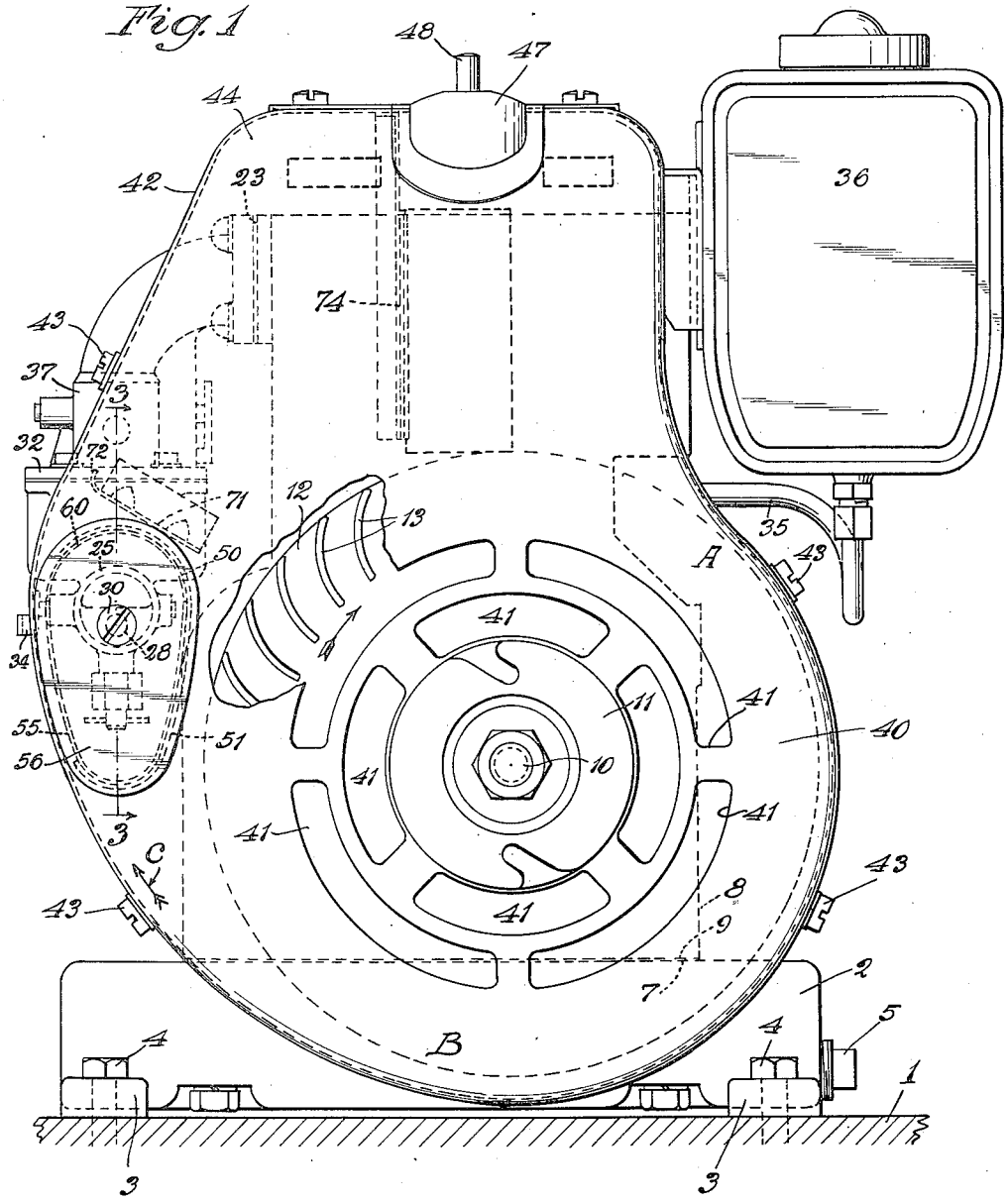
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INTERNAL-COMBUSTION ENGINE AND AIR CLEANER THEREFOR

