This invention relates to rotary brooms for moving materials such as snow, ballast, dirt, water, slush, or other like materials, from a variety of situations, such as railroad yard switch tracks, sidewalks, streets, highways, yards, airports, etc.

In my co-pending U.S. patent application Ser. No. 319,611 is described a rotary broom assembly which can be attached to a wide variety of vehicles and can be readily transferred from one vehicle to another, as occasion demands.

The broom assembly basically comprises an impeller assembly, for sweeping and moving the material, rotatably mounted on the end frames of a support frame structure. The impeller assembly is rotatably driven by any suitable means, such as a gasoline or diesel engine, hydraulic motor, etc., mounted on the support frame, and the support frame structure is adapted to be mounted on any suitable means of conveyance, such as a tractor with front end loader.

The present invention provides turbine means, positioned at the discharge of the impeller assembly, to increase the discharge velocity of material from the impeller and to provide directional casting of the material as it leaves the rotary broom.

Moving blade arrangements are positioned along the lower edge of the rear frame of the support frame structure to provide additional sweeping when an exceptionally clean surface is required, such as road or aircraft runway surfaces, or where high speed sweeping is required.

A further additional feature of the present invention provides a means whereby suitable oil is injected into the turbine casings, to provide a film of oil between the casing walls and the material passing there-through, to prevent build up of such material on the casing walls.

It is, therefore, the main object of the present invention to provide a rotary broom assembly for sweeping snow, ballast, dirt, water, slush, or like materials, from railroad yard switch tracks, sidewalks, streets, highways, yards, airports, etc., said broom assembly embodying turbine means for additional output velocity.

Another object of the present invention is to provide a rotary broom assembly incorporating discharge chute means for directional casting of material from the broom output.

Another object of the present invention is to provide a rotary broom assembly having sweeping blades along the lower edge of the support frame structure, to provide additional sweeping on relatively flat surfaces.

A further object of the present invention is to provide a rotary broom assembly having turbine means for increased output velocity and including a means for supplying suitable oil to the turbine casings, to prevent build-up of material on the casing inside walls.

These and other objects and advantages of the present invention will be more fully apparent by reference to the following detailed specification and figures in which:

FIG. 1 is a side elevation of a rotary broom assembly incorporating a turbine arrangement according to the preferred execution of this invention and shown mounted on the front end loader of a tractor.

FIG. 2 is a side elevation, to an enlarged scale, of the rotary broom and turbine assembly shown in FIG. 1.

FIG. 3 is a section on 3-3 in FIG. 2, to a further enlarged scale.

FIG. 4 is an end elevation taken in the direction of arrow 4 in FIG. 2.

FIG. 5 is an end elevation, similar to FIG. 4, but showing an alternative execution embodying a partially enclosed turbine and a discharge duct at the mid impeller discharge position.

FIG. 6 is a section on 6-6 in FIG. 5.

FIG. 7 is an end elevation similar to FIG. 5, but embodying a fully enclosed turbine.

FIG. 8 is a section on 8-8 in FIG. 7.

FIG. 9 is an end elevation similar to FIG. 4, but showing another alternative execution embodying a partially enclosed turbine and a discharge duct, at the impeller end discharge position.

FIG. 10 is a section on 10-10 in FIG. 9.

FIG. 11 is an end elevation similar to FIG. 9, but embodying a fully enclosed turbine.

FIG. 12 is a section on 12-12 in FIG. 11.

FIG. 13 is a section similar to FIG. 8, but showing details of the oil distribution arrangement.

FIG. 14 is a plan elevation in the direction of arrow 14 in FIG. 13.

FIG. 15 is a side elevation, similar to FIG. 2, but showing one execution of supplementary sweeping blades.

FIG. 16 is a partial end elevation in the direction of arrow 16 in FIG. 15.

FIG. 17 is a side elevation, similar to FIG. 2, but showing another execution of supplementary sweeping blades.

FIG. 18 is a partial end elevation in the direction of arrow 18 in FIG. 17.

With reference now to the figures in which like numerals represent parts throughout the several views, and with particular reference to FIGS. 1-4, the preferred execution of the rotary broom and turbine assembly, indicated generally at 21, is shown mounted on the front end loader 22 of tractor 23.

Rotary broom and turbine assembly 21 is mounted on front end loader 22 by means of mounting bars 24 and 25, attached to the rear frame of support frame structure 26. Gasoline engine 27, or other suitable driving means, is mounted on the top frame of support frame structure 26, with output shaft 28 supported in bearing 29 and driving lay shaft 30 through sprockets 31 and 32 and chain 33.

