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(54) Fibre delivery system for asphalt production

(57) Fibre delivery system comprising a hopper (2) for accomodating a bale (20) of fibrous material, and which is closed at its base by a plurality of rollers (8,9),

each roller having on its surface a plurality of projections, and means (21) for forcing a bale (20) accommodated in the hopper onto the rollers (8,9).

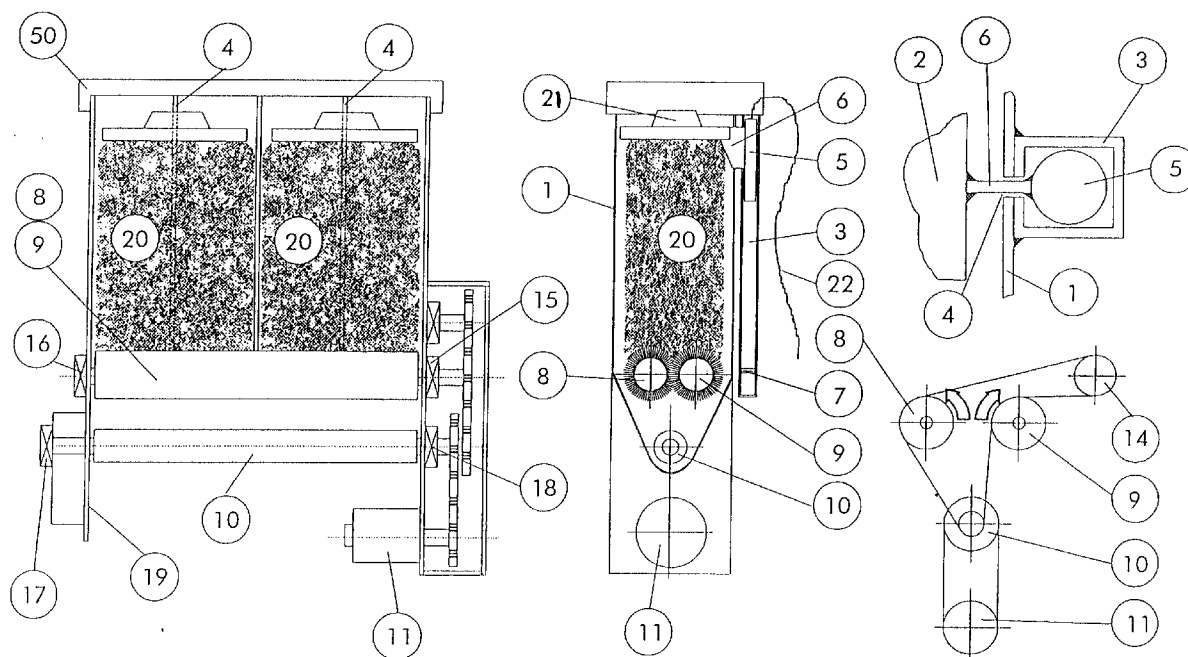


FIGURE 1

Description

Introduction

The use of fibrous materials as a means of increasing the wet film thickness of liquid coatings is well known. The use of such fibrous material in asphalt mixtures to increase the bitumen coating on the stone contained in the asphalt mix is also an established technique. There is also some evidence to support the idea that asphalt containing fibres are more resistant to rutting.

Fibre-containing asphalt is normally produced as a hot thermoplastic material in a fixed blending plant, and then transported to site in an insulated vehicle. The hot thermoplastic asphalt is then applied to the substrate through conventional asphalt pavers.

Recently an alternative method has been to produce the asphalt, in cold form, using bitumen emulsions, in a mobile blending, mixing and paving machine, which blends and mixes the material at the point of application. The addition of fibres to such a system has been found to enhance the surface texture, as well as impart the other aforementioned advantages.

The fibre additions are generally between 0.1% and 0.5% and it has been found that only some types of fibres are suitable. The fibre size is usually between 2mm and 6mm long with a diameter ranging from 1 μ to 100 μ .

The difficulty in handling tightly packed fibrous material is accepted. The feeding of such materials within acceptable limits to meet the demands of a continuous blending process is critical for the range of fibre materials likely to be encountered.

Moreover to aid uniform distribution of the fibres throughout the material, requires that the fibre material is broken up prior to it being metered to the mixer with all the other asphalt components.

To date, equipment used to deliver fibres into road composition manufacturing equipment has been designed to handle fibres which are supplied in palletised form.

