Sept. 3, 1946. C. G. TROXLER 2,406,931

AIR CLEANER

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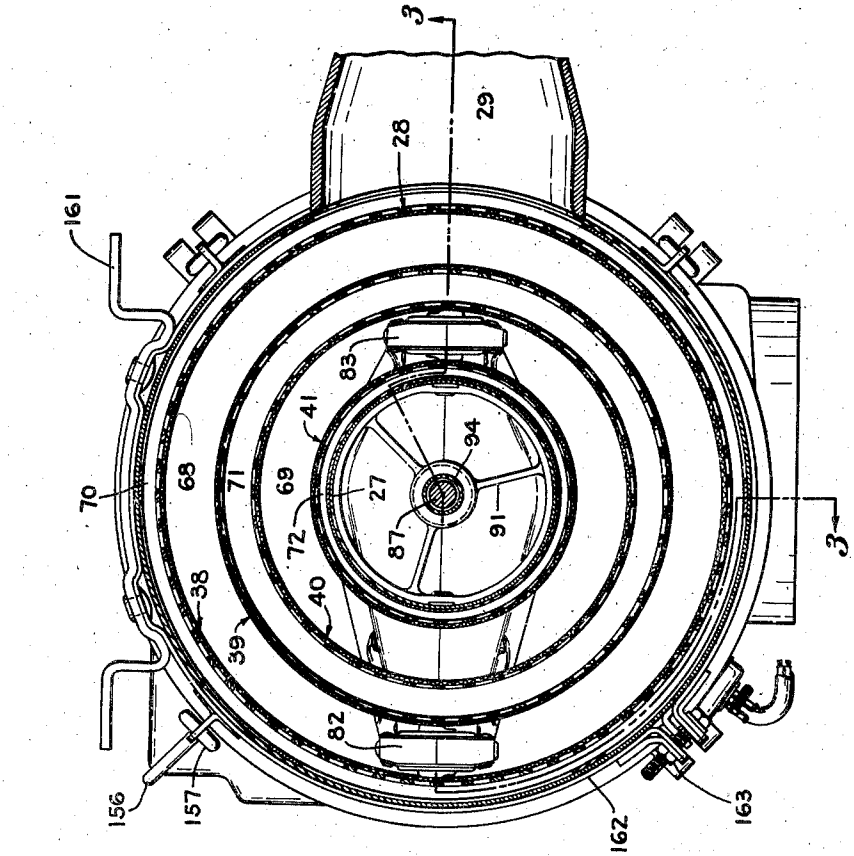