Main shaft 34 is rotatably mounted in bearings 35 and 36 attached to the end frames of support frame structure 26.

Impeller assemblies 37 and 38, of the type shown and described in my co-pending U.S. patent application Ser. No. 319,611, comprise impeller shafts 39 and 40, respectively, with flexible impeller blades 41 positioned thereon, the angle between blades 41 and the axes of the impeller shafts being adjustable and arranged such that the material being swept is moved inwardly. Impeller assembly 37 is rotatably mounted on main shaft 34 and is driven from lay shaft 30 by means of sprockets 42 and 43 and chain 44, and impeller assembly 38 is rotatably mounted on main shaft 34 and is driven from lay shaft 30 by means of sprockets 45 and 46 and chain 47.

Axial flow fans 48 and 49 are positioned at the outside ends of impeller assemblies 37 and 38, respectively, to assist the sweeping action thereof.

Axial flow fan 48 is non-rotatably mounted on main shaft 34 and is driven from lay shaft 30 through sprockets 50 and 51 and chain 52, and axial flow fan 49 is rotatably mounted on main shaft 34 and is driven from lay shaft 30 through sprockets 53 and 54 and chain 55. Axial flow fan 49 may be fixed to main shaft 34 and driven thereby.

Impeller shroud 56 is positioned on the inside of support frame structure 26 close to the peripheries of impeller assemblies 37 and 38 and includes an adjustable front
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shroud 57. Flat bladed impeller assembly 58 is non-rotatably mounted on main shaft 34 between impeller assemblies 37 and 38, flat blades 59 being flexible and positioned in axial alignment with main shaft 34.

Turbine assembly 60 is mounted on the fixed portion of front shroud 57 and includes turbine shaft 61 having axial flow fan blades 62 and turbine impeller blades 63 mounted thereon. Turbine shaft 61 is rotatably mounted in bearing 64, attached to the front face of turbine casing 65.

The inlet side of turbine casing 65 comprises fan casing 66 and includes peripheral surface 67 which tapers inwardly towards the centre of the turbine impeller and provides a clearance around the angled ends of blades 62. Turbine casing 65 includes discharge outlet 68, to which is attached, discharge duct 69. Turbine shaft 61 is driven by means of 90° gear direction changer 70 through shaft 71, sprockets 72 and 73 and chain 74.

Ramp portion 75, which is formed in turbine casing 65 as an extension of 3, is positioned close to discharge outlet 68 and causes the tips of flexible turbine blades 63 to deflect when passing over ramp 75 and to snap rapidly back to their normal positions when leaving ramp 75, thereby providing additional impact to the material passing into discharge duct 69. In a simplified form of this execution, axial flow fans 48 and 49 may be omitted.

The operation of this preferred execution, in snow for example, is as follows:

Snow, or other material, is picked up by the rotating impeller assemblies 37 and 38 which act as both screw conveyors and fans, with blades 41 impacting and picking up the material and moving it axially and inwardly and with the blasts of air created by blades 41 adding to the inward screw conveyor action. Axial flow fans 48 and 49 create additional air blast in the direction of material movement.

Flat bladed impeller assembly 58 changes the direction of the inwardly moving material and directs it into axial flow fan blades 62 which, in turn, impel it into the centre regions of turbine impeller blades 63. The material is then centrifuged outwardly, by turbine blades 63, through discharge outlet 68 and into discharge duct 69. Discharge duct 69 is adjustable to cast the material discharge in the required direction.

The arrows in FIGS. 3 and 4 show the direction of material movement through rotary broom and turbine assembly.

Refer now to FIGS. 5 and 6 which show an alternative execution in which turbine assembly 60 is omitted and flat bladed impeller assembly 58 is utilized as a partially enclosed axial turbine.

FIG. 6 shows details of the partial turbine casing 76 with discharge outlet 77 and including adjustable shrouds 78 and 79. Discharge duct 69 is adjustably attached to discharge outlet 77. This execution would preferably include ramp 75, as shown in FIG. 3.

The operation of this execution is similar to the operation of the preferred execution, except that flat bladed impeller assembly 58 centrifuges the material and discharges it through discharge outlet 77 and into discharge duct 69, where it is cast in the required direction.

The direction of material movement is shown by the arrows in FIG. 5.

Refer now to FIGS. 7 and 8 which show an execution similar to the execution in FIGS. 5 and 6 but which embodies a fully enclosed turbine.