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Fig. 1



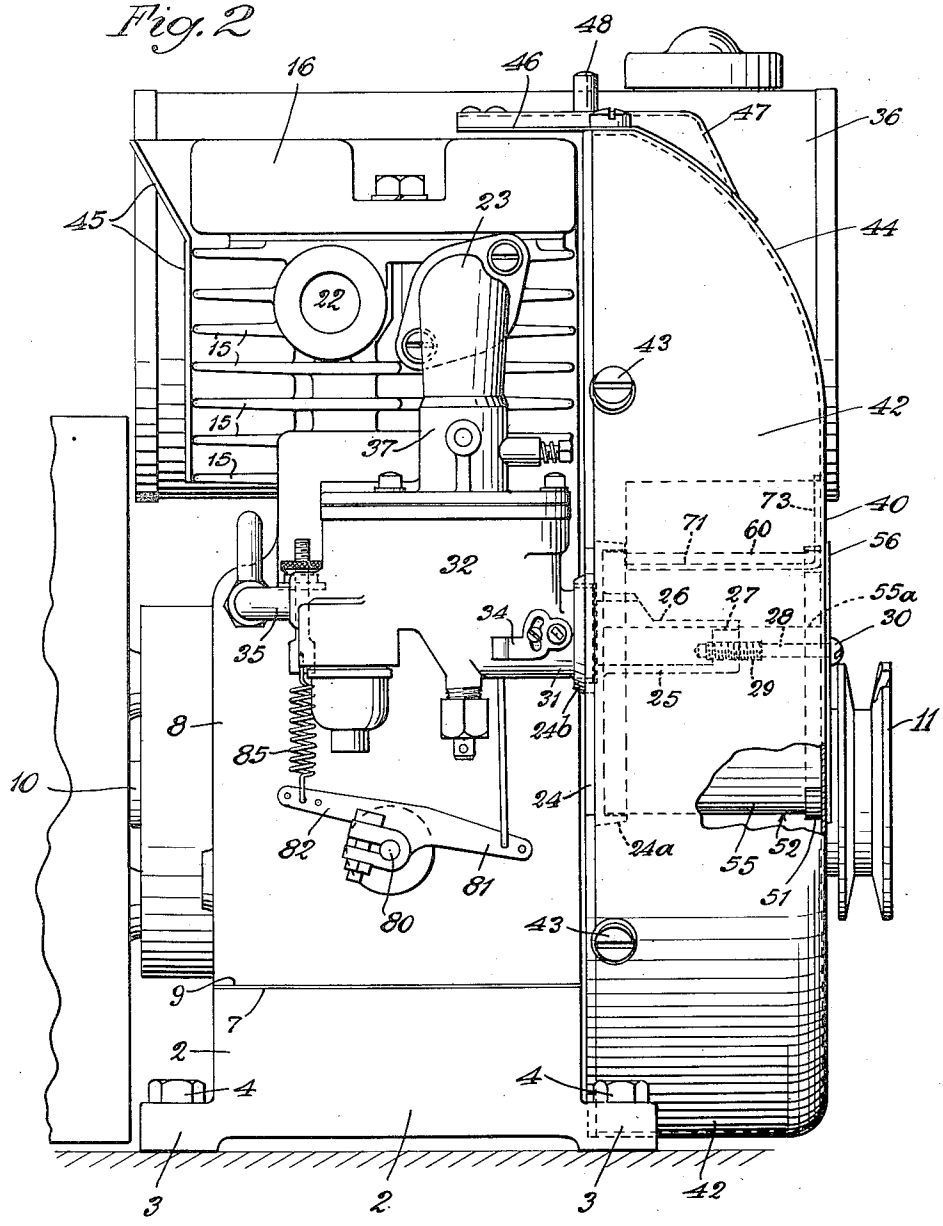

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INTERNAL-COMBUSTION ENGINE AND AIR CLEANER THEREFOR

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Fig. 2




