June 27, 1961 C. O. FINN 2,990,019

LITTER CLEANING APPARATUS

Filed Aug. 22, 1958 3 Sheets-Sheet 1

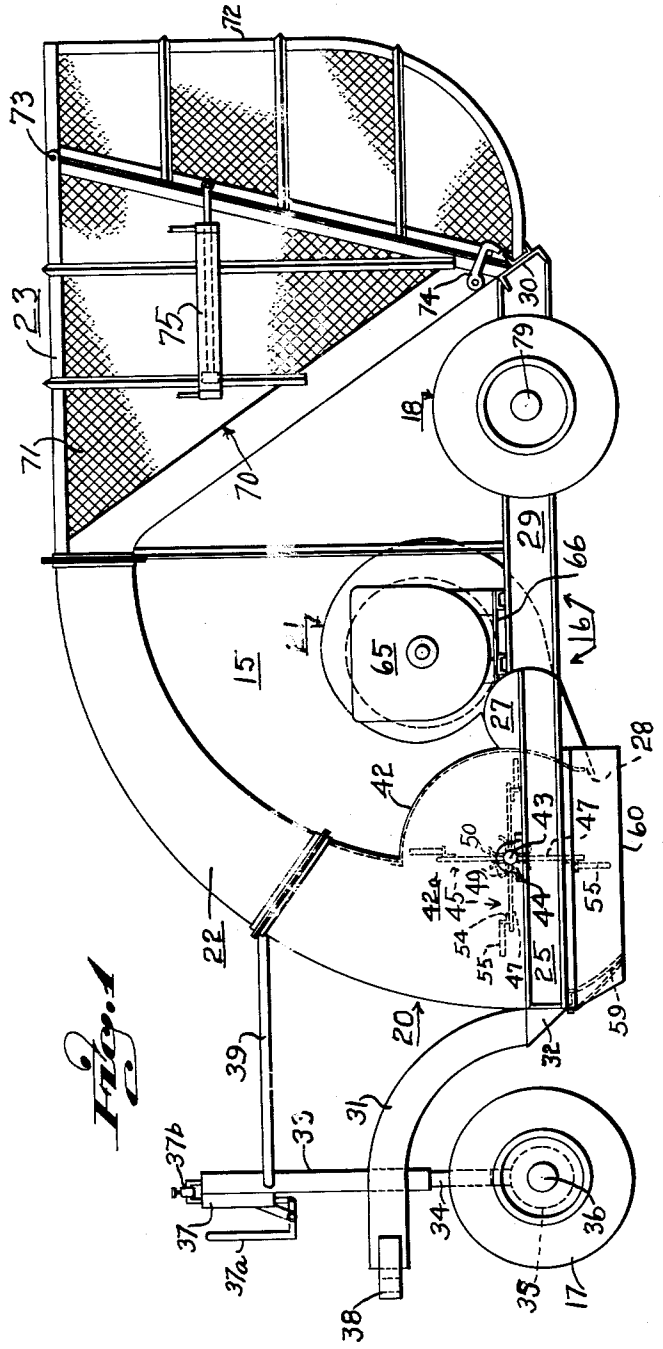


Fig. 1

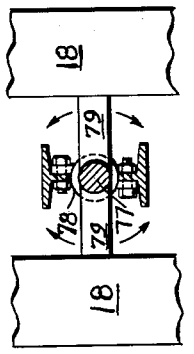


Fig. 6

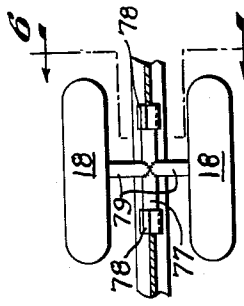