Fig. 2

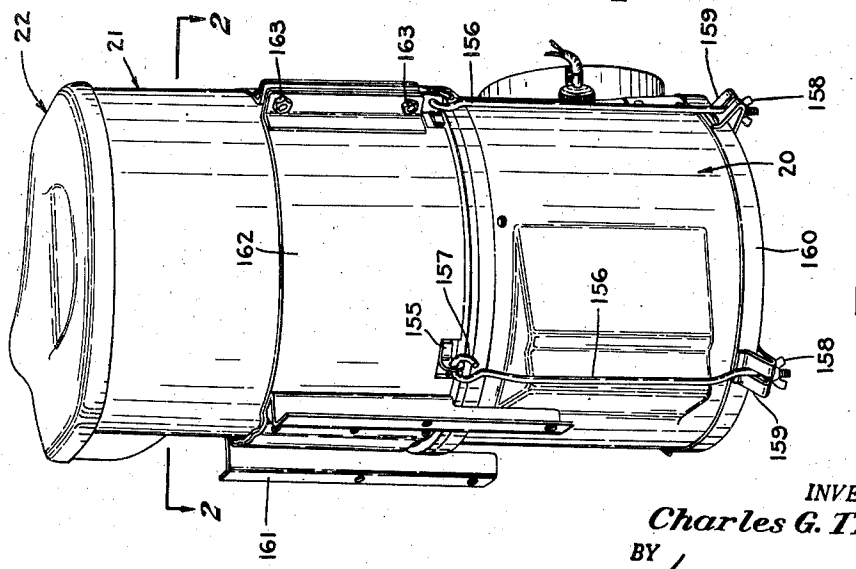


Fig. 1

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AIR CLEANER

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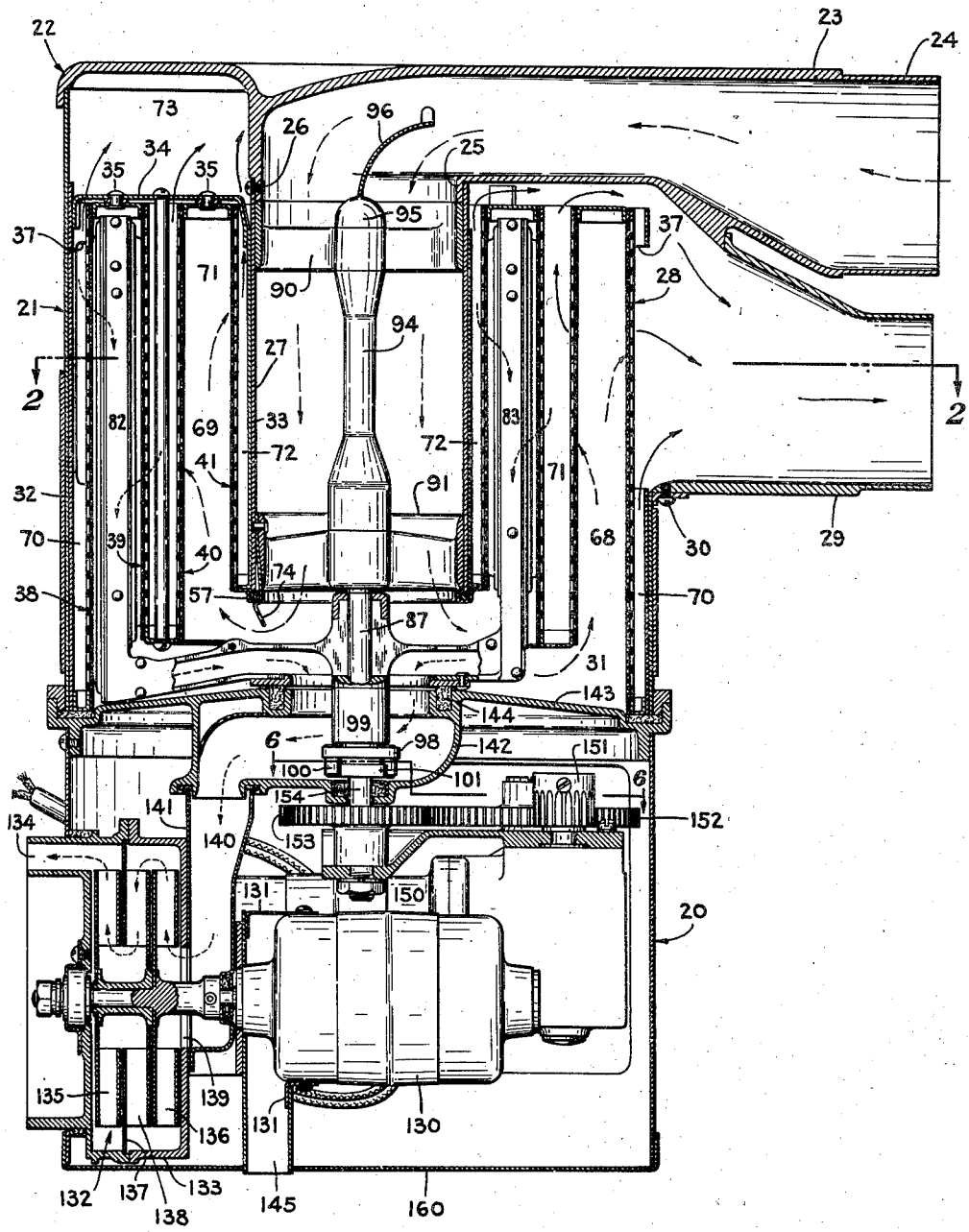


Fig. 3

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AIR CLEANER

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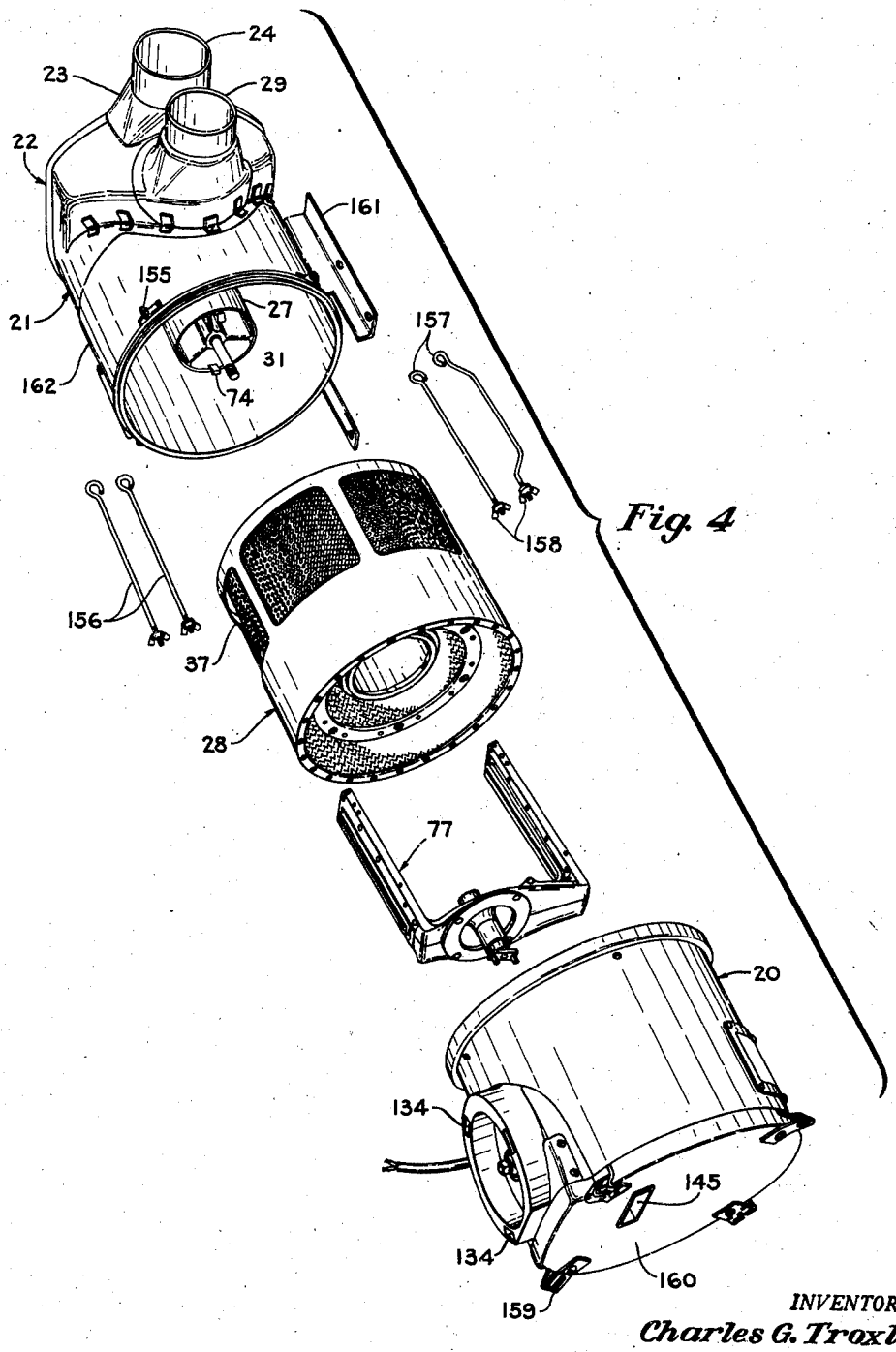


