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(54) **Mobile apparatus and method for producing and laying a cold or emulsion macadam on a surface**

Vorrichtung und Verfahren zur mobilen Herstellung und Verlegung eines Belags aus Kaltmakadam

Dispositif et procédé mobile pour préparer et poser des revêtements en macadam à froid

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Description

Prior Art

Macadam is a combination of quarried, crushed stone and a binder, usually a hydrocarbon bitumen. It may be produced by raising the temperature of both components to 150°C-180°C, and mixing so that the binder coats the surface of the stones. Alternatively, an emulsion of bitumen in water may be used instead of a hot binder, in which case the resulting macadam is referred to as a cold macadam or as emulsion macadam.

The production units for the use of hot or cold binder are normally static, and sited at a quarry. Transportable production units do exist, but these are always static during the actual production of Macadam.

Macadams are of a granular nature and employ predominately a single or nominal sized stone, the size varying according to the requirement. For instance a macadam may be available with nominal stone sizes of 3mm, 6mm, 10mm, 14mm or 20 mm. The nominal sized stone may be combined with smaller sizes in varying proportions to provide an open textured, medium textured or dense macadam. The material is capable of being heaped, and the technique of placing is either by hand raking or paving machine. Such a paving machine is filled with pre-mixed macadam, which it then deposits in a layer on the surface to be covered. Normally a very thin layer of bitumen (perhaps 0.1-0.2 litres of 40% bitumen emulsion per M^2) would be applied to the recipient surface to augment the adhesion of the new macadam to the surface. This is called a "tack coat" and a very low level of adhesive bonding is achieved.

Macadams require mechanical compaction by rolling with metal wheels to achieve both structural stability and a smooth finished surface. The surface displays voids and a negative or concave texture. Macadams have good regulating capacity, improve ride quality and contribute to the structural strength of the road. Open or medium textured macadams have a high texture depth, and are pervious. They provide good skid resistance, surface water shedding and drainage and low perceived levels of tyre noise.

A drawback of macadams is that they do not achieve structural stability in layers of less than 20 mm, and the normal lower limit for thickness on roads is 30 mm. To allow for this thickness it is necessary either to remove an equivalent depth of the substrate, or to raise kerbs and other street furniture. Both of these alternatives are costly and inconvenient.

Another example of a product made by combining stone with a bitumen emulsion is Slurry Seal or Micro Asphalt. This material employs stones of gradually reducing size, smoothly graded from the maximum size employed to less than 75 microns. The stones are combined with binder emulsion, water, and other additives, so as to produce a flowable liquid slurry with no capacity for heaping. The material is placed in layers either by brush, rubber bladed squeegee, or a towed applicator with rubber sealing gaskets at the leading edge and elsewhere to reduce material leakage. The layers are normally relatively thin, i.e. around 3 mm to 20 mm, and the use of slurry seal therefore avoids the problems of macadams described above.

Slurry seals are very dense impervious materials which are not normally rolled to achieve compaction. If rolling is specified, it is with a smooth pneumatic tyred machine. Slurry seals display a relatively low texture depth. Texture is achieve by designing the material so that a proportion of the largest stones therein are exposed so as to provide a positive, or convex texture. Drawbacks of slurry seals are that:

a) They do not contribute significantly to the structural strength of the road.

b) They have limited regulating capacity, tending to follow and reproduce, albeit to a reduced extent, profile deficiencies in the substrate. In consequence, they will not significantly improve the riding quality of a road.

c) They are not pervious, and water will be shed across the surface rather than through the material.

d) They do not achieve high skid resistance, and are not usually recommended for high speed roads.

e) Thinner slurry seals, e.g. nominal thickness of 3-6mm would not be expected to provide long service life.

Document EP-A-0409700 discusses a method and apparatus for producing a surface coating on a surface such as a road. The surface coating comprises a layer of binding material into which loose aggregates are compacted. These aggregates, which consist of loose chips covered in bitumen mixed with a pulverulant material, have been described as dressed aggregates so as to distinguish them from macadam which is a bituminous coated product formed as an amorphous mass.