Fig. 5

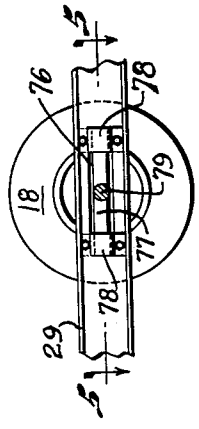


Fig. 4

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LITTER CLEANING APPARATUS

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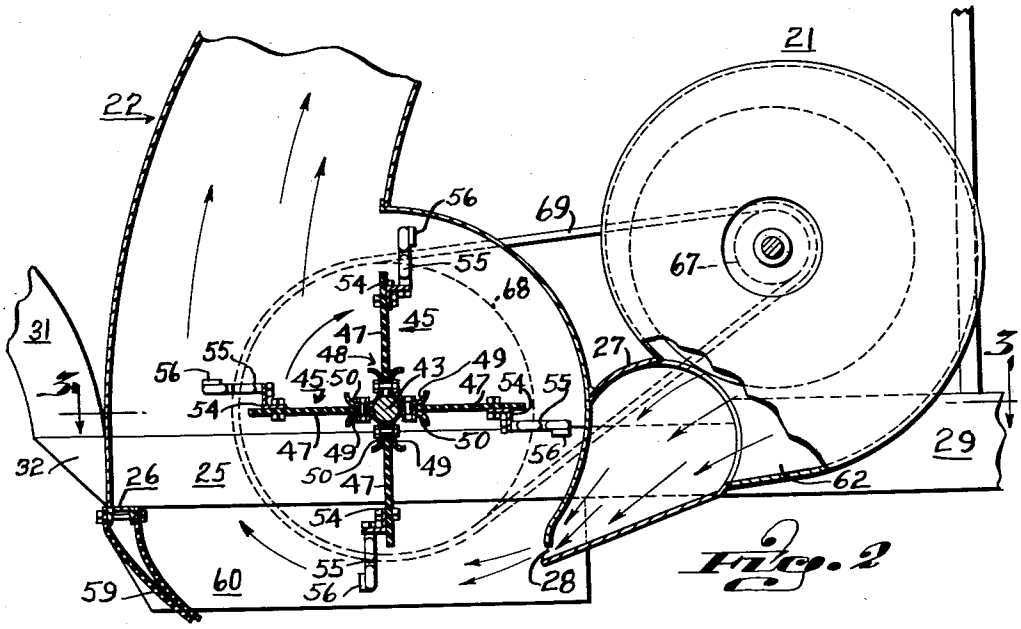