Fig. 4

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AIR CLEANER

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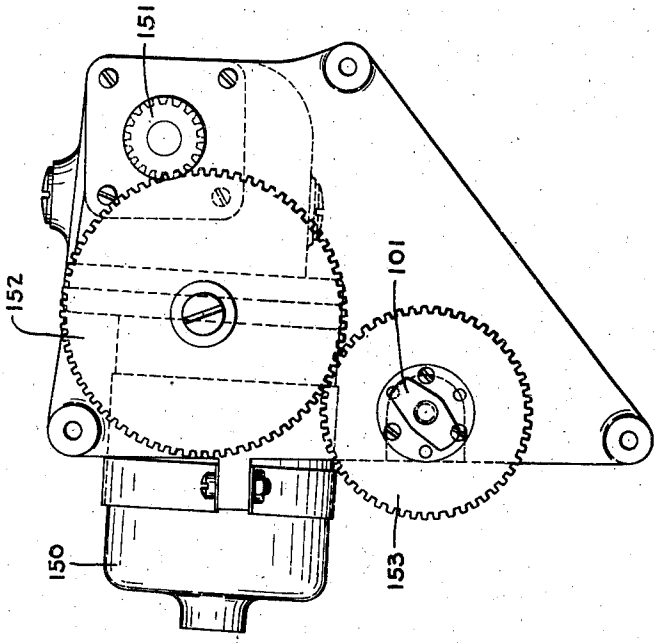


Fig. 6

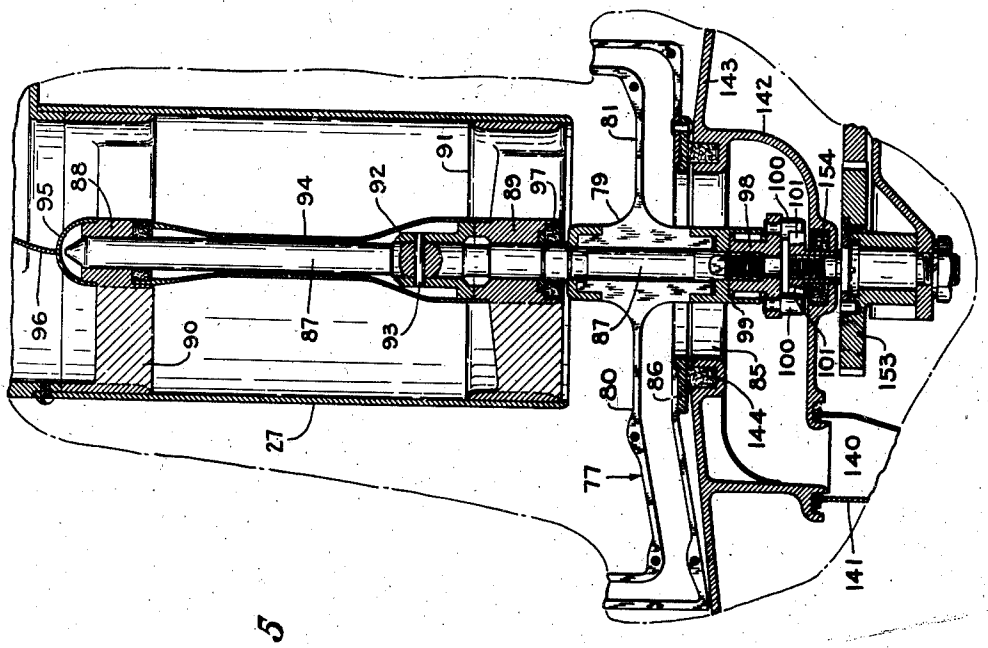


Fig. 5

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AIR CLEANER

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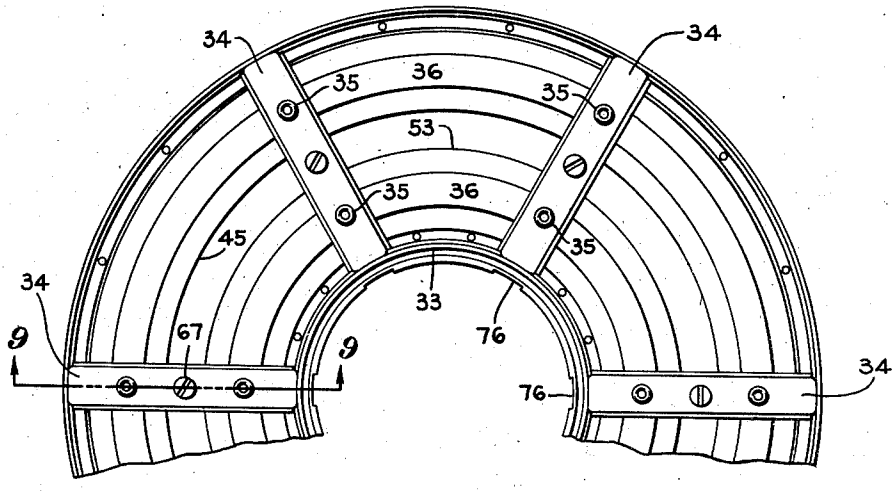


