Oct. 17, 1961 K. RINGER 3,004,279

MOBILE VACUUM CLEANING MACHINE FOR STREETS, AIRPORT RUNWAYS AND THE LIKE

Filed Feb. 26, 1958 4 Sheets-Sheet 1

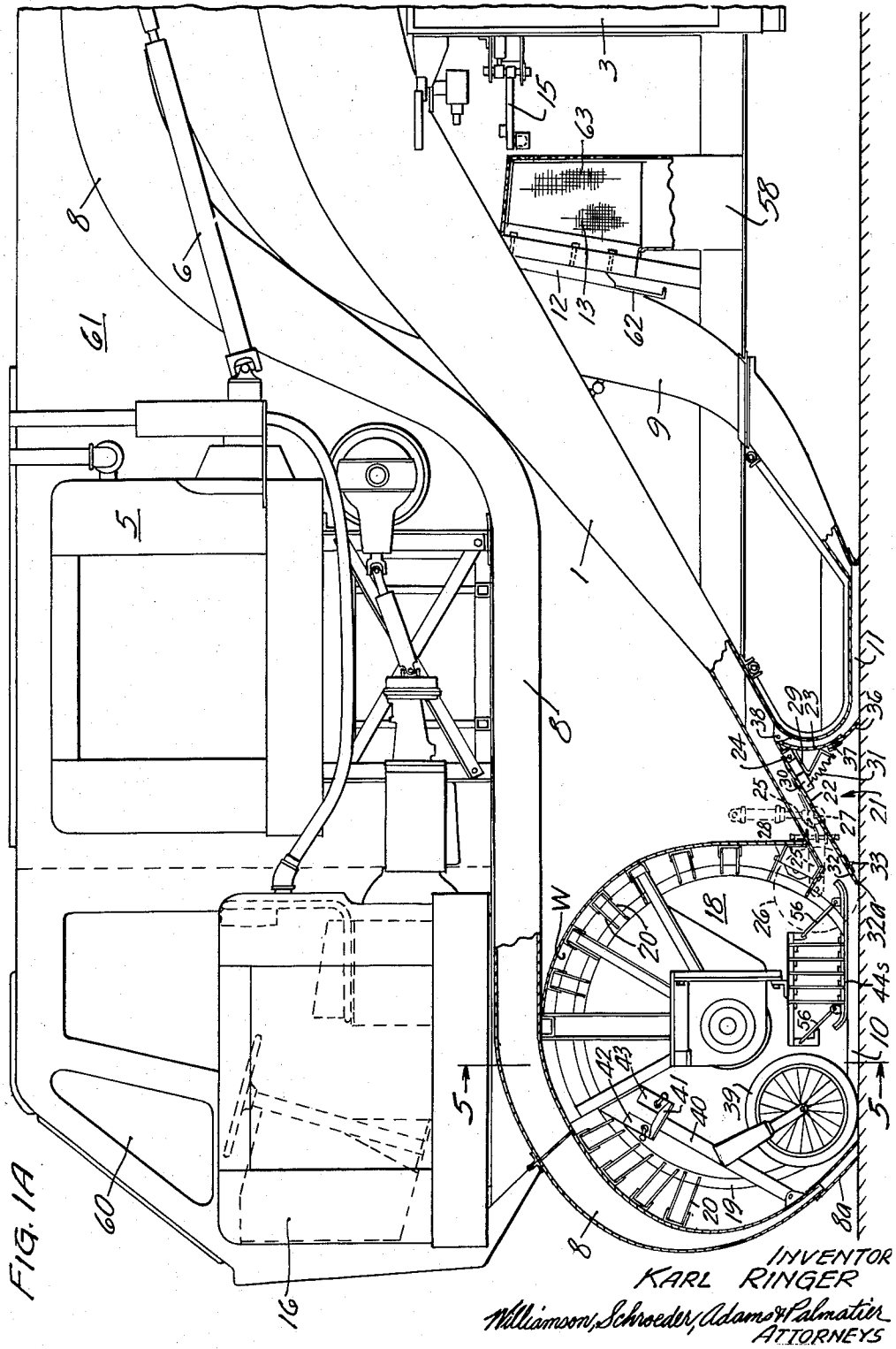


FIG. 1A

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FIG. 2

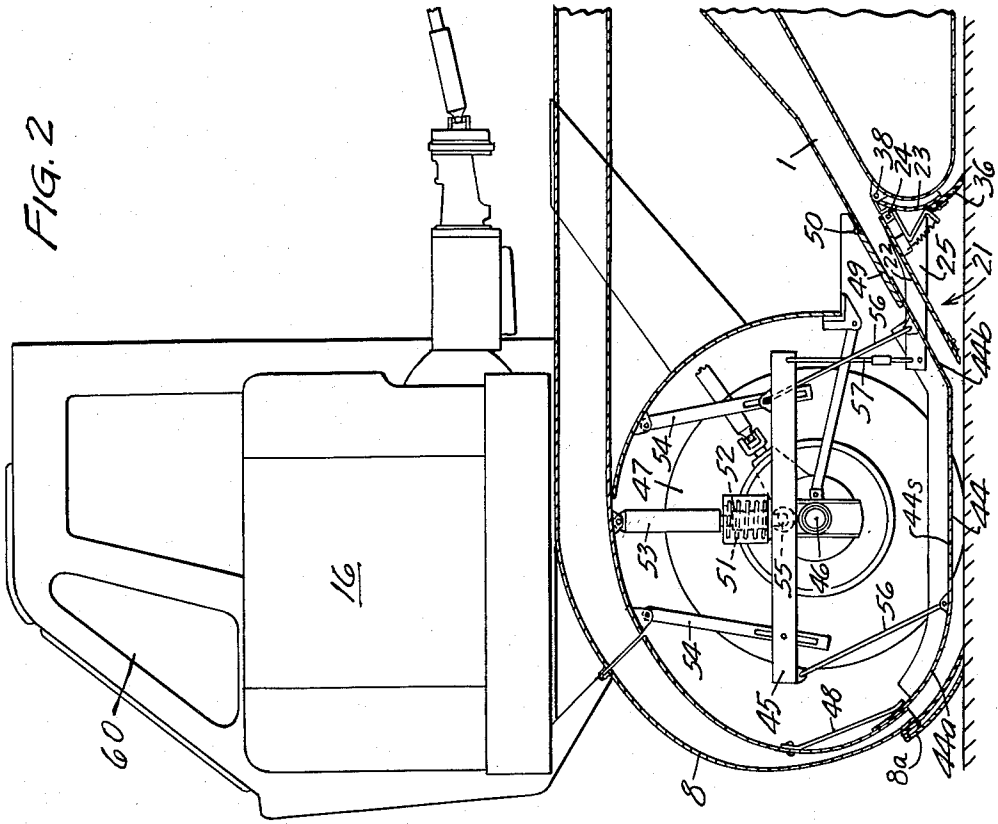