Fig. 2

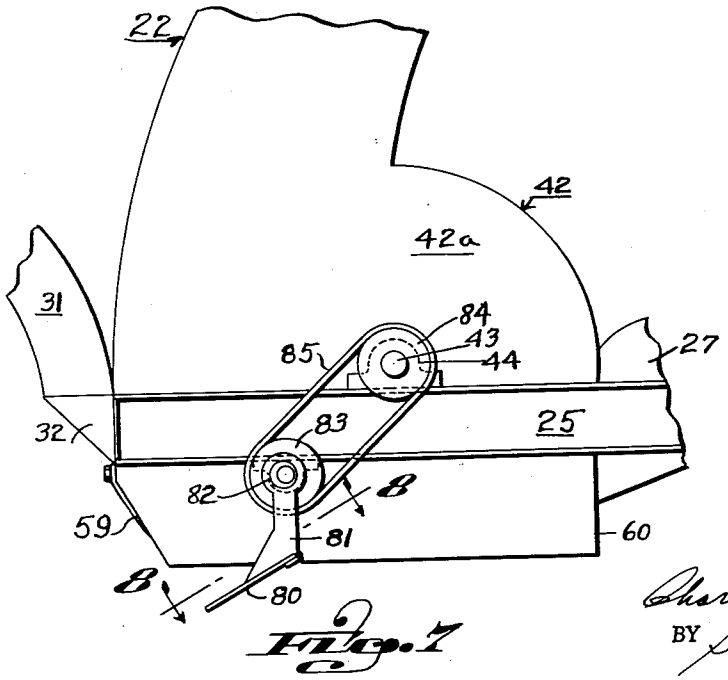


Fig. 7

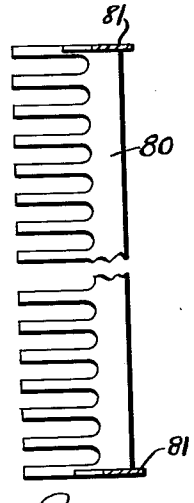


Fig. 8

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LITTER CLEANING APPARATUS

Filed Aug. 22, 1958 3 Sheets-Sheet 3

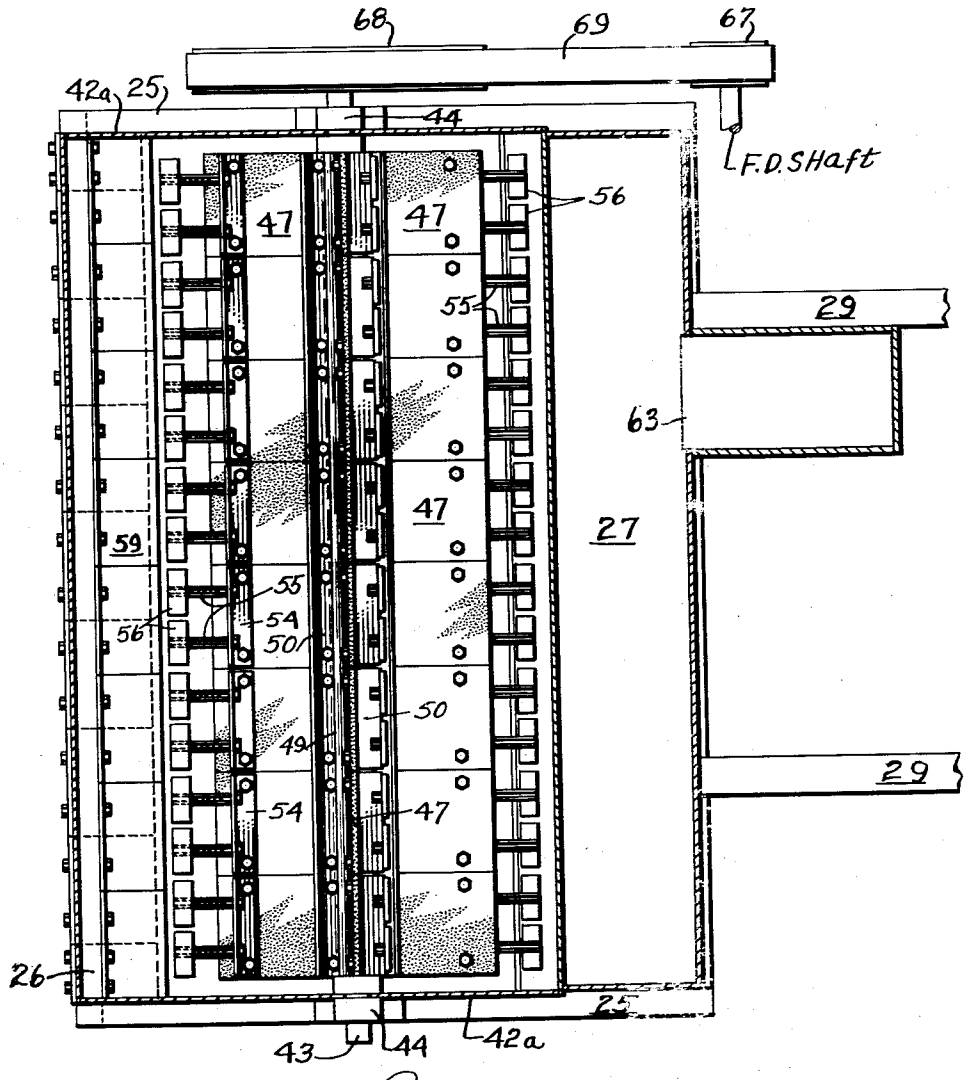


Fig. 3

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2,990,019

LITTER CLEANING APPARATUS

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Filed Aug. 22, 1958, Ser. No. 756,588
7 Claims. (Cl. 171—89)

This invention relates to a mobile apparatus for gathering debris from roadways, runways, parks, beaches and the like.

The volume of debris in the form of bottles, cans, paper in various forms and other litter, that accumulates on highways, parks and beaches, is tremendous and the cost of removing the same is extremely high by the use of present methods and machines.

Many trucks and crews are required to gather and remove debris from our modern highways and the cost per mile is very high, primarily because of the high labor costs and the relatively low production involved.

