United States Patent [19]

Foster

[11] **3,709,436**

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[54] **HIGH PRESSURE JET CLEANING DEVICE**

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[21] Appl. No.: **104,277**

[52] **U.S. Cl.** **239/287,** 239/169, 239/550

[51] **Int. Cl.** **B05b 9/02**

[58] **Field of Search**.....239/287, 159, 195, 266, 269, 239/164, 169, 172, 175, 550

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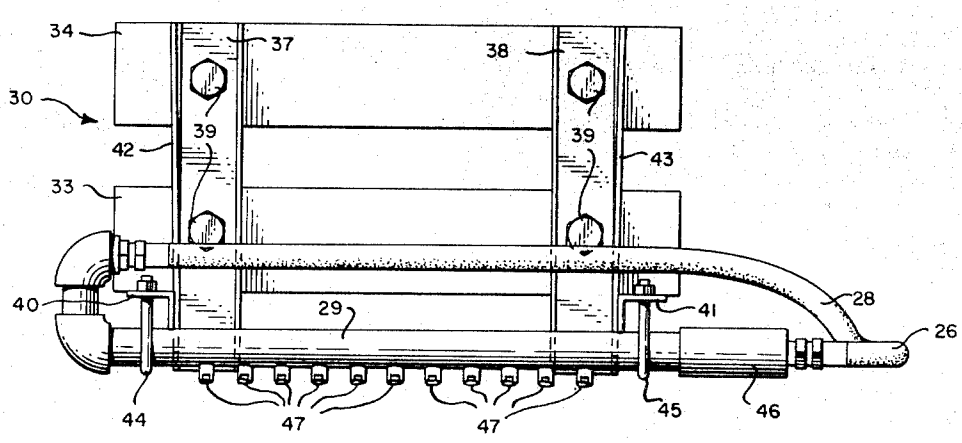
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[57] **ABSTRACT**

A machine for cleaning rubber tire marks from the surface of an airport runway by means of high pressure jets of water including a frame adapted to be mounted on the front of a fork lift, a manifold on the frame, a plurality of nozzles on the manifold for supplying fan-shaped jets of liquid, said nozzles being spacedly mounted lengthwise of the manifold and each being oriented so that the fan-shaped jets extend at an acute angle to the axis of the manifold, and quick disconnect means on opposite ends of the manifold for alternately coupling a high pressure liquid supplying conduit to opposite sides of the manifold depending on the direction in which the fork lift is to travel along the runway.