Alternatively the fibre metering equipment is designed to maintain the fibres in a loose form by containing them in an agitated hopper equipped with paddles or the like. The loose material is then metered into the road composition manufacturing equipment via a rotary valve device or screw arrangement.

The present invention provides a compact storage and delivery system capable of accepting the fibrous material as high density packaged bales, and then breaking up the material into a loose form, and metering it in terms of mass-or-volume to ensure the correct dosing level.

The whole assembly is suitable for integration into a mobile continuous mixing cold asphalt machine designed to mix asphalt materials and apply them as a road surfacing product.

Details of the Invention

Reference to Figure 1 shows the essential components of the first embodiment.

The container (1) is designed to accommodate one or more fibre bales (20) as well as form a structure to enclose and support the mechanism necessary for metering and delivering the fibres.

Items (2) to (7) form a press mechanism which forces the bales, in a controlled manner, onto a set of contra-rotating spiked, or barbed, rollers (8) and (9).

These spiked rollers tear and break up the material from the bale (20) and transport it into a void situated above the metering delivery auger (10). The drive system is by chains (12) (13), powered by an hydraulic or electric motor (11) and tensioned by idle sprocket (14). Generally the auger is geared to rotate faster than the speed of the spiked rollers to prevent material jamming. Bearings (15), (16), (17) and (18) attached to the container (1) support the spiked rollers and auger.

Auger (10) can be of progressive nature to avoid jamming. Material is delivered through duct (19). The metering rollers (8) and (9) are equipped with pointed spikes, typically of round cross-section, and upto around 10 mm, eg. 4-5mm, long and upto 5 mm, eg. around 1.5mm, in diameter. They are preferably spaced at 5-15 mm, eg. 12mm, centres both longitudinally and circumferentially.

The feeding system consists of a platen (2), square guide tube (3) with slot (4) and guide plug (5) connected to platen (2) via gusset (6). Platen (2) and gusset (6) can be raised out of engagement of slot (4) and rotated through 180° to enable loading of fresh bales.

To maintain a controlled feed, platen (2) can be weighted with mass (21).

Figure 2A shows an electric motor (30) driving a lead screw (31) which controls the feed rate of platen (32) via plug nut (33) which is constrained by guide tube (34) and slot (35).

Figure 2B shows an hydraulic cylinder (40) which controls the feed rate of Platen (41) through lead screw (42) contained in guide tube (44).

In both cases the platen can be rotated 180° for loading when clear of container (1).

Hinged lid (50) is designed to reduce the ingress of rain etc.

It was discovered that not only can the auger vary the flow rate as would be expected from previous practice, but that material flow rate is dependent upon the speed of the spiked rollers (8) and (9) and can also be adjusted by varying the force between the bale of fibre and the spiked rollers. Table 1 shows the changes in output that can be achieved by either varying the spiked rollers speed or by changing the feeding force (21) applied to the bale (20), for a variety of fibrous materials.

It will be noticed, from Table 1, that the spiked roller speed is generally proportional to fibre flow rate, but that the weight applied to the bale to control the flow rate to meet a process target flow rate varies with the material type and its packing factor. Indeed, auger speed variations within certain limits resulted in little variation of feed rate.

In the second embodiment the design has been changed to eliminate the auger metering device and use the spiked rollers only to meter the material as well as process the compacted material into a form suitable for admixing. All other aspects of the system are the same as for the first embodiment.

Reference to Figure 3 shows the second embodiment with the fibrous material (1) contained in the hopper (2) which also forms the support structure for the spiked rollers (3) which are geared together (4) to give contra rotation. The drive system which can take the form of either an electric or hydraulic motor (5) of variable speed. Chain and sprocket transmission (6) is capable of rotating the spiked rollers typically from 10 rpm to 300 rpm. The mechanism for pressing a bale onto the spiked rollers is not shown, but is the same as that used in the first embodiment.

Fibrous material is delivered in suitable form from the base of the hopper and the delivery rate is proportional to the rotational speed of the spiked rollers and the force with which the compacted fibrous bale is applied to the roller.

Hopper (2) is designed such that its height is sufficient to prevent human contact with the rotating spiked rollers.

The metered and processed fibrous material can be delivered directly to the mixing facility by gravity, or, the metered and processed material issuing from the hopper can be deposited on a feeding means. In this particular case the endless conveyor belt (7) is an existing part of the surfacing machine, used to transport aggregate (8) to the mixing facility. The metered and processed fibrous material (9) is conveyed on top of the aggregate (8).