In the case of runways and landing strips, the presence of rocks, bolts, nuts and other hard objects present a serious hazard to jet engines because if any of these are drawn into the intake of the engine, the impeller blades and the turbine blades are seriously damaged. The machine set forth in the foregoing objects is particularly suited for removing such hazardous objects, including other litter, from the runways and landing strips for aircraft.

Recent news releases indicate the air branch of the military has expended some millions of dollars in the development of ways and means for removing the above mentioned debris from the runways and landing strips. So far as is known, the devices and machines provided for that purpose have not been fully satisfactory.

Our sea and lakeshore beaches become littered with debris and because of the loose nature of the soil, extreme care must be taken to effect removal of sunken bottles and other sharp objects as well as other litter. But up to the present, so far as is known, no machine has been made available for the inexpensive and efficient removal of such debris.

An object of this invention is to provide a machine for removing debris and litter from our highways, beaches, aircraft runways and park areas that can be manufactured at a cost not in excess of several thousand dollars and which is capable, with one or two operators, of clearing many miles of highway per day.

A still further object of the invention is to provide a machine that may be operated at speeds of six or seven miles per hour, more or less, while effectively and efficiently gathering debris, such as paper, bottles, cans and other forms of litter, and depositing it in a receptacle while the machine is in motion; to provide a machine that is capable of clearing a strip six feet or more in width at speeds above mentioned with no more than two operators, one for driving the tractor or truck which pulls the vehicle and another for observing the operation of the machine; and to provide a machine in which the debris is removed entirely by air currents and without any mechanical brushing of the surfaces to be cleaned.

A still further object is to provide a machine having means for shattering frangible objects, such as bottles, and discharging the same and other litter with such force into the receiver that it is compacted into a dense mass so that it may easily be disposed of in a dump or other disposal, thereby greatly increasing the area that can be cleared between unloadings of the machine.

A still further object is to provide a machine having an induced draft blower unit for exerting suction at the surface to be cleaned and a forced draft blower unit so located as to discharge high velocity air against the surface being cleaned and into the inlet of the induced draft blower, the high velocity of air lifting both heavy and light debris into the intake of the former.

A still further object is to provide a mobile machine having a housing provided with an inlet for debris which is located relatively close to the surface to be cleared, a rotor therein having impellers which are driven in such a direction as to draw air into the inlet and discharge it at the outlet, the impellers being provided with means for shattering frangibles, and which is provided with another blower having an outlet arranged to discharge air at high velocity along the surface to be cleared and thence into the inlet of the housing, thereby lifting and floating the litter, both heavy and light, into the housing where it is propelled by the first blower through the discharge thereof into the litter receptacle.

A further object is to provide a machine as in the next preceding object in which the housing inlet is provided with flexible members at the leading edge and sides of the inlet thereof to provide a seal between the ground surface and said inlet; and to provide a wheel mounting for accommodating the machine to uneven terrain and surfaces, thereby maintaining the seal.

A still further object is to provide a machine as in the preceding objects in which the impellers of the induced draft blower are composed of flexible material that are held in operative position by centrifugal force but which yield on contact with heavy objects or obstructions; and to provide the impellers with rigid members at their free ends for shattering frangibles and propelling relatively large objects through the machine and its discharge outlet to the receptacle.

A still further object is to provide a machine as above set forth, having means for bringing litter which is hidden in the sands of beaches to the surface where it can be picked up by the machine while leaving the sand behind.

And a still further object is to provide a machine that can be built in sizes suitable for use in the removal of litter from park grounds, both public and private, as well as from highways and aircraft runways and landing strips.

The above and other objects of the invention will be apparent to those of ordinary skill in the art to which the invention pertains from the following description taken in conjunction with the accompanying drawings.

In the drawings:

FIGURE 1 is a view in side elevation of a machine embodying the invention;

FIG. 2 is a partial view showing the induced draft fan and the forced draft nozzle in section and forced fan in elevation;

FIG. 3 is a view in section taken on line 3—3 of FIG. 2;

FIG. 4 is a fragmentary view in side elevation of a wheel mount for the machine;

FIG. 5 is a view in section taken on line 5—5 of FIG. 4;

FIG. 6 is a view in section taken on line 6—6 of FIG. 5;

FIG. 7 is a partial view in elevation of the induced draft fan housing and an attachment for use in cleaning sandy beaches; and

FIG. 8 is a view of a member embodied in the modification of FIG. 7.

