and as here illustrated, the shutters extend down only to an elevation a spaced distance above the lower end of the core to provide ample clearance for the arm 29. It will

be understood that in tractors which do not have the interfering auxiliary steering arm 29, the shutters will extend substantially to the bottom of the core face.

The shutter unit indicated generally as 30 includes a rectangular frame consisting of lateral frame members 31, an upper frame member 32 and a lower frame member 33. Each lateral frame member 31, as shown in Figs. 5 and 6, is Z-shaped in cross section and comprises a forward flange 34, a web 35 and a rearward flange 36 which is disposed against the forward flange of the channel-shaped frame side 25 of the radiator and to which it is secured by cap screws 37.

The lower frame member 33 is of somewhat similar Z-shaped section with its forward and rearward flanges coplanar with those of the lateral frame members 31. At its ends the lower frame member 33 is secured to the lateral frame members 31 by inside angle braces 38, the respective legs of which are spotwelded to the inside faces of the webs of the respective shutter frame members. The upper shutter frame member 32 is secured at its ends to the lateral frame members 31 by an outside angle brace 39, one leg of which is spotwelded to the upper side of the horizontal web 40 of the upper frame member and the other leg of which is removably secured by bolts 41 to the outer side of the web of the lateral frame member 31.

A plurality of vertically journaled shutters 46 are mounted on the frame to extend between the upper and lower shutter frame members so that when the shutters are closed they shut off the field defined by the frame. Each shutter 46 comprises a web 47, a rolled bead 48 at one lateral edge and a channel 49 at the opposite lateral edge adapted to embrace and seal against the rolled bead 48 of the next shutter.

Each shutter at its respective ends carries a protruding pivot pin or trunnion 50 aligned with the rolled bead 48. The trunnions 50 are journaled in suitably spaced holes in upper and lower bearing strips 51. Each bearing strip (see Fig. 3) comprises a metal channel 52 facing away from the adjacent ends of the shutters, a filler strip 53 and a metal angle strip 54, the horizontal flange of which forms a closure plate for the channel 52. The filler strip 53 is preferably of laminated and oil impregnated fibre and the bearing holes therein rather snugly fit the trunnions, while the registering holes in the webs of the channels 52, in the closure flange of the angle strips 54, and in the horizontal webs of the upper and lower shutter frame members 32 and 33 are somewhat oversize, so that metal to metal bearing contact is avoided. The bearing strips 51 are secured by rivets 55 to the associated webs of the frame channels. Preferably the trunnions 50 carry washer-like shoulders 56 whereby the edges of the body of each shutter are kept out of contact with the bearing strips.

At its upper end the web portion 47 of each shutter is extended forwardly in a horizontal plane to provide an operating arm 57. Each arm 57 is pivotally connected at 58 to a shutter operating bar 59 for gang operation of the shutters. A post 60 extends upwardly through a slot 61 in the web 40 of the upper frame member. The slot 61 is arcuate to conform with the arcuate path to which the post 60 is confined as the operating bar 59 swings the shutters through 90° between their open and closed positions.

A bell crank 62 is pivotally mounted at 63 to a bracket 64 at one of the upper corners of the shutter frame. The bell crank 62 interconnects a link 65 pivotally mounted on the post 60 and an operating rod 66. The operating rod 66, as shown in Fig. 1, extends rearwardly of the tractor to an adjusting lever 67 within convenient reach from the driver's seat. A tension spring 68 between a bracket hook 69 and the post 60 urges the operating bar 59 in the direction to close the shutters. The adjusting lever 67 may be releasably locked in any one of a number of adjusted positions whereby the rod 66 will shift the bar 59 to hold the shutters in full open position or in closed position or in a plurality of intermediate partially closed positions.

As previously explained, in order to provide clearance for the arm 29 of the auxiliary steering mechanism, the shutters do not extend down to the bottom of the core face, but only to the intermediately placed lower frame member 33. A removable panel 70 closes the face of the core below the shutters.