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Fig. 3

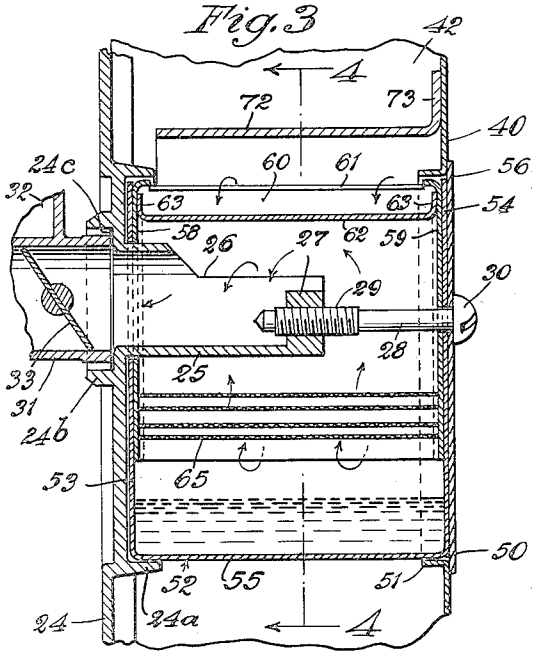



Fig. 4

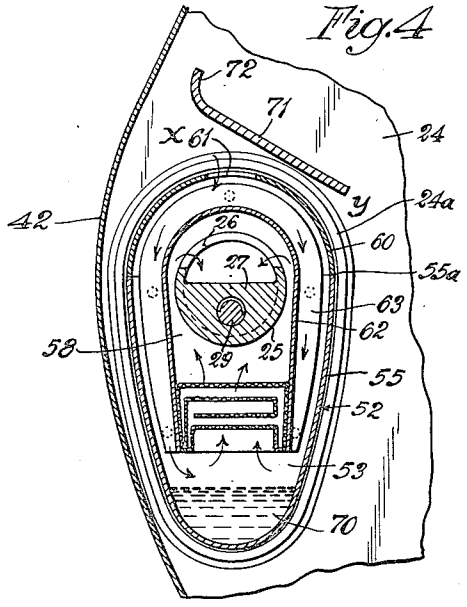
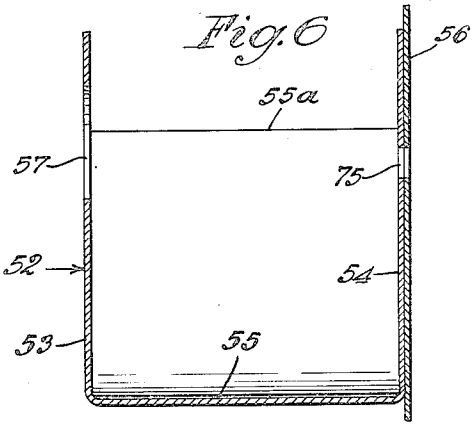



Fig. 6




6 → Fig. 5

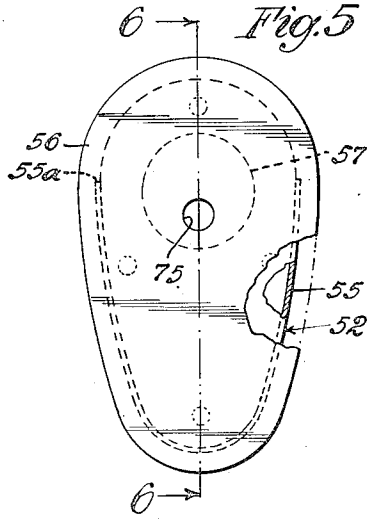
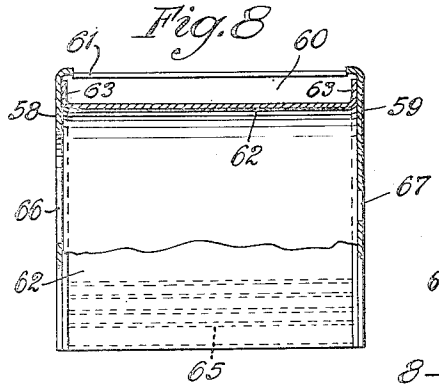



