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(71) Applicant *(for all designated States except US):* FLEET (LINE MARKERS) LIMITED [GB/GB]; Spring Lane South, Spring Lane Industrial Estate, Malvern Link, Worcestershire WR14 1AJ (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* McGUFFIE, Iain, Peter [GB/GB]; Hungry Hill Farm, Stoke Lacy, Nr. Bromyard, Herefordshire HR7 4HD (GB).

(74) Agents: MOON, Donald, Keith et al.; Brewer & Son, Quality House, Quality Court, Chancery Lane, London WC2A 1HT (GB).

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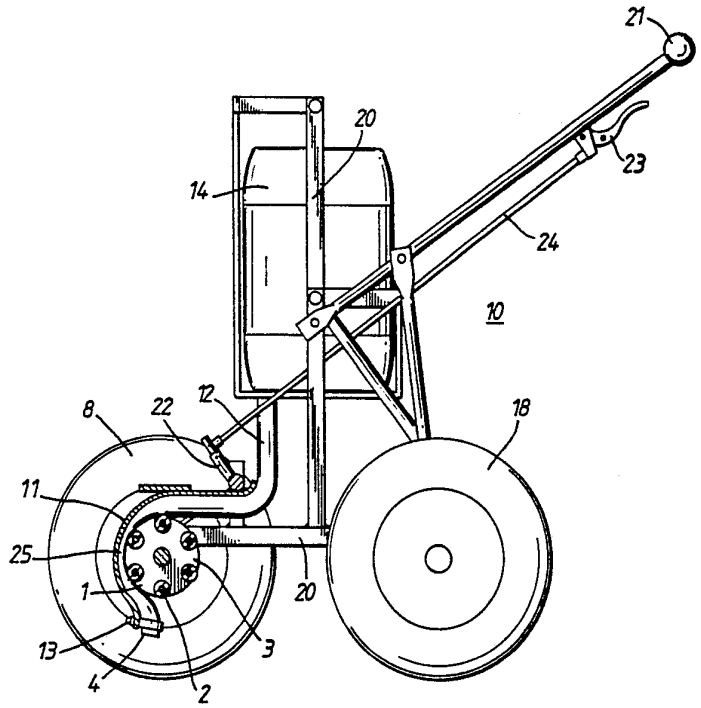

(57) Abstract

Liquid dispensing apparatus is proposed comprising a reservoir (14) and a tube (12) with an outlet (4) in which the liquid is supplied from the reservoir (14) to the outlet (4) via the tube (12) without the liquid contacting any of the moving parts of the apparatus. The tube is nipped in a nip (25) between first (1) and second (11) members of the apparatus and the nip (25) is advanced along the tube (12) to dispense the liquid via the outlet (4). The tube (12) can be released easily from between the first (1) and second (11) members and therefore the tube (12) and reservoir (14) can be changed easily for a different tube and reservoir containing different liquid. In an embodiment, the apparatus forms part of a Line Marking Machine (10) in which the apparatus is arranged to be driven by support wheels (8, 9) of the Machine (10).

* See back of page

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LIQUID DISPENSING APPARATUS

This invention relates to an apparatus for dispensing liquid, particularly sports line marking liquid. However the invention also relates to other liquid or paste dispensing apparatus in which liquid or paste is dispensed in controlled amounts from a reservoir for the liquid or paste e.g. apparatus for dispensing liquid fertilizer or weedkiller on to grass or crops.

Apparatus for dispensing sports line marking liquid, e.g. for the marking of tennis courts or cricket pitches, is well known. Such apparatus is generally mounted on wheels and comprises a reservoir for the marking liquid and a means of transferring the liquid in a steady flow on to the horizontal surface to be marked.

Several ways of transferring the liquid on to the surface to be marked have hitherto been proposed.

In one liquid transfer system hitherto proposed interconnecting wheels are provided, one wheel being partially immersed in the liquid, and the last of the interconnecting wheels being in contact with the ground. The liquid is transferred from one wheel to the next where the wheels touch each other until it reaches the last wheel, from which it is transferred to the ground.

In another arrangement for liquid transfer an adjustable tap is located towards the bottom of the reservoir so that, when opened, it allows liquid to fall on to a marker wheel. Rotation of the wheel transfers the liquid on to the ground.