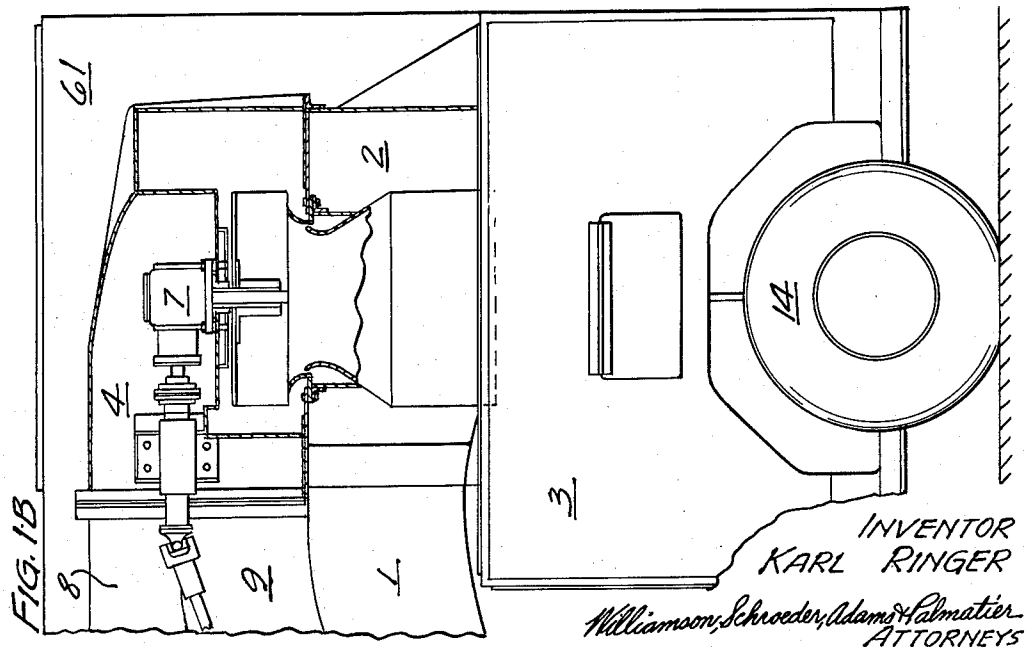


FIG. 1B



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FIG. 3

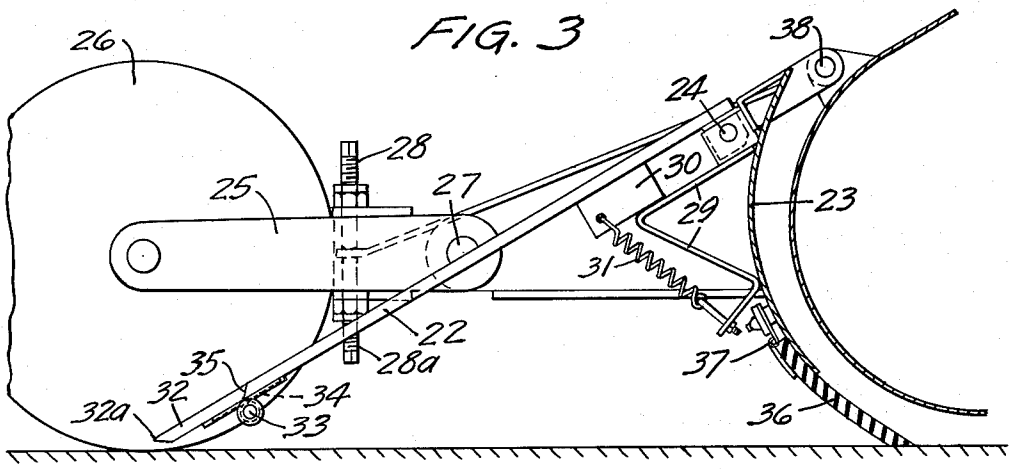


FIG. 4

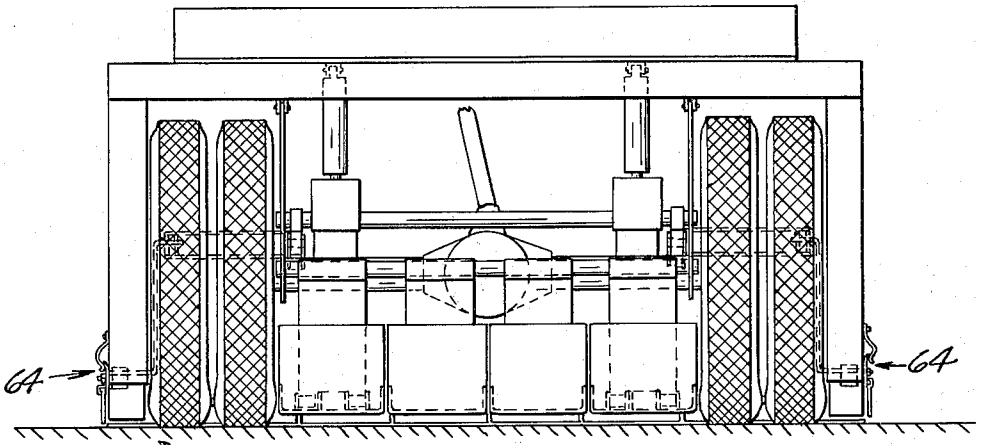


FIG. 10

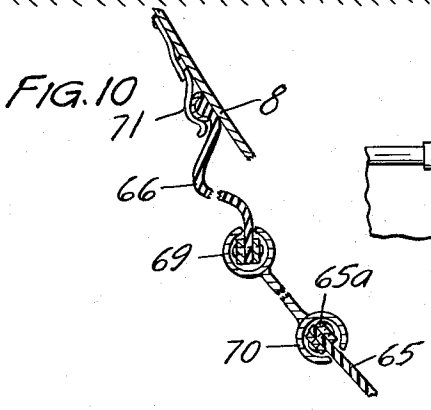
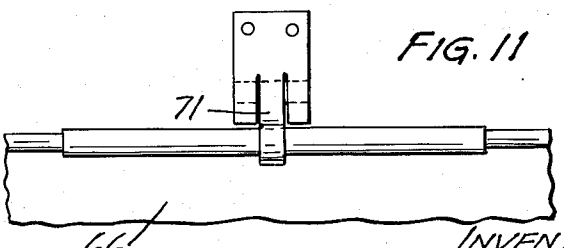