FIG. 8 shows details of the fully enclosed turbine casing 80 and including discharge outlet 81 with discharge duct 69 adjustably attached thereto. Flat bladed impeller assembly 82 is of smaller diameter than the diameter of impeller assemblies 37 and 38 to allow for additional sweeping flaps 83, 84 and 85, beneath turbine casing 80, and thus providing full sweeping across the rotary broom assembly. Flaps 83, 84 and 85 are made of flexible material and may be flat, as shown, or curved into a V shape in the direction of material movement.

Flaps 83 and 85 are pivotally mounted on turbine casing 80 by pivots 86 and 87, respectively, and are arranged to be of such width that the rotating impeller blades 41 will strike flaps 83 and 85 and cause them to be displaced in a clockwise direction. Flap 83 is biased against displacement by compression spring 88 and thus snaps back when released by impeller blades 41. Flap 85 is biased against displacement by tension spring 89 and thus snaps back when released by impeller blades 41. Flap 84 is pivotally mounted on turbine casing 80 by pivot 90 and includes an upper portion which extends into turbine casing 80 and is struck by flat impeller blades 91 and caused to rotate in an anti-clockwise direction. Flap 84 is biased against displacement by tension spring 92 and thus snaps back when released by impeller blades 91.

The operation of this execution is similar to the operation of the execution shown in FIGS. 5 and 6 except that the fully enclosed turbine casing 80 provides increased discharge velocity and thus more accurate directional casting of the discharged material. Flaps 83, 84 and 85 are continuously moving to clear the material beneath turbine casing 80.

The direction of material movement is shown by the arrows in FIG. 7.

This execution would also preferably embody the ramp 75 as shown in FIG. 3.

Refer now to FIGS. 9 and 10 which show another execution in which rotary broom assembly 93 comprises impeller shaft 94 with impeller blades 41 positioned thereon, the angle between blades 41 and the axis of impeller shaft 94 being adjustable and arranged such that the material being swept is moved from right to left as shown in FIG. 9. Impeller shaft 94 is non-rotatably mounted on main shaft 34 and is driven from lay shaft 30 through sprockets 95 and 96 and chain 97.

Axial flow fan 49 is rotatably mounted on main shaft 34 and positioned at the right-hand end of impeller assembly 93 and is driven from lay shaft 30 by sprockets 53 and 54 and chain 55. Flat bladed impeller assembly 98 is rotatably mounted on main shaft 34 and positioned at the left-hand end of impeller assembly 93 and driven from lay shaft 30 by sprockets 99 and 100 and chain 101.

Flat bladed impeller assembly 98 is utilized as a partially enclosed turbine by being shrouded in partial turbine casing 76, in a manner similar to the execution shown in FIG. 6.

The execution would preferably include ramp 75 for increased discharge velocity.

In the operation of this execution impeller assembly 93 augers the material from right to left by screw conveyor action and by the blast produced by impeller blades 41 and is assisted by an additional blast produced by axial flow fan 49. Flat bladed impeller assembly 98 centrifuges the material into discharge outlet 77 and through discharge duct 69. Discharge duct 69 is again adjustable to vary the cast direction of material discharge.

The direction of material movement through the broom assembly is shown by the arrows in FIG. 9.

Refer now to FIGS. 11 and 12 which show an execution similar to the execution in FIGS. 9 and 10, but which embodies a fully enclosed turbine and fan assembly, similar to turbine and fan assembly 60 in FIGS. 1-4. In this execution the diameter of axial flow fan 102 is smaller than the diameter of impeller assembly 93 and is rotatably mounted on separate stub shaft 103 and driven from lay shaft 30 through sprockets 104 and 105 and chain 106.

Axial flow fan 102 is also enclosed around its periphery by shroud 107, to produce a concentrated air blast. Turbine and fan assembly 108 is mounted on separate stub shaft 109 and includes turbine shaft 110 having axial flow fan blades 111 and turbine impeller blades 112 mounted thereon.
Turbine shaft 110 is driven from output shaft 28 through sprockets 113 and 114 and chain 115. The inlet side of turbine casing 116 comprises axial flow fan casing 117 and includes peripheral surface 118 which tapers inwardly towards the centre of the turbine impeller and provides a close clearance around the angled ends of blades 111. Turbine casing 116 includes discharge outlet 119, to which discharge duct 69 is attached. Ramp portion 75 would again be added to this execution to increase discharge velocity.

The operation of this execution is similar to the operation of the execution shown in FIGS. 9 and 10, except that the fully enclosed turbine and fan assembly 108 increases the discharge velocity and thus provides more accurate directional casting of the discharged material.

The direction of material movement is shown by the arrows in FIG. 11.

Reference to FIGS. 10 and 11 show details of an arrangement for distributing oil to specific internal areas of the turbine casings to provide a film of oil between the casing inside walls and the material passing therethrough, to prevent build up of said material on said inside walls. The oil used may be an emulsifying oil, or any suitable oil, depending upon the material being swept.

