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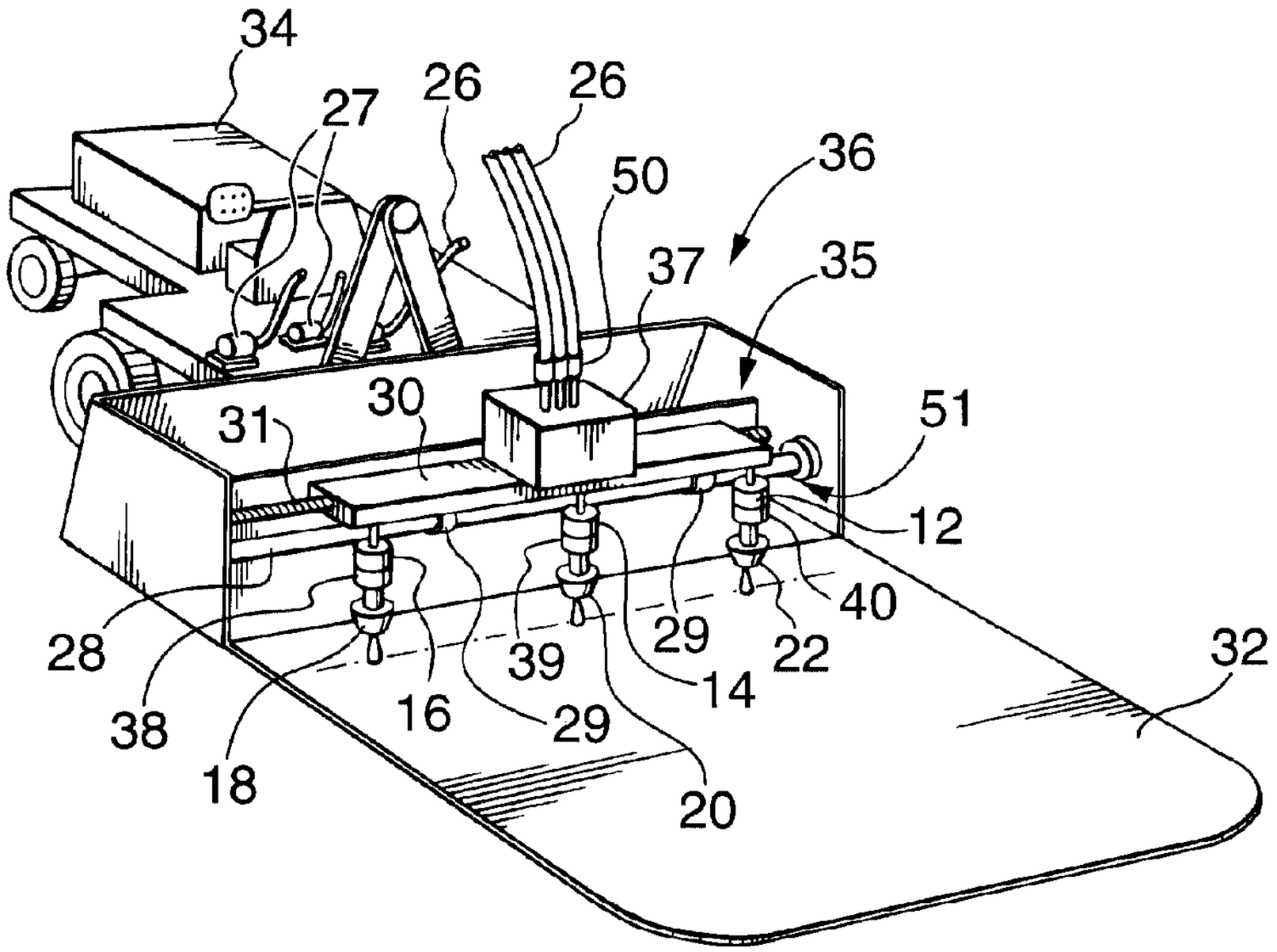
(54) Title: MULTIPLE JET HYDRODEMOLITION MACHINE