In accordance with the method of the invention, debris, such as paper, leaves, stones, bottles, cans and the like, are removed from the berms of roadways, from the runways of air landing strips or any other area, including sandy beaches, by creating a low pressure area adjacent the surface and moving the low pressure area over the surface to be cleaned and in directing a high velocity blast of air into the low pressure area. The high velocity

blast is so directed that it will float debris off the surface being cleaned into the low pressure area from which it is carried by the air stream into a collector that moves along the areas as they are cleaned.

In the case of cleaning sandy beaches, the sand is probed by means of a tined member so as to bring debris, such as bottles or stones, to the surface into the low pressure area and at the same time directing a strong, high velocity blast of air into that area so as to float the debris into the stream of air by which it is carried to the collector.

The velocity of the swiftly moving current of air, and the degree of vacuum created over the surface to be cleaned, is adjusted in accordance with the nature of the debris to be removed.

The method may be practiced by the apparatus shown in the drawings and described infra.

In the drawings, and particularly with reference to FIGURES 1, 2 and 3, a machine **15** is shown for removing debris from surfaces, such as highways, the berms or shoulders of highways, aircraft runways and landing strips, etc. The machine comprises a chassis **16** supported at its forward end by a pair of wheels **17**, only one of which is shown, and at its rear on spaced pairs of wheels **18**, only one pair of which is shown.

The chassis carries an induced draft fan assembly **20** at its forward end and a forced draft fan **21** mounted on the chassis to the rear of the induced draft fan.

The induced draft fan assembly **20** picks up and discharges debris into a duct **22** through which it is carried to a receiver **23**.

The duct **22** may be so turned that the receiver may be located either forwardly or to the rear of the induced draft fan. Normally, it is preferred to mount the receiver **23** at the rear of the chassis as shown.

The chassis comprises spaced, parallel, longitudinally extending side frame members **25** preferably of channel form, which are connected rigidly at their forward ends by a cross member **26** of structural shape, such as a channel, and at their rear ends by a cross member. As shown, the cross member comprises a manifold **27** which is welded or otherwise rigidly connected to the side frame members. The manifold **27** distributes forced draft air through an orifice **28** in a direction to impinge on the surface to be cleaned at a location approximately under or directly below the shaft of the induced draft fan assembly.

The chassis frame includes, also, rearwardly extending, spaced, parallel frame members **29**, preferably of structural shape, such as I-beams. These are more closely spaced than the side frame members **25**, see FIG. 3. The forward ends of members **29** may be welded to the manifold **27** while the rear ends thereof may be rigidly connected together by a cross member **30**, preferably of channel shape, see FIG. 1.

The forward end of the chassis is provided with a gooseneck member **31** that is connected at its rear end by a hollow section **32** to the side and cross frame members **25** and **26**. The gooseneck **31** forms both a connection to the axle of the wheels **17** and a draw bar by which the machine **15** may be transported along highways and other places where debris and litter are to be collected.

The forward end of the gooseneck **31** is provided with a vertically extending hydraulic jack cylinder **33**, having therein a piston not shown that is connected by a downwardly extending rod **34** to an axle housing **35** in which the wheel axle **36** is journaled. A pump **37**, operable by a handle **37***a*, is provided for pumping fluid under pressure into the cylinder **33** to raise the front end of the machine **15**. A valve **37***b* may be provided in the line from the pump to the jack cylinder so as to trap the fluid in the cylinder when the machine has been elevated to the proper height or to release fluid therefrom to lower the machine to any desired position. By raising or lowering the front end of the machine, the clearance between the induced fan assembly **20** and the ground surface may be adjusted in accordance with requirements.

At the forward end of the gooseneck **31** is a hitch **38** to which a tractor or other motive vehicle may be coupled.

In order to rigidify the forward mounting of the machine, a strut **39** is provided that connects the cylinder **33** to the duct **22**.