This oil distribution arrangement may be applied to any or all of the previously detailed rotary broom and turbine executions.

In FIG. 13 the oil is supplied through oil line 120 to discharge outlet 81 and to the upper region of turbine casing 80. Reference to FIG. 14 shows oil line 123 connected to oil distributing ring 121. Oil distributing ring 121 surrounds discharge outlet 81 and admits oil into discharge outlet 81 through metering orifices 122. Oil is also admitted to the upper region of the turbine casing 80 through metering orifice 123 in oil line 120.

The oil may be supplied to oil line 120 from any convenient source by means of gravity feed, oil pump, air pressure, etc.

The arrows in FIGS. 13 and 14 indicate the areas into which the oil discharges. It will, of course, be fully understood that the discharge areas indicated are for purposes of illustration only and that any area of the turbine casing can be supplied with oil, as required.

Reference now to FIGS. 15 and 16 shows an arrangement for supplementary sweeping blades.

Flexible blades 124 and 125, made of rubber-canvas belting material, or similar, are attached to shaft 126 which is rotatably mounted in bearings 127 and 128 positioned on the lower edge of the rear frame of support frame structure 26. Blades 124 and 125 overlap, as shown in FIGS. 15 and 16, to effectively cover the entire width of the broom assembly and are normally in the substantially vertical position shown in FIG. 15.

Arm 129, which can be made of flexible or non-flexible material, is attached to the impeller shaft and rotates thereof. Arm 130, which can be made of flexible or non-flexible material, is attached to shaft 126 and rotates therewith. Arm 130 is positioned in alignment with arm 129 such that, when rotated in a clockwise direction, arm 129 will strike arm 130 causing shaft 126 to rotate in an anti-clockwise direction and blades 124 and 125, which are attached thereto, will snap in a backward or anti-clockwise direction.

Arm 131, which is also attached to shaft 126, is held against stop 132 by tension spring 133. Thus blades 124 and 125 are moved in an anti-clockwise direction against the pull of spring 133 and when arm 129 moves past arm 130 blades 124 and 125 will snap back to the normal position under the pull of spring 133.

In a simplified form of this arrangement, arms 129, 130 and 131, stop 132 and spring 133 may be omitted and shaft 126, maintained in a fixed position such that blades 124 and 125 remain substantially vertically, thus providing a scraping action when the broom assembly is moved.

Blades 124 and 125 may be made adjustable to provide variable ground clearance.

Although this arrangement has been shown as being operated from one side of the broom and only, it will be readily understood that shaft 126 could be made as two halves and having the flexible blade deflecting arms positioned at each side of the broom assembly.

Reference now to FIGS. 17 and 18 shows a further arrangement for supplementary sweeping blades.

Flexible blades 134 and 135 are attached to shaft 136 and spaced at 180° to each other and overlapping. Shaft 136 is rotatably mounted in bearings 137 and 138 positioned on the lower edge of the rear frame of support frame structure 26.

Shaft 136, together with blades 134 and 135, constitutes a small rotary broom and is driven from main shaft 34 through sprockets 139 and 140 and chain 141.

The attachment of shaft 136 and bearings 137 and 138 to support frame structure 26 is made adjustable to provide variable ground clearance.

The action of this small rotary broom is to sweep any material, left from the sweeping action of the main broom assembly, into the main broom assembly and to be carried away thereby.

Both of the aforementioned supplementary sweeping arrangements provide an improved air and material seal to assist the actions of the main broom assembly and impeller fans.

It will be apparent that further combinations of the features disclosed herein can be constructed within the scope of this invention.

Sections of pneumatic tire casings, either new or used, are a convenient and economical material for the construction of flexible blades in accordance with this invention. This material provides a rugged flexible blade material and can also provide curved blade contours when these are required.

In all executions of this invention a bag type, or cyclone type, dust collector may be attached to the broom discharge outlets.

It will be seen from the foregoing that I have provided new and improved means for accomplishing all of the objects and advantages as set forth.

What is claimed is:

1. A rotary broom assembly for material handling including a support frame structure, an impeller assembly rotatably mounted in said support frame structure, a shroud attached to said support frame structure and extending at least partially around the periphery of said impeller assembly, said impeller assembly including an impeller shaft having flexible impeller blades extending radially outwards therefrom, the angle between said blades and the axis of said impeller shaft being adjusted such that rotation of said impeller assembly will move said material substantially axially with respect to said impeller assembly and discharge from said impeller at a substantial velocity, turbine means positioned at the discharge of said impeller assembly to increase the velocity of said discharged material, the said turbine means including a turbine shaft and flexible turbine blades extending radially outwards from said turbine shaft and including a turbine casing at least partially enclosing said turbine blades and having a discharge outlet.