Fig. 7

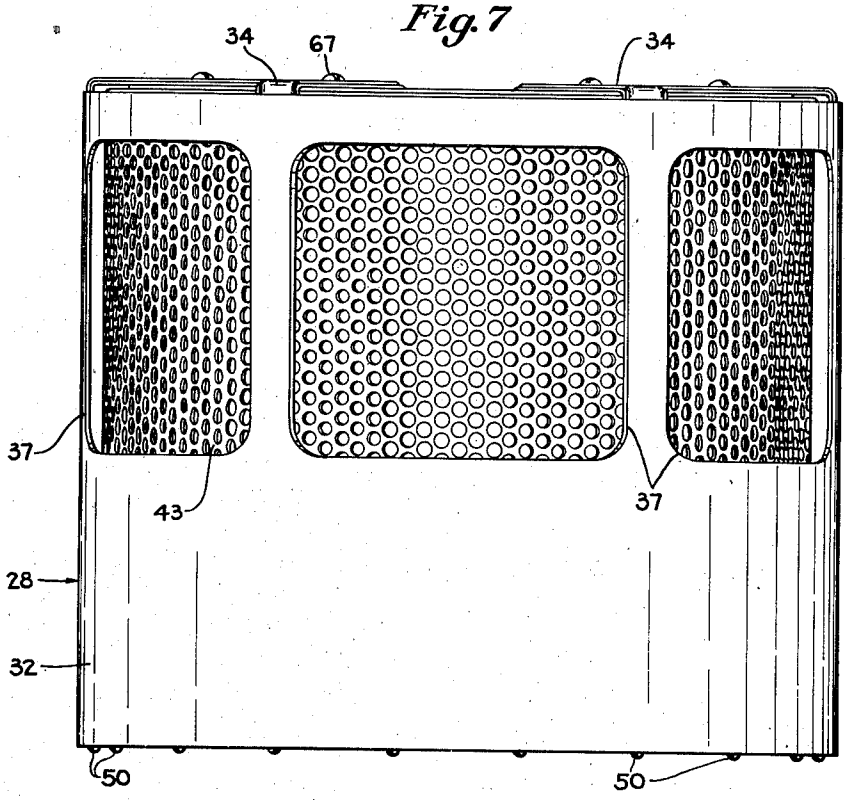


Fig. 8

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AIR CLEANER

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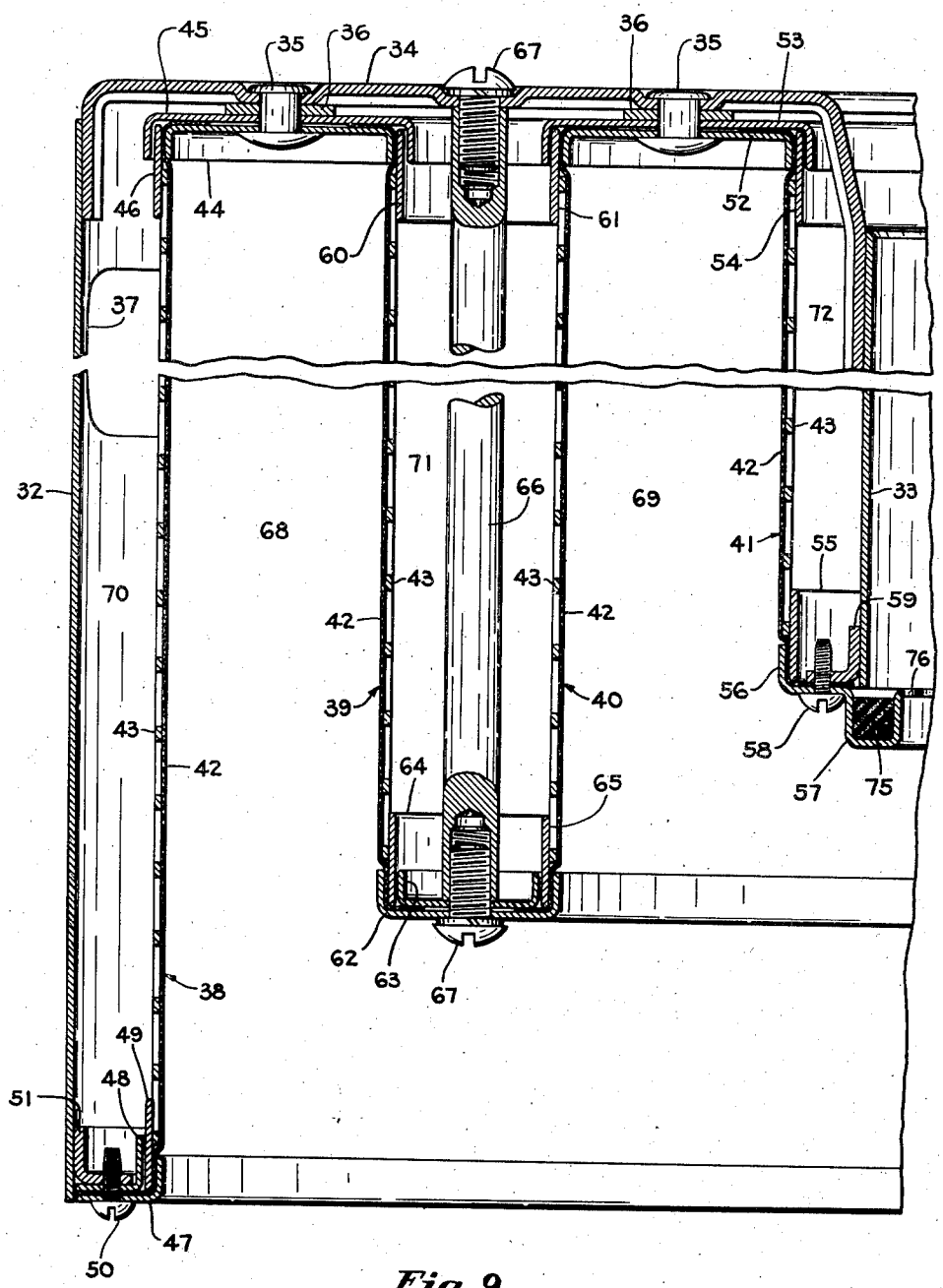


