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Remarks:
A request for correction to Figure 2 has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO , A-V, 2.2).

(54) A road scarifying machine with a perfected milling drum for the removal of road surfacings

(57) The invention discloses a road scarifying machine (1; 10) for the removal of road surfacings comprising a frame (2) mounted on wheels (3) which supports a milling drum (6) put into contact with the road surfacing (9) to be removed and supported by a driving shaft (7) connected to said frame (2) and driven into rotation by rotating means. Said milling drum (6) is composed of a plurality of modular annular elements (61), facing one another in tight succession one after the other and co-axially coupled over said driving shaft (7). Said annular elements (61) are provided with projecting elements (64) in order to scratch and crush said road surfacing (9) to be removed.

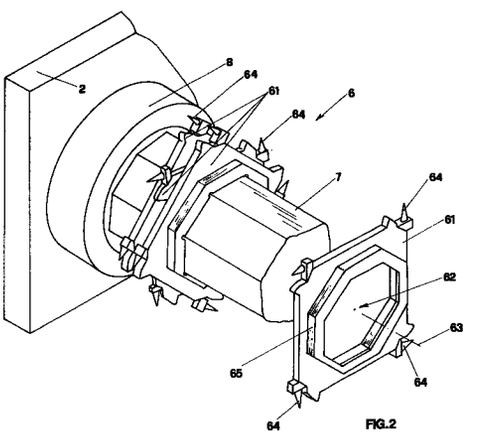

FIG.2

EP 0 735 192 A2

Description

The invention concerns a road scarifying machine used for the removal of road surfacings, provided with a milling drum formed by modular elements.

It is a known fact that road scarifyers are machines that are used for the removal of the asphalt surfacing which covers the roadways. They essentially comprise a wheel-mounted frame provided with a driving unit, with a driver's seat and with a milling drum put into contact with the road surfacing to be removed. The milling drum presents a plurality of projecting parts which, during the rotation of the milling drum, crush the road surfacing.

Should the machine also be provided with a conveyor belt, the centrifugal force of the milling drum which is rotating, discharges the debris resulting from the crushing on said conveyor belt which conveys it, for instance, to a lorry.

The road scarifying machines are manufactured according to different embodiments which differ from one another, not only because of the presence of the conveyor belt or the absence of it, but also because of the width of the milling drum which determines the type of work to which the machine can ultimately be applied. Therefore, it is clear that the road scarifying machines with milling drums having considerable widths are used, for instance, to perform works on motorways or freeways, while machines with milling drums having a limited width are used to perform works on roads presenting narrower carriageways. The productivity of the work which is performed, in fact, essentially depends on the width of the milling drum with which the machine is provided.

During the performance of road works, it often happens that it is necessary to remove the road surfacing on stretches of rather limited width, i.e. when it is necessary to dig some trenches for the laying of electrical cables, telephone cables, pipelines or others. In that case, it is necessary to use road scarifying machines provided with a milling drum of limited width, said machines not always being available to the enterprise performing the works.

It is easy to understand, in fact, that the enterprises performing such road works should invest in a very large number of road scarifying machines available, thus facing, as a consequence, the burden of high operating and amortization costs.

It is for this reason that, in case of removals over small widths, tractors, mechanical shovels, and similar are often used. These equipped with some milling aggregates of small dimensions, suitable to perform the removal of the road surfacing over the required width.

It is easy to understand that such solutions are, however, makeshift solutions which do not permit high productions and, therefore, force the user to operate under conditions which are often hardly financially profitable and operatively not very safe.

With the purpose of overcoming such an inconvenience, so-called "universal" road scarifying machines have been realized and are currently used, in which the user has the possibility of varying the width of the milling drum so as to adapt it to the width of the road surfacing which needs to be removed. In said universal machines, in fact, the milling drum consists of a fixed part, stably connected to the driving shaft which drives into rotation the milling drum itself, and of a removable part consisting of a pair of sectors presenting an essentially circular outer profile and provided with projecting elements, which are attached to the driving shaft, placed opposite to each other and on both sides of the fixed part.

The universal road scarifying machines of the mentioned type, solve the problem only partially. The available spare sections, in fact, usually present a rather extensive width (a few dozens of centimeters) and, therefore, they permit to obtain a limited number of widths of milling drum, which also differ considerably from each other. Therefore, there is the inconvenience that the universal machines are not always able to realize the removal over the required width.