Fig. 8



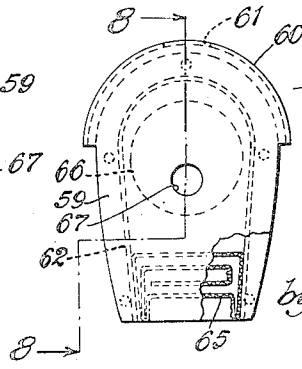




Fig. 7

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# UNITED STATES PATENT OFFICE

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## INTERNAL-COMBUSTION ENGINE AND AIR CLEANER THEREFOR

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Application January 8, 1945, Serial No. 571,844

14 Claims. (Cl. 123—195)

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This invention relates to an improvement in internal combustion engines and has for one purpose to provide a light, compact, efficient engine unit.

Another purpose is to provide improved means for supplying clean air to the carburetor of an engine unit.

Another purpose is to provide an improved shroud structure.

Another purpose is to provide an improved air cleaning means.

Other purposes will appear from time to time in the course of the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

Figure 1 is a front elevation with parts broken away and with some concealed parts indicated in dotted line;

Figure 2 is a side elevation;

Figure 3 is a section on the line 3—3 of Figure 1, on an enlarged scale;

Figure 4 is a section on the line 4—4 of Figure 3;

Figure 5 is an end view of part of the structure shown in Figure 4, with parts broken away;

Figure 6 is a section on the line 6—6 of Figure 5;

Figure 7 is an end view of part of the air filter structure, with parts broken away; and

Figure 8 is a section on the line 8—8 of Figure 7.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, 1 generally indicates any suitable support or surface on which the engine structure as a whole may be positioned. 2 is a hollow base structure adapted to serve as an oil reservoir. It is provided with flanges or lugs 3 through which may pass securing bolts 4. 5 is any suitable drain plug. 7 indicates the upper edge of the surface of the base which surrounds any suitable aperture, not shown, for communication with the interior of the engine block. The engine block is generally indicated at 8, and has a bottom wall portion 9 abutting against the corresponding portion 7 of the base 2. The details of the base and engine block do not of themselves form part of the present invention. It will be understood however that the engine block includes and surrounds an appropriate engine cylinder in which any suitable piston, not herein shown, may move, and wherein any suitable crank shaft 10 is rotatably positioned and is driven by said piston. 11 is any suitable starting pulley, the details of which do not form part of the present invention. 12 is any suitable fly wheel having a fan component or a series of blades 13. The upper portion of the engine block is provided about its sides with a plurality of cooling fins 15. Other cooling fins

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16, shown in end view in Figure 2, may extend upwardly from the top of the engine block. 22 is any suitable exhaust aperture from which may extend any suitable exhaust passage, not herein shown. 23 is any suitable inlet for the mixture. 24 generally indicates a unitary side plate with an outwardly extending tubular portion 25 having an upper cut away or air inlet portion 26 and an end lug 27 screw threaded to receive the thread 29 of a securing element or screw 28 having an external head 30. 31 is an air inlet passage extending to and preferably integral with a carburetor structure 32. Entry of air through the inlet 26 and along the member or passage 31 may be controlled by any suitable choke valve such as the butterfly valve 33 controlled by an exterior lever 34. 35 is any suitable liquid fuel inlet or passage extending to any suitable fuel tank 36, the details of which do not form part of the present invention. 37 is a mixture passage along which the carbureted mixture flows to the inlet 23 of the engine block. The details of the carburetor do not of themselves form part of the present invention.

Surrounding the fly wheel 12 and the fan 13 is a shroud generally indicated as at 40. It is provided with a series of arcuate air inlets 41, generally concentric with the axis of the shaft 10. The shroud includes a surrounding or side wall 42, extending to the engine housing to which it may be secured by any suitable securing screws 43. The direction of rotation of the fly wheel is indicated by the arrow in Figure 1. It will be noted that a substantial part of the side wall 42 of the shroud conforms roughly to the periphery of the fly wheel 12. This arc of conformity extends roughly from the point A of Figure 1 counter-clockwise to the point B. From that point the wall 42 diverges outwardly from the periphery of the fly wheel. The upper portion of the shroud includes a top wall portion 44 curved or inclined toward the top of the engine block and terminates at or slightly above the level of the upper edges of the top cooling fins 16. The shroud is so formed as to direct air horizontally along and between the fins 16 and along and between the fins 15. Any suitable baffle structure 45 may be employed in connection with the fins to deflect the air delivered along the fins. An upper deflector 46 may also be employed. The upper portion of the shroud 40 is also provided with a top plate 47 through which extends a shorting button 48 which may be moved into contact with any suitable spark plug located within the shroud.