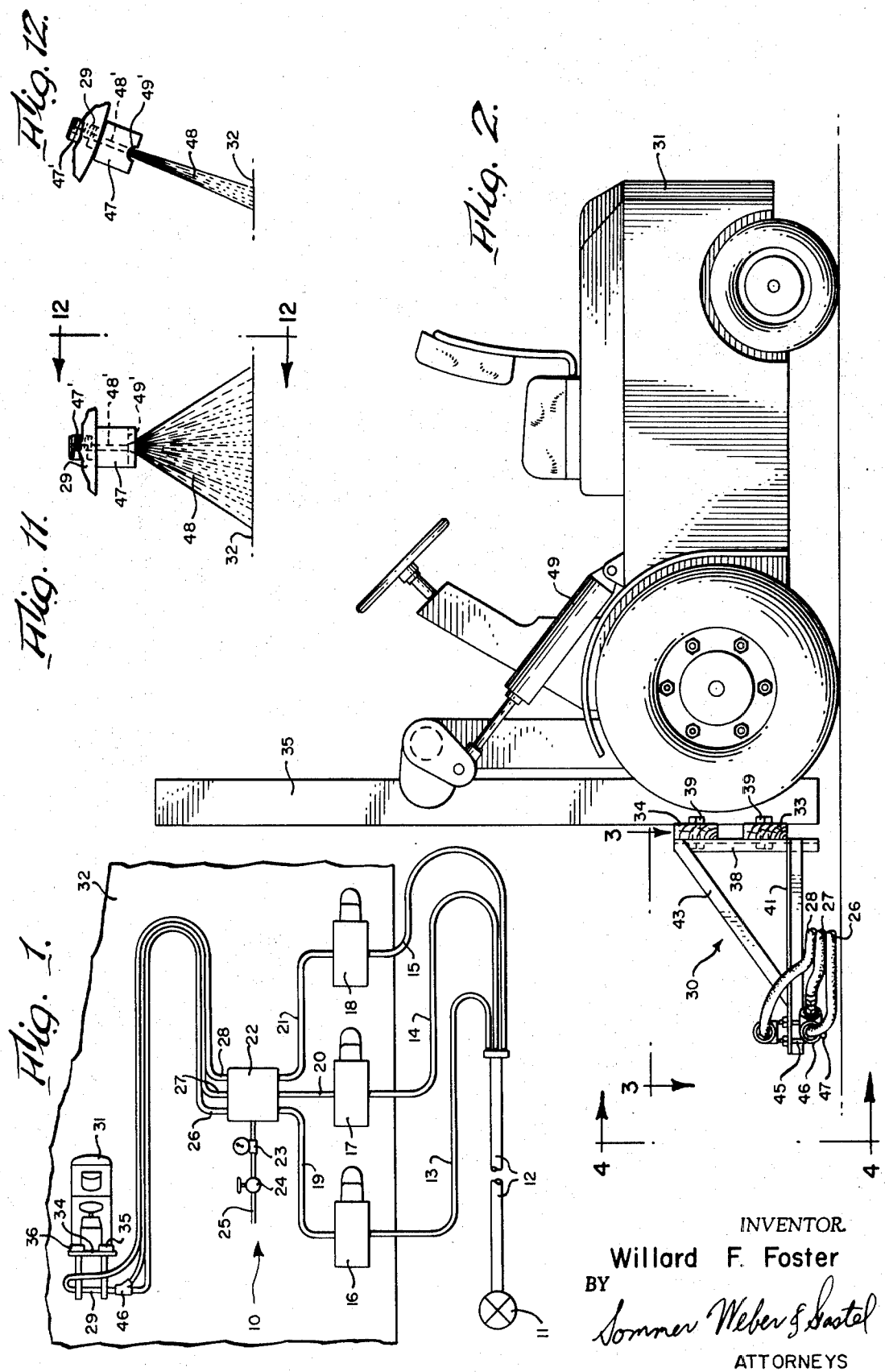
8 Claims, 12 Drawing Figures



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SHEET 1 OF 3



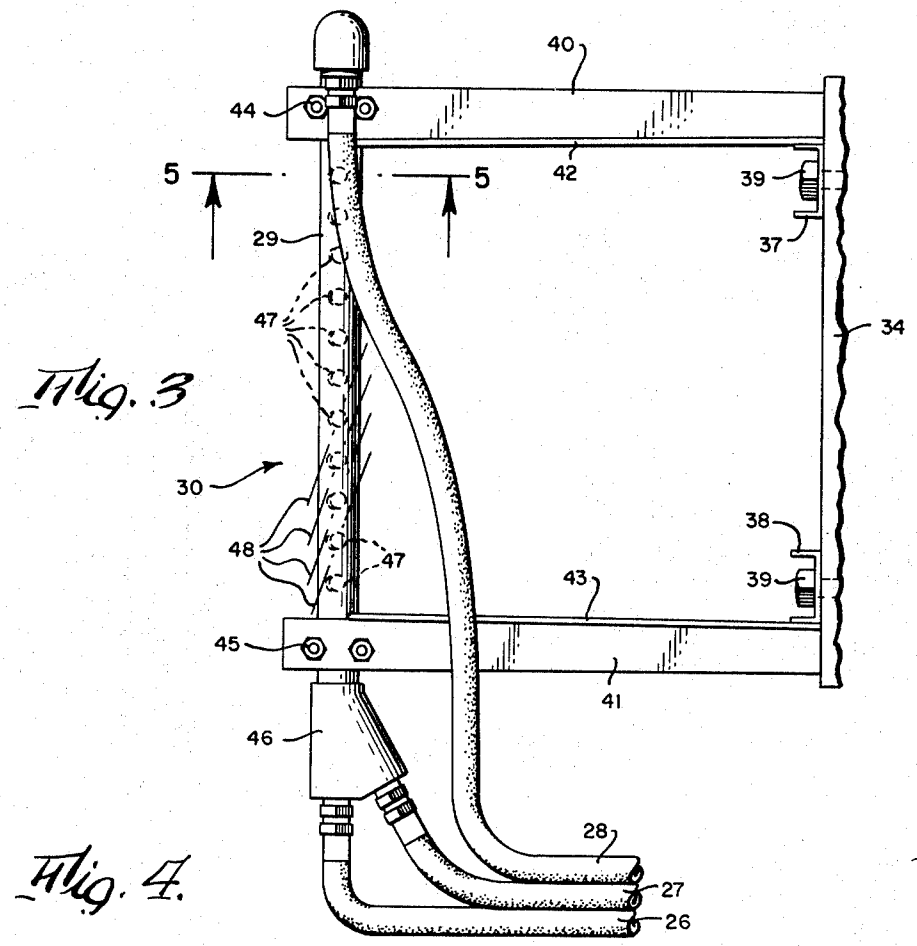