The induced draft fan assembly **20** comprises a housing **42**, the side plates **42***a* of which are secured as by welding to the manifold **27** as shown and to the side and cross frame members **25** and **26**. The assembly **20** includes an impeller shaft **43**, journaled in bearings **44** carried by the side frame members **25**. On the shaft **43** are impellers **45** disposed at about 90° to each other. Each impeller comprises a plurality of relatively closely spaced sections **47** composed of flexible material, such as heavy belting.

The inner ends of these sections **47** are secured by clamps **48** to the shaft **43**. Each clamp **48** comprises flanged members **49** and **50**, the inner edges of which are welded to the shaft. The outer edges of members **49** and **50** are flared in opposite directions as shown to allow the sections **47** to flex without being cut by the clamps. The inner ends of the sections **47** are received between the members **49** and **50** and secured by bolts or other means, that pass through the clamp members and the sections **47** as shown.

The outer ends of the impeller sections **47** may be provided with rigid members **54** such as angle iron members. These may be bolted or otherwise secured to the sections **47**. The angle members **54** give rigidity to the sections **47** in a direction axially of the shaft **43**. They also serve to break bottles and stones into fine pieces.

The outer ends of the members **47** may be provided with relatively flexible fingers **55** to the outer ends of which cross members **56** are secured. The cross members **56** are optional, and may comprise heavy belting. The members **55** may be formed from short lengths of roller chain for example and secured as with bolts to the outwardly projecting flanges of the respective angle members **54**. The fingers **55** with their cross members **56** serve to pick up the heavier and bulkier objects, such as tin cans and bottles, and propel them in the air stream through the duct **22** into the collector or receiver **23**.

The intake of assembly **20** may be provided at its front and sides with flexible sealing members **59** and **60** for the purpose of confining the area upon which the effect of the suction of the induced draft fan and the velocity of the air of the forced draft fan, to one which is the equivalent of the area bounded by the length and width of the intake of the induced draft fan assembly.

The impeller of the induced draft fan assembly creates, at a location relatively close to the ground, a vacuum at the intake thereof. That vacuum, when reinforced by the booster action of the forced draft fan, is sufficient to pick up and propel bottles, cans, paper, stones, nuts, bolts and other objects through the duct **22** to the collector **23**.

The blast of high velocity air from fan **21** provides tremendous pick-up power. It is mounted as shown and discharges through its outlet **62** into the manifold **27** through an opening **63** therein. The manifold has sufficient volume to provide a uniform distribution of the forced draft air through the orifice **28** of the manifold. The orifice is so located and is of such size that the forced draft air will strike the ground approximately directly below the center of the induced draft fan at its point of lowest suction, with such a velocity that heavy objects, such as stones, bottles, cans etc., will be floated off the ground and into the intake of the induced draft fan assembly. In case the objects are quite heavy, they

will be forced through the duct **22** and into the collector **23** by the impellers and the fingers at the outer ends thereof.

The velocity of the air issuing from the orifice **28** may be of the order of 100 to 160 miles per hour depending upon the speed at which the forced draft fan **21** is driven.

Since the impellers **47** are flexible, they yield and deflect as necessary when encountering rigid heavy debris. The angle members **54** at the outer ends of the impellers shatter stones and bottles into fine fragments. The fingers **55** at the ends of the impeller sections **47** aid in carrying solid objects into and through the duct **22**.

The forced draft fan is driven by an engine **65** which is preferably directly coupled to the fan shaft. The engine may be mounted on a platform **66** carried by the side frame members **29**.

The outboard end of the shaft of the forced draft fan **21** is provided with a pulley **67** by which the induced draft fan impeller shaft **43** is driven. The shaft **43** is provided with a pulley **68**. Belting **69** runs over these pulleys and drives the induced draft fan.

As indicated in FIGURE 2, the pulley of the forced draft fan is much smaller than the pulley on the induced draft fan shaft **43**. Thus the induced draft fan runs at a slower r.p.m. than the forced draft fan. It has been found in practice that a reduction of 3 to 1 from the forced draft fan shaft to the induced draft fan shaft is suitable for most purposes.