FIG. 11



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FIG. 5

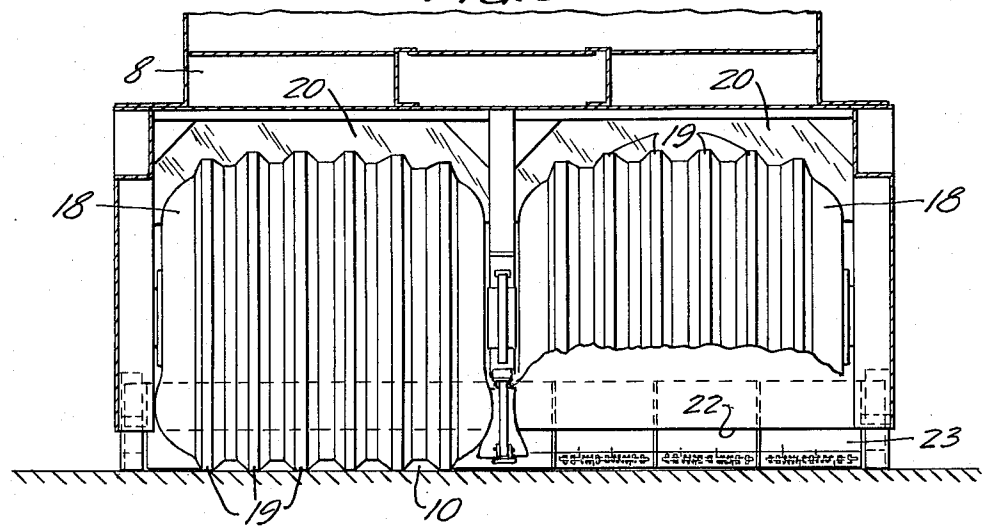


FIG. 6

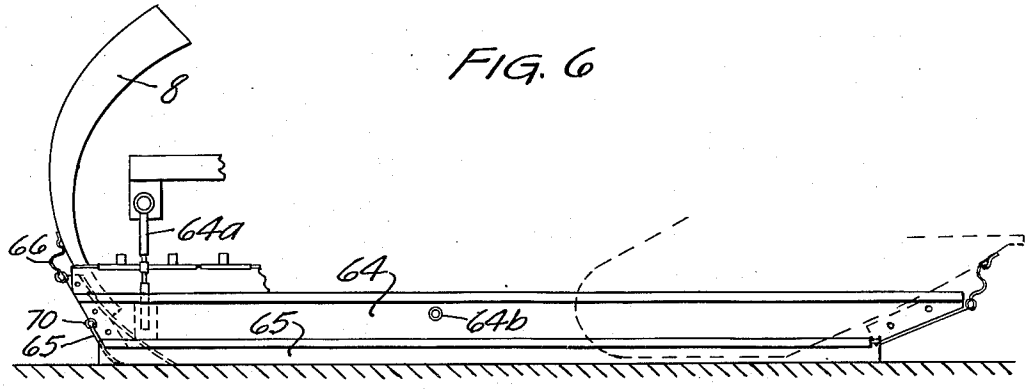


FIG. 7

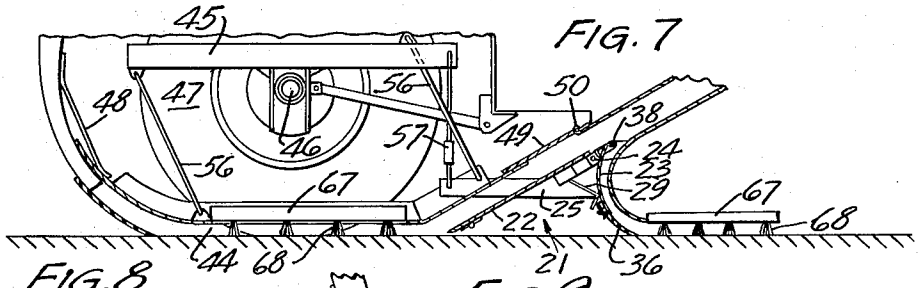


FIG. 8

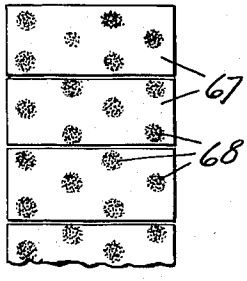
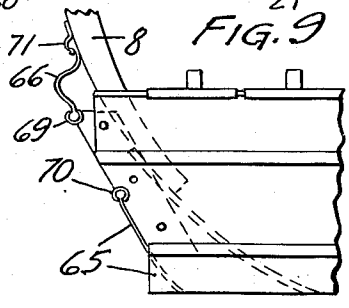


FIG. 9



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United States Patent Office 3,004,279 Patented Oct. 17, 1961

3,004,279

MOBILE VACUUM CLEANING MACHINE FOR STREETS, AIRPORT RUNWAYS AND THE LIKE

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Filed Feb. 26, 1958, Ser. No. 717,650
16 Claims. (Cl. 15—340)

This invention relates to a mobile vacuum cleaner for paved areas to remove loose objects such as sand, rock, metal parts and other debris therefrom more economically and more readily.

In the present state of the art a given nozzle of a vacuum cleaner opening determines the maximum size of objects the system can handle and the air volume necessary to generate air velocities sufficient to pick up the debris. This creates a dilemma because the objects require a nozzle opening as large as possible, whereas sufficiently high air velocities demand a nozzle opening as low as possible.