It is therefore desirable to provide an apparatus for laying a surface for roads and the like which avoids the drawbacks of a traditional macadam surface, without the loss of performance that results from using a slurry seal.

The Invention

The invention provides a mobile apparatus for producing and laying a cold or emulsion macadam on a surface to be covered, comprising:

means for metering stones and a binder into a mixing chamber;
means for mixing the stones and the binder together

in the mixing chamber to produce a cold or emulsion macadam;
means for laying a primer on the surface to be covered;
means for laying said macadam on the surface to be covered, including means for distributing said macadam laterally and means for controlling the depth of said macadam laid;
means for moving the apparatus along the surface to be covered such that any part of the surface is first laid with said primer and then with said macadam.

The apparatus preferably further includes means for providing primer and macadam for hand application in inaccessible areas.

The invention also provides a method for producing and laying a cold or emulsion macadam on a surface to be covered, the method comprising the steps of:

providing a supply of stones and binder within a mobile apparatus;
metering the stones and binder into a mixing chamber within the mobile apparatus;
mixing the stones and binder in the mixing chamber to produce a cold or emulsion macadam;
laying a primer on the surface to be covered;
thereafter laying said macadam on the surface to be covered, distributing said macadam laterally and controlling the depth of said macadam laid on the surface.

The step of laying the primer and the macadam on the surface to be covered may be carried out by hand in inaccessible areas, with the primer and the macadam being provided from the mobile apparatus.

In easily accessible areas, these steps are preferably carried out fully automatically, and the method further includes the step of moving the mobile apparatus along the surface to be covered so that any part of the surface is first laid with said primer and then with said macadam.

Cold or emulsion macadam is used and therefore no heating is required in the mixing chamber. Cold macadam is non-hazardous in terms of high temperature and fumes, and is therefore preferable to hot macadam from an environmental and a Health and Safety point of view. In addition, hot macadam becomes progressively less satisfactory for laying as its temperature falls, and viscosity of the binder increases. The consequence of delays is that either the material is rejected or defective work is carried out.

The binder may be an emulsion of bitumen, polymer modified bitumen or other hydrocarbon binding agent, and additives may be included to improve its performance.

Solid components may be conveyed to the mixing chamber by use of a moving belt, a screw, by air blowing or by gravity. The rate at which these materials are conveyed may be controlled by adjustment of the linear or rotational velocity of the belt, air flow, screw or rotary valve, or alternatively by adjustment of a gate or aperture.

Liquid components may be conveyed by creating elevated pressure in the storage tanks, pumping or any other means of liquid propulsion.

The mixing of the stones and binder in the mixing chamber may be carried out by any design of blending apparatus, provided that thorough and continuous blending is achieved in the macadam discharged therefrom. An effective design is a horizontal twin shafted pug mill with contra rotating shafts, and interlocking blades. The length of the pug mill may be 1 - 2.0 metres long designed such that the components enter at one end, and are blended en route to the discharge or opposite end.

The application of the adhesive or priming layer of binder to the road surface may be effected by a series of spray nozzles placed within a spray bar, such that an even transverse distribution of binder is made over the operational width. The binder is conveyed to the spray nozzles under pressure. Other methods of distribution may include brushing, screeding, extrusion and the like. The distribution rate may be controlled or varied by effecting a constant flow in the priming binder, and varying the forward speed of the apparatus, or integrating the flow rate with a variable forward speed.

The macadam discharging from the blending apparatus is preferably distributed across the pre-primed operational width required by screw augers which may be rotated in either direction. As the apparatus moves forward, macadam passes under a screed bar whose height and inclination may be adjustable as required to provide depth control, and conform to other features such as camber.

Screed adjustment may be effected mechanically, hydraulically or electrically by manual or automatic means. Screed adjustment control may be provided remotely by cabling or radio transmission, and a platform may be provided at the rear of the screed for use by the operator. Heating of the screed may be required, and this may be provided by means such as compressed combustible gas.

Following the laying of the macadam, the new surface is preferably compacted by rolling, as previously described.