Fig. 3

Fig. 4.

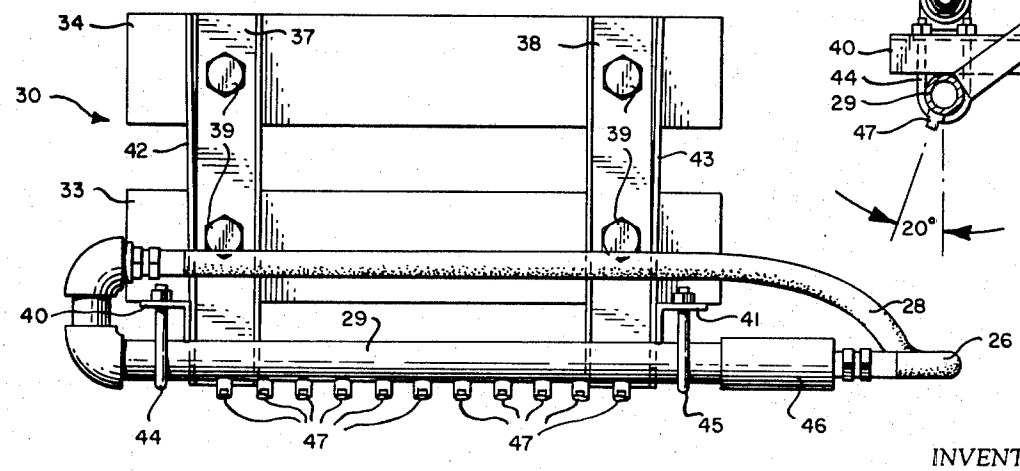


Fig. 5.

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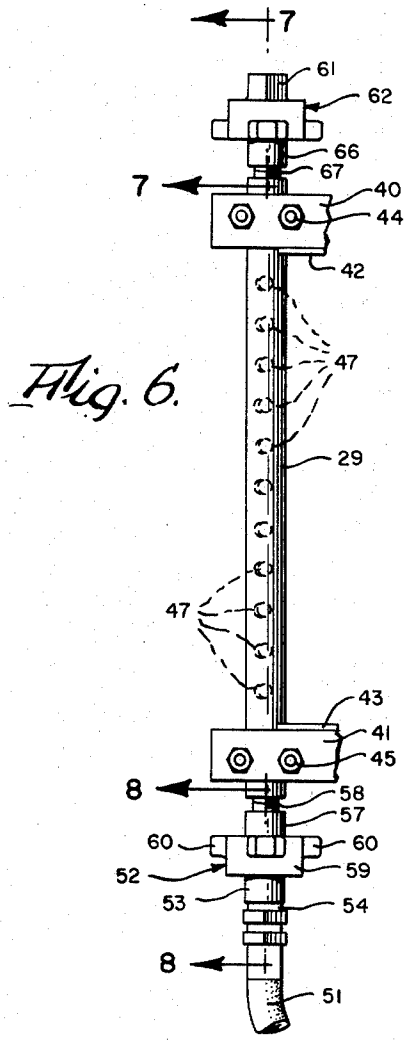


Fig. 6.

Fig. 7.