The nozzle is also an aerodynamically very tricky and difficult part of a vacuum system. Most of the requirements for an efficient nozzle are well known. The intake end of any suction duct is basically a nozzle, however, its efficiency is extremely low. In space any nozzle sucks air from all sides and the average deflection of all streamlines is 90°. Depending on the velocity of the airstream this turning requires a minimum radius for efficient execution. This requirement is fulfilled with the well known bell-mouth shape of air intakes. The way a nozzle is used in vacuum systems it operates no longer in space but normally against a plane (ground, floor or pavement) parallel to its opening and a certain distance from it. This wall cuts out a certain segment of the sphere from which the nozzle draws its air and allows the air to come in only from the sides through the gap between the wall and bell mouth. This creates a ring of high velocity streamlines rushing into the nozzle from all sides with an area of stagnation in the center. The narrower the gap between the wall and bell mouth is, the more pronounced this said effect becomes, the velocity of the streamlines increases, the thickness of the ring of streamlines decreases and the area of stagnation expands and intensifies. As of necessity the close proximity of a stagnant mass of air next to a mass of air moving at high velocity is detrimental to the maintenance of a concentrated high speed flow, which is essential for good pick-up characteristics. To obtain best pick-up performance it is, however, essential to reduce the gap between the bell mouth and the surface to be cleaned to a minimum, i.e., the necessary clearance for the objects to be picked up, and provide means which maintain a continuity of the air velocity throughout the nozzle.

Another problem area is the efficient dust control of the unit at the nozzle as well as at the exhaust point, these dust problems being interdependent. Furthermore, all the present designs require some type of chasis on which the parts of the vacuum system may be assembled, although this complicates and adversely affects the aerodynamic efficiency of the duct system as well as the overall dimensions.

An object of my invention is to reduce the necessary air-flow in the system to reduce the necessary horsepower with the attendant saving in costs of building and operation.

Another object is to increase the air velocities in the nozzle area and thereby improve the pick-up efficiency.

Still another object is to concentrate the air stream at the bulk of the finer debris, while not impeding the entry of relatively large objects such as beer cans into the nozzle.

These seemingly contradictory objects are attained through several closely cooperating mechanisms, an important one of which comprises a locally yieldable front approach to the nozzle which can be designed and built in various ways, two of which are shown in the accompanying drawings and are described hereafter.

Still another object is to maintain a continuity in the air stream which enters the nozzle from the front and the rear by blocking out the area of stagnation, which develops in any nozzle working close to a plane.

A further object is to construct the leading edge of this stagnation block out, which of necessity has to reach substantially down to the ground to be effective, so it will positively ride over any irregularity or fixed obstruction in the pavement with a minimum of interruption of its function as an effective stagnation block out and without a possibility of hanging up.

Another object is to reduce the over-all dimensions of the machine for easier andling and better maneuverability.

Another object is to simplify the machine by designing the vacuum system as a self-supporting structure.

Another object is to provide dust control all round the machine.

Another object is to improve performance at elevated speeds by separating all parts, the ground clearance of which is critical for efficient performance, from the main vehicle with its spring action and independently suspending them directly from an unsprung axle.

Another object is to facilitate lifting of the nozzle off the ground for transportation.

With these and other objects in view my invention consists in the construction, arrangements and combination of the various mechanisms and parts of my device, whereby the objects contemplated are attained as hereinafter more fully described, pointed out in my claims and illustrated in the accompanying drawings in which:

FIG. 1–A shows a vertical section of the greater portion including the forward portion of a machine embodying my invention taken along its longitudinal center line utilizing as a locally yieldable front nozzle approach a low pressure, beaded bag tire;

FIG. 1–B shows a similar vertical section of the aft or rear portion of said machine;

FIG. 2 shows a vertical section of the front part of another form of my invention along its center line with standard tires and yieldable nozzle approach;

FIG. 3 shows a vertical section of the stagnation block out of both machines;

FIG. 4 is a frontal elevational view of FIG. 2 with the hinged duct removed;

FIG. 5 is a cross section taken through the line 5—5 of FIG. 1–A with part of the bag tire broken away to expose the leading edge of the stagnation block;

FIG. 6 is a side elevation showing the floating seal frame, with the mechanism of the ducts, nozzle, and nozzle approaches removed;

FIG. 7 is a somewhat diagrammatical view in vertical and longitudinal section showing an alternative nozzle and pick-up construction employing stationary floating brush agitation; and

FIG. 8 is a diagrammatical bottom plan view of one of the brush areas.

FIG. 9 is a detail view in side elevation showing the forward end of the floating seal structure;

FIG. 10 is a vertical cross section showing the forward wall of said seal structure; and

FIG. 11 is a detail front elevation showing spring-loaded clamp means for retaining the upper forward edge of the floating-seal-frame.

As described in the drawings, the mobile vacuum cleaner shown in FIGS. 1–A and 1–B, consists of the following main components:

a nozzle with yieldable front approach described in

detail later on, a suction duct 1 connecting the nozzle with one or more separators 2, a hopper 3 to collect the debris, one or more blower means 4 preferably of centrifugal design driven by a constant speed engine 5 through a universal drive shaft 6 and preferably a gear box 7, split exhaust ducts 8 and 9, the first connecting the blower means 4 to the front approach 10 of the nozzle, the latter to the rear approach 11 of the nozzle, controllable bleed-off means 12 preferably located in the bottom side of the exhaust duct 9 and equipped with dust control means 13 which have preferably a self-cleaning characteristic such as the "Rotonamic" cyclone filter to permit continuous operation, wheels 14 to support this unit in a vehicular fashion, steering means 15, power and drive mechanism indicated as an entirety by the numeral 16 and control elements and mechanism (not shown) necessary to operate the unit both as a vacuum cleaner and a vehicle.

The nozzle shown in FIG. 1 depicts one of various possible ways of constructing a yieldable front approach to the nozzle to force the air positively down to the pavement and restrict the inlet area to attain higher air velocities with smaller flow volume and still not prevent large objects from entering the nozzle. This results in better pick-up performance at less power input.

The nozzle connects the outlet of the front recirculation duct 8 and aft recirculation duct 9 respectively with the suction duct 1. In order to increase the time which the air stream has for picking up the debris, the distance between the front recirculation duct 8 and aft recirculation duct 9 is held at a maximum within the practical limits of a particular vehicle. The inlet to to the suction duct 1 is located approximately in the middle between the two recirculation ducts and is connected with them by aerodynamically efficient approach passages 10 and 11 respectively. The front approach 10 naturally determines the size of the largest particle to be ingested unless it is yieldable. For this yieldable characteristic, a locally yieldable, ground-engaging support medium such as a bag tire 18 of known construction, such as the Goodyear "Terra Tire" made by Goodyear Tire & Rubber Company of Akron, Ohio, provides this front approach 10 to the nozzle. It is equipped with parallel circumferential tread rings 19 which run on the surface to be cleaned.