It will be observed that the partition plate 24 carries at one side the carburetor structure 32 and at the other an air cleaner structure entirely housed within and included within the normal contour of the shroud 40. The plate 24 is provided

with a circumferential shoulder or outwardly extending flange 24a on the air cleaner side, and has a shoulder or integral sleeve 24b outwardly extending from the carburetor side. As shown in Figure 3 the carburetor is so positioned that its air intake element 31 extends within the shoulder 24b and is gasketed in any suitable fashion, as by the gasket 24c.

The air cleaner assembly is removably positioned within the shroud 40. The shroud is provided with an aperture 50 partially surrounded by an inwardly extending flange 51 opposite to and of the same shape as the circumferentially extending flange 24a. The assembly includes an outer air housing generally indicated as 52 and having end walls 53, 54 connected by a partly circumferential side wall 55 having upper edges 55a. 57 is an aperture in the end wall 53 of such size that the housing 52 can be slipped over the air inlet duct 25. It will be understood that the contour of the wall 55 is the same as that part of the flanges 24a and 51 which it engages. 56 is an outer wall or plate welded or otherwise secured to the end wall 54. The two walls are apertured as at 75 to receive the securing screw 28, whereby the air cleaner assembly may be locked or fastened in position as shown in Figure 3. It will be noted that the plate 56 is somewhat larger than the end wall 54, and overlaps the edges of the aperture 50. Removably inserted in the outer air cleaner housing 52 is a structure which includes end plates 58, 59 connected by an arcuate top wall 60 which, with the wall 55 completes the closure of the outer housing 52. The top wall 60 is provided with a longitudinally extending air inlet slot 61, herein shown as at its highest portion. Welded between the walls 58, 59 is a U-shaped partition 62 which conforms generally to the contour of the end walls 58, 59 but is spaced inwardly therefrom. The wall 62 may be provided with end flanges 63 which may be welded to the inner faces of the plates 58, 59. It will also be noticed that the wall 62 defines a space somewhat greater in diameter than the outside diameter of the air duct 25. The lower edges of the wall 62 are connected by any suitable screen structure herein shown as a labyrinth or a succession of layers of mesh 65, the spaces between which may, if desired, be filled with air pervious material such as metallic fibers or the like. The wall 58 is provided with an aperture 66 of such size that the assembly can be slipped over the air inlet duct 25. The opposite end wall 53 is apertured as at 67 to permit the passage of the securing screw 28. When the securing screw 28 is in the position in which it is shown in Figure 3 the parts are all solidly locked in position. It will be understood that the assembly is assembled outside and any suitable quantity of a liquid such as oil, as indicated at 70, is positioned in the bottom of the housing 53.

Extending above the slot 61 is a sloped baffle 71 having an upturned edge 72. It may be secured to the shroud 40 as by a flange 73 which may be welded to the shroud. A vertical baffle 74 is also positioned within the shroud 40 and is shown in dotted line in Figure 1.

80 indicates any suitable governor shaft carrying a lever having arms 81 and 82. 83 is any suitable actuating rod for actuating the throttle valve not herein shown. The butterfly valve or choke 33 is controlled by hand, for starting and for running with a cold engine. 85 is any suitable spring tending to move the governor shaft 80 in a clockwise direction, referring to the position of the parts as shown in Figure 2. It will be understood that the details of the carburetor and its actuating means do not of themselves form part of the present invention.

It will be realized that, whereas, we have described and illustrated a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of the invention. We therefore wish our description and drawings to be taken as in a broad sense illustrative or diagrammatic rather than as limiting us to our precise showing.