The third and preferred embodiment is shown in Figure 4 and includes a method of replenishing the hopper unit with compressed fibre bales without interrupting the delivery of metered and processed fibre into the process. Essentially this embodiment consists of two hoppers similar to that described in the second embodiment, arranged to form a double hopper metering system with the spiked roller drive for each hopper organised such that only one hopper/roller assembly will deliver material at any one time. The roller drive is automatically switched to the other hopper roller assembly only when the first hopper is almost empty.

In this way fibre bales can be replenished, as the processing time for each hopper is some 8 mins. Elevations (1), plan (2) and rear view (3) show the fibre delivery system installed in an existing machine aggregate hopper (4). This enables a quick and effective addition of the facility to existing microasphalt road surfacing equipment.

Reference to Figure 5 shows how the sequential switching is effected by using a detector switch (1) mounted in the wall of the fibre hopper (2) which is activated by the presence of platen (3) and so organised that only a small amount of fibre remains in the hopper once automatic changeover has occurred. This enables the empty hopper to be replenished with compacted bales of fibre ready for the next change over to occur and so on.

Figure 6 shows a typical circuit diagram to control the automatic changeover operation. The independent roller hydraulic drive motors (1) and (2) are switched on and off by hydraulic change-over valve (3).

The valve activation is controlled by detector switch (4) via change over relay (5).

There is a need to deliver fibres only when other ingredients are being processed and this switching function is provided by switch (6).

A manual over-ride system is also provided by switches (7) and (8) which enable the fibre system to be run independently of other ingredients for calibration, or can be used to operate the process in event of component failure.

An emergency stop (9) is provided in the event of the need to stop the process quickly.

Fibre Material Type	Carding Roller Speed in RPM	Applied Weight in Kg mass	Flowrate of Fibre in Kg/min	Process Target Flowrate
Cellulose short fibre	25	10	3.1	4 Kg/mm
	42	10	5.28	
	93	10	11.20	
Cellulose long fibre	93	50	1.28	2 Kg/mm
	153	50	2.54	
	223	50	3.59	
Acrylic Flock	60	10	1.33	1.5 Kg/mm
	70	10	1.80	
	90	10	2.16	
Polyacrylonitrile (Draylon)	13	0	1.2	1.5 Kg/mm
	16	0	1.5	
	24	0	2.6	

Table 1

Claims

- 5 1. Fibre delivery system comprising a hopper for accommodating a bale of fibrous material, and which is closed at its base by a plurality of rollers, each roller having on its surface a plurality of projections, and means for forcing a bale accommodated in the hopper onto the rollers.
2. A system according to claim 1, wherein the projections are in the form of spikes.
- 10 3. A system according to claim 1 or claim 2, wherein adjacent rollers are arranged to rotate in opposite directions to one another.
4. A system according to any preceding claim, which further comprises a delivery auger spaced apart and below the rollers.
- 15 5. A system according to any preceding claim, wherein the forcing means comprises a removable plate which closes the upper end of the hopper and which is movable down the hopper in a substantially horizontal plane.
6. A system according to claim 5, which further comprises hydraulic means for controlling the movement of the plate.
- 20 7. A system according to claim 5, which further comprises electric means for controlling the movement of the plate.
8. A system according to claim 5, which further comprises variable mass means, increasing in mass down the hopper, for controlling the movement of the plate.
- 25 9. A system according to any of claims 5 to 8, wherein the plate is pivoted about, or hinged at, one of its sides, so as to allow opening of the top of the hopper for loading a bale thereinto.
- 30 10. A system according to any preceding claim, which comprises a plurality of hoppers and associated forcing means, and switching means responsive to the height of material in one hopper for activating the rollers, and auger when present, in another hopper.
- 35 11. A mobile asphalt blending and laying machine comprising a blending unit, feeding into the blending unit a delivery system as defined in any preceding claim, and means for the laying material from the blending unit onto a substrate surface.
- 40 12. A machine according to claim 11, which further comprises means for feeding aggregate into the blending unit.
13. A machine according to claim 12, which further comprises a conveyor running into the blending unit, and wherein the aggregate feed means and the hopper are arranged to deliver material onto the conveyor for entry into the blending unit.
- 45 14. A machine according to claim 13, wherein the hopper is located after the aggregate feeding means, so that, in use, fibrous material from the hopper is laid on top of the aggregate on the conveyor.
- 50 15. A method of introducing fibrous material into asphalt, comprising loading a bale of fibrous material onto a plurality of contra-rotating rollers, each roller having a plurality of projections on its surface, thereby scraping fibres from the bale, and metering the fibres into asphalt.
- 55 16. Use of a system as defined in any of claims 1 to 10, for incorporating fibrous material from bale form into an asphalt mixture for application to a substrate surface.