(57) Abrégé/Abstract:
A hydrodemolition machine for removing a layer of hard cement-like material. The machine includes a moveable vehicle, a guide coupled to the vehicle, oriented transversely to a direction of travel of the vehicle, and a carriage coupled to the guide and movable along the guide transverse to a direction of travel of the vehicle. The machine further includes means for moving the carriage along the bed and a plurality of spaced apart nozzles mounted to the carriage. The nozzles are operative to issue jets of fluid in a direction towards the hard material and move with movement of the carriage so as to remove a layer of the hard material along a swath in a direction of travel of the vehicle. A high pressure water supply assembly is coupled to the nozzles and is operative to supply water under pressure to each of the nozzles.

ABSTRACT

A hydrodemolition machine for removing a layer of hard cement-like material. The machine includes a moveable vehicle, a guide coupled to the vehicle, oriented transversely to a direction of travel of the vehicle, and a carriage coupled to the guide and movable along the guide transverse to a direction of travel of the vehicle. The machine further includes means for moving the carriage along the bed and a plurality of spaced apart nozzles mounted to the carriage. The nozzles are operative to issue jets of fluid in a direction towards the hard material and move with movement of the carriage so as to remove a layer of the hard material along a swath in a direction of travel of the vehicle. A high pressure water supply assembly is coupled to the nozzles and is operative to supply water under pressure to each of the nozzles.

MULTIPLE JET HYDRODEMOLITION MACHINE

FIELD

The present invention relates to a multiple jet hydrodemolition machine of a kind used for the removal of concrete and other hard particulate based material.

BACKGROUND

Many concrete surfaces whether in parking lots, over bridges, on tunnel walls, building walls or any other concrete surface are frequently accompanied by heavy steel reinforcement. Once cracks in the concrete develop, road salts corrode the steel. This corrosion accelerates the destructive cycle of moisture, salt, freeze-thaw, corrosion, vibration and traffic. Conventional methods of repairing these concrete surfaces involves first the removal of the deteriorated concrete surface around and below the reinforcing steel bars. This removal allows placement of new concrete surface over the reinforcing steel.

Ordinarily concrete removal has been accomplished by jackhammers, but the use of jackhammers is time-consuming, and costly and makes it difficult to achieve complete removal of deteriorated concrete. In addition, the use of a jackhammer causes microcracking of the remaining concrete in surrounding areas. In order to improve the speed and efficiency of concrete removal from bridge decks, highways, substructures and parking garages and, at the same time, avoiding the problems caused by microcracking, contractors began using high-pressure water jets to remove the concrete. The use of high pressure water jets, termed Hydrodemolition, involves moving an oscillating or rotating nozzle back and forth across a bed for a number of passes and then indexing or advancing a vehicle on which the bed and nozzle are supported to a next position where the process is repeated until a desired depth of concrete deck

surface has been removed. The removal leaves reinforcing rod cleaned and descaled with a rough textured concrete surface under the reinforcing rod which is ideal for bonding of new overlay. All deteriorated concrete is removed and entrained chlorides washed away. There is a greatly reduced noise and no vibration or dust.

The conventional equipment used in hydrodemolition has one nozzle which runs over a guide bed and traverses a swath to be treated. After each pass the machine is indexed until a region has been impacted by one traversal. The vehicle is then reversed and the process repeated with the machine moving in indexes in reverse. Again once the swath has been covered the vehicle is moved forward in an indexed manner and traversals of the nozzle are repeated until the swath has been covered three times. Ordinarily three such passes are required to complete the hydrodemolition. Since the cost of a job is directly proportional to the time taken to accomplish it, there is a need for a faster more efficient method of applying hydrodemolition than that currently used. Some conventional equipment will complete a number of passes in a given position before being indexed forward where a like number of passes is then completed.