The use and operation of the invention are as follows:

We provide a simple compact engine structure with a minimum of exterior parts and with a streamlining of contour which saves space and produces a sightly engine assembly. The shroud 40 may be formed as a single metal body, or from a single metal sheet, when stamped. Its front wall and its side wall 42 may be unitary, and the air directing baffles 71 and 74 may, if desired, be permanently secured thereto. The air cleaning mechanism is entirely housed within the shroud 40 and is mounted on the shroud 40. The separator or partition plate 24 cooperates with the shroud 40 in supporting the air assembly, and also supports or connects to the air cleaner intake portion 31 of the carburetor assembly 32.

With reference to the air cleaning feature, the fly wheel 12 rotates in a clockwise direction, referring to the position in which it is shown in Figure 1. In response to the rotation of the fan component 13 of the fly wheel, air is drawn in through the air inlets 41 and is delivered generally tangentially outwardly from the periphery of the fan. Under the influence of the rotation of the fan air will travel in the direction of the arrows C, along the inner face of the shroud side wall 42 and will flow between the wall 42 and the adjacent portion or wall 55 of the cleaner housing.

Where there is grit or dirt in the air the heavier particles will tend to travel along the inner face of the wall 42 and will pass beyond the baffle 71. If these heavier particles drop, they are deflected by the baffle 71, and its upward extension 72, away from the cleaner air inlet opening 61. Thus there will be an initial separation of coarser particles from the air before the air passes to the interior of the air cleaner assembly. The coarser particles will be carried by the air on passing across or about the top of the engine block. They will also be arrested by the baffle 74 which will assist in protecting the spark plug. The coarser particles will finally escape with the air which passes along the cooling fins 15 and 16. Some finer particles may pass downwardly and inwardly through the slot 61. The direction of movement of air carrying these finer particles is indicated by arrows in Figure 4. A body of oil 70 is located in the bottom of the air cleaner housing 52. The air is constrained to several sharp changes of direction and much of the dirt will be received in the oil bath 70. Also the movement of air through the cleaner will tend to carry oil up into the air pervious filter structure 65, where other particles will there be removed from the air. The air passes upwardly through the filter, and with another change of direction flows through the aperture 26 of the air duct 25 and thence, passes the choke valve 33 and along the passage 31 to the carburetor.

The structure thus shown is compact, is en-

tirely housed within the shroud, is easily applied and easily removed for inspection, cleaning, or addition of oil. The engine herein shown lends itself to streamlining and to compactness and provides a substantially enclosed structure which, however, is readily accessible by removal of the screw 30, or by bodily removal of the whole shroud structure. Before removing the shroud it will be necessary, however, to release the screw 30 and remove the air cleaner assembly. The rope starting pulley which is also readily removable must also be removed to permit removal of the shroud.

An important feature of the invention is the provision for obtaining an initial separation of the heavy particles from the air before it enters the cleaner. Referring for example to Figure 4, the heavy particles hug the face of the wall 42 of the shroud and pass upwardly through the space between the air cleaner and the shroud wall and continue through the gap between the baffle portion 72 and the shroud 42.

Referring to Figure 4, the heavy particles pass upwardly along the inner face of the wall 42 and on beyond the upwardly bent flange portion 72. Only the final particles reach and pass through the slot 61. There are zones of turbulence at the areas marked *x* and *y*, in Figure 4. Thus the location of the air cleaner in relation to the shroud and the employment of the flange or baffle 71, 72 insures an initial separation or elimination of the heavy particles.

For purposes of convenience we have illustrated our invention as applied to a single cylinder four-stroke Otto cycle engine because it happens that that is the particular type of engine on which this air cleaning air supply system is used. Obviously a multiplicity of cylinders might be supplied with cleaned air to support combustion by the same type of combustion as that disclosed and obviously also while we have illustrated and in many cases specifically claim a carburetor. A carburetor is nothing more or less than a means for measuring out the right amount of fuel to be burned in the engine cylinder in the presence of clean air so if our invention were applied to a Diesel cycle engine the effect of air cleaning would be exactly the same. It is our intent, therefore, that our invention be applicable to any suitable type of engine with any desired number of cylinders and with any desired internal combustion engine cycle.