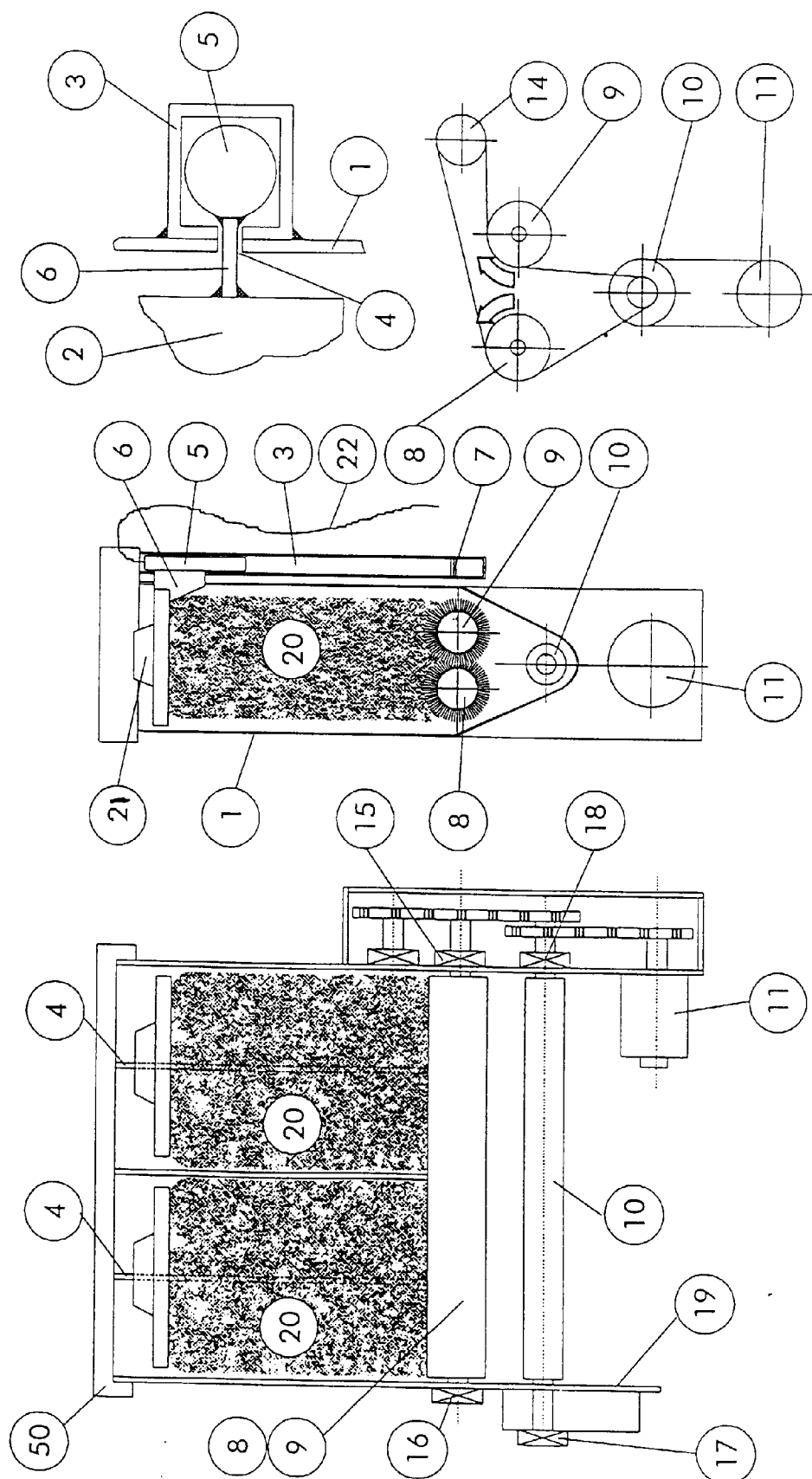


FIGURE 1

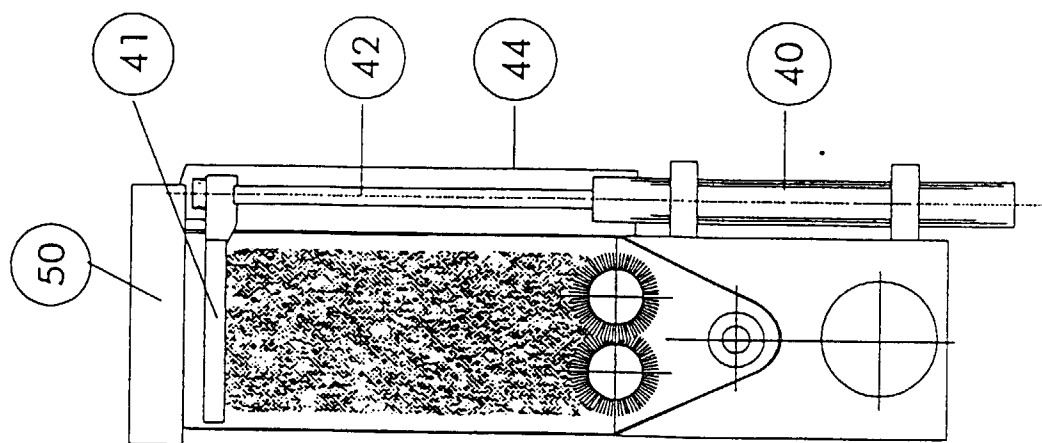