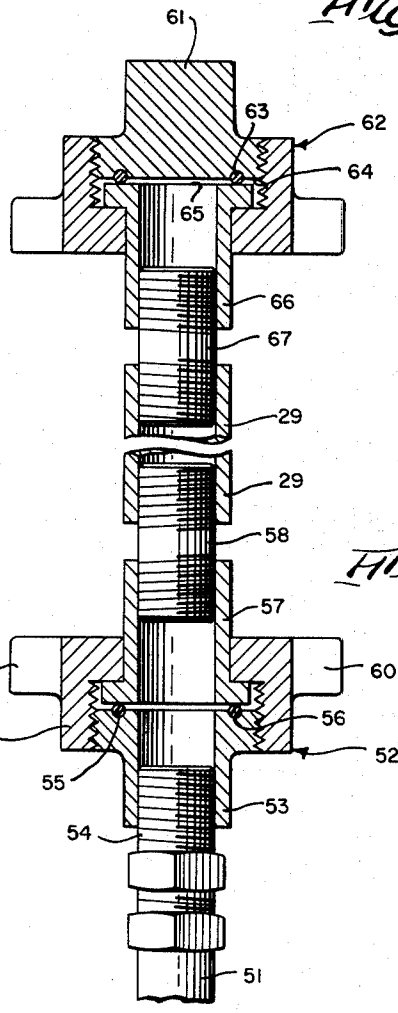


Fig. 8.

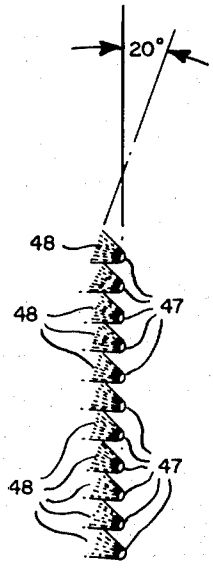


Fig. 10.

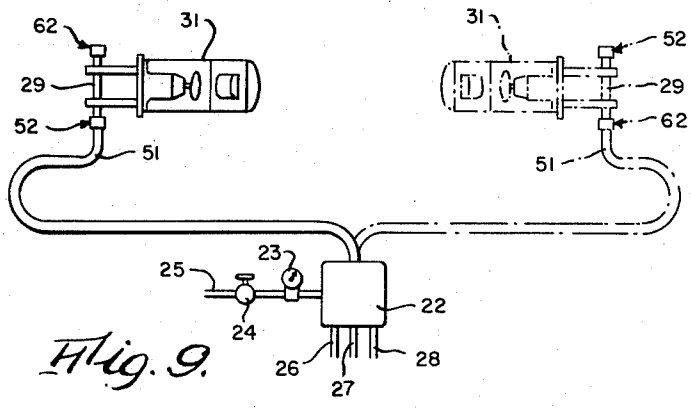


Fig. 9.

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HIGH PRESSURE JET CLEANING DEVICE

The present invention relates to an improved device and system for cleaning large areas, such as runways, by means of high pressure jets of water.

In the past the cleaning of rubber tire marks from airport runways has been very difficult and costly. The tire marks on the runways had to be removed from time to time because of the hazard they posed. First of all, they obscured the markings on the runways, and secondly they caused the runways to be hazardously slick during rainy weather. The present invention relates to an improved machine for cleaning rubber tire marks by the use of high pressure jets of water.

It is accordingly one object of the present invention to provide an improved apparatus for cleaning large surfaces, such as airport runways, by means of high pressure jets of water in which the apparatus consists of a lightweight highly portable unit which can be attached to any standard fork lift which is in use at any airport, thereby permitting the apparatus to be shipped from place to place, as required, with a minimum of effort and expense.

Another object of the present invention is to provide an improved device for cleaning airport runways and the like by means of high pressure jets of water in which the device is mounted on a vehicle and connected to its source of high pressure water in such a manner that the runway may be cleaned as the vehicle moves in two directions back and forth on the runway.

A further object of the present invention is to provide an improved extremely simple and efficient apparatus for producing high pressure fan-shaped jets of water. Other objects and attendant advantages of the present invention will readily be perceived hereafter.

The present invention relates to an improved machine for cleaning a surface by means of high pressure jets of liquid including a frame adapted to be mounted on a vehicle, such as a fork lift, a manifold on the frame, a plurality of adjacent nozzles mounted in spaced relationship lengthwise along the manifold each for supplying a fan-shaped jet of high pressure liquid, with the nozzles being oriented relative to the manifold so as to cause the jets of liquid supplied thereby to extend at an acute angle with respect to the manifold, and first and second fast connection means at opposite ends of the manifold for selectively alternating the ends of the manifold to which a high pressure conduit is attached to permit the vehicle carrying the manifold to be turned around at the end of its travel in each direction to clean a swath while traveling forward in opposite directions on the runway.