We claim:

1. For use with a shroud and a fan in said shroud, an air cleaner assembly adapted to clean air drawn into said shroud by said fan, said assembly including a housing, mounted within said shroud, in the general line of delivery of air from said fan, said housing having an air inlet aperture masked by the housing itself from the direct delivery of air by the fan, and an air outlet duct extending from the interior of said housing to the exterior of the shroud.

2. For use with a shroud and a fan in said shroud, an air cleaner assembly adapted to clean air drawn into said shroud by said fan, said assembly including a housing, mounted within said shroud, in the general line of delivery of air from said fan, said housing having an air inlet aperture masked by the housing itself from the direct delivery of air by the fan, an air outlet duct extending from the interior of said housing to the exterior of the shroud and baffle means, mounted in said shroud and outside of said housing, overlying said air inlet aperture.

3. For use with a shroud and a fan in said shroud, an air cleaner assembly adapted to clean air drawn into said shroud by said fan, said assembly including a housing, mounted within said shroud, in the general line of delivery of air from said fan, said housing having an air inlet aperture masked by the housing itself from the direct delivery of air by the fan, an air outlet duct extending from the interior of said housing to the exterior of the shroud, said housing defining, with an opposed portion of said shroud, a restricted air passage through which air and entrained coarse particles may pass.

4. For use with a shroud and a fan in said shroud, an air cleaner assembly adapted to clean air drawn into said shroud by said fan, said assembly including a housing, mounted within said shroud, in the general line of delivery of air from said fan, said housing having an air inlet aperture masked by the housing itself from the direct delivery of air by the fan, an air outlet duct extending from the interior of said housing to the exterior of the shroud, said housing defining, with an opposed portion of said shroud, a restricted air passage through which air and entrained coarse particles may pass and baffle means in said shroud overlying said air inlet aperture, and adapted to prevent the access of heavy particles thereto.

5. In air cleaner means for the carburetor of an internal combustion engine, a partition plate, one side of which is adapted to form part of a motor shroud, a carburetor secured in relation to the opposite side of the plate, an air cleaner including a housing positioned on the shroud side of the plate, said housing having an air inlet adapted to receive air from the shroud side of the plate, and an air outlet extending through said partition plate to said carburetor, said air inlet being protected by the housing itself from the direct flow of air moving within said shroud.

6. In air cleaner means for the carburetor of an internal combustion engine, a partition plate, one side of which is adapted to form part of a motor shroud, a carburetor secured in relation to the opposite side of the plate, an air cleaner including a housing positioned on the shroud side of the plate, said housing having an air inlet adapted to receive air from the shroud side of the plate, and an air outlet extending through said partition plate to said carburetor, said air inlet being protected by the housing itself from the direct flow of air moving within said shroud, and a baffle adjacent said shroud, overlying said air inlet.

7. In combination, a fan and a shroud, said shroud having an intake aperture and including a side wall having a portion conforming generally to but spaced slightly outwardly from the periphery of the fan, and a portion diverging outwardly from the periphery of the fan, along the direction of flow of air delivered by said fan, and an air cleaner located within said outwardly diverging portion of the shroud, and positioned radially outwardly beyond the periphery of the fan, the air cleaner including a housing having an air intake aperture within the shroud, and an outlet aperture in communication with a space exterior to said shroud, said air intake aperture being on the lee side of said cleaner housing, in relation to the direction of flow of air within said outwardly diverging portion of the shroud side wall.

8. In combination, a fan and a shroud, said shroud having an intake aperture and including a side wall having a portion conforming generally

to but spaced slightly outwardly from the periphery of the fan, and a portion diverging outwardly from the periphery of the fan, along the direction of flow of air delivered by said fan, and an air cleaner located within said outwardly diverging portion of the shroud, and positioned radially outwardly beyond the periphery of the fan, the air cleaner including a housing having an air intake aperture within the shroud, and an outlet aperture in communication with a space exterior to said shroud, said air intake aperture being at the top of said housing, said diverging portion of the shroud side wall being formed and adapted to direct air upwardly about said housing, along both sides thereof, one side of said housing conforming generally to but being spaced slightly inwardly from the face of said shroud side wall.