The height of these treads 19 and their spacing determine the size of the air passages and are selected for best aerodynamic efficiency of the vacuum system with respect to the average debris. As these tires also carry the load of the vehicle, they deform to considerable length in the direction of travel of the vehicle, thereby providing the necessary length of time for the air to become effective. However, these low pressure bag tires overroll any large objects and permit their ingestion into the vacuum system without at any time increasing the cross sectional area of said air passages to thereby reduce the air velocities and pick-up characteristics of the vacuum system. The air flow channel which is formed between the sheet metal of the wheel well W and the top side of the tire is blocked off by a series of flexible and resilient contoured seal strips 20 which form an effective labyrinth. Thus, practically all the air exhausted at the end of the recirculation duct is forced at very high velocities through the channels under the bag tire into the center part of the nozzle where the two approaches 10 and 11 (see FIG. 1) converge to the inlet of the suction duct 1. For reasons of aerodynamic efficiency, the change of direction of an air flow cannot be too abrupt, which however, means that the physical arrangement of the suction duct 1 and the two approach passages 10 and 11 creates a relatively very large space where the high velocity air streams from the two nozzle approaches 10 and 11 under the conditions of the prior art, suddenly expand and lose all their pick-up efficiency. To obviate such an undesirable result and in order to maintain the best possible flow

continuity (see FIGS. 1 and 3), the core of this space where an area of stagnation develops, is blocked out by a stagnation block out 21.

In accordance with its function of blocking out the area of stagnation (see FIGS. 3 and 1–A) the two main parts 22 and 23 of the stagnation block out 21 parallel the respective walls of the nozzle to provide a maximum degree of continuity in the air flow. Its shape therefore, depends entirely on the nozzle. Depending on the actual gap at any point around the bell mouth, its cross section shows a peak dividing the line, where the nozzle attaches to the suction duct, in the ratio of the gaps between said wall and the two opposite points of the bell mouth shown in the cross section. From this peak one wall of said body 21 follows forwardly as parallel as possible the one wall of the nozzle cross section unit, it substantially meets the surface to be cleaned and the other wall of said body follows as parallel as possible rearwardly the other side of the nozzle down to the surface to be cleaned.

For best efficiency these two main parts of stagnation block-out 21 have to reach down to the ground as far as possible, which of course creates severe problems for the leading edge thereof, particularly at high speeds. The stagnation block-out assembly is fastened to the inlet of the suction duct 1 at its highest and most rearward point by a hinge 38. The two main parts, the straight front plate 22 and curved rear plate 23 are connected by another hinge 24. The proper location of stagnation block-out and especially of the leading edge to the ground is determined and maintained by a guide arm 25 rigidly welded to rear plate 23, the forward end of which is held at a consistent, uniform distance from the ground by a guide wheel 26 or the adjustable link 57 as described in the alternate nozzle design (see FIG. 2). When equipped with the guide wheel 26 the guide arm 25 is jointed in the middle by joint 27 which in conjunction with two set screws 28 and 28*a* provide for adjustment of the ground clearance of the leading edge. The straight plate 22 which is connected to the curved plate 23 by hinge 24 is normally held in the required position by a support bracket 29 and a spacer 30. To offset any lifting force from suction, spacer 30 and the lower end of support bracket 29 are connected by an adjustable tension spring 31. The straight plate 22 is equipped with an easily replaceable front plate 32 connected to it by hinge 33 and held in the proper position by a heavy torsion spring 34. The split 35 between plate 22 and the front plate 32 is oblique to prevent particles from settling in it when open. The lower end of the curved plate 23 is formed by suitable deformable material such as heavy rubber belt stock 36, which rides and seals off the ground at the trailing edge of the stagnation block-out. To prevent damage when the vehicle backs up, this belt 36 is fastened to plate 24 by a hinge 37 which allows the belt 36 to trail the motion of the vehicle also in reverse.

If the leading edge 32*a* hits a fixed obstruction in high speed cleaning, it will hingedly buckle the assembly straight plate 22 and front plate 32 upwards at the hinge 33. The front part 32 will then swingably fold under and in so doing lift the hinge 33 over said fixed obstruction because plate 22 has freedom of upward motion through hinge 24. The front plate 32 then will itself slide over the obstruction and thereafter snap forward into its proper position under pressure from torsion spring 34. This action is very similar to the tripping edge of a snow plow blade. Front plate 32 and straight plate 22 are also sectionalized like some snow plow blades to reduce both the shock introduced into the vehicle from the inertial forces resisting this tripping, and the amount of disturbance introduced into the vacuum system.

The bag tire 18 is further used as a means of improving the ground clearance of the front part of the vehicle in transportation. In cleaning position the rolling radius of the tire is for example 17 inches. By inflating the tire to

its maximum pressure the rolling radius increases to approximately 20½ inches for transportation, thereby increasing the ground clearance of the nozzle in the example given by 3½ inches. The necessary controls for the inflation pressure of the bag tires are located in the cab so that the operator can select either transport or cleaning position of the nozzle. The proper maximum inflation pressure for transportation is controlled by a pressure switch. For cleaning, however, it is important to maintain the design dimension of the exemplary 17 inches for the rolling radius within very close tolerances regardless of variation in load distribution during cleaning due to consumption of fuel and pickup of debris. This design dimension is therefore controlled by a ground height sensing device, which consists of a wheel 39 mounted on a bracket 40 pivotally attached to the end of recirculation duct 8. At the free end of bracket 40 an adjustable cam 41 is mounted, which actuates two limit switches 42 and 43. Switch 42 becomes actuated when the rolling radius becomes less than, for example, 16 and ⅞ inches and inflates the bag tire 18 through a solenoid operated valve (not shown). Switch 43 is actuated when the rolling radius exceeds 17 and ⅛ inches deflating bag tire 18 through another solenoid operated valve (not shown). In order to adjust only for real changes in load distribution a time delay mechanism (not shown) cuts out all momentary impulses from debris or uneveness of the ground the wheel 39 might hit.