The various aspects of the present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic view of the system of the present invention;

FIG. 2 is a side elevational view showing the improved apparatus of the present invention mounted on the front of a lift truck;

FIG. 3 is a view taken substantially in the direction of arrows 3—3 of FIG. 2;

FIG. 4 is a view taken substantially in the direction of arrows 4—4 of FIG. 2;

FIG. 5 is a fragmentary cross sectional view taken substantially along line 5—5 of FIG. 3 and showing the inclination of the nozzles relative to the vertical;

FIG. 6 is a fragmentary plan view similar to FIG. 3 but showing an alternate embodiment of the invention having a quick disconnect connection on opposite ends of the manifold;

FIG. 7 is an enlarged fragmentary cross sectional view taken substantially along line 7—7 of FIG. 6;

FIG. 8 is an enlarged fragmentary cross sectional view taken substantially along line 8—8 of FIG. 6;

FIG. 9 is a fragmentary schematic view of the system in which the embodiment of FIGS. 6–8 is used;

FIG. 10 is a schematic plan view showing the manner in which the nozzles are oriented at an angle to the longitudinal axis of the manifold for the purpose of providing jets which overlap each other lengthwise of the manifold without interfering with each other;

FIG. 11 is a front elevational schematic view of the fan-shaped jet which is produced; and

FIG. 12 is a view taken in the direction of arrows 12—12 of FIG. 11.

In FIG. 1 the basic system 10 of the present invention is shown which includes a hydrant 11 or other suitable source of water, such as a stream, coupled to an irrigation conduit 12 which in turn is in communication with a plurality of conduits 13, 14 and 15 which in turn are in communication with motor-pumping units 16, 17 and 18, respectively. For convenience, the motor-pumping units 16, 17 and 18 are mounted on trucks for ease of mobility. The liquid is pumped by these units into conduits 19, 20 and 21 which in turn are in communication with a manifold 22 mounting a pressure gauge 23 and a valve 24 in outlet conduit 25. Manifold 22 is in turn in communication with conduits 26, 27 and 28 which in turn are in communication with manifold 29 forming a part of the high pressure spraying unit 30, which is removably mounted on the front of lift truck 31, which may be of conventional construction. Fork lift 31 traverses runway 32 for the purpose of removing the rubber tire marks therefrom by means of the high pressure water jets which are supplied by unit 30.

One advantage of the high pressure water jet supplying unit 30 is that it is relatively small in size and is fabricated for mounting on any fork lift which is conveniently available at any airport. Therefore the apparatus 30 of the present invention can be shipped from location to location without the vehicle on which it is mounted, and once it arrives at its destination it can be mounted on a fork lift which is located in the particular area. In this respect, the fork lift 31 includes horizontally spaced plates 33 and 34 which are mounted for vertical reciprocating movement on spaced ways 35 and 36 (FIG. 1). The motor mechanism for moving members 33 and 34 is not shown.

The high pressure water unit 30 includes a pair of vertical channel members 37 and 38 which are secured by screws 39 to members 33 and 34, as shown in FIGS. 3 and 4. Fixedly secured to the lower ends of channels 37 and 38, as by welding, are angle members 40 and 41, respectively. Diagonal struts 42 and 43 are provided. Strut 42 has its upper end welded to an upper portion of channel 37 and its lower end welded to angle 40. Diagonal strut 43 has its upper end welded to channel 38 and its lower end welded to angle 41. It can thus be seen that the foregoing frame which is defined by the above described structural members is relatively lightweight but strong for supporting manifold 29

which is secured to angles **40** and **41** by means of U-bolts **44** and **45**, respectively, the upper edges of manifold **29** abutting the underside of the vertical legs of angles **40** and **41**.

As can be seen from FIG. **3**, high pressure conduits **26** and **27** are connected to one end of manifold **29** by means of Y connector **46**, and conduit **28** is connected to the opposite end of manifold **29** by means of a plurality of fittings (not numbered). It is in this manner that high pressure liquid is supplied to manifold **29**.