figure 2b

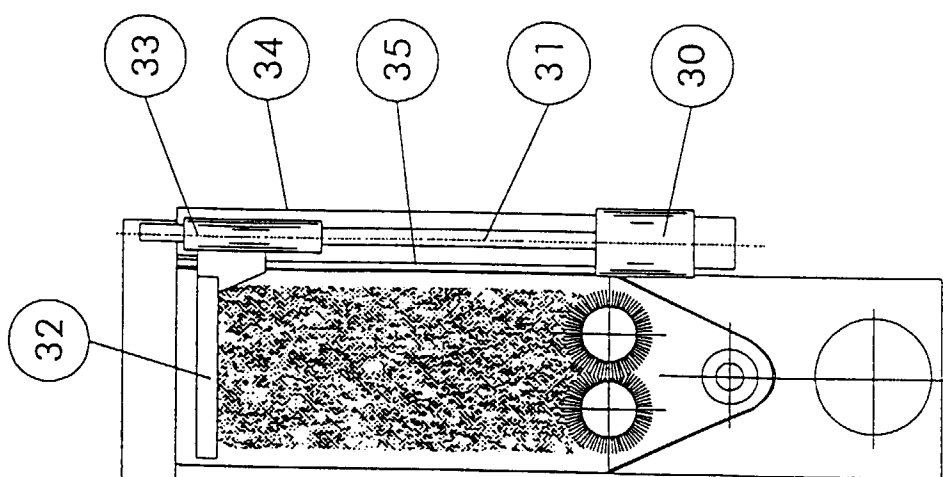