In FIG. 2, an alternate nozzle desgin to the use of bag tires is shown. The front approach 44 to the nozzle is located as shown approximately only 1½ inches off the ground, thereby pressing the air stream onto the pavement. In order to maintain this proper ground clearance also at high speeds this nozzle approach 44 is separated from the frame of the vehicle and suspended from a framework 45 which is directly mounted on the drive axle 46 thus eliminating all spring action except that of the high pressure pneumatic tires 47. Their spring action is not great enough to significantly disturb the air flow conditions through the channel between the nozzle approach 44 and the ground. The upwardly curved front part 44*a* of the nozzle approach 44 overlaps the end of the recirculation duct 8 and is pressed against its back side by spring 48, thereby allowing relative movement between nozzle approach 44 and duct 8 without losing contact. At the upwardly curved aft end 44*b*, the nozzle approach 44 is in line with the top side of suction duct 1, but separated by a wide gap. Nozzle approach 44 is preferably made up of a series of relatively narrow parallel plate sections 44*s*, each having the forwardly upturned portions 44*a* and the rearwardly and upwardly inclined rear portions 44*b*. The individual plate sections 44*s* are suspended for parallelogram lifting and falling by parallel links 56. This gap is closed off by a rather stiff sheet 49 such as rubber belt material fastened to the suction duct 1 by a hinge 50. In operation, the suction causes this sheet to tightly seal without hindering movement of the nozzle approach 44.

The drive axle 46 is a standard truck rear axle equipped with differential gear drive, brakes and hubs for dual tires. This axle 46 supports the front part of the vehicle through a set of coil springs 51 dampened by a set of hydraulic shock absorbers 52 and held by a set of hydraulic cylinders 53 which are pivotally mounted to the frame of the vehicle. By this arrangement the vehicle has the benefit of spring action while the nozzle approach 44 remains at a practically constant ground level.

Through the action of the hydraulic cylinders 53 it is possible to lift the whole front part of the vehicle off the ground for better ground clearance in transportation. As the cylinders 53 expand and lift the front part of the vehicle, the links 54 begin to fold up frame 45 around its pivot support 55 which is mounted on the axle 46. The nozzle approach 44 which is suspended from frame 45 by links 56 has to follow the frame upwards. From FIG. 2 it will be seen that for each of the nozzle approach sections 44*s* a pair of links 56 in parallel relationship support the several adjoining sections, thereby providing for sectional upward displacement of the approach 44 throughout the entire horizontal links thereof.

Tied into the frame 45 is also an adjustable link 57 which is fastened to the guide arm 25 of the stagnation block-out 21. This stagnation block-out is pivotally mounted, by hinge 38, on the suction duct 1 which is part of the vehicle and thereby subjected to its spring action. In cleaning position, the link 57 controls and maintains a constant ground height of the leading edge 32*a* of the stagnation block-out 21. In transportation, link 57 pulls the leading edge of stagnation block-out 21 up against the underside of the nozzle approach 44.

The function of the nozzle shown in FIG. 2 during sweeping, is as follows:

The exhaust air from the fan is returned through the recirculation duct 8 into the nozzle approach 44. To allow the debris to enter the system the rigid recirculation duct 8 ends approximately as shown 6 inches off the ground and a flexible, double walled rubber seal 8*a* reaches down to the ground containing the air stream without restraining entrance of the debris. One wall of the seal 8*a* it will be seen is at the forward and outer portion of the restricted lower portion of duct 8 while the other wide or portion of the seal is on the inner portion of said duct. At operating speeds the nozzle approach 44 and the leading edge of the stagnation block-out 21 follow the ground very closely, whereas the recirculation duct 8 and suction duct 1 may oscillate considerably. The differential motion between the nozzle approach 44 and the recirculation duct 8 is taken up by the spring 48, between the nozzle approach 44 and the suction duct 1 by the rubber belt sheet 49 and between the leading edge of the stagnation block-out 21 and the suction duct 1 by the hinge mounting 38. In this position the nozzle approach 44 allows entry to all particles in the form shown up to 1½ inches in diameter. When a larger object is incurred, it will wedge between the front of the nozzle approach 44 and the ground and force a swinging of nozzle approach 44 around its suspension points on frame 45. This swinging increases the ground clearance of the nozzle approach 44 to permit ingestion of those large objects up to 3 inches in diameter. After ingestion of the object into the suction duct 1 the nozzle approach 44 returns by gravity and spring action to its normal position. To minimize the impact and disturbance of the air flow by the ingestion of large objects the nozzle approach 44 is built in independent sections of approximately one foot in width.

Another very important feature of this mobile cleaner in both forms illustrated is its greatly improved maneuverability. This feature has been achieved by designing and arranging the necessary non-mechanical components such as suction duct 1, nozzle, recirculation ducts 8 and 9, hopper 3, separator 2, dust bin 58, in a way to form a rigid, integral and self-supporting structure, as shown in FIG. 1, strong enough to carry the weight of all the necessary mechanical gear, such as fans 4, gear boxes 7, engines 5 and 16, controls and the cab 60 and shrouding 61 and the substantial weight of the picked up debris. The elimination of a standard chassis not only eliminates a costly item but it simplifies the design of an aerodynamically more efficient dust system of much greater compactness. Furthermore, the steering geometry of a standard chassis is not concerned with and adaptable to maximum maneuverability and sets very definite limits to it far below the desirable standards for a mobile cleaner. Thus, the machine according to this invention can be built for the same capacity as present units, but with greatly reduced overall dimensions and practically unrestricted steering geometry, which results in both greatly improved maneuverability and handling ease. It further, not only simplifies the design by reducing the number of necessary

components, but permits an arrangement, which makes all service and maintenance parts readily accessible.

A further feature is the dust control system. As shown in FIG. 1–A, the bottom side of the aft recirculation duct 9 is provided with a bleed off 12. The amount of air to be taken out of the recirculating system at this point depends on efficiency of the seals around the nozzle. The bleed off has to be slightly larger than the additional air sucked in at the nozzle so that there is a slight air deficiency at the nozzle creating suction all around it and thereby avoiding external dusting at the nozzle. In order to compensate for the wear on the seal the bleed off is regulated by an adjustable shutter 62. The bleed off air is exhausted into a self-cleaning cyclone filter 13 such as the "Rotonamic" filter, which separates about 90 percent of all dust contamination from the bleed off and collects it in dust bin 58. The precleaned bleed off air is then sent through surface type filters 63 before being exhausted into atmosphere practically free of dust.