Since there is a minimum nozzle jet dwell time required for the removal of concrete, there is a minimum time required to transverse the guide bed and return to the original position. It is not possible to move the nozzle beyond a speed corresponding to the minimum dwell time of the nozzle by simply increasing the nozzle pressure in order to increase production. Considering that speed of production usually translates into lower cost of removal, it is important to develop machines that can remove a given amount of material in less time than conventional hydrodemolition machines.

Accordingly, it is an object of the invention to provide an improved hydrodemolition machine. It is a further object of the invention to provide a hydrodemolition machine that operates at a higher rate of material removal than conventional hydrodemolition machines.

SUMMARY OF THE INVENTION

According to the invention there is provided a hydrodemolition machine for removing hard, cement-like material. The machine includes a moveable vehicle, a guide coupled to the vehicle, oriented transversely to a direction of travel of the vehicle, and a carriage coupled to the guide and movable along the guide transverse to a direction of travel of the vehicle. The machine further includes means for moving the carriage along the bed and a plurality of spaced apart nozzles mounted to the carriage. The nozzles are operative to issue jets of fluid in a direction towards the hard material and move with movement of the carriage so as to remove a layer of the hard material along a swath in a direction of travel of the vehicle. A high pressure water supply assembly is coupled to the nozzles and is operative to supply water under pressure to each of the nozzles.

Advantageously, a bed may be coupled to the vehicle and the guide may be affixed to the bed.

A hydraulic arm may be mounted on the vehicle at one end of the arm and affixed to the bed at another end thereof. The means for moving is preferably a lead screw mounted parallel but spaced apart from the guide.

The high-pressure water supply assembly, preferably, includes a separate source of high-pressure water for each nozzle.

In another aspect of the invention there is provided a method of removing a layer of material from a hard cement-like material which includes positioning a bed having a plurality of spaced apart nozzles aligned along a direction transverse to a direction of travel of the bed and directed at the hard cement-like material, and supplying the nozzles with a source of high pressure fluid so that they emit jets of the fluid which impact on the hard cement-like material. Advantageously, the nozzles are moved back and forth transversely to the direction of movement of the bed until a desired thickness of the material is removed. Next the bed is indexed to a next position and the nozzles are again moved back and forth. The indexing and nozzle movement in sequence is repeated until a desired thickness of hard material has been removed.

The nozzles move over ranges of equal distances and each range is contiguous with at least one other of the ranges.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages will be apparent from the following detailed description, given by way of example, of a preferred embodiment taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a perspective view of the hydrodemolition machine;

Fig. 2 is a front elevation view showing the orientation of mounting the nozzles; and

Fig. 3 is a top view showing the ranges covered by the jets.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

Referring to Figure **1** a self-propelled vehicle **34** tows a hydrodemolition unit **36** over a concrete deck **32**. The hydrodemolition unit **36** has a carriage **30** and a guide **28**. A pair of sleeves **29** below the carriage **30** slide along the guide **28** in response to movement of carriage **30**. A lead screw **31** threadedly engages a threaded hole in the carriage **30** and, in response to rotation of the lead screw, the carriage **30** moves transversely to the direction of travel of the vehicle **34.** A fluid distribution box **37** is mounted on the carriage **30** and has hose couplings **50** which couple to the water hoses **26**. The hose couplings **50** connect to internal conduits (not shown) which direct water to internal conduits in the carriage **30** which direct the water to actuated valves **12**, **14**,and **16**, which, in turn, are coupled to respective exchangers **38**, **39**, and **40**. The valves **12, 14,** and **16** are actuated hydraulically, by air pressure but can also be operated manually. Exchangers **38**, **39**, and **40** couple the high pressure water to rotating nozzles **18**, **20**, and **22**, respectively. Nozzles **18**, **20**, and **22** are positioned and pressurized by three separate pumps **27** to permit fluid under pressure through each of nozzles **18**, **20**, and **22**. The spacing of the nozzles **18**, **20**, and **22** is 1/3 of the width of the bed **35**. However, if four or more nozzles were used the spacing would be 1/4, 1/5, etc. Three hoses **26** couple to respective ones of three pumps **27**. A piston cylinder unit (not shown) permits vertical adjustment of the nozzle assembly **51**. Instead of using separate pumps for each nozzle it is possible to use a single large pump for two or more nozzles with one of more splitters to divide the water equally between the nozzles when all are active.