figure 2a

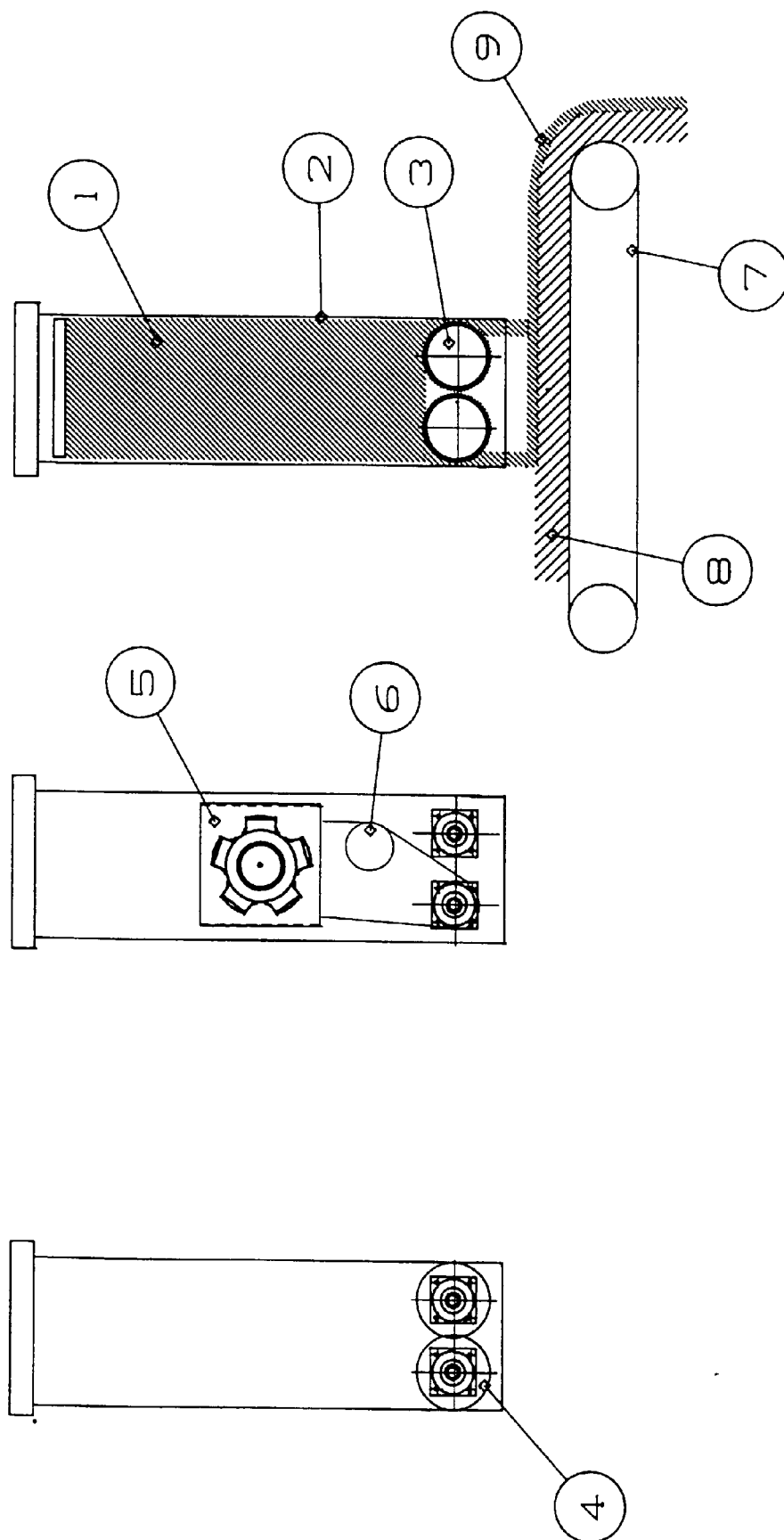


FIGURE 3