A further inconvenience is that such spare circular sectors present a considerable weight, amounting to dozens of kilograms for each section and this entails some difficulty for the assembly on and the removal from the rotating shaft of the milling drum, especially if one considers that the rotating shaft is arranged underneath the frame of the machine and, therefore, the operators must intervene under very adverse working conditions.

Another inconvenience is that at least two operators are always necessary, since one of them operates on the ground assemblying the sections on the shaft of the milling drum, while the other one, by means of a hoist, hands him the circular sections which have to be coupled with one another and with the transmission shaft. Thus the operation becomes labourious, long in its execution and it also presents a certain danger.

The present invention proposes to overcome all the mentioned inconveniences.

In particular, one of the purposes of the invention is to realize a road scarifying machine provided with a milling drum having a variable width, which, as compared with machines of the universal type equivalent to it, permits to vary the width of the milling drum more quickly.

It is another purpose that the operation of changing the width of the milling drum can be performed by a single operator.

It is another purpose that such a milling drum can be shaped according to a wider range of widths, as compared to that obtainable by using universal road scarifying machines with a milling drum consisting of sections. The described purposes are achieved by a road scarifying machine for the removal of road surfacings which, in accordance with the main claim, comprises:

- a wheel-mounted frame which supports at least one driving unit and at least one driver's seat;

- a milling drum put into contact with the road surfacing to be removed and supported by a driving shaft connected to said frame and driven into rotation by rotating means,

and is characterized in that said milling drum is composed of a plurality of removable annular elements, facing one another in tight succession one after the other and co-axially coupled over said driving shaft, said annular elements being provided with projecting elements suited to scratch and crush said road surfacing to be removed.

According to one preferred embodiment, said annular elements are essentially shaped in the form of a parallelepiped provided with a through hole for the coupling to the driving shaft. Each of said annular elements presents, according to a cutting plane which is transversal to the axis of said hole, an essentially square profile with the active elements protruding from and arranged near the corners. In addition, said annular elements present a central hole, the profile of which matches the corresponding profile of the driving shaft which is attached to and projects from the frame of the road scarifying machine, in order to allow an easy assembly and removal of the annular elements themselves. Said annular elements are coupled in a tight succession one after the other and each of them is angularly offset in relation to its adjacent annular element. Moreover, they are spaced from each other by means of a spacer which is interposed between two surfaces facing one another and belonging to two adjacent annular elements.

Advantageously, the road scarifying machine according to the invention provided with a modular milling drum having annular elements, permits a higher versatility of use as compared with equivalent machines, since the width of the milling drum is adjustable with much precision to the required width of the road surfacing which needs to be removed. This is very advantageous, since each of said annular elements presents a rather limited width and, as a consequence, they have a limited weight, such as to permit a single operator to handle them easily.

The operator can then assemble them on and remove them from the driving shaft of the milling drum in shorter performance times, as compared with the times required by universal machines of the known type for the assembly and removal of the circular sections.

Moreover, the operator can work under much safer conditions, less exertion is required and he can operate alone. Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific example, while indicating a preferred embodiment of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description and from the drawings, wherein:

- Fig. 1 shows in a schematic lateral view the road scarifying machine according to the invention;
- Fig. 2 shows in an axonometric representation the detail of the milling drum of the machine of Fig. 1;
- Fig. 3 shows the detail of three annular elements which form the milling drum, represented in an axonometric view;
- Fig. 4 shows in a front-view representation a pair of the annular elements represented in Fig. 3 and facing one another
- Figs. from 5 to 8 show four different configurations of the milling drum, each of them being obtained by putting together a different number of rings, in order to obtain a different milling width;
- Figs. from 9 to 11 represent the road scarifying machine according to the invention provided with a lateral conveyor belt.

As can be observed in Fig. 1, the road scarifying machine according to the invention, indicated as a whole with 1, comprises a frame 2 mounted on wheels 3 which supports a driving unit 4 and a driver's seat, indicated as a whole with 5. In the lower part of frame 2 there is a milling drum 6 which is connected to frame 2 and which is put into contact with the road surfacing to be removed 9 into which it penetrates by a depth 8, which essentially corresponds to the thickness of asphalt to be removed.

The road scarifying machine 1 which is being described is also provided with a conveyor belt 21, as can be observed, which immediately moves the crushed material away from the working area of the milling drum.

It is pointed out, however, that all the following considerations concerning the road scarifying machine according to the invention, are also applicable to a road scarifying machine without a conveyor belt.