By using a priming layer of high performance binder or adhesive, the invention enables the adhesive strength of the bond between the macadam and the substrate to be greatly increased. The amount of binder used in the priming layer is preferably between 0.6 and 1.8 litres of binder per M^2, i.e. significantly more than is used in the traditional "tack coat" for macadam. The greatly increased bond strength enables the independent strength of the macadam layer to be reduced below its normal lower limit for independent structural stability,

without adversely affecting the structural stability of the road. The loss in strength in the macadam is made up for by the increase in bond strength.

By carefully controlling the application of the priming layer and the macadam, the invention allows the layer thickness of the macadam to be as low as 15 mm to 25 mm, dependent on the nominal stone size used.

In addition, the invention allows macadam to be mixed and laid continuously which is more convenient than the traditional method of pre-mixing the macadam at a quarry. It provides independence of any external manufactured material supply source, and eliminates the normal requirement for manufactured material supply vehicles to operate in train. The total size and weight of machinery is therefore reduced and access and manoeuviability are improved. Only sufficient macadam required for laying is manufactured and wastage is therefore negligible.

Drawings

Figure 1 is a schematic representation of a side view of apparatus according to the invention.

Figure 2 is a top view of the apparatus of Figure 1.

Description of Preferred Embodiment

Referring to Figures 1 and 2, apparatus according to the invention includes a stone aggregate hopper 4, which is filled with stones of an approximately uniform size. Their size depends on the macadam specification and may be, for example, 6, 10, 14 or 20 mm.

A binder tank 2 is filled with binder material to be used in making the macadam, and a water tank 3 stores the water that is also required in this process. Additional liquid components such as chemical additives are stored in tanks 11 and 12. Each tank includes means for metering its contents into a blender chamber 6, where the binder, water and stone and any additives are mixed together to make a macadam. Additional fines or other solids may be fed into the mixture from a solids hopper 5. The rate of delivery for each component is displayed on an operator's instrument panel (not shown) and the systems are routinely monitored for consistency and reliability.

A priming material tank 1 contains binder to be used as the adhesive or priming coat, applied to the road surface before application of the macadam. This binder is conveyed to a primer material spray bar 7 under pressure for application to the road. The distribution rate may be controlled or varied by effecting a constant flow in the priming binder and varying the forward speed of the apparatus, by adjusting the flow speed, or by a combination of the two.

As the apparatus moves forward, macadam is discharged from the blender chamber 4 onto the pre-primed road surface. The macadam is distributed across the operational width required by screw augers 8 which may be rotated in either direction. Behind the distribution auger 8 is a screed bar 9 whose height and inclination may be adjusted by a screed height control 13 as required, to provide depth control and ensure that the macadam layer conforms to road features such as camber. A platform 10 is provided at the rear of the screed for use by a screed control operator.

Claims

1. A mobile apparatus for producing and laying a cold or emulsion macadam on a surface to be covered, comprising:

   means for metering stones and a binder into a mixing chamber (6).
   means for mixing the stones and the binder together in the mixing chamber (6) to produce a cold or emulsion macadam;
   means for laying a primer (7) on the surface to be covered;
   means for laying said macadam on the surface to be covered, including means (8) for distributing said macadam laterally and means (13) for controlling the depth of said macadam laid ;
   means for moving the apparatus along the surface to be covered such that any part of the surface is first laid with said primer and then with said macadam.

2. Apparatus according to claim 1 further including means for providing primer and macadam for hand application to the surface to be covered.

3. A method for producing and laying a cold or emulsion macadam on a surface to be covered, the method comprising the steps of :

   providing a supply of stones and binder within a mobile apparatus;
   metering the stones and binder into a mixing chamber within the mobile apparatus;
   mixing the stones and binder in the mixing chamber to produce a cold or emulsion macadam;
   laying a primer on the surface to be covered;
   thereafter laying said macadam on the surface to be covered, distributing said macadam laterally and controlling the depth of said macadam laid on the surface.

4. A method according to claim 3 further including the step of moving the mobile apparatus along the surface to be covered so that any part of the surface is first laid with said primer and then with said macadam.

5. A method according to claim 3 or claim 4, further including the step of compacting the newly laid macadam surface by rolling.