In yet another arrangement a peristaltic pump pumps liquid from the reservoir to a pressure chamber and then to a dispensing nozzle.

A disadvantage common to existing liquid dispensers is that, especially in the case of use with marking liquid, due to the tendency of the marking liquid to solidify over a period of time, during periods of non-use, the parts of the dispenser that come into contact with the marking liquid become covered with a thick layer of solidified marker liquid. The resulting thick deposit clogs working parts, preventing further efficient use of the dispenser without cleaning. To avoid this build up of solidified marker liquid, the apparatus has to be cleaned following each use.

The result of not cleaning the apparatus is that the apparatus is either difficult or impossible to use.

A disadvantage of liquid dispensers utilizing a pressure chamber is that there is a time delay between commencement of use of the dispenser and the first dispensing of the liquid from the nozzle, this delay being due to the necessity for a rise in pressure to a threshold level inside the pressure chamber before liquid can leave the pressure chamber.

Another disadvantage of liquid dispensers hitherto proposed is that if the apparatus has previously been used for one liquid, and, following this use, it is desired to be used for dispensing a liquid of another type or colour then the apparatus has first to be cleaned before it can be used with the second liquid. This necessary cleaning makes the change from one liquid to another of a different type or colour awkward and/or

time-consuming.

Line marking apparatus has also hitherto been proposed in which liquid is dispensed from a pressurised source of liquid, such as an aerosol can. Such apparatus has the disadvantage of requiring expensive replacement aerosol cans, whilst each can contains a relatively small amount of liquid.

According to the present invention a liquid dispensing apparatus comprises a reservoir for a liquid to be dispensed, and a tube with an outlet end, the reservoir being connected to the outlet end via the tube characterised in that the tube passes through a nip between first and second members and that drive means are provided for so moving at least one of the members to advance the nip along the tube in the direction of the outlet end to cause controlled amounts of liquid to be supplied from the reservoir to the outlet end.

The reservoir can be formed from a part of the tube or may be separate to the tube and connected thereto. However, all of the reservoir, the tube and the outlet end can be made removable from the apparatus.

In an embodiment of the invention as described below the first member is a rotatable member. The drive means so advances the nip between the rotatable member and the second member along the tube that liquid is supplied from the reservoir via the tube to the nozzle. The liquid is dispensed through the outlet end and this process occurs rapidly after commencement of use of the apparatus.

The rotatable member can take various forms, for example, the rotatable member can be substantially triangular or

square in cross-section and rotatable about an axis generally transverse to the longitudinal direction of the tube. The rotatable member can be substantially solid and have rounded corners.

The reservoir and tube are easily removable from the apparatus and so, following use of the liquid dispenser, the reservoir and tube can be removed and stored. The liquid only contacts the inside of the reservoir and the inside of the tube and this means that the mentioned problems arising with hitherto proposed liquid dispensing apparatus as a result of liquid being left in the apparatus during long periods of non-use can be avoided.

If the reservoir becomes empty then a new one can be exchanged for it without the need for a new tube. Alternatively, if a different colour or type of liquid is desired to be used then replacement of the previously used reservoir and tube is possible quickly and easily and without the delays associated with other liquid dispensers.

The second member can be a stationary member which bears against one side of the tube and wherein the other side of the tube is engaged by the rotatable member.

The stationary member may be a flat plate but is preferably a displaceable hood which is lockable in an operational position in which it engages the one side of the tube. The rotatable member can be mounted with the hood such that the tube passes between the rotatable member and the hood so that by bringing together the hood and the rotatable member the tube is caused to bear between the rotatable member and the hood. With the tube bearing between the rotatable member and the hood in this

way, rotation of the rotatable member in the direction of the outlet will cause liquid to be pumped along the tube and dispensed via the outlet.

The rotable member can be a roller but is preferably one of a plurality of identical rollers rotatably mounted on the periphery of a rotatable roller support drum and wherein the drive means serves to rotate the roller drum to bring each roller in turn into rolling contact with the tube and to advance it along the tube.