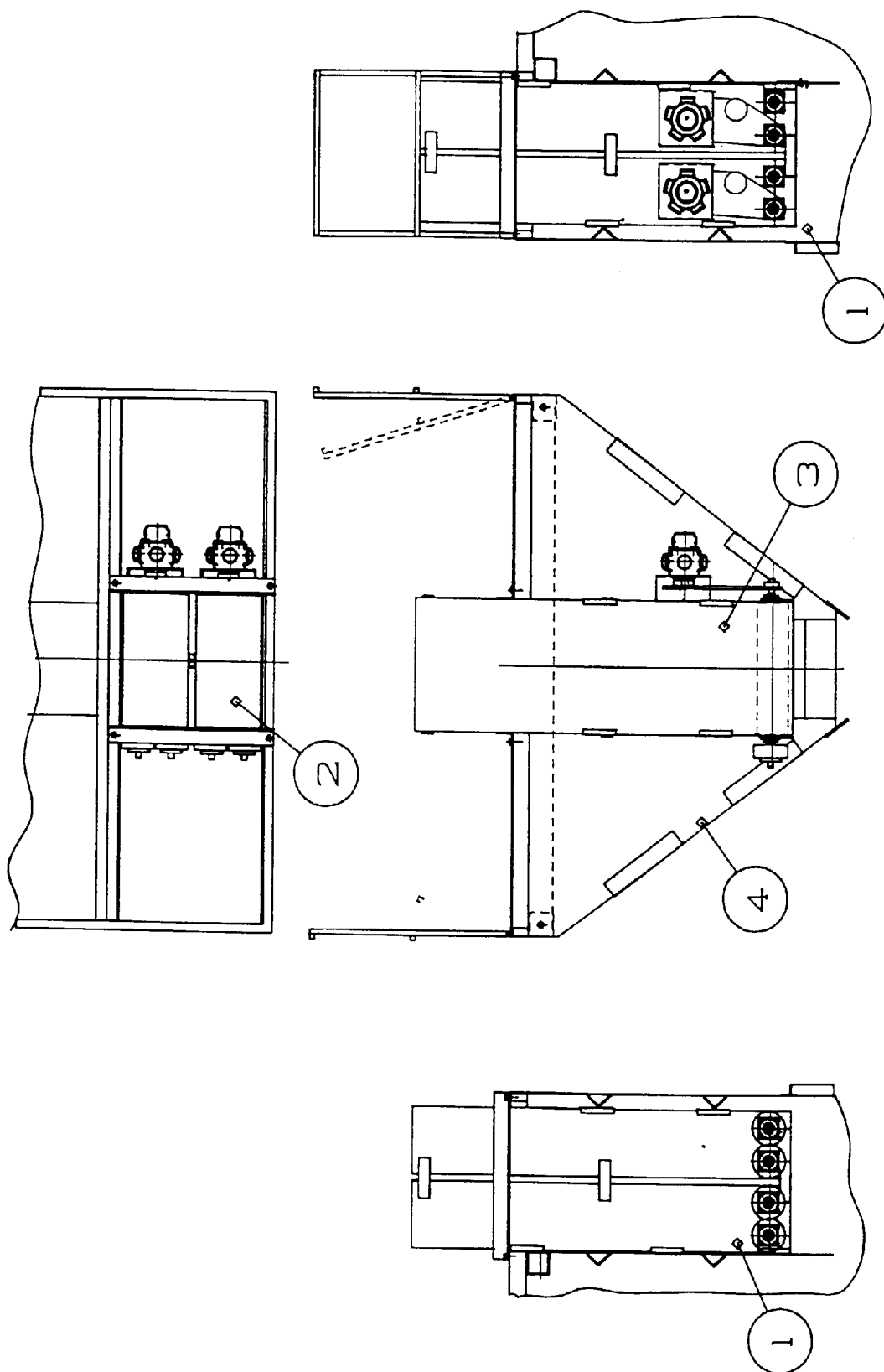


FIGURE 4

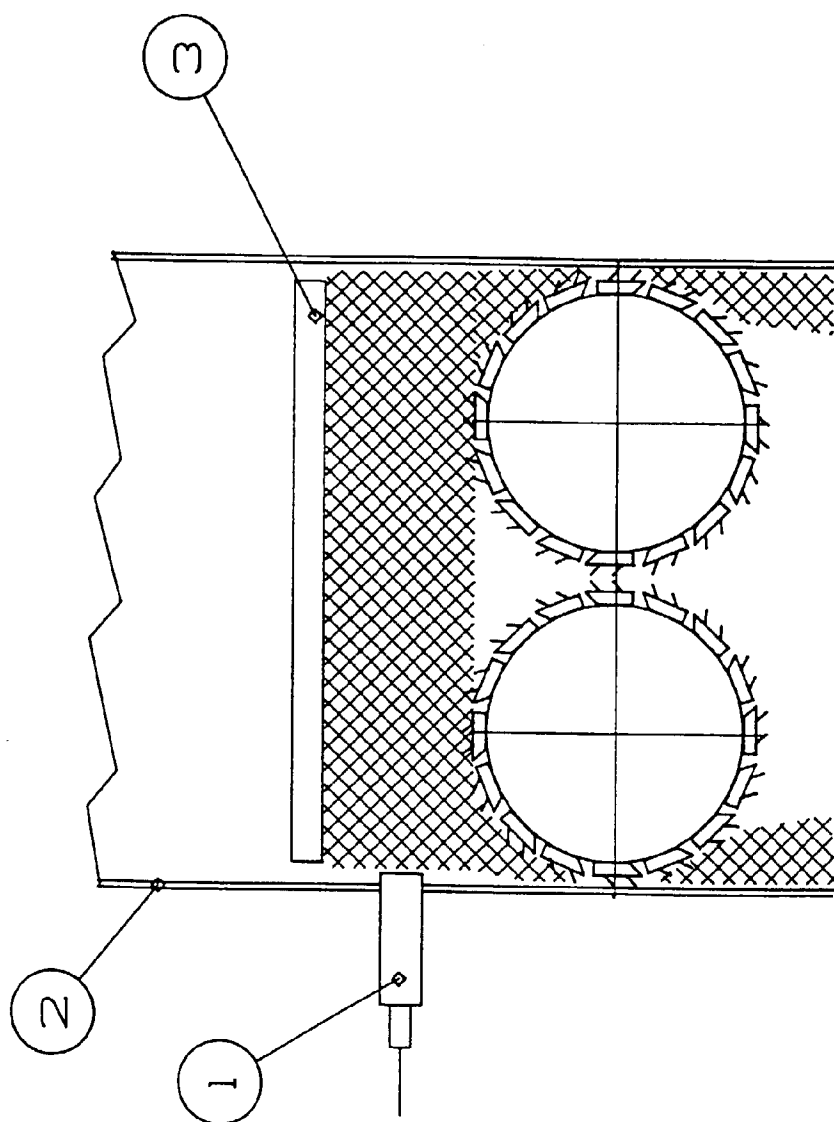