The ends of the panel 70 overlap the forward flange 71 of the radiator frame sides 25 and are removably secured thereto by cap screws 74. The lower edge of the panel 70 is inserted immediately behind the lower washer plate 72, by which the lower header plate 73 is bolted to the attaching flange of the lower header 24. The upper margin of the panel 70 has a forward offset 75 which overlaps and seals against the downturned flange 76 of the lower frame member 33. In this manner the panel 70 has a substantially air tight contact at its edges whereby the panel effectively shuts off air supply to the radiator below the shutters.

By unscrewing the cap screws 74, the panel 70 may be removed and stored elsewhere during the summer season. It is not necessary to remove the shutters during the summer season; they may be locked in full open position where they do not substantially interfere with the air supply to the radiator.

The shutter unit is mounted on the radiator frame by the cap screws 37 threaded into the radiator frame sides 25. The upper edge of the vertical flange 78 of the upper frame member 33 extends into the slot-like space between the rearward edge of the upper washer plate 81 and the forward face of the radiator core whereby leakage of air around the upper edge of the shutter frame is effectively precluded.

By removing the screws 37 and disconnecting the control rod 66, the shutter unit may be removed after the panel 70 is removed from the tractor.

If it is necessary to remove one of the shutters for repair or replacement, the bolts 41 are removed, permitting the upper frame member, together with the bearing strip, to be removed from the remainder of the frame and from the shutters. This permits any shutter to be lifted out of its bearing in the lower bearing strip.

A protective screen 82 of woven wire, or as here shown of expanded metal, is preferably mounted on the shutter frame forwardly of the open position of the shutters to prevent any injury to them and to keep out any foreign matter, such as twigs, straw, etc., which might clog the shutters. At its lateral and bottom margins the screen 82 is spotwelded to the rearward faces of the forward and vertical flanges of the bottom frame member 33 and the lateral frame members 31. Its upper edge, however, is not similarly welded to the forward depending flange 83 of the upper frame member 32. That would

interfere with the ready removability of the upper frame member 32 for repairs of the shutters. Instead (see Fig. 3) the upper edge of the screen 82 carries a reinforcing strip 84 of angle section to which it is spotwelded. The strip 84 is received in a channel formed by the flange 83 and the depending flange of an angle strip 85 spotwelded to the underface of the web 40 of the upper frame member 32 near its forward edge.

The reinforcing strip 84 and the angle strip 85 cooperate to hold the upper edge of the screen in position and against inward movement, while still permitting the ready removal of the upper frame member 32. For certain models of tractors, an opening 86 (to be seen at the right of Fig. 2) may be provided at one lateral edge of the screen for passage of the connecting pipe of an oil cleaner, not shown.

The operation of the shutter unit is as follows: when the tractor engine is to be started, when it is cold, the driver manipulates the adjusting lever 67 to push the rod 66 forwardly and together with the tension of the spring 68 swing the shutters to their closed position. In the closed position the channel 49 formed in the free edge of each shutter embraces the bead 48 of the pivotal edge of the adjacent shutter and forms a substantially air tight seal therewith.

The beaded pivotal edge of the first shutter, as shown in Fig. 6, comes in close working contact with a terminal strip which is secured by means of a forwardly offset flange to the inner face of the web 35 of the adjacent lateral shutter frame member 31. The free or channel edge of the last shutter seals against the terminal strip 87 at the other side of the shutter frame. The upper and lower edges of the shutters extend to their respective bearing strips with only the necessary working clearance. The shutter frame shuts off air leakage at the sides and top of the shutters, and the panel 79 shuts off air leakage below the shutter unit. Referring to Fig. 3, the vertical flanges of the upper and lower angle strips 54 overlap, and lie in intimate planar proximity to, the shutter panels when in their closed position, thereby further sealing the slight working clearance between the shutter ends and the bearing strips occasioned by the trunnion shoulders 56. This prevents any air passing from the front of the radiator through the core.

The fuel feed to the motor is turned to its gasoline starting supply and the motor is started. The shrouded fan will churn the air, but cannot cause any substantial circulation of air through the radiator. After the engine, the water or other medium in the circulating system, and the radiator have been warmed up with the heat of the engine to the required operating temperature, the fuel feed is turned to the kerosene or other lower grade fuel supply and the control lever 67 is reset to open the shutters to the degree necessary to maintain the required operating temperature.