2. A rotary broom assembly as set forth in claim 1 in which said turbine includes ramp means positioned in said turbine casing adjacent said discharge outlet, such that the tips of said flexible turbine blades will deflect when passing over said ramp means and will snap back to their original lengths when leaving said ramp means to increase the discharge velocity.

3. A rotary broom assembly as set forth in claim 1 including an oil distributing system for distributing oil, through metered orifices, to the upper inside region of said turbine casing and to the inside of said discharge outlet.
4. A rotary broom assembly as set forth in claim 1 in which said impeller assembly moves material axially inwards from each end thereof and discharges said material at a point substantially midway along the length of said impeller assembly and in which said turbine means is positioned adjacent said impeller assembly discharge position and mounted coaxially with said impeller shaft, and including a turbine casing axially extending from the periphery of said turbine blades and partially enclosing the side portions of said turbine means, and flap means positioned under said turbine casing to sweep material from thereunder.

5. A rotary broom assembly as set forth in claim 4 in which said flap means includes at least one flap pivotally mounted at the upper edge thereof to the undersurface of said turbine casing and being of such width that the rotating innermost impeller blades will strike the side edges thereof to rotate said flap in a sweeping motion, and spring means to return said flap to its original position.

6. A rotary broom assembly as set forth in claim 4 in which said flap means includes at least one outer flap pivotally mounted at the upper edge thereof to the undersurface of said turbine casing and being of such width that the rotating innermost impeller blades will strike the side edges thereof to rotate said flap in a sweeping motion, and spring means to return said outer flap to its original position, and including at least one inner flap pivotally mounted to the undersurface of said turbine casing and having a sweeping portion extending downwardly on one side of the pivot and to the other side of the pivot a portion extending upwardly into said turbine casing such that said rotating turbine blades will strike the upwardly extending portion of said inner flap to rotate said downwardly extending portion in a sweeping motion, and spring means to return said inner flap to its original position.

7. A rotary broom assembly for material handling including a support frame structure, an impeller assembly rotatably mounted in said support frame structure, said impeller assembly including an impeller shaft with flexible impeller blades extending radially outwards therefrom, the angle between said blades and the axis of said impeller shaft being adjusted such that rotation of said impeller assembly will move said material substantially axially with respect to said impeller assembly and discharge from said impeller assembly at substantial velocity, turbine means positioned at the discharge of said impeller to increase the velocity of said discharging material, drive means for rotating said impeller assembly and said turbine means, the said support frame structure includes a rear frame member, a support shaft rotatably mounted on said rear frame member, supplementary sweeping blades mounted on said latter shaft adjacent the lower edge of said rear frame, a first arm means extending outwardly from said impeller shaft and a second arm means extending outwardly from said support shaft, said first and second arm means being aligned and overlapping such that when said impeller shaft is rotated said first arm means will strike said second arm means and rotate said support shaft, and said supplementary blades attached thereto, and spring means to return said supplementary blades to their original positions when said first arm means has passed said second arm means.

8. A rotary broom assembly as set forth in claim 7 in which the said support frame structure includes a shroud, the said shroud extending at least partially around the periphery of said impeller assembly.

9. A rotary broom assembly as set forth in claim 1 in which said impeller assembly moves material inwards from each end thereof and discharges said material at a point substantially midway along the length of said impeller assembly and in which said turbine means is positioned adjacent said impeller assembly discharge position and mounted coaxially with said impeller shaft, and a pair of axial flow fans are located, one at each of the outer ends of said impeller assembly, the said axial flow fans adapted to pass a stream of air axially through the said impeller assembly into the said turbine means.

10. A rotary broom assembly for material handling including a support frame structure, an impeller assembly rotatably mounted in said support frame structure, said impeller assembly including an impeller shaft with blades of flexible material extending radially outwards therefrom, the angle between said blades and the axis of said impeller shaft being adjusted so that rotation of said impeller assembly will move said material substantially axially with respect to said impeller assembly and discharge from said impeller assembly at substantial velocity, turbine means positioned at the discharge of said impeller assembly to increase the velocity of the discharging material, drive means for rotating said impeller assembly and said turbine means, said support frame structure including a rear member, a support shaft rotatably mounted adjacent the lower edge of said rear frame member, supplementary flexible sweeping blades mounted on said support shaft, and drive means between said impeller shaft and said support shaft for rotating said supplementary sweeping blades.

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