Patentansprüche

1. Mobile Vorrichtung zum Herstellen und Aufbringen eines Kalt- oder Emulsionsmakadams auf eine zu belegende Oberfläche mit:

   einer Einrichtung zum Dosieren von Steinen und eines Bindemittels in eine Mischkammer (6);
   einer Einrichtung zum Vermischen der Steine und des Bindemittels in der Mischkammer (6), um einen Kalt- oder Emulsionsmakadam herzustellen;
   einer Einrichtung zum Aufbringen einer Grundierung (7) auf die zu belegende Oberfläche;
   einer Einrichtung zum Aufbringen des Makadams auf die zu belegende Oberfläche mit einer Einrichtung (8) zum seitlichen Verteilen des Makadams und einer Einrichtung (13) zum Steuern der Stärke des aufgebrachten Makadams;
   einer Einrichtung zum Bewegen der Vorrichtung auf der zu belegenden Oberfläche, so daß jeder Teil der Oberfläche zuerst mit der Grundierung und dann mit dem Makadam belegt wird.

2. Vorrichtung nach Anspruch 1, ferner mit einer Einrichtung zum Bereitstellen von Grundierung und Makadam zum manuellen Auftragen auf die zu belegende Oberfläche.

3. Verfahren zum Herstellen und Auftragen eines Kalt- oder Emulsionsmakadams auf eine zu belegende Oberfläche, wobei das Verfahren die folgenden Schritte aufweist:

   Bereitstellen einer Zufuhr von Steinen und Bindemittel innerhalb einer mobilen Vorrichtung;
   Dosieren der Steine und des Bindemittels in eine Mischkammer innerhalb der mobilen Vorrichtung;
   Mischen der Steine und des Bindemittels in der Mischkammer, um einen Kalt- oder Emulsionsmakadam herzustellen;
   Aufbringen einer Grundierung auf die zu belegende Oberfläche;
   anschließendes Aufbringen des Makadams auf die zu belegende Oberfläche, seitliches Verteilen des Makadams und Steuern der Stärke des auf die Oberfläche aufgebrachten Makadams.

4. Verfahren nach Anspruch 3, ferner mit dem Schritt zum Bewegen der mobilen Vorrichtung auf der zu belegenden Oberfläche, so daß jeder Teil der Oberfläche zuerst mit der Grundierung und dann mit dem Makadam belegt wird.

5. Verfahren nach Anspruch 3 oder Anspruch 4, ferner mit dem Schritt zum Verdichten des neu aufgebrachten Makadambelags durch Walzen.

Revendications

1. Appareil mobile de production et d'étalement d'un macadam froid ou en émulsion sur une surface à recouvrir, comprenant:

   des moyens pour introduire des quantités dosées de pierres et d'un liant dans une chambre de mélange (6);
   des moyens pour mélanger les pierres et le liant dans une chambre de mélange (6) pour produire un macadam froid ou en émulsion ;
   des moyens pour étaler une couche de primaire (7) sur la surface à recouvrir ;
   des moyens pour étaler ledit macadam sur la surface à recouvrir, comprenant des moyens (8) pour distribuer ledit macadam latéralement et des moyens (13) pour contrôler la profondeur dudit macadam étalé ;
   des moyens pour déplacer l'appareil le long de la surface à recouvrir de sorte que toute partie de la surface est d'abord recouverte de ladite couche de primaire puis dudit macadam.

2. Appareil selon la revendication 1 comprenant en outre, des moyens pour fournir du primaire et du macadam pour une application à la main sur la surface à recouvrir.

3. Un procédé de production et d'étalement d'un macadam froid ou en émulsion sur une surface à recouvrir, le procédé comprenant les étapes consistant à:

   - fournir un approvisionnement de pierres et de liant à l'intérieur d'un appareil mobile ;
   - introduire des quantités dosées de pierres et de liant dans une chambre de mélange à l'intérieur de l'appareil mobile ;
   - mélanger les pierres et le liant dans la chambre de mélange pour produire un macadam froid ou en émulsion ;
   - étaler une couche de primaire sur la surface à recouvrir ;
   - étaler ensuite ledit macadam sur la surface à recouvrir, en répartissant latéralement ledit macadam et en contrôlant la profondeur dudit macadam étalé sur la surface.