Referring to Fig. **2**, each nozzle **18**, **20, 22** is oriented at an acute angle θ to the vertical **21** along an axis of rotation **23**. Rotation of the nozzles **18**, **20**, and **22**

sweep a circular area D. The actual area swept by the jet from each nozzle will be centered on a circle of diameter D and will extend out a distance equal to the radius of the jet emanating from each nozzle.

Referring to Fig. **1** and **3** the three nozzles **18**, **20**, and **22** are equally spaced apart along a bed **35** oriented transversely to the direction of travel **48** of the hydrodemolition machine. All nozzles **18**, **20**, and **22** move in unison along the bed **35** with each nozzle **18**, **20**, and **22** moving over a range equal to 1/3 of the width **46** of the bed **35**. The first nozzle **18** moves back and forth along the bed **35** over its range **41** as far as the start of the range **42** of the second nozzle **20** and back again. The second nozzle **20** moves from the start of its range **42** to the start of the range **44** of the third nozzle **22**. The third nozzle **22** moves from the start of its range **44** to the end of the bed **35**. Although three nozzles **18**, **20**, and **22** have been shown, any number of nozzles may be used. Similarly, the ranges **41**, **42**, and **44** can be adjusted to cover any desired swath **46** along the direction of travel. By moving the nozzles **18**, **20**, **22** transversely back and forth at a speed which provides the minimum dwell time, it is possible to remove three times as much material in a given amount of time as is possible with a single nozzle.

Although the three nozzles **18**, **20**, and **22** have been shown as mounted to a common carriage **30** and moving together along the guide **28**, obviously each of nozzles **18**, **20**, and **22** could be moved independently. Moreover, the nozzles **18**, **20**, and **22** could move over any desired range within the width of bed **36**. Obviously other means of moving the carriage **30** could be employed such as a moving track system.

Accordingly, while this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to this description. It is therefore contemplated that the appended claims will cover any such modifications or embodiments as fall within the true scope of the invention.

WE CLAIM:

1. A hydrodemolition machine for removing a layer of hard cement-like material, comprising:

(a) a moveable vehicle;

(b) a guide coupled to said vehicle oriented transversely to a direction of travel of said vehicle;

(c) a carriage coupled to said guide and movable along said guide transverse to a direction of travel of said vehicle;

(d) means for moving said carriage along said guide;

(e) a plurality of spaced apart nozzles mounted to said carriage and operative to issue jets of fluid in a direction towards said hard material and movable with movement of said carriage so as to remove a layer of said hard material along a swath in a direction of travel of said vehicle, a height of each of said nozzles being separately adjustable to accommodate surface variations of said material; and

(f) a high pressure water supply assembly coupled to said nozzles operative to supply water under pressure to each of said nozzles.

2. A machine according to claim 1, including a bed coupled to said vehicle and wherein said guide is affixed to said bed.

3. A machine according to claim 2, including a hydraulic arm mounted on said vehicle at one end of said arm and affixed to said bed at another end thereof.

4. A machine according to claim 1, wherein said means for moving is a lead screw mounted parallel but spaced apart from said guide.

5. A machine according to claim 1, wherein said high pressure water supply assembly includes a separate source of high pressure water for each nozzle, each said source having a pressure adjuster operative to adjust water pressure of water supplied to said each nozzle.