The hood may be substantially semi-circular in cross-section with a smooth surface so that when the hood is brought towards the roller drum, because of the shape of the roller drum the tube is caused to be periodically compressed between the hood and the roller drum when the latter rotates. In one embodiment, the hood may be part of a line marking machine in which the hood is pivotally connected to the frame of the line marking machine so that by pivoting the hood the tube is caused to bear against the roller drum and in which means are provided for securing the hood in such a position that the hood causes the tube to bear against the roller drum. In such an embodiment the hood can be pivoted so that the tube is not caused to bear against the roller drum, thereby facilitating removal of the tube from between the roller drum and the hood.

The position of the reservoir relative to the outlet may be such that with the outlet in an open position liquid flows out of the reservoir through the tube and out of the outlet by gravity alone. The viscosity of the liquid will affect this flow, there being greater flow for less viscous liquids and vice versa. One method of preventing unwanted flow of this sort is to have a cap that fits

over and seals the outlet end, and to remove the cap when the apparatus is to be used. However, the first and second members can be arranged so that the nip between them reduces the cross-sectional area of the tube at the nip to substantially zero or to zero. This arrangement of the first and second members can avoid the necessary use of a cap. Also, this arrangement may be necessary when using the liquid dispensing apparatus with some liquids to assist in controlling the supply of liquid to the outlet. As an alternative and/or additional way of preventing the mentioned unwanted flow the hood can be arranged so that when the hood is in the up position the tube is caused to bend so that a kink appears in the tube, the kink reducing the cross-sectional area of the tube at that point to zero or to substantially zero.

The tube may be made of PVA, polythene or polypropylene or any other suitable material that is not attacked by the liquid to be dispensed.

The tube may be releasably connected to the reservoir. The means of connection of the tube to the reservoir can be by a screw cap incorporated into the end of the tube, the screw cap being received by a screw-thread at the bottom of the reservoir. The means of connection of the tube to the reservoir may be of a clip-on type whereby the outlet end of the tube receives a hollow projection protruding from towards the base of the reservoir, the tube being tightly held around the hollow projection by means of a screw-clip. For ease of use this screw-clip may incorporate a hand adjustable butterfly clip.

The outlet end can be simply the open end of the tube but is preferably fashioned into a nozzle for altering the dispensing characteristics of the outlet end.

Alternatively, a nozzle can be provided separately to the tube and connected to the outlet end.

The tube can be releasably connected to the nozzle, or the tube and nozzle may form a single unit. If the nozzle is releasable from the tube, then the connection of the tube to the nozzle may be of a clip-on type or may consist of a screw-on type whereby the outlet end of the tube is fashioned into a screw thread for receiving the nozzle or part of the nozzle, the nozzle or part of the nozzle being screwed into the outlet end of the tube.

In order that a single nozzle can provide a selection of possible nozzle openings, the nozzle can comprise several sets of opening holes, each set being covered by a removable adhesive strip. The nozzle may comprise a 10 cm diameter ring of holes, a 7.5 cm diameter ring of holes, a 5 cm diameter ring of holes and a 3.5 cm diameter ring of holes. If the 5 cm ring of holes were the opening required then the adhesive strip covering the 5 cm ring of hoes would be removed and the adhesive strips covering the other set of holes left in their respective positions. As an alternative, the nozzle can comprise lines of holes, the lines being covered by removable adhesive strips as described above.

The nozzle and tube may hang freely or may be releasably attached to part of the frame of a line marking machine. The nozzle may be releasable attached to the frame or the hood of a line marking machine in such a position that, with the nozzle attached, the nozzle hangs down in a suitable position from which the liquid can be dispensed.

In an embodiment of the invention there is provided a ground vehicle for dispensing liquid comprising a support

frame with one or more support wheels for movement of the vehicle over the ground and characterised by the provision of liquid dispensing apparatus as claimed in any of the preceding claims which is mounted on the frame and in that the drive means are arranged to be driven by the support wheels or by the means for driving the support wheels. The drive means can alternatively be arranged to be driven by a motor or by a bicycle partly or wholly incorporated into the vehicle.

In another embodiment of the invention, the liquid dispensing apparatus is incorporated into a line marking machine. This machine comprises at least one set of wheels, a roller drum and movable hood, the roller drum being mounted on a frame including at least one set of wheels for transport so that the drive means are directly or indirectly driven by the axle of a set of wheels. In this embodiment the liquid dispensing apparatus is only working whilst the wheels are in motion - i.e. in this case the line marker is being pushed or driven - and the hood is moved downwards and locked in position so that the tube is located between the drum and the hood and so that rotation of the drum compresses the tube against the hood and advances the nip between the hood and the rollers of the drum along the tube.