4. Procédé selon la revendication 3, comprenant en outre l'étape de déplacement de l'appareil mobile le long de la surface à recouvrir, de sorte que toute partie de la surface soit d'abord recouverte de ladite couche de primaire puis dudit macadam.

5. Procédé selon la revendication 3 ou la revendication 4 comprenant en outre l'étape de compactage de la surface du macadam nouvellement étalée au rouleau compresseur.

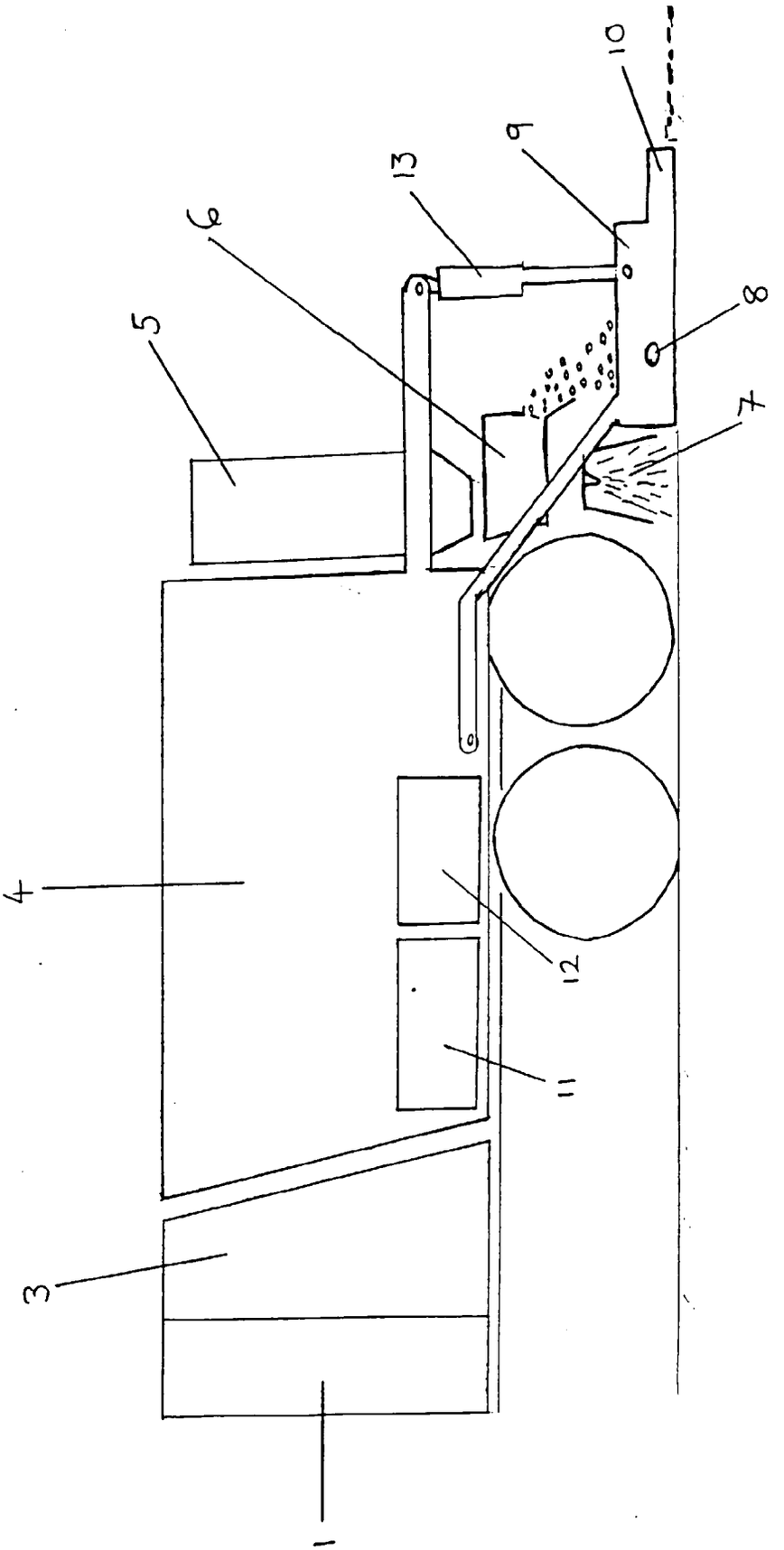

FIG 1

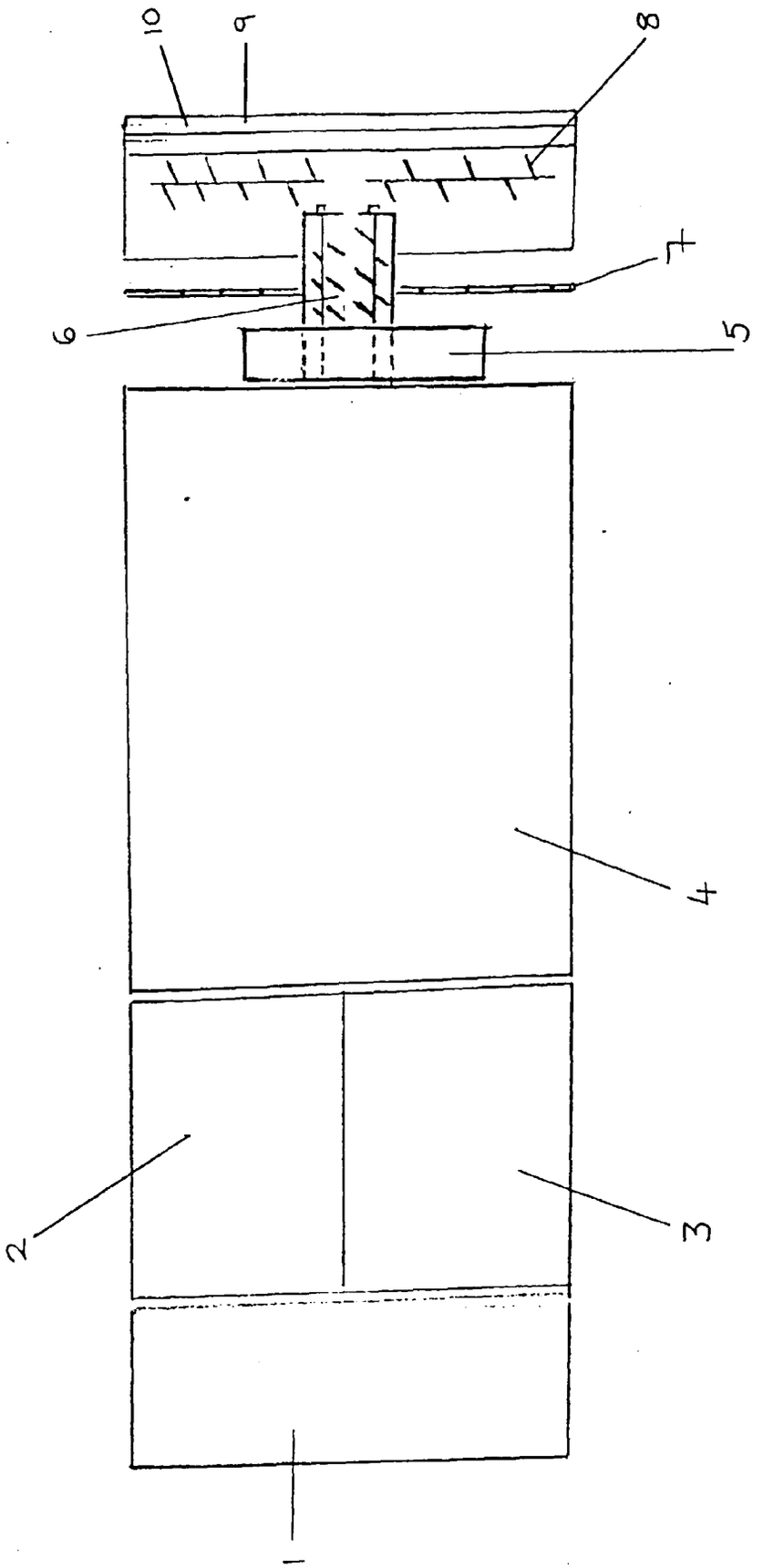

FIG 2