6. A machine according to claim 1, wherein each of said nozzles is oriented at an acute angle to a perpendicular to a surface of said hard cement-like material when said bed is positioned for the removal of the hard cement-like material, and rotates about said perpendicular.

7. A machine according to claim 2, wherein the swath covered by movement of said nozzles substantially equals a width of said bed.

8. A machine according to claim 1, wherein transverse movement of said nozzles is synchronized.

9. A method of removing hard cement-like material, comprising:

(a) positioning a bed having a plurality of spaced apart nozzles aligned along a direction transverse to a direction of travel of said bed and directed at said hard cement-like material;

(b) separately adjusting a height of each of said nozzles;

(c) supplying said nozzles with a source of high pressure fluid so that they emit jets of said fluid at said hard cement-like material;

(d) moving said nozzles back and forth transversely to the direction of movement of said bed until a desired thickness of said material is removed;

(e) indexing said bed to a next position; and

(f) repeating steps (d) and (e) until a desired length of said hard material has been removed.

10. A method according to claim 9, wherein each of said nozzles moves over ranges of equal distances and each range is contiguous with at least one other of said ranges.

11. A method according to claim 9, including separately adjusting fluid pressure of fluid applied to each of said nozzles.

12. A method according to claim 9 wherein said fluid is water.

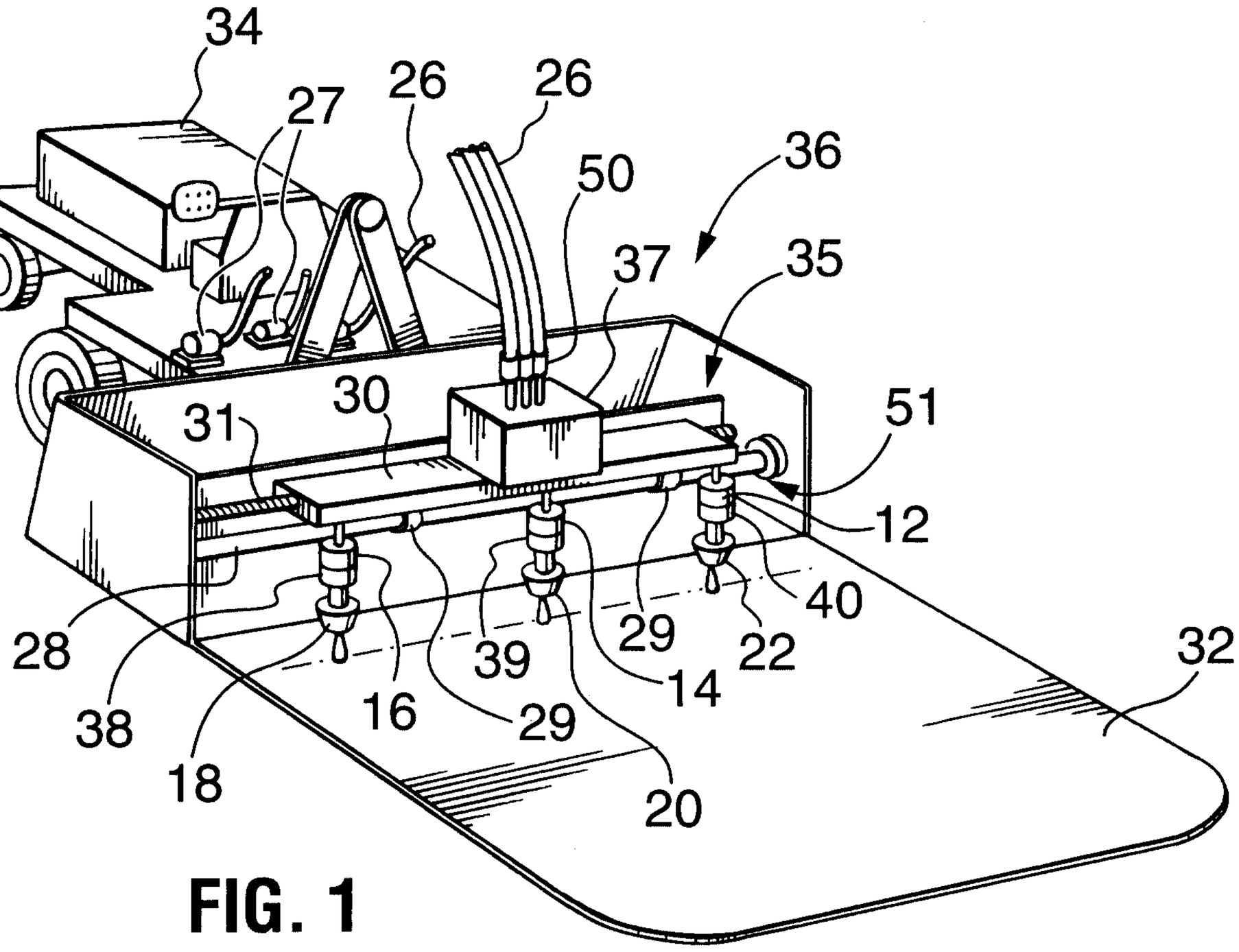

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FIG. 1

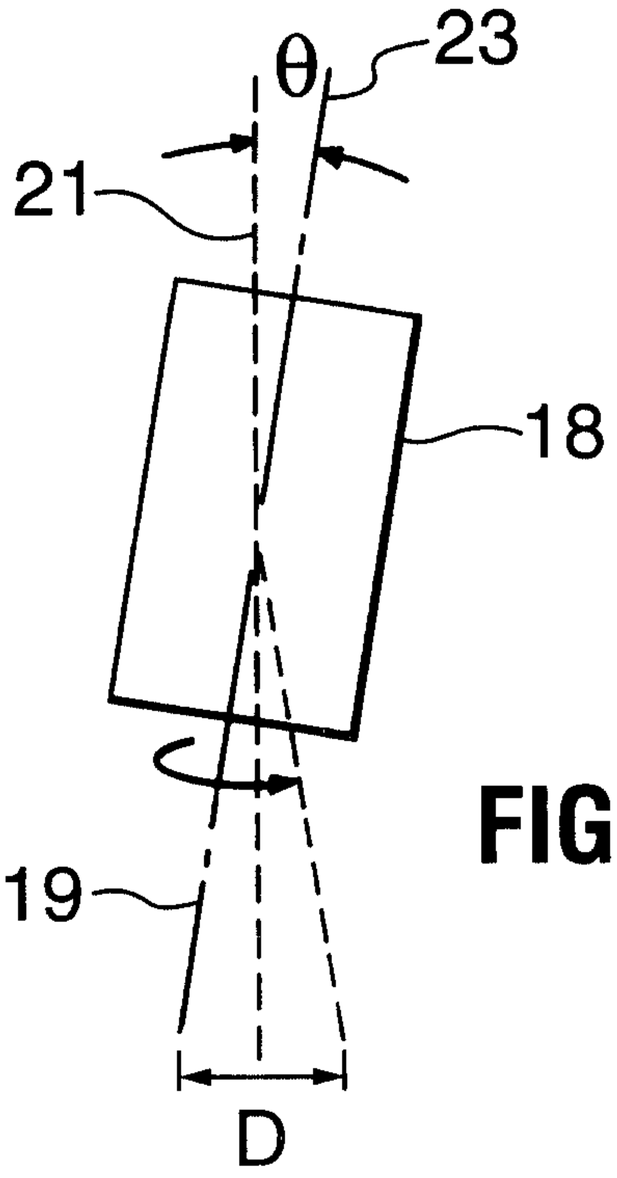
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FIG. 2