9. In a shroud and air cleaner structure, a plate defining the inner end of a shroud, a shroud housing secured to said plate and including a circumferential side wall portion and an end wall portion having air inlet aperture means, an air cleaner removably mounted in said shroud, said cleaner including a housing having a circumferential wall extending between the end walls of said shroud, and an air inlet in said shroud, said first mentioned plate having an aperture adapted to act as an outlet aperture for said air cleaner, said air cleaner being bodily outwardly removable through the last mentioned end wall of the shroud.

10. In combination, a rotary air impeller, a housing enclosing it, having two generally parallel walls one on either side thereof and between them a generally spiral wall outwardly diverging from the periphery of the impeller in the general direction of the flow of air discharged thereby, an air cleaner housing of air foil contour located in the angular space between the spiral wall and the impeller and extending across that space between the two parallel walls, there being an air intake port for the air cleaner on the trailing edge thereof, an air discharge passage leading from the interior of the cleaner out through one of the parallel walls.

11. In combination, a rotary air impeller, a housing enclosing it, having two generally parallel walls one on either side thereof and between them a generally spiral wall outwardly diverging from the periphery of the impeller in the general direction of the flow of air discharged thereby, an air cleaner housing of air foil contour located in the angular space between the spiral wall and the impeller and extending across that space between the two parallel walls, there being an air intake port for the air cleaner on the trailing edge thereof, an air discharge passage leading from the interior of the cleaner out through one of the parallel walls, the air cleaner being inwardly spaced from the spiral wall and so positioned with respect thereto as to define a flat curved passage for dust laden air of uniform width and generally uniform thickness between the spiral wall and the cleaner housing.

12. In combination, a rotary air impeller, a housing enclosing it, having two generally parallel walls one on either side thereof and between them a generally spiral wall outwardly diverging from the periphery of the impeller in the general direction of the flow of air discharged thereby, an air cleaner housing of air foil contour located in the angular space between the spiral wall and the impeller and extending across that space between the two parallel walls, there being an air intake port for the air cleaner on the trailing edge thereof, an air discharge passage leading from the interior of the cleaner out through one of the parallel walls, an engine block adjacent one of the parallel walls, that wall being ported to discharge air under pressure against the engine block, an air conduit leading from the discharge passage to the engine to supply cleaned air to support combustion therein.

13. In combination, a rotary air impeller, a housing enclosing it, having two generally parallel walls one on either side thereof and between them a generally spiral wall outwardly diverging from the periphery of the impeller in the general direction of the flow of air discharged thereby, an air cleaner housing of air foil contour located in the angular space between the spiral wall and the impeller and extending across that space between the two parallel walls, there being an air intake port for the air cleaner on the trailing edge thereof, an air discharge passage leading from the interior of the cleaner out through one of the parallel walls, the air cleaner being inwardly spaced from the spiral wall and so positioned with respect thereto as to define a flat curved passage for dust laden air of uniform width and generally uniform thickness between the spiral wall and the cleaner housing, an engine block adjacent one of the walls, that wall being ported to discharge air under pressure against the engine block, an air conduit leading from the discharge passage to the engine to supply cleaned air to support combustion therein.

14. In combination, a rotary air impeller, a housing enclosing it having a generally spiral wall outwardly diverging from the periphery of the impeller in the general direction of flow, an air cleaner located in the angular space between the spiral wall and the impeller, having an air intake port on the upstream side of and masked by the air cleaner housing, an exhaust tube extending at least partially across the interior of the cleaner and through one wall thereof and the wall of the impeller housing, a port in the tube communicating with the interior of the cleaner and a labyrinthine passage in the cleaner between the intake port and the port in the tube, there being an uninterrupted air passage on both sides of the cleaner between it and the impeller and between the cleaner and the spiral wall.

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