Said milling drum 6 is represented in better details in the axonometric representation of Fig. 2, wherein it can be observed that it is composed of a plurality of annular elements 61, each of them essentially shaped in the form of a prism, preferably a parellelepiped. Each of said annular elements 61 is provided with a through-hole 62 and presents, in relation to a cutting plane arranged transversally to the axis 63 of said through-hole 62, an essentially square outer profile. In particular, hole 62 of each of said annular elements 61 presents an octagonal profile suited to match a driving shaft 7 which, as can be also observed in better detail in the Figs. from 5 to 8, projects from and is connected to frame 2 through the interposition of motorizing means which consist, for instance, of a speed reducer 18 which is kinematically connected to the driving unit 4 which belongs to the road scarifying machine.

With regard to the profile of hole 62 and of the driving shaft 7, the octagonal shape is just one of the possible geometrical configurations suited to prevent the reciprocal idle rotation of the annular elements 61 on the driving shaft 7. Therefore, it is clear that said profiles

can be of any type, including the circular shape. In that case they will have to be provided with one or more contrast elements such as keys, tabs or others, suited to prevent the reciprocal rotation. The octagonal configuration which is described is given by way of illustration only.

More in particular, it can be observd also in the details of the Figs. 3 and 4, that each of said annular elements 61 is provided with milling elements 64 essentially arranged in correspondence with the corners of the annular element itself. Between each pair of adjacent rings, there is a spacer 65 which is used for obtaining the required milling width, by suitably spacing the annular elements 61 from one another. The presence of such spacers 65, however, is optional.

Said annular elements 61, as can be observed in particular in Fig. 2, are co-axially coupled outside the driving shaft 7, by arranging them facing one another in a tight succession one after the other and spaced from each other through the interposition of the possible spacer 65. They are also angularly offset in relation to one another so that, between anyone of the milling elements 64 of anyone of the annular elements 61, and the milling element belonging to the adjacent annular element, there is a staggering 66.

In the drawings accompanying the description, for an easy representation, such a width is represented as 45ø, but it can take any value.

The driving shaft 7 is projecting from and attached to frame 2 of the machine, so as to facilitate the assembly of the annular elements 61 which can be assembled and removed quite easily by a single operator. It can be observed, in fact, that the thickness of each of said annular elements 61 is rather limited and, consequently, each annular presents a weight which can be easily handled by a single operator.

In the Figs. from 5 to 8 it can be observed that on the same driving shaft 7, which belongs to the road scarifying machine, it is possible to assemble any number of annular elements 61, so as to obtain the required milling width, eventually with the interposition of spacers 65.

So, for instance, in Fig. 5 it can be observed that on the driving shaft 7, thirteen annular elements 61 are assembled in order to obtain the milling width 91 which is the maximum one that can be obtained compatibly with the length of the driving shaft 7 fitted on the machine.

Similarly, by coupling a number of seven annular elements 61 all in a tight succession one after the other against frame 2 of the machine, as can be observed in Fig. 6, a milling width 92, which is smaller than the previous one and is arranged on the left-hand side of the machine, is obtained.

Again, in Fig. 7 it can be observed that by fitting a number of seven annular elements 61 arranged facing one another in a tight succession one after the other and at the end of the driving shaft 7, the same milling width 92 is obtained, but this is arranged on the right-hand side of the road scarifying machine.

Finally, in Fig. 8 it can be observed that by arranging a number of five annular elements 61 facing one another and in a tight succession one after the other, placed in an essentially central position in relation to the driving shaft 7, a milling width 93 is realized, which is positioned essentially in the centre of the machine.

When the annular elements 61 are not arranged along the whole length of the driving shaft 7, they are centered and properly spaced in relation to the sides of the machine, by assembling some centering rings 161.

Once the annular elements have been coupled with the driving shaft 7 supporting them, they are locked into position through locking means, not represented and which are not described but they are locking means of the known type and they can consist, indifferently, of flanges, check pins and similar.

According to what has been described, it is easy to understand that the road scarifying machine according to the invention provided with a milling drum realized by means of modular annular elements 61, achieves all the proposed purposes.

First of all, it has already been said that, given the limited dimensions of each of said annular elements, the weight of each of them is rather limited and such as to be easily handled by a single operator. Consequently, the composition of the milling drum 6 can be easily performed by a single operator.

Moreover, the limited thickness of each of said annular elements permits, as has been illustrated with some examples in the Figs. from 5 to 8, to compose a milling drum having variable widths, within an extremely wide range of possible widths, all of them obtainable by matching together a different number of annular elements.