Fig. 9

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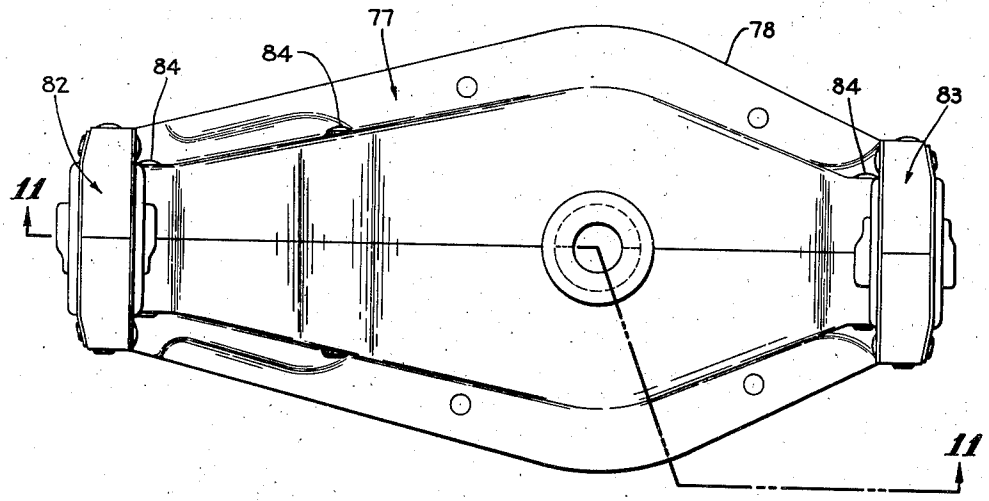


Fig. 10

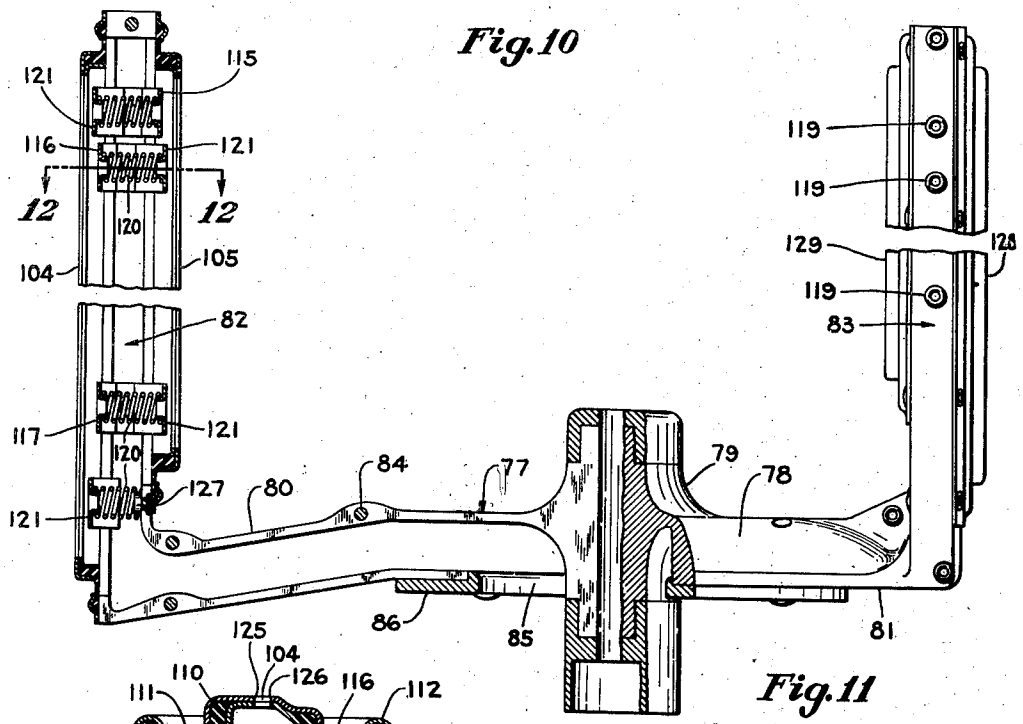


Fig. 11

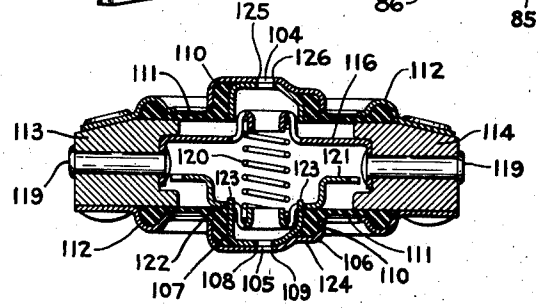


Fig. 12

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2,406,931

UNITED STATES PATENT OFFICE

2,406,931

AIR CLEANER

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Application October 18, 1943, Serial No. 506,625

3 Claims. (Cl. 183—57)

1

The present invention relates to an air cleaner for filtering dirt from dirt-laden air and for removing the accumulated dirt from the filter.

It has been found that the duration of efficient operation of gasoline engines is greatly shortened by the passage of dirt, sand and other foreign materials into the engines, and if the engine is not immediately overhauled and cleaned, the mechanical parts are injured and may require replacement.

The purpose of this invention is to filter out all foreign material from the air stream passing into the engine and to also clean the filters so that it is unnecessary frequently to repair the motors or replace the filters.