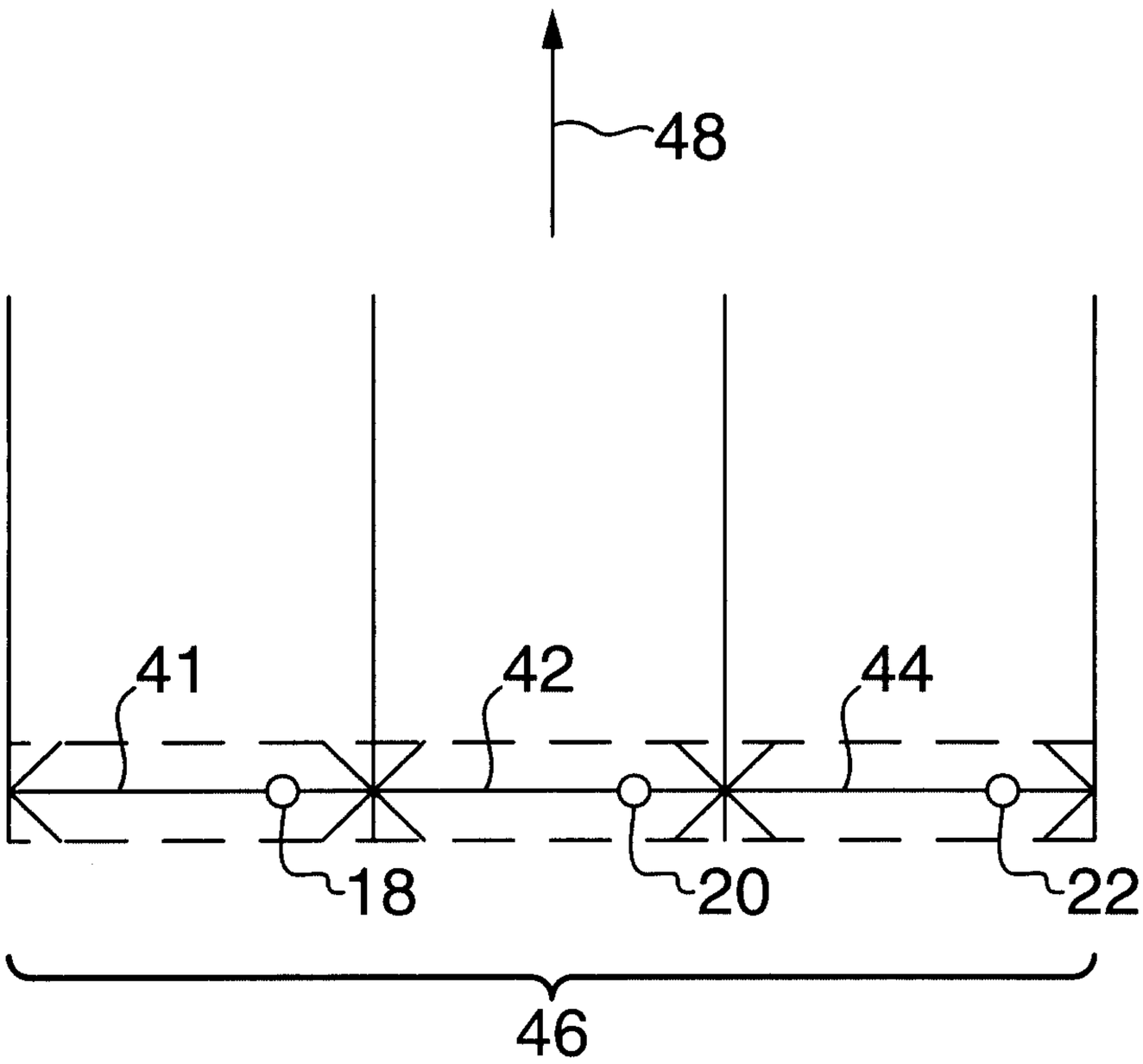
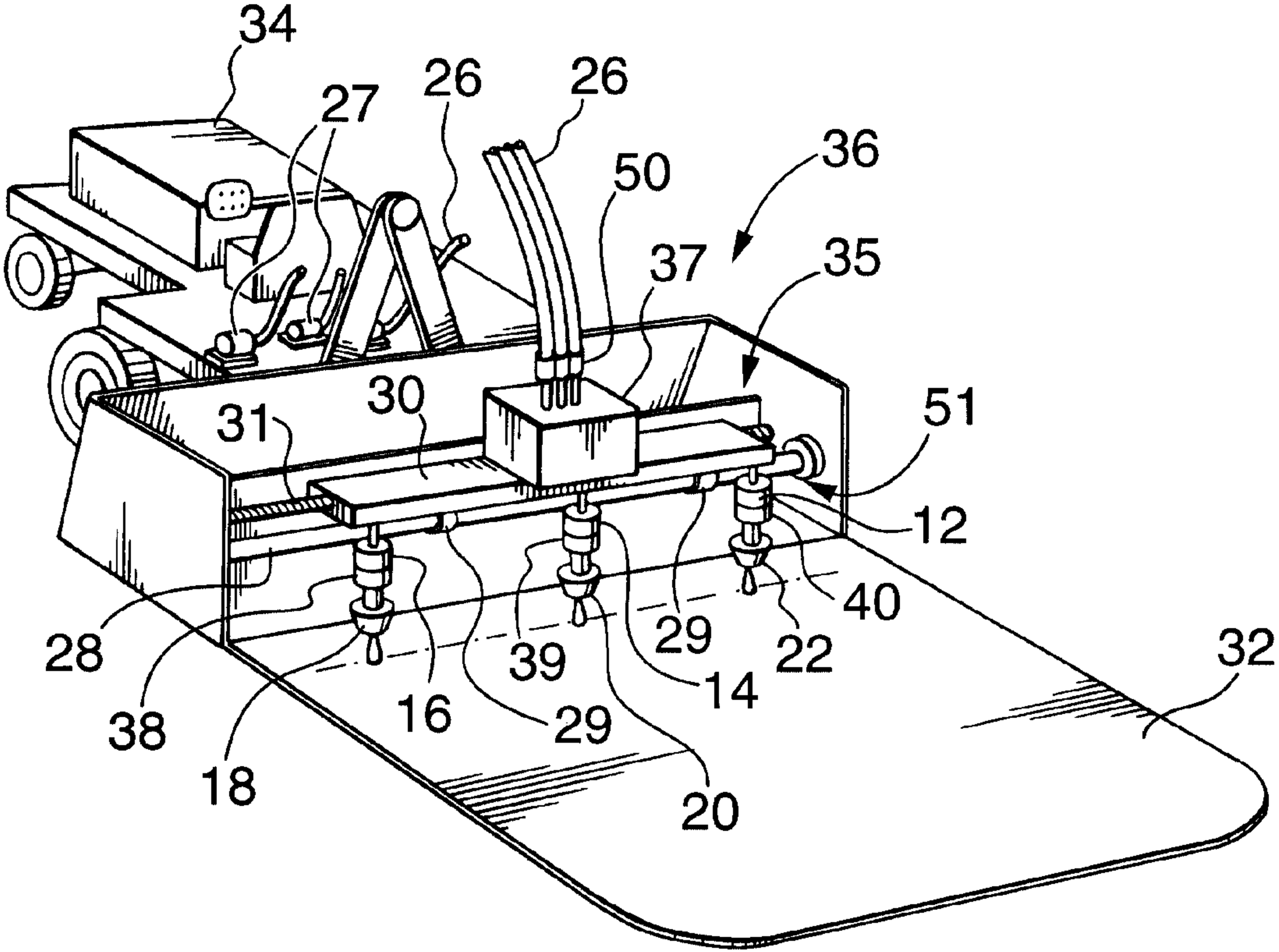


FIG. 3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