In an embodiment of the invention in which the liquid dispensing apparatus is mounted on a frame of a vehicle comprising one or more support wheels and in which the drive means are arranged to be driven by one of the support wheels, it will be appreciated that with this arrangement the rate of liquid dispensing will be related to the rate of movement of the drive means, which will in turn be related to the rate of movement of the support wheels across the ground. However, it will also be

appreciated that with this arrangement, within certain speed limits of the vehicle, a similar amount of liquid will be dispensed per distance travelled by the vehicle independent of the speed of the vehicle.

In a preferred embodiment, the liquid dispensing apparatus is part of a line marking machine. This machine comprises two sets of wheels for transport, a roller drum and a movable hood, wherein the roller drum is mounted coaxially with one set of wheels so as to rotate in unison with the set of wheels, the hood is attached to the frame of the machine and is lockable in a position in which the tube is caused to bear against the roller drum, the drum as it rotates causing the nip between the hood and each of the rollers in turn to advance along the tube, and wherein the nozzle releasably is secured to the hood so that with the nozzle attached to the tube the nozzle is directed downwards in a suitable position for liquid to be dispensed onto the surface of the ground whilst the line marking machine is in use.

One embodiment of the invention will be described with reference to the drawings in which:-

Fig. 1 shows a part-sectional side view of a Line Marking Machine into which the apparatus has been incorporated;

Fig. 2 shows a front view of the Line Marking Machine of fig 1; and

Fig. 3 shows a perspective view of the apparatus incorporated into the Line Marking Machine of fig 1.

Like numerals are used for all three figures.

In Fig.s 1 and 3 is shown a roller drum 1 which comprises a number of hollow cylinders 2 rotatably mounted on horizontal axes between the circular plates 3. The hollow cylinders 2 are rotabably mounted on long bolts (not shown) that extend through the middle of the hollow cylinders 2 and are attached to the circular plates 3.

The plates 3 are attached to an axle 7 running through the centre of each plate so that they rotate with the axle.

Fig.s 1 and 2 show the apparatus incorporated into a Line Marking Machine 10 comprising a frame 20, handle 21 and four wheels 8, 9, 18 and 19.

Fig. 3 shows a perspective view of the apparatus incorporated into the line marking machine shown generally at 10. The roller drum 1 is mounted on the axle 7 of the front wheels 8 and 9 of the machine 10. The hood 11 is mounted on the machine 10 above the roller drum 1. The outlet end 4 of the tube 12 is attached to the hood 11 by a clip 13. The outlet end 4 of the tube 12 is fashioned into a socket (not shown) for attachment of a nozzle (not shown). The other end of the tube 12 is connected to a reservoir 14 for marking liquid by a screw cap 17.

The hood 11 is pivotable about an axis 15 so that the hood 11 can cause the tube 12 to bear against the roller drum 1. In the fig 3 the hood 11 is in the up position and away from the roller drum 1, this arrangement enabling easy removal of the tube 12 from between the roller drum 1 and the hood 11.

roller drum 1 and the hood 11.

In figs 1 and 2 the hood 11 is locked in the down position so that the hood 11 causes the tube 12 to be nipped between the hood 11 and the roller drum at a nip 25 this is best seen in fig. 1. Locking means 22 are provided for securing the hood 11 in the down position, the locking means 22 being operated by a locking lever 23 on the frame 20 via a cable 24.

During use of this preferred embodiment, as the line marking machine moves along the surface, rotation of the wheels of the machine causes rotation of the roller drum which, with the hood locked so as to cause the tube to bear against the roller drum, causes the nip between the roller drum and the hood to advance along the tube in the direction of the outlet and thereby causes the liquid in the reservoir to be supplied from the reservoir via the tube to the nozzle from which the liquid is dispensed. The resulting width of the band of liquid thus dispensed depends on the shape and size of the nozzle.