In trial runs it has been found that a machine having a width of 6 feet at the intake of the induced draft fan and a corresponding width of nozzle **28** will remove debris from roadsides and other surfaces at a rate of 2000 to 4000 square feet per minute. It will remove such debris more efficiently and more completely than it can be removed manually. It has been found, also, that debris may be removed from roadsides even though the grass is fourteen to eighteen inches high. In doing so, the grass is cut to a height of 4 to 6 inches at the same time. Thus two operations are performed in one, namely, the removal of debris and the trimming or cutting of the grass to pleasing heights.

The nature of the debris to be collected by the machine determines to a large extent the speed at which the forced and induced draft fans are driven. In order to remove heavy objects, such as stones of large size, weighing several pounds, including glass bottles, tin cans and the like, the fan speed should be such as to deliver forced draft air through the nozzle **28** at speeds varying from 100 to 160 miles per hour. At the higher range of speeds, some gravel and loose sand will of necessity be picked up. At lower speeds, there is no appreciable pick-up of gravel and other loose soil.

The machine may be made as wide as circumstances dictate. For example, the width of the intake of the induced draft fan may be varied from 6 to 10 or 12 feet and the machine may be operated at speeds of from four to eight miles per hour. Thus the width of the intake to the induced draft fan and the speed at which the vehicle is propelled, indicates the tremendous areas that may be cleaned in an eight-hour day, with no more than two men operating the machine, one for driving the tractor or truck and the other for attending to the operation of the litter collector **15**.

The collector **23** at the rear of the machine comprises frame work as shown having front, side and rear walls of strong metal screening. The rear wall **72** may be hinged at the top as at **73** and latched with a hook **74** near the bottom and provided with a jack **75** of the hydraulic cylinder type, for swinging the back wall outwardly when it is necessary to dump a load of debris. Because of the velocity at which debris enters the collector, the debris is compacted to a high degree. For that reason, the collector need not have a large volume.

Where it is necessary to contain small particles of debris

and to minimize the amount of dust blowing through the collector, the inside surface of the collector walls may be covered with duck or other fabric which is sufficiently porous to allow air to permeate the same but at the same time holding back small particles and minimizing dust. Likewise, a fabric cover may be placed over the top of the collector for the same purpose.

The rear wheels **18** are so mounted that the machine may be operated over uneven terrain. As shown in FIGS. 4–6, the webs of the side frame members are slotted at **76** to accommodate wheel axle pivot shafts **77**. The shafts **77** are journaled in bearings **78** at the ends thereof, the bearings being secured to the respective webs of the frame members **29**.

Each wheel **18** is provided with an axle **79**. The inner ends of each pair of axles are welded to its pivot shaft **77**. Thus, as the machine travels over uneven terrain, the pivot shafts **77** so rotate that the wheels can accommodate themselves to the ups and downs of the surface over which the machine is pulled. Thus it enables the machine to clean debris from ditches along roadsides and the like.

In cases where the machine is to be used for cleaning sandy beaches, the modification shown in FIGS. 7 and 8 may be employed. That modification includes the addition of a tined fork **80** that extends crosswise and below the intake of the induced draft fan assembly **20**. The member **80** is supported at its ends by brackets **81** from eccentrics **82**, only one of which is shown, secured to the side frame members **25**. The eccentrics are provided with pulleys **83** and the ends of the fan shaft **43** are provided with pulleys **84** over which belts **85** run to drive the eccentrics, thereby continuously vibrating the tined member **80**.

The member **80** may be pitched downwardly as shown in FIG. 7, at such an angle that it will penetrate the sand to the required depth, say five or six inches, and carry hidden objects such as rocks, stones or bottles, to the surface of the sand. Thus, as the machine passes over the sandy beach, the induced suction of the induced draft fan and the swift air blast from the force draft fan pick those objects up and propel them into the duct **22** and thence to the receiver or collector **23**.

As the machine moves along the sand, the vibration of the member **80** causes the sand to be sifted while leaving the objects to be removed on the surface.

Having thus described the invention, it will be apparent to those of ordinary skill in the art that various modifications and changes may be made without departing from either the spirit or the scope thereof.