As shown in FIG. 6, the seals around the nozzle are mounted on a separate floating frame 64 which is held at the proper ground clearance by a rod 64*a* suspended from frame 45 and a pivot mounting 64*b* on guide arm 25. This frame 64 holds a fairly stiff rubber strip 65 sealing off the rather uniform ground clearance and a fairly flexible, bellows-like rubber strip 66 sealing off the ever changing gap to the oscillating vehicle.

The frame 64 is equipped with a slit tube 69 at its top and another slit tube 70 at its bottom. The slit of tube 69 is facing up and the slit of tube 70 is facing down. To facilitate mounting of the rubber strip 65 its one edge 65*a* is built up or beaded so when it is threaded into the slit tube 70 it will not fall through. The strip 66 has both edges built up so that the lower edge may be threaded into slit tube 69 whereas the upper edge will be held tightly against the oscillating vehicle by spring-loaded clamps 71.

Under certain sweeping conditions it may be advantageous to have some positive mechanical agitation of the debris while it is exposed to the airstream. It is part of this invention to provide, as shown in FIG. 7, either the aft nozzle approach 11 or the yieldable front nozzle approach 44 with a set of stationary brushes 67 consisting of a number of bunches of bristles 68 which are arranged in a staggered fashion so as to cover the full width of the nozzle and yet allow the air to pass through. Thus, not only will every particle in the path of the cleaner be agitated mechanically, but the vortices set up by the staggered pattern of the broom increase the pick-up capacity of the airstream itself. As the speed of the cleaner increases the agitation of the broom becomes more effective because the slight inherent bouncing of the pneumatic tires of the axle 46 which supports the yieldable front approach 44 causes periodic interference of the broom bristles with the ground, bending the bristles backward and thereby tensioning the same, followed by periodic release of the ground contact, letting the bristles snap forward and flipping debris up into the airstream.

From the foregoing description, it will be apparent that I have conceived and provided a number of novel and improved features and components (as contrasted with the prior art) which closely cooperate in the operation and travel of my machine to provide a highly efficient, large area vacuum pick-up with increased air velocities throughout front and rear nozzle areas while nevertheless reducing the quantity of air flow required and consequently effecting economies in power requirements, machine production and operational costs.

The closely cooperating, novel features of my invention including the locally yieldable nozzle-approach-passages with sectionally yieldable stagnation block-out and the control of a substantially continuous, thin stream of air forward and aft throughout the entire width of the pick-up area, together with the independent suspension (from the main vehicle support with its cushioning spring action) of all parts having critical ground clearance, produces a substantially improved performance of the machine at relatively high travel speed (18 to 22 miles per hour).

The foregoing results and advantages are attained despite irregularities in the ground or pavement over which the machine travels since the skirt sections or approaches of front and rear nozzles as well as the sectional construction of the front plate 32 which constitutes the forward portion of the straight top plate 22 of the stagnation blockout indicated as an entirety by the numeral 21 with the multiple hinge construction thereof, all locally yield throughout the transversely disposed edges thereof, to fixed and large movable obstructions, permitting overriding of the same without damage to machine parts and without substantially affecting the continuity and velocities of the wide air streams of the nozzles and suction duct.

With the relationship and suspension and separation of the nozzle structures and suction duct independently of the spring cushioned, main vehicle supports, high pressure force of air from front and rear provides concentration of the discharged air streams and pick-up suction on the bulk of the debris which of course constitutes the smaller and lighter material to be removed.

Attention is called to the simplicity of the overall machine construction through the multi-functional use of the overall vacuum system including ducts, walls and housings as a unitary self-supporting structure, thereby eliminating the need for a special chassis or frame to support the motors, working parts, axles and the like. This same self-supporting construction enables me to materially compact the overall structure and steering facilities, thereby making the overall machine more readily maneuverable and less expense to build as contrasted with machines of the prior art.

It will of course be understood that various changes may be made in the form, details and arrangement of parts and equivalencies without departing from the scope of my invention.

The term "ground" as used in the appended claims, is intended to include pavement, streets, air strips and any and all supporting surfaces upon which the improved machine is adapted to travel.

What is claimed is:

1. In a mobile vacuum pick-up machine, a wide front nozzle structure having a rearwardly directed, very narrow air discharge, a front nozzle approach communicating with said air discharge and defined at least partially between ground and a medium disposed transversely of the machine in very close relation to ground and extending generally horizontally parallel with ground, said medium being locally bodily yieldable upwardly throughout substantially the length thereof to over-ride relatively large, fixed and movable obstructions and a suction duct disposed rearwardly of said approach and also extending transversely of the machine, and declined at an acute angle to ground and to said front nozzle approach.

2. The structure set forth in claim 1 wherein said locally yieldable approach medium includes a readily deformable, generally cylindrical, low inflation bag-tire having generally circumferential, spaced ground-engaging elements thereon, the intervening spaces between said ground-engaging elements in aggregate, defining a very high velocity, rearwardly directed air discharge.

3. The structure set forth in preceding claim 2, mechanism for varying the inflation of said bag-tire to increase inflation and so elevate the nozzle for transport purposes and a ground-height-sensing device for maintaining the effective rolling radius and flatting of said bag-tire for pick-up purposes.

4. In a mobile vacuum pick-up machine, a front nozzle structure extending transversely through the greater part of the width of the machine and including structure defining a series of side-by-side, sectionally deformable,

generally horizontal nozzle-approach passages defined by wall portions disposed in close relation to ground and bodily movable upwardly throughout their rearwardly extending lengths to enable said structure to over-ride relatively large obstructions without seriously affecting velocity of air discharged through said passages, an air discharge duct disposed forwardly of said structure and directing air under pressure rearwardly through all of said nozzle-appoach passages and said nozzle including a suction duct disposed immediately rearwardly of said nozzle-approach passages and extending transversely substantially the full width of said approach and declined rearwardly at an acute angle to ground and said approach passages.

5. The structure set forth in claim 4 and a rear nozzle-approach communicating at its rear portion with a forwardly directed source of air under pressure and spaced widely from said forward nozzle-approach structure, said suction duct being connected throughout its width with said rear nozzle-approach and a stagnation block-out medium of generally triangular configuration disposed in spaced relation between the inner ends of said nozzle-approach passages and having an apex extending upwardly into an intermediate portion of said suction duct.