CLAIMS

1. A liquid dispensing apparatus comprising a reservoir for a liquid to be dispensed, and a tube with an outlet end, the reservoir being connected to the outlet end via the tube characterised in that the tube passes through a nip between first and second members and that drive means are provided for so moving at least one of the members to advance the nip along the tube in the direction of the outlet end to cause controlled amounts of liquid to be supplied from the reservoir to the outlet end.

2. Apparatus as claimed in claim 1 wherein the nip between the first and second members reduces the cross sectional area of the tube at the nip to zero or substantially zero.

3. Apparatus as claimed in claim 1 or 2 wherein the first member is a rotatable member and the drive means serves to advance the rotatable member along the tube, thereby to advance the nip along the tube.

4. Apparatus as claimed in claim 3 wherein the second member is a stationary member which bears against one side of the tube and wherein the other side of the tube is engaged by the rotatable member.

5. Apparatus as claimed in claim 4 wherein the stationary member is a displaceable hood which is lockable in an operative position in which it engages the one side of the tube.

6. Apparatus as claimed in claim 3, 4 or 5 wherein the rotatable member is one of a plurality of identical

rollers rotatably mounted on the periphery of a rotatable roller support drum and wherein the drive means serves to rotate the drum to bring each roller in turn into rolling contact with the tube and to advance it along the tube.

7. Apparatus as claimed in any of the preceding claims wherein the reservoir and the tube form a single unit which is removably mounted in support structure of the apparatus.

8. Apparatus as claimed in any of the preceding claims wherein there is a nozzle connected to the outlet end of the tube for altering the dispensing characteristics of the outlet end.

9. A ground vehicle for dispensing liquid comprising a support frame with one or more support wheels for movement of the vehicle over the ground and characterised by the provision of liquid dispensing apparatus as claimed in any of the preceding claims which is mounted on the frame and in that the drive means are arranged to be driven by the support wheels or by the means for driving the support wheels.

10. A ground vehicle for dispensing liquid comprising a support frame with one ore more support wheels for movement of the vehicle across the ground and characterised by the provision of liquid dispensing apparatus as claimed in any of preceding claims 1 to 8 which is mounted on the frame, and further characterised in that the drive means are arranged to be driven by an electric motor.

11. A line marking machine substantially as herein before described with reference to the drawings.

AMENDED CLAIMS

[received by the International Bureau on 5 February 1991 (05.02.91); original claims 1 and 7 replaced by new claim 1; new claim 2 added; claims 2-4 replaced by new claims 3-5; claims 5 and 6 replaced by new claims 6 and 7; claims 8-11 replaced by new claims 8-11 (3 pages)]

1. A liquid dispensing apparatus comprising a reservoir for a liquid to be dispensed, and a tube with an outlet end, the reservoir being connected to the outlet end via the tube, wherein the tube passes through a nip between first and second members and drive means are provided for so moving at least one of the members to advance the nip along the tube in the direction of the outlet end to cause controlled amounts of liquid to be supplied from the reservoir to the outlet end characterised in that the reservoir and the tube form a single unit removably mounted in support structure of the apparatus.

2. Apparatus as claimed in claim 1 in which the first and second members are moveable apart so as to facilitate removal of the tube from between the first and second members and the unit from the apparatus.

3. Apparatus as claimed in claim 1 or 2 wherein the nip between the first and second members reduces the cross sectional area of the tube at the nip to zero or substantially zero.

4. Apparatus as claimed in any of claims 1 to 3 wherein the first member is a rotatable member and the drive means serves to advance the rotatable member along the tube, thereby to advance the nip along the tube.

5. Apparatus as claimed in claim 4 wherein the second member is a stationary member which bears against one side of the tube and wherein the other side of the tube is engaged by the rotatable member.

6. Apparatus as claimed in claim 5 wherein the stationary member is a displaceable hood which is lockable in an operative position in which it engages the one side of the tube and wherein the hood is pivotable away from the rotatable member, thereby to release the tube and facililate removal of the reservoir and tube unit from the apparatus.

7. Apparatus as claimed in claim 4, 5 or 6 wherein the rotatable member is one of a plurality of identical rollers rotatably mounted on the periphery of a rotatable roller support drum and wherein the drive means serves to rotate the drum to bring each roller in turn into rolling contact with the tube and to advance it along the tube.

8. Apparatus as claimed in any of the preceding claims wherein there is a nozzle connected to the outlet end of the tube for altering the dispensing characteristics of the outlet end.