FIGURE 5

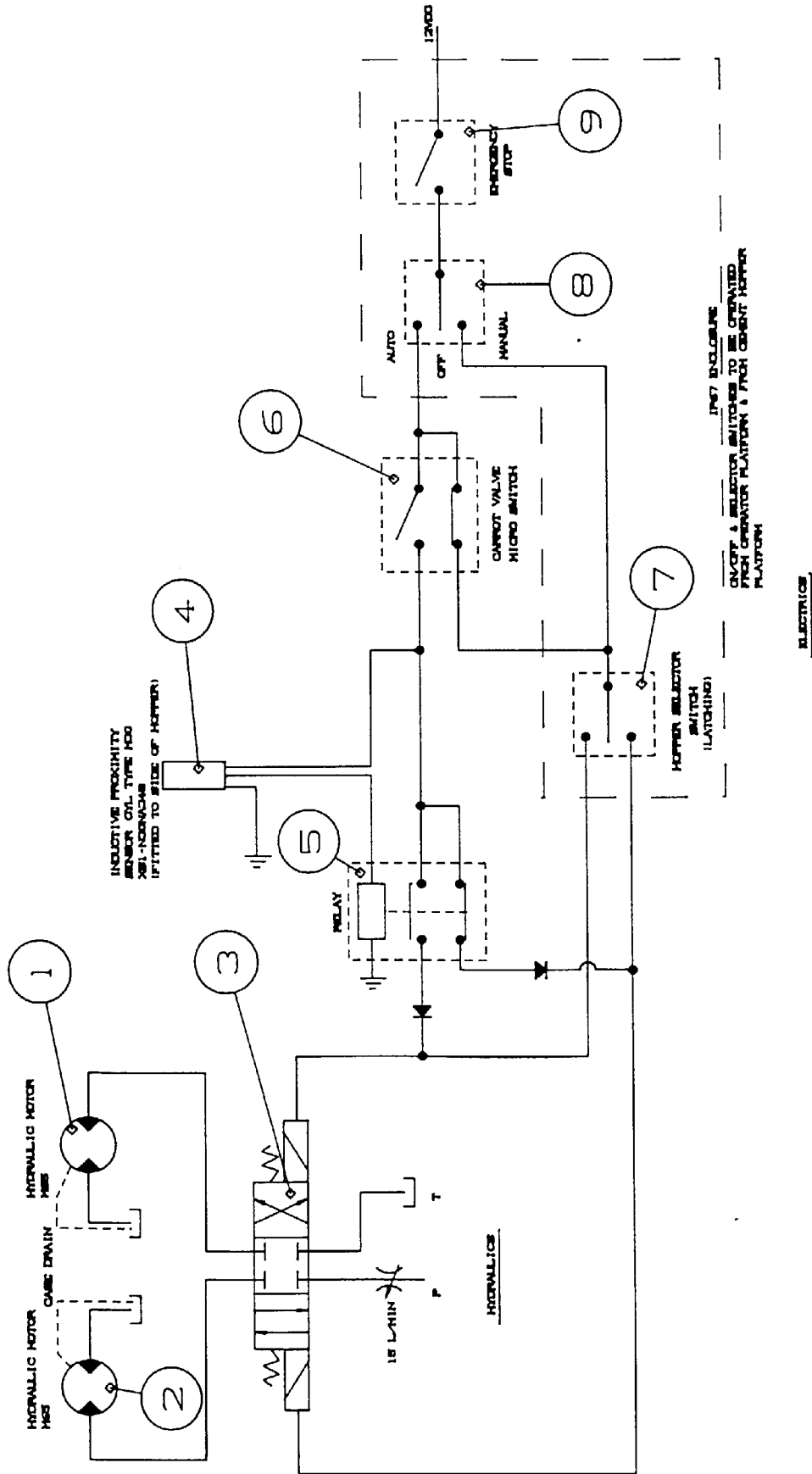


FIGURE 6