It is an object of the invention to provide a new and improved air cleaning machine. Another object is to provide an air cleaner in which the filters are constantly being cleaned during the operation of the air cleaner. Another object is to provide a unitary filter having a plurality of filtering surfaces which are removable as a unit from the air cleaner. Still another object is to provide filter cleaning nozzles having a plurality of inlets for cleaning a plurality of filters in one operation. Another object is to provide a plurality of nested cylindrical filters spaced apart for movement of the nozzles therebetween to remove the accumulated dirt from the filters. Another object is to provide driving means to rotate the filter cleaning nozzles in annular paths around the filters. A further object is to provide means for drawing clean air in a direction reversed to the flow of the dirt-laden air stream, through the filters to clean the latter. A further object is to provide an air cleaner which is assembled and disassembled into a few parts, the interiors of which are easily accessible. Further objects and advantages of the invention will be apparent from the following specification and claims, wherein:

Figure 1 is an exterior perspective view of the air cleaner;

Figure 2 is a horizonal sectional view along the line 2—2 of Figures 1 and 3;

Figure 3 is a vertical sectional view along the line 3—3 of Figure 2 and illustrates the path of the dirt-laden air being filtered and the scavenging air for removing the accumulated dirt from the filters;

Figure 4 is an exploded perspective view of the major sub-assemblies of the air cleaner;

Figure 5 is a vertical section of the bearing supports and drive connections for rotating the filter cleaning nozzles;

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Figure 6 is a view along the line 6—6 of Figure 3 showing the motor and gear reduction for driving the filter cleaning nozzles;

Figure 7 is a fragmentary top view of the filter cartridge assembly;

Figure 8 is a side elevational view of the filter cartridge assembly;

Figure 9 is a broken enlarged vertical section along the line 9—9 of Figure 7;

Figure 10 is a top plan view of the filter cleaning nozzle assembly;

Figure 11 is a broken vertical section along the line 11—11 of Figure 10 with parts in elevation showing the internal construction of the filter cleaning nozzles, and

Figure 12 is an enlarged horizontal section along the line 12—12 of Figure 11 showing the lip construction of the filter cleaning nozzles.

The embodiment of the invention herein disclosed comprises a cylindrical base forming a motor-fan housing 20 on which is removably supported a filter housing 21 closed at its upper end with a rigidly attached cap 22 provided with a radially extending conduit 23 which communicates at its outer end 24 with the incoming dirt-laden ambient air, and has its open inner end 25 downwardly disposed axially of the filter housing 21. Attached to the inner end 25 of the conduit 23 by means of screws 26 is a cylindrical dirt inlet tube 27 which is open at both ends and terminates short of the lower end of the filter housing 21, and forms with the wall of the latter a chamber 31 for receiving the dirt filtering cartridge assembly 28. The chamber 31 communicates with a clean air outlet conduit 29 removably attached by screws 30 to the filter housing 21 beneath the inlet conduit 23. The clean air outlet conduit 29 is connected to a suction creating means not shown and to the carburetor of the gasoline engine, or other part of the engine, which is to receive the cleaned air.

The supporting frame for the filter cartridge 28 is shown most clearly in Figures 3 and 7 to 9 and comprises concentric outer and inner cylindrical walls 32 and 33, respectively, joined at their upper extreme ends by spaced radially extending brackets 34 secured in position by rivets 35 attached to annular radially spacer brackets 36. The inner wall 33 is in slidable removable contact throughout the length of the exterior surface of the tubular inlet 27, and the outer wall 32 is in removable contact with the interior surface of the filter housing outer wall, and is also provided in its upper peripheral portion with spaced annularly arranged openings 37.

Housed within the filter supporting frame are four cylindrical concentric filters 38, 39, 40 and 41. Each filter includes a filtering material 42 of cloth, or other suitable material, to filter out fine dust particles and is backed up by a perforated metal cylinder 43. The filter 38 is secured at its upper end between a pair of nested annular channel shaped members 44 and 45 and a metal annular band 46, while the lower end is secured between a pair of nested flanged rings 47 and 48 and a metal annular band 49. The annular channels 44 and 45 are affixed to the top of the filter supporting frame by the rivets 35 and the flanged rings 47 and 48 are secured by screws 50 to a flanged ring 51 permanently affixed to the lower end of the outer cylindrical wall 32 of the filter supporting frame.

The filter 41 is secured at its upper end between a pair of nested annular channel shaped members 52 and 53 and a metal annular band 54, while its lower end is secured between a metal annular band 55 and the annular flange 56 of an annular bracket 57 secured by screws 58 to a flanged ring 59 permanently attached to the inner wall 33 of the filter supporting frame.

The filters 39 and 40 are supported at their upper ends between the nested channels 44, 45 and 52, 53, respectively, and metal annular bands 60 and 61, respectively, while the lower ends are supported in annular nested channels 62 and 63 and annular metal bands 64 and 65, respectively. The nested channels 62 and 63 are rigidly spaced and supported from the radial brackets 34 by means of spaced rods 66 and screws 67, 67.

The filters 38, 39 and 40, 41 define therebetween annular or cylindrical chambers 68 and 69, respectively, for the incoming dirt-laden air indicated in Figure 3 by arrows with broken shafts. The arrangement of the filters also defines a plurality of annular or cylindrical chambers for the cleaned air, after the dirt-laden air has been filtered, as indicated in Figure 3 by arrows with solid shafts, one chamber 70 being between the outer wall 32 and the filter 38, another chamber 71 between the filters 39 and 40, and still another chamber 72 between the filter 41 and the inner wall 33. All of these annular chambers for the clean air communicate with a chamber 73 above the top of the filter supporting frame and which communicates with the outlet conduit 29.

The filter cartridge 28 is removably retained on the tube 27 of the filter housing 21 by means of a plurality of leaf springs 74 having one end permanently attached to the dirt inlet tube 27 and their free ends resiliently receiving the bracket 57 which is provided with a resilient seal 75 to prevent leakage of dirt-laden air into the clean air chamber 72. The bracket 57 is notched at 76 to receive the springs 74 and to also position one of the openings 37 in the outer wall 32 opposite the clean air outlet conduit 29.

The filter cleaner nozzle sub-assembly indicated generally at 77 and clearly shown in Figures 5 and 10 to 12 includes a base 78 having a hub 79 from which radially extends hollow arms 80 and 81, each of which terminates respectively in an upwardly extending nozzle 82 and 83 which travels in the annular chambers 68 and 69, respectively. The nozzle assembly is split along a vertical median line and is formed in two halves, secured together by rivets 84 and its base 78 is provided with a single opening 85 defined by a gasket bearing plate 86 riveted to the bottom wall of the nozzle base and is concentric with the hub 79.