9. A ground vehicle for dispensing liquid comprising a support frame with one or more support wheels for movement of the vehicle over the ground and characterised by the provision of liquid dispensing apparatus as claimed in any of the preceding claims which is mounted on the frame and in that the drive means are arranged to be driven by the support wheels or by the means for driving the support wheels.

10. A ground vehicle for dispensing liquid comprising a support frame with one ore more support wheels for movement of the vehicle across the ground and characterised by the provision of liquid dispensing apparatus as claimed in any of preceding claims 1 to 8 which is mounted on the frame, and further characterised

in that the drive means are arranged to be driven by an electric motor.

11. A line marking machine substantially as hereinbefore described with reference to the drawings.

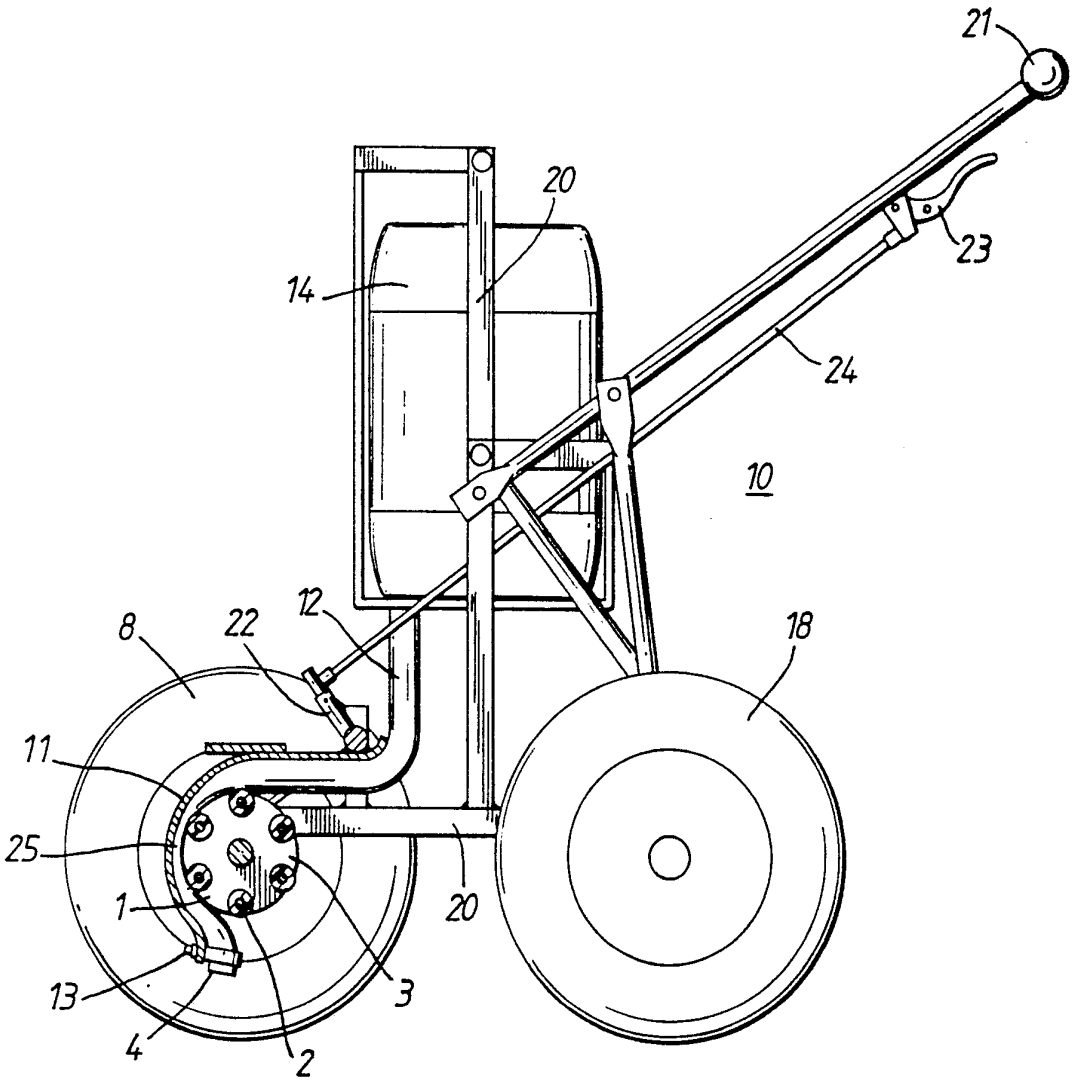

Fig.1.