Opening movement of the hand lever 67 pulls the rod 66, turning the bell crank 62 clockwise (Fig. 4) and through the link 65 pulling the operating bar to the left (Fig. 4) against the tension of the spring 68. The operating bar acts through the several shutter arms 58 to swing the shutters toward their open positions. In any subsequent complete or partial closing movement of the shutters, the lever 67 exerts a push on the rod 66, but rigidity of the rod 66 is not essential because the tension spring 68 is then permitted to pull the shutters toward closed position, and this is supplemented by the effect of the air drawn through the shutters by the fan.

If the shutters were mounted to swing rearwardly when they open, the plane of the closed shutters would be at a considerable distance away from the front face of the core. The same would be true to a lesser degree if each shutter were pivotally mounted on an axis intermediate its edges. One of the salient features of the present invention is that the plane of the closed shutters substantially juxtaposes the front face of the radiator. This is important, especially in installations on tractors or radiators for other engines where the fans are especially powerful. If there is a relatively large space left between the front face of the core and the closure plane of the shutters, the fan will set up local eddy currents through the core, the air traveling rearwardly through the core at the region of greatest pull of the fan and returning forwardly through the core at regions of lesser pull, especially toward the corners of the core. When the plane of the closed shutters lies very close to the front face of the core, such eddy currents are effectively minimized because there is then but very restricted passage for such currents between the shutters and the core face.

Fig. 9 shows a modification where this advantage is realized still further. A honeycomb radiator core is used and the lateral margins of its face are recessed for reception of the front flange 71 of the channel shaped side frames of the radiator. In this manner the front face of the core is brought into contact with the panel portions of the shutters when they are in their closed positions. In this modification there is no opportunity for any eddy currents. In practice, the preferred form shown suffices to avoid such eddy currents to an extent necessary to avoid most of their harmful effects.

We have thus found that if the space between the plane of the closed shutter and the forward face of the core is excessively large, measuring from front to back, it offers a substantially unrestricted space for local circulation whereby cold air is circulated from the space behind the fan and shroud, forwardly through the core especially adjacent the corners of the core, thence transversely or vertically through the space between the front face of the core and the plane of the closed shutters and back through the core at the region of greater pull of the fan. This is not necessarily recirculation of the same air, which in time would become warm, but involves introduction of new and cold air from the space at the rear of the radiator. If this condition prevails under very low temperatures, enough cold air may be circulated through the core, even though the shutters are closed, to permit the water to freeze in the radiator while the engine is running.

By mounting the shutters so that when closed they come close to the front face of the core and by mounting them so that the draft of the fan tends to close them, a peculiarly effective closing-off of any substantial air circulation through the core is obtained, even though the fan is unusually powerful.

While we have described these specific embodiments of our invention, we contemplate that many changes and substitutions may be made thereover without departing from the scope or spirit of our invention.

We claim:

1. The combination of a cooling radiator for an internal combustion engine, the radiator comprising a core and a frame, said core having a core face, a fan at the rear of the radiator for pulling air rearwardly through the core, a shutter unit comprising a frame and a plurality of shutters, means for mounting the shutter frame on the radiator frame, each shutter having a bead at one edge, means for journalling each shutter on the frame at its beaded edge, the opposite edge of each shutter being constructed and arranged to swing into sealing contact with the beaded edge of its neighboring shutter to close the shutters, the journals of the shutters being disposed closely adjacent the front face of the core whereby, when the shutters are swung to closed position, their inner faces lie in a plane somewhat inwardly of their pivotal axes and sufficiently close to the core face to prevent substantial air circulation between the core face and closed shutters and parallel therewith, the shutters in opening swinging away from the core face whereby the pull of the fan tends to close them, and gang operating means for swinging the shutters.

2. A radiator shutter unit comprising a marginal frame having frame members at two opposed sides, each of said frame members having a bearing flange in an outwardly extending plane, and a rearward flange extending upwardly from the bearing flange and adapted to lie in the plane of, and closely adjacent the front face of, a radiator core, a bearing strip extending along the inner face of each bearing flange, a set of shutters extending between, and journaled in, the bearing strips, and an angle strip associated with, and extending along, each bearing strip and having one flange inserted between the bearing strip and its associated bearing flange and another flange extending inwardly between the bearing strip and core face for closely overlapping the associated ends of the shutters and the space between them and the bearing strip.