Each of the nozzles 82 and 83 are identical in construction with the exception as to the overall nozzle lip length which depends upon the length of the filters and accordingly the description of one nozzle will apply to both. The nozzle 82 is provided with two oppositely disposed inlets 104 and 105 which extend throughout the length of their adjacent filters 38 and 39, respectively. The nozzle inlet 105 is formed by a pair of nested rectangular metal plates 106 and 107, each having an elongated opening in register to form the nozzle lips 108 and 109. The rectangular metal plates 106 and 107 have their marginal edges spread apart to receive therebetween a flange 110 of a rectangular apertured resilient rubber frame 111 which has its outer marginal edge clamped between an apertured rectangular metal frame 112 and two spaced vertical supports 113 and 114 forming part of the halves of the nozzle base 78, and the vertical supports 113 and 114 are spaced apart by three stationary brackets 115, 116 and 117 secured to the supports 113 and 114 by rivets 118.

In order to resiliently urge the nozzle lips 108 and 109 against the filter 39, a pair of spaced springs 120 are provided and each have one end supported in one of the stationary brackets 115 and 117, the opposite ends of the springs are each mounted in movable brackets 121 which have a shouldered surface 122 bearing against the resilient rubber frame 111, and the movable frames 121 are slidably supported on a pair of tabs 123 in the lip forming metal frame 107. The leading portion of the metal frame 106 is depressed at 124 to receive the filter 39 as the nozzle inlet 105 travels around and engages the filter 39.

The nozzle inlet 104 is constructed similarly to the nozzle inlet 105 and the two springs 120 urge the nozzle lips 125 and 126 into contact with the filter 38 with the exception that the lower spring 120 shown in Figure 11 has its stationary end mounted on a rivet 127 in the nozzle base 78. In the nozzle 83 the opposed nozzle inlets 128 and 129 are constructed similarly to the nozzle inlets 104 and 105, respectively of nozzle 82.

The nozzle assembly is rigidly mounted by its hub 79 on a rotating shaft 87 which is supported in upper and lower bearings 88 and 89 carried in upper and lower spider frames 90 and 91 permanently secured to the interior of the dirty air inlet tube 27. A thrust bearing 92 is rigidly secured by a pin 93 to the shaft 87 and provides a surface abutting the lower bearing 89 to support the weight of the nozzle assembly. A dust protecting sleeve 94 encloses the shaft 87 between the bearings 88 and 89, and the top of the upper bearing is protected by a dust cap 95 which contains grease and also supports a baffle 96 to direct the incoming dirt-laden air into the dirty air inlet tube 27. The bottom end of the lower bearing 89 is also protected by a dust seal 97. The hub 79 of the nozzle base 78 is rigidly removably attached to the shaft 87 by a nut 98 threaded onto the lower end of the shaft 87 and is in the form of a captive nut permitting it to be unthreaded from the shaft 87 but is retained in a collar 99 pinned to the hub 79, by means not shown, so that in disconnecting the nozzle assembly from the shaft 87 the nut 98 will remain attached to the nozzle assembly. The nut 98 is provided with two downwardly extending pins 100 which receive therebetween a driving arm 101 forming part of a nozzle driving mechanism.

A nozzle driving electric motor 150, best shown

in Figure 6, is suitably connected to a source of current and is arranged horizontally in the motor-fan housing 20 and has a speed reducing mechanism including a motor pinion 151, intermediate spur gear 152 and a nozzle drive gear 153 mounted on a shaft 154 projecting into a conduit 142 and is provided at its upper end with the driving arm 101 which is disposed between the driving pins 100 on the nozzle shaft 87. The speed reducing mechanism rotates the nozzles 82 and 83 slowly along the circumferential periphery of their adjacent filters 38, 39 and 40, 41, respectively.

Disposed in the motor-fan housing 20 is a horizontally arranged electric motor 130 suitably connected to a source of current and is supported on brackets 131 and has its armature shaft extended to support a fan 132 in a fan casing 133 which is provided with spaced annularly arranged exhaust outlets 134. The fan is of a double-stage type having movable blades 135 and 136 and a stationary partition 137 and vanes 138. The inlet 139 to the fan chamber is concentric with the armature shaft and is connected to a suction air passageway 140 formed in part by a conduit 141 in the housing 20 and a conduit 142 in the top wall 143 of the housing 20. The fan 132 creates suction to draw clean air through the filters 38, 39, 40 and 41 into the nozzles 82 and 83 to remove the accumulated dirt from the filters. A running seal 144 of felt, or other suitable material, is mounted in an annular recess formed in the top wall 143 of the motor fan housing 20 and engages the metal gasket bearing plate 86 in the nozzle base to prevent leakage of air therebetween from the filter housing chamber 31. A conduit 145 is provided for the exhaust of ventilating air from the suction creating motor 130.

The filter housing 21 is removably supported on the motor-fan housing 20 by means of a plurality of bolts 156 having hooks 157 at one end removably disposed in apertured brackets 155 on the filter housing 21, and the opposite ends of the bolts 156 are provided with wing nuts 158 which engage slotted brackets 159 receiving the bolts 156 to rigidly secure the assemblies together. The bottom cover plate 160 and the top wall 143 are removably attached to the motor-fan housing 20 for access to the motors 130 and 150.

In order to attach the air cleaner to an engine, or other device to which the cleaned air is to be delivered, a mounting bracket 161 is welded to a split clamping band 162 which encircles the filter housing 21 and is adjustable by means of nut and bolt connections 163, and the mounting bracket 161 may be attached to the engine to support the air cleaner thereon.