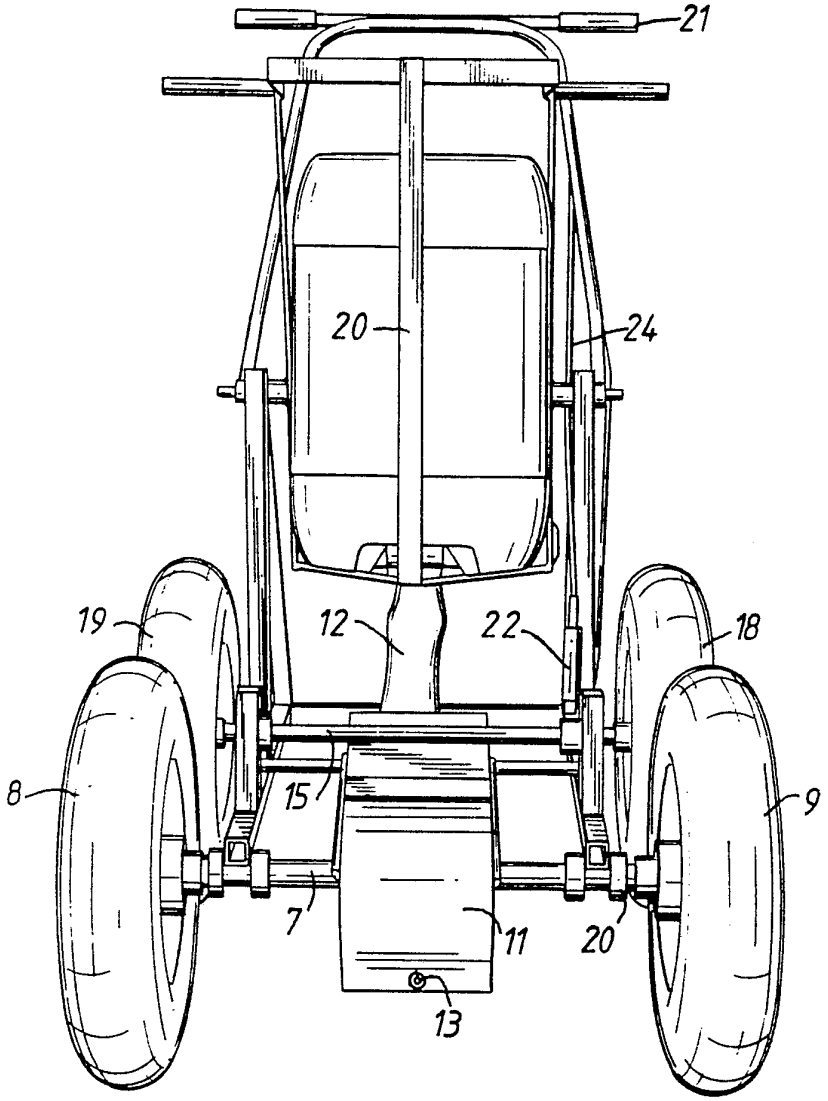

Fig.2.