A plurality of nozzles **47** are spacedly mounted on the underside of manifold **29**. These nozzles are of the type which produce a fan-shaped jet of liquid which is relatively broad across the front but relatively narrow from front to back. Jets **48** of this type are shown in FIGS. **11** and **12** and can be obtained by the use of commercially available nozzles which are used for obtaining jets of this type. These nozzles include a threaded portion **47'**, a bore **48'** and a groove **49'**. Nozzles of this type are shown on page 30 of Catalog 25–A of Spray Systems Corporation, Bellwood, Ill., published in 1966. Nozzles of this general type are also shown in U.S. Pat. Nos. 2,621,078, 2,683,627 and 2,701,412. As can be seen from FIG. **5**, nozzles **47** are oriented to cause the jets supplied thereby to be inclined to approximately 20° to the vertical. This angle may be changed as desired for different cleaning operations by merely loosening U-bolts **44** and **45** and rotating manifold **29** about its longitudinal axis. Furthermore, the nozzles **47** are oriented relative to each other on manifold **29** so as to cause the jets **48** to be inclined at approximately 20° to the longitudinal axis of manifold **29**. This is also schematically shown in plan in FIG. **3**. Thus the outer edges of adjacent jets **48** will not conflict with each other to negate the cutting action which each can provide. In other words as a result of inclining the jets **48** at 20° to the longitudinal axis of conduit **29**, the adjacent edges of each of the jets **48** will overlap lengthwise of manifold **29**, without interfering with each other, as can be visualized from FIGS. **3** and **10**. The angles which the jets **48** make with the axis of manifold **29** can be adjusted merely by turning nozzles **47** with a wrench, as they are threaded into manifold **29**.

If for any reason it is desired to change the angle of unit **30** relative to the ground, it is merely necessary to actuate hydraulic motor **49** mounted on fork lift **31** to pivot ways **35** and **36** forwardly or rearwardly around their pivot point which is located at approximately the bottom of fork lift **31**. Fork lift **31** is particularly desirable for use because of its relatively large weight and stability. In this respect, the reactive force produced by jets **48** is relatively high and this is counteracted by the weight of the vehicle **41** so that the nozzles are maintained at the desired distance from the surface of the runway.

As can be visualized from FIG. **1**, if the fork lift **31** were turned around every time it came to the end of its travel, as determined by the length of conduits **26**, **27** and **28**, these conduits could become tangled, considering that they are connected to the fork lift **31** at one side thereof. In order to overcome this, the embodiment of FIGS **6–9** is used. More specifically, manifold **29** is secured to the remainder of the frame as described above relative to the preceding figures. However, each end includes a quick disconnect union thereon. As can be seen from FIG. **6**, one inlet conduit **51** is used rather than the three inlet conduits **26**, **27** and **28** of the preceding figures. The quick disconnect union **52** includes a portion **53** rigidly secured to nipple **54** which is rigidly secured to conduit **51**. An O-ring **55** is located in a circular groove **56** in portion **53**. In order to assemble portion **53** onto portion **57** which is rigidly mounted on nipple **58** extending outwardly from manifold **29**, it is merely necessary to turn the outer annular portion **59** by grasping wings **60** until portion **53** is pulled up into mating seated relationship with portion **57**, as shown in FIG. **8**. Thus, conduit **51** can be connected rapidly by the use of union **52**. This is shown in FIG. **9**. The opposite end of manifold **29** at this time mounts a plug **61** which is threaded into union **62** with an O-ring **63** located between the face **64** of plug **61** and the face **65** of union portion **66** which is rigidly mounted on manifold **29** by means of nipple **67**.

As can be seen from FIG. **9**, when the fork lift **31** reaches the limit of its travel to the left, it is merely necessary to actuate dump valve **24** to cause the water to be dumped from manifold **22**. This effectively terminates flow to manifold **29**. After this is done, speed unions **52** and **62** are manipulated so as to remove conduit **51** from the end of the manifold **29** on which it is located and to remove the plug **61**. The vehicle **31** is then turned around so that it faces the opposite direction, while still at its leftmost position of travel, and conduit **51** is then installed at the end of manifold **29** on which plug **61** was previously located and plug **61** is inserted in the end of manifold **29** on which conduit **51** was previously mounted. By the use of the foregoing interchange, the fork lift **31** can be driven to the right to the limit of its travel as determined by the length of conduit **51** and after this travel has been completed, conduit **51** and plug **61** are again disconnected and reversed on the manifold **29** so that the relationship shown in dotted lines in FIG. **9** is again realized.