The method of disassembling the air cleaner is shown clearly in Figure 4 and includes loosening the wing nuts 158 to remove the bolts 156 from the slotted brackets 159 which permits separation of the filter housing 21 and motor-fan housing 20. The captive nut 98 is then loosened from the shaft 87 so that the nozzle assembly can be removed from the filter cartridge 28 and the shaft 87. The filter cartridge is removed from the filter housing 21 by pressing inwardly on the springs 74 and exerting a slight pull on the filter cartridge. From the foregoing it is seen that the complete air cleaner comprises but four sub-assemblies which are easily disconnected.

In operation, the clean air conduit 29 is connected to the motor which is to be supplied with cleaned air, such as the engine carburetor, and also to a source of suction which may be part of the motor, and the dirty air inlet conduit 23 is exposed to the ambient air. The suction creating device in the engine causes the dirt-laden air, indicated by arrows having broken shafts in Figure 3, to enter the conduit 23 and tube 27 from which it is distributed into the dirty air chambers 68 and 69. The dirt-laden air contacts the fine mesh filter cloth of the filters 38, 39, 40 and 41 and the dirt is removed from the dirt-laden air and accumulates on the surfaces of the filters which are exposed to the dirty air chambers 68 and 69, while the cleaned air, indicated by arrows having solid shafts, passes into the annular clean air chambers 70, 71 and 72 from which it passes upwardly into the clean air collecting chamber 73 and thence into the cleaned air outlet conduit 29 to the motor being supplied with cleaned air. The cleaned air in the air chamber 70 also passes through the openings 37 in the outer wall 32 of the filter cartridge which are arranged opposite the outlet conduit 29.

At the same time the motor 150 through its speed reduction gears rotates the shaft 87 causing the nozzles 82 and 83 to move slowly in annular paths, the nozzle 82 rotating in the dirty air chamber 68 between the filters 38 and 39, and the nozzle 83 rotating in the dirty air chamber 69 between the filters 40 and 41. During the rotation of the nozzles 82 and 83, the suction motor 130 drives the fan 132 which creates suction in the nozzles 82 and 83. The suction nozzle 82 draws the cleaned air from the annular chambers 70 and 71 through the filters 38 and 39 into the nozzle inlets 104 and 105, respectively, and movement of the resilient nozzle lips along the filters, combined with the suction, removes the accumulated dirt from the filters, as indicated by arrows with dotted shafts, into the hollow interior of the nozzle assembly to convey the dirt through the suction air passageway 140, fan inlet 139 and fan casing 133, from which the fan 132 discharges the dirt removed from the cloth filters 38 and 39 through the exhaust outlets 134. Similarly the resilient lips of the nozzle inlets 128 and 129 of the nozzle 83 engage the filters 40 and 41, respectively, and the cleaned air passes from the clean air chambers 72 and 71 through the filters 41 and 40 to remove the accumulated dirt from these filters. In fact, there is reversal of air flow through the filters 38, 39, 40 and 41 during the filter cleaning operation since the ambient dirt-laden air being cleaned passes in one direction through the filters, and the cleaned air in the opposite direction, during the filter cleaning operation.

From the foregoing it will be perceived that the filter housing 21 and motor-fan housing 20 are easily removably connected, that the nozzle assembly is removed as a unit from the filter housing by loosening the captive nut 98, that the filter cartridge 28 including the four filters are removed as a unit from the filter housing 21, and that access to the motors 130 and 150 is had by removing the top and bottom covers 143 and 160, respectively, of the motor-fan housing. Also each nozzle 82 and 83 has a pair of resilient nozzle inlets to remove the accumulated dirt from the two adjacent filters, so that all four filters are cleaned at the same time. During the filter cleaning operation, cleaned air is passed through the dirty filters in a direction reverse to the flow of the ambient dirt-laden air to the filters during removal of dirt from the ambient dirt-laden air.

I claim:

1. An air cleaning device, comprising a hous-

ing having an inlet for dirt-laden air and an outlet for cleaned air adapted to be connected to a source of suction, a plurality of spaced filters for removing the dirt from said dirt-laden air prior to discharge through said outlet, a movably mounted filter cleaning nozzle having opposed nozzle inlets, each of said nozzle inlets being mounted on a flexible diaphragm forming a part of said nozzle, resilient means interiorly of said nozzle and exerting a force on said diaphragms to urge said nozzle inlets into engagement with the adjacent filter during movement of said nozzle inlets along said filters, and suction creating means for said filter cleaning nozzle inlets to remove the dirt accumulated on said spaced filters during the filtering of the dirt-laden air.

2. An air cleaner, comprising a casing having an inlet for dirt-laden air and an outlet for cleaned air, a unitary filter cartridge having a filter housing removably insertable in said casing, a plurality of concentrically arranged filters in said filter housing, an open frame at one end of said filter housing for supporting said concentric filters, said frame having openings for passage of air therethrough from said concentric filters, said filter housing having annularly spaced openings in the outer wall thereof for passage of air therethrough, said unitary filter cartridge arranged as

a unit in said casing for connection of said openings in the filter supporting frame and said annularly spaced openings in the filter housing for removable connection with said inlet and outlet.

3. An air cleaning device, comprising a casing having an inlet for dirt-laden air and an outlet for cleaned air, a tube supported in said casing and open at both ends, a unitary filter cartridge having a filter housing removably insertable in said casing between said tube and the outer wall of said casing, a plurality of concentric filters in said filter housing, an open frame at one end of said filter housing for supporting said concentric filters, said tube having one end connected to said inlet and having its opposite end open for passage of dirt-laden air to said filters, said frame having openings for passage of air therethrough from said filters, the outer wall of said filter housing having a plurality of spaced openings for passage of air therethrough from said filters, said unitary filter cartridge arranged as a unit in said casing about said tube for connection of said openings in the filter supporting frame and said annularly spaced openings in the filter housing for connection with said inlet and outlet, and means on said tube for removably supporting said unitary filter cartridge in said casing.

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