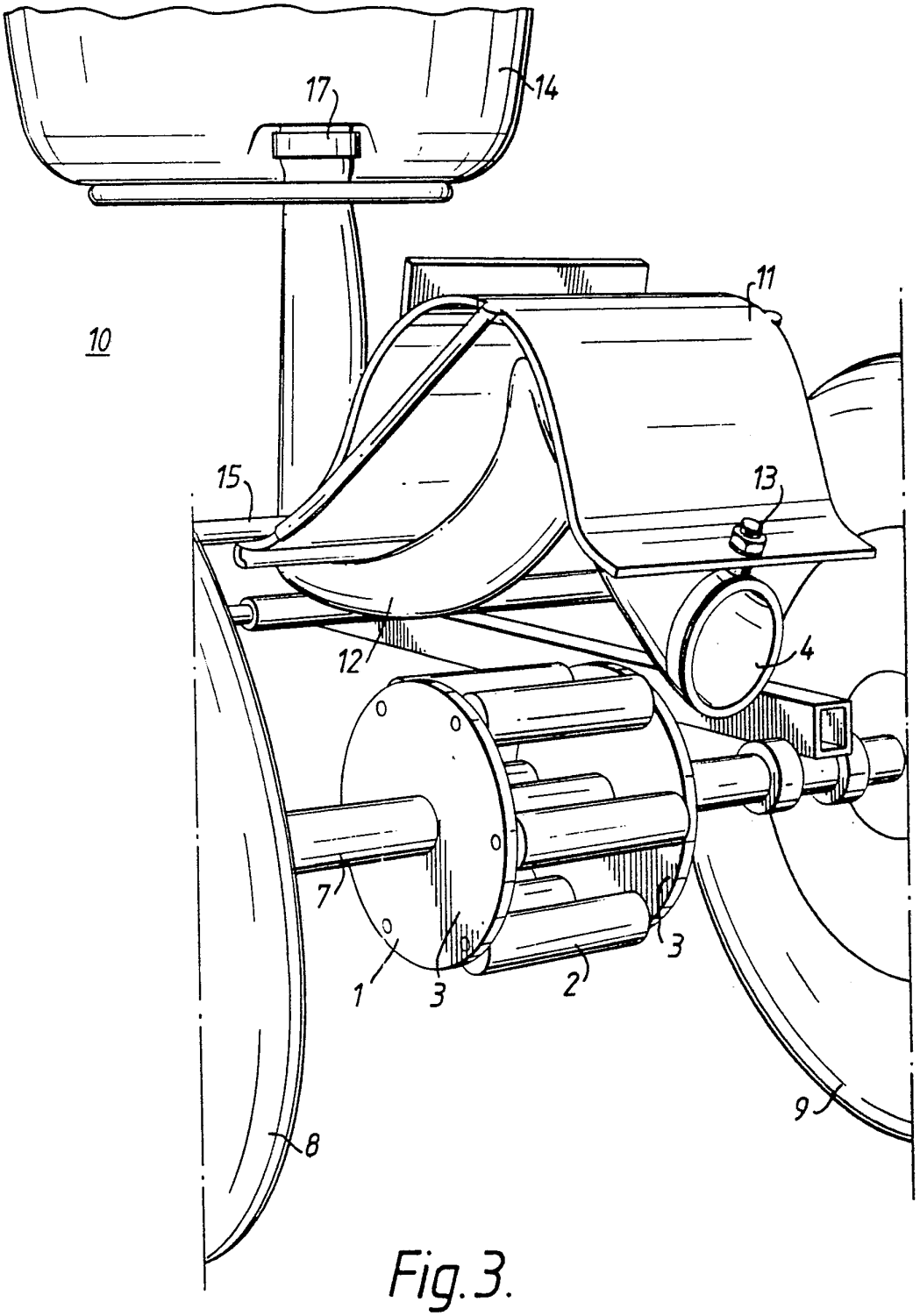

Fig. 3.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/01347

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: E 01 C 23/16, B 05 B 9/06, A 01 C 23/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	E 01 C, B 05 B, F 04 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4214681 (LEVINE) 29 July 1980 see the whole document	1-6
Y		9,11
A		8

Y	US, A, 4483486 (MAGDA) 20 November 1984 see figures	9
A		1,2,3,6,10

Y	CH, A, 214363 (SACCHETTI) 16 July 1941 see main claim; figures	11

X	EP, A, 0013002 (ARA-WERK) 9 July 1980 see page 6, line 18 - page 10, line 4; figures	1-6
Y		8,9
	--- ./.	

* Special categories of cited documents: [10]

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
23rd November 1990	17. 12. 90
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	N. Toribio Nuria TORIBIO

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	US, A, 4240583 (HUGHES) 23 December 1980 see column 6, lines 25-55; figures	8,9
A		1-3

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9001347 SA 40030

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 07/12/90
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4214681	29-07-80	None	
US-A- 4483486	20-11-84	None	
CH-A- 2143363		None	
EP-A- 0013002	09-07-80	DE-A- 2855634	26-06-80
US-A- 4240583	23-12-80	None	