It can thus be seen that the high pressure supply unit can be shipped to any location at which it is to be used and mounted on a fork lift which forms part of equipment which is in use at any airport. The trucks **16**, **17** and **18** are driven to the location where they are to be used and the entire system is set up by attaching the irrigation pipe **12** to the water source **11**. The manifold **29** is capable of providing 120 gallons per minute at a pressure of 4,000 pounds per square inch. This means that each of the pumps on trucks **16**, **17** and **18** supplies 40 gallons per minute at 4,000 pounds per square inch which in turn requires an engine of 100 brake horsepower for driving each pump. The nozzles **47** shown in FIG. **4** are capable of washing or cleaning a 24 inch swath on each pass of the equipment.

Valve **24** was discussed above as being used to dump water selectively from manifold **22** when conduit **51** was to be disconnected. However, it will be appreciated that by adjusting the opening of valve **24**, the pressure at nozzles **47** can be adjusted to any desired value.

While preferred embodiments of the present invention have been disclosed, it will be appreciated that it is not limited thereto as the angles of the nozzle jets **48** relative to manifold **29** can be changed from the 20° shown to any desired number of degrees as required with the particular nozzles then being used, and

furthermore the 20° inclination to the vertical as shown in FIG. 5 can also be changed as required for the particular cleaning being done.

What is claimed is:

1. A machine for cleaning a surface by means of high pressure jets of liquid comprising a frame, a manifold mounted on said frame, a plurality of adjacent nozzles mounted on said manifold with each of said nozzles being of a configuration for supplying a fan-shaped jet of high pressure liquid, said nozzles being oriented relative to said manifold so as to cause the jet of liquid supplied thereby to extend at an acute angle with respect to said manifold, whereby adjacent jets will overlap each other across the length of said manifold without interfering with each other, first connection means on one end of said manifold for selective coupling to a liquid supplying conduit, second connection means on a second end of said manifold for selective coupling to said liquid supplying conduit, and plug means for attachment to either of said first or second connection means which is not connected to said liquid supplying conduit.

2. A machine for cleaning a surface by means of high pressure jets of liquid as set forth in claim 1 including means on said frame for attaching said frame to a vehicle, whereby said liquid supplying conduit may be located to one side of said vehicle and may be coupled to opposite sides of said manifold depending on the direction of travel of said vehicle.

3. A machine for cleaning a surface by means of high pressure jets of liquid as set forth in claim 2 including conduit means for supplying liquid to said manifold, and valve means in communication with said conduit means for selectively diverting flow of liquid from said manifold.

4. A machine for cleaning a surface by means of high pressure jets as set forth in claim 3 wherein said valve means comprise a second manifold in communication with said conduit means, and a valve in communication with said second manifold for selectively dumping the liquid therein to prevent said liquid from reaching said first manifold under sufficient pressure to produce said high pressure jets to thereby permit selective coupling of said liquid supplying conduit to opposite sides of said manifold.

5. A machine for cleaning a surface by means of high pressure jets as set forth in claim 4 including a plurality of second liquid supplying conduits in communication with said second manifold, whereby said valve diverts flow from all of said second liquid supplying conduits through said manifold.

6. A machine for cleaning a surface by means of high pressure jets of liquid as set forth in claim 1 wherein said manifold comprises a single elongated conduit, and wherein said nozzles are spacedly positioned lengthwise of said conduit.

7. A machine for cleaning a surface by means of high pressure jets of liquid as set forth in claim 1 wherein said frame includes a vertically extending mounting portion for attachment to a vehicle, and attachment means secured to said mounting portion for securing said manifold relative thereto.

8. A machine for cleaning a surface by means of high pressure jets of liquid as set forth in claim 7 wherein said attachment means includes means for permitting selective rotation of said manifold about its longitudinal axis to vary the angle of inclination of said jets relative to the vertical.

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