3. A radiator shutter unit comprising a pair of spaced bearing strips at opposed sides of the unit, a set of shutters extending between, and journaled in, the bearing strips, and an angle strip disposed along each bearing strip, each angle strip having one of its flanges disposed in the plane of the bearing strip and along the outer side thereof opposite the shutters and fixed to the bearing strip and having its other flange extending inwardly along an edge of the bearing strip and closely overlapping the ends of the shutters and the space between them and the bearing strip.

4. A radiator shutter unit mounted to lie across the front of a radiator core at the face thereof which is opposite its pull fan, the shutter unit comprising a battery of gang-operated shutter blades, frame members extending along the respective ends of the blades, and means for pivotally mounting the respective blades to swing between an open position and a laterally interengaging closed position, which closed position precludes substantial fan-drafted circulation of air parallel with the adjacent face of the core and between it and the blades, said mounting means comprising cooperating sets of male and female bearing elements journaling the blades to swing forwardly to open position and to swing rearwardly into close substantial parallelism with the adjacent core face for the closed position, the bearing of each set being carried respectively by, and at the rear of, the frame members and by, and at one lateral edge of, each of the blades.

5. A radiator shutter unit, according to claim 4, wherein the blades, when closed, present a rear closure face for the shutter unit which, in general, lies closer to the adjacent face of the core than do the axes of the bearing elements.

6. The combination with a radiator having front and rear core faces, a pull fan therefor behind the rear core face, and a battery of gang-operated shutter blades, of means for pivotally mounting the respective blades to swing between the open position and a laterally interengaging closed position which closed position brings the shutter blades so close to the front face of the core as to preclude substantial fan-drafted circulation of air parallel with the front face of the core and between it and the blades, said mounting means comprising frame members extending along the respective ends of the blades and cooperating sets of male and female bearing elements journaling the blades to swing forwardly to open position and to swing rearwardly into close substantial parallelism with the front core face for the closed position, the bearing elements of each set being carried respectively by, and at the rear of, the frame members and by, and at one lateral edge of, each of the blades.

7. The combination according to claim 6 wherein the blades, when closed, present a rear closure face for the shutter unit which, in general, lies closer to the adjacent face of the core than to the axes of the pivotal mounting means for the blades.

8. The combination of a pull fan radiator having a core face on the side opposite the fan, and a set of shutters for the radiator, each shutter comprising a generally flat panel, a bead along one lateral edge of the panel, and a running offset along the other edge of the panel for partially embracing and sealing against the bead of the adjoining shutter when the shutters are closed, and mounting means for spacedly mounting the shutters across the front core face to pivot about their respective beaded edges for gang-operation between (*a*) a co-planar closed position with the panels lying substantially in a plane in close proximity to the front core face with the pivots, beads and offsets lying outwardly of said plane, said proximity being sufficiently close to preclude substantial fan-drafted circulation of air between the front core face and the shutters, and (*b*) an open position with the panels extending away from the core face.

9. A shutter unit for a radiator comprising a pair of bearing strips at opposed sides of the unit, a set of laterally spaced vertical shutters extending between the bearing strips, means for journaling the ends of each shutter on the respective strips at one lateral edge of the shutter, means for mounting the strips on the radiator with the shutters covering the core face of the radiator, and a covering strip extending along each bearing strip and disposed parallel with, and closely adjacent, the plane of the closed shutters at the core face side thereof vertically to overlap the adjacent ends of the shutters and the gap between the ends of the shutters and the bearing strip to block passage of air through the gap.

10. The combination with a radiator having a core, an upper core plate, a top tank thereon, portions of the plate and tank protruding forwardly of the front face of the core, a washer

strip below the protruding portion of the plate and spaced forwardly of the core face to leave a downwardly opening slot between the core face and washer, and a marginally framed shutter unit,—of means for mounting the shutter unit on the front side of the radiator, including a rearward vertical flange extending upwardly from the top of the shutter frame into the slot to hold the upper end of the shutter end against outward movement.

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