6. Pick-up structure for a mobile vacuum cleaner, having in combination a bell mouth housing defining a pick-up area, said housing having a generally horizontal forward approach and a generally horizontal rearward approach, both approaches extending transversely of the machine in close spaced relation to the ground and both being sectionally and upwardly yieldable throughout their lengths, front and aft air discharge ducts having discharges extending substantially the full width of said housing and spaced widely apart, an upwardly extending suction duct disposed intermediately of said discharge ducts and a stagnation block-out structure disposed behind said suction duct and intermediately between said forward and rear approaches and defined by forward and aft upwardly converging transverse walls extending substantially to ground, and said forward transverse wall having depending, hinged front portions sectionally yieldable.

7. The structure set forth in preceding claim 6 wherein said front portion of said forward wall is sectionally yieldable downwardly and rearwardly and wherein the main portion of said forward wall is hinged for upward yielding action and buckling hinge action in combination with said sectional front portion.

8. The structure set forth in preceding claim 6 wherein the forward and rear walls of said stagnation block-out structure converge upwardly and are connected together and wherein said connected structure is swingably mounted on a hinge axis at the rear thereof and adjacent the upwardly converging portions of said walls.

9. A mobile vacuum pick-up machine having in combination blower means having a rigid housing, forward and rear rigid recirculation, air-discharge ducts having trunks leading from said blower housing and rigidly connected thereto, a rigid suction duct disposed in contingent relation to said trunks, a material separator connected for communication with said blower means having a rigid housing, said previously recited parts being rigidly interconnected to form an integral, elongated supporting structure fully serving the purposes of a vehicle body and frame, ground-engaging supporting means suspended from said integral supporting structure to permit travel of said machine over the ground with provision for steering of the machine, pick-up stucture depending from the medial portion of said integral supporting structure and having a forward nozzle approach extending transversely of said structure throughout the greater portion of the overall width of the machine, said forward recirculating duct communicating with said forward nozzle approach, a stagnation block-out disposed rearwardly of said forward nozzle approach and said second recirculation duct having a nozzle approach discharging forwardly and disposed rearwardly of said suction duct.

10. The structure set forth in claim 9 wherein said rigidly interconnected ducts extend forwardly of the machine constituting supporting medium for a source of power and the driver of the machine and wherein said blower housing, separator housing and other related interconnected structure constitutes the rear portion of said elongated supporting structure and has attached to the lower portion thereof, rear axle structure.

11. A mobile vacuum pick-up machine having in combination, a vehicle body mounted for travel over the ground, blower mechanism mounted on said body, a suction duct communicating with the intake of said blower mechanism, a forward recirculation duct and an aft recirculation duct, said recirculation ducts communicating with the discharge of said blower mechanism, a pick-up structure depending from the intermediate portion of said vehicle body and comprising a forward, rearwardly-directed nozzle approach communicating with said forward recirculating duct and a rearward, forwardly discharging nozzle approach communicating with the aft recirculation duct, said pickup having in its area of stagnation a stagnation block-out having skirt portions extending substantially to ground and interposed between said forward and rear nozzle approaches, an air-bleed-off provided in said aft recirculation duct, rearwardly and above said rear nozzle approach, a dust filter connected with said bleed-off and delivering to a dust collector and mechanism for controlling the amount of air discharged through said bleed-off to constantly remove a slightly larger quantity of air than the additional air taken in from without by said pickup structure thereby providing a slight air deficiency all around the pick-up structure to avoid external dusting at the pick-up structure.

12. The structure set forth in claim 11 wherein said bleed-off is regulated by an adjustable shutter and wherein the bleed-off air is exhausted into a self-cleaning cyclone filter delivering collected material into a dust bin.

13. Pick-up structure for a mobile vacuum cleaner having in combination, a bell mouth housing defining a pick-up area, said housing having a forward nozzle approach extending transversely of the machine in close relation to the ground and extending rearwardly and substantially horizontally and being locally and bodily yieldable substantially throughout the width of said structure, front and aft air discharge ducts extending substantially the full width of said housing and spaced widely apart, a suction duct disposed intermediately of said discharge ducts, a stagnation block-out structure disposed intermediately of said suction duct and said forward and rear approaches and defined by forward and aft transverse walls extending substantially to ground and said forward wall having depending, hinged front portions sectionally yieldable, guide arm means for determining the general ground elevated position of said sectionally yieldable front portion, unsprung-ground-engaging media for supporting said guide arm and a linkage between said media and said guide arm for determining the suspension of said hinged front portion of said stagnation block-out structure.

14. The structure set forth in preceding claim 13 and means for readily adjusting said linkage for optimum gound clearance of the leading edge of said stagnation block-out structure.

15. The structure set forth in claim 14 further characterized by a vehicle, to the underportion of which said bell mouth housing is connected, hydraulic means for lifting the front of said vehicle and said linkage being interconnected with the front of said vehicle to lift high the leading edge of said stagnation block-out and the front nozzle approach when the front end of the vehicle is lifted high through said hydraulic means.

16. In a mobile vacuum pick-up machine, a vehicular

body and frame, forward axle structure mounted below said frame and having ground-engaging supporting media, means interposed between said axle structure and frame for supporting said frame with provision of vertical cushioning effect, a vacuum nozzle structure disposed for the most part rearwardly of said axle structure and having a foward, rearwardly discharging nozzle approach including a plurality of generally horizontal, independently elevatable, longitudinal sections disposed in side-by-side arrangement, means for suspending said plurality of nozzle approach sections from said axle structure independently of the up and down movement of said vehicular body and frame, said suspending means including depending, substantially parallel links for permitting substantially uniform upward deflection of said plurality of sections from forward to rearward ends thereof when obstacles are encountered, means for discharging air under

pressure rearwardly longitudinally beneath all of said secitons of said nozzle approach and a suction duct disposed rearwardly of said front nozzle approach and having a width substantially equal to the cumulative width of said front nozzle approach sections.

References Cited in the file of this patent

UNITED STATES PATENTS

819,178	Sheley	May 1, 1906
1,033,164	Fahrney	July 23, 1912
1,229,737	Furnas	June 12, 1917
2,210,950	Replogle	Aug. 13, 1940
2,224,202	Smellie	Dec. 10, 1940

FOREIGN PATENTS

344,274	Great Britain	Mar. 5, 1931