Therefore, what is claimed as new and desired to be secured by Letters Patent is:

1. A mobile apparatus for removing litter such as papers, bottles, stones and the like from the surfaces of turf, pavements, roadsides and the like, comprising a housing having a downwardly facing debris receiving opening and having an outlet formed therein, an induced draft fan including a shaft rotatably supported in said housing, a plurality of rows of flexible blades symmetrically disposed about and secured to said shaft, each row of blades extending continuously along the shaft for a distance substantially equal to the width of said debris receiving opening to produce a large flow of air to and through said outlet, said flexible blades being urged to extended position by centrifugal force during operation of the induced draft fan, means for directing high velocity air into said debris receiving opening so as to impinge upon a surface to be cleaned at an acute angle and beneath said induced draft fan so as to float heavy objects off the ground whereupon such heavy objects are moved vertically by the force created by said induced draft fan, and flexible seal means depending from said housing about said debris receiving opening and extending to a position adjacent a surface to be cleaned for confining the effect of said induced draft fan and said high velocity air while permitting large objects to enter said debris receiving opening.

2. Apparatus as in claim 1, in which the outer ends of said blades are provided with rigid members, and jointed, articulated flexible members secured at their inner ends to the rigid members, the outer ends of the flexible members being actuated to extended position by centrifugal force as the rotor rotates, said rigid and articulated members shattering frangibles contained in the debris.

3. Apparatus as defined in claim 1, wherein said apparatus includes a discharge duct leading away from said outlet formed in said housing, and a receiver means for receiving debris discharged through said discharge duct.

4. Apparatus as defined in claim 3, wherein said discharge duct curves upwardly and rearwardly from said housing, said receiver means being disposed rearwardly of said housing.

5. A mobile apparatus for removing litter such as papers, bottles, stones and the like from the surfaces of turf, pavements, roadsides and the like, comprising a housing having a forward wall portion and a rearward wall portion and having a downwardly facing debris receiving opening, said housing also including an outlet opening formed in the upper portion of said housing and being positioned in overlying relationship to the forward portion of said debris receiving opening, an induced draft fan including a shaft rotatably supported in said housing, a plurality of rows of flexible blades symmetrically disposed about and secured to said shaft, each row of blades extending continuously along the shaft for a distance substantially equal to the width of said debris receiving opening to produce a large flow of air tending to lift the debris in a vertical direction and to discharge the debris through said outlet opening, said flexible blades being urged to extended position by centrifugal force during operation of the induced draft fan, means adjacent said rearward wall portion for directing high velocity air into said debris receiving opening so as to impinge upon a surface to be cleaned at an acute angle and beneath said induced draft fan so as to float heavy objects off the ground whereupon said heavy objects are moved vertically by the force created by said induced draft fan, and flexible seal means depending from said housing at the sides and the leading edge of said debris receiving opening, said seal means extending to a position to operate relatively close to a surface to be cleaned for confining the effect of said induced draft fan and said high velocity air while permitting large objects to enter said debris receiving opening.

6. Apparatus as defined in claim 5, wherein said means for directing high velocity air into said debris receiving opening includes a blower having an outlet manifold, said outlet manifold having a discharge opening extending substantially the width of said debris receiving opening.

7. A mobile machine for removing litter, such as paper, bottles, stones and the like, from the surfaces of turf, pavements, roadsides and the like, said machine comprising a motor drivable induced draft blower having a housing and a rotor shaft journaled therein and provided with flexible blades extending along the shaft a distance substantially equal to the width of said housing, said housing having an intake opening facing said surfaces, through which is induced the flow of air containing litter, and a discharge duct, and a motor drivable forced draft blower having a discharge opening disposed rearwardly of but adjacent to the trailing edge of the intake opening for discharging high velocity air so as to impinge upon a surface to be cleaned at an acute angle and beneath said induced draft blower so as to lift and float debris into the intake of said induced draft blower, and a tined member carried by the forward end of the machine, said tined member extending below the intake opening of the housing and depending forwardly thereof so as to raise buried objects into the airflow zone, and means for vibrating said tined member to sift soil through the tines.

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