Advantageously, the user can then choose over which width the milling will be done on the ground within a higher number of possible widths, which are larger in quantity than those obtainable by using the universal road scarifying machines of the known type.

In the description of the present patent, reference has been made to a road scarifying machine provided with a conveyor belt arranged in the rear position. It is clear, however, that the road scarifying machine provided with a milling drum having annular elements, can be also of the type with a conveyor belt arranged in the front position or without a conveyor belt.

Particularly advantageous is, however, the application of the milling drum having modular annular elements, to a road scarifying machine provided with a lateral conveyor belt and with a transversal auger feeding the conveyor belt itself which has been described in the patent for industrial invention No. VI95A000052 and registered in the name of the same inventor. In that case, as can be observed in the Figs. 9, 10 and 11, the milling drum, indicated as a whole with 6, is applied to a road scarifying machine, indicated as a whole with 10, which is provided with a lateral conveyor belt 11 and

with a transversal conveyor auger 12 suited to feed said conveyor belt 11. Such a machine, combines the advantage of a better control and smaller overall dimensions, due to the presence of the lateral conveyor belt, to the advantage of a versatility of use, due to the wider range of widths of the milling drum which can be realized and, therefore, to the higher number of milling widths obtainable.

The milling drum which belongs to the machine object of the present invention is composed, as has been said, of a plurality of annular elements facing one another and assembled on a single rotating shaft. Said drum can be assembled on any existing road scarifying machine of the known type, whether it is provided or not with a front, rear or lateral conveyor belt. Such a machine, will then be transformed into the road scarifying machine object of the present invention.

It understood that during the realization phase, the shape and dimensions of the annular elements equipping the milling drum of the road scarifying machine according to the invention, may undergo modifications. So, for instance, each annular element, rather than presenting an outer square profile, can present any polygonal profile or, also, a possible circular or a somehow curved profile. With regard also to the hole for the coupling to the driving shaft, as well as the profile of the driving shaft itself suited to be matched into said hole, it can also acquire a configuration differing from the described octagonal configuration such as it is represented in the drawings.

Therefore, it can be shaped according to any polygonal profile or also according to a circular or, somehow curved profile.

In particular, should a circular driving shaft be used, it will be necessary to have suitable connecting means to realize a connection by interference between the shaft and the annular elements, in order to prevent the idle rotation of the same on the shaft itself during the working operation.

It is clear that other modifications differring from those described, based, however, on the same inventive idea, all fall within the spirit and scope of the present invention.

Claims

1. A road scarifying machine (1; 10) for the removal of road surfacings comprising:

   - a frame (2) mounted on wheels (3) which supports at least one driving unit (4) and at least one driver's seat (5);
   - a milling drum (6) put into contact with the road surfacing (9) to be removed and supported by a driving shaft (7) connected to said frame (2) and driven into rotation by rotating means,

   characterized in that said milling drum (6) is composed of a plurality of modular annular movable elements (61), facing one another in tight succession one after the other and co-axially coupled over said driving shaft (7), said annular elements (61) being provided with projecting elements (64) suited to scratch and crush said road surfacing (9) to be removed.

2. A road scarifying machine (1; 10) according to claim 1, characterized in that said driving shaft (7) is attached to and projects from the frame (2) of said road scarifying machine.

3. A road scarifying machine (1; 10) according to claim 1, characterized in that each of said annular elements (61) provided with said projecting elements (64) is essentially shaped in the form of a parallelepiped provided with a through hole (62) for the coupling to said driving shaft (7), said parellelepiped presenting an essentially square profile in a plane transversal to the axis (63) of said hole (62).

4. A road scarifying machine (1; 10) according to claim 3, characterized in that in each of said annular elements (61) said projecting elements (64) are arranged in correspondence with the corners of said essentially square profile.

5. A road scarifying machine (1; 10) according to claim 3, characterized in that the transversal profiles of said driving shaft (7) and of said through hole (62) drilled in each of said annular elements (61), are conjugate profiles suited to prevent the reciprocal rotation between said shaft (7) and said annular elements (61).

6. A road scarifying machine (1; 10) according to claim 1, characterized in that said annular elements (61) which compose said milling drum (6) are spaced from one another by means of the interposition of spacers (65).

7. A road scarifying machine (1; 10) according to claim 3, characterized in that each of said annular elements (61) is assembled on the corresponding driving shaft (7) and is angularly offset in relation to its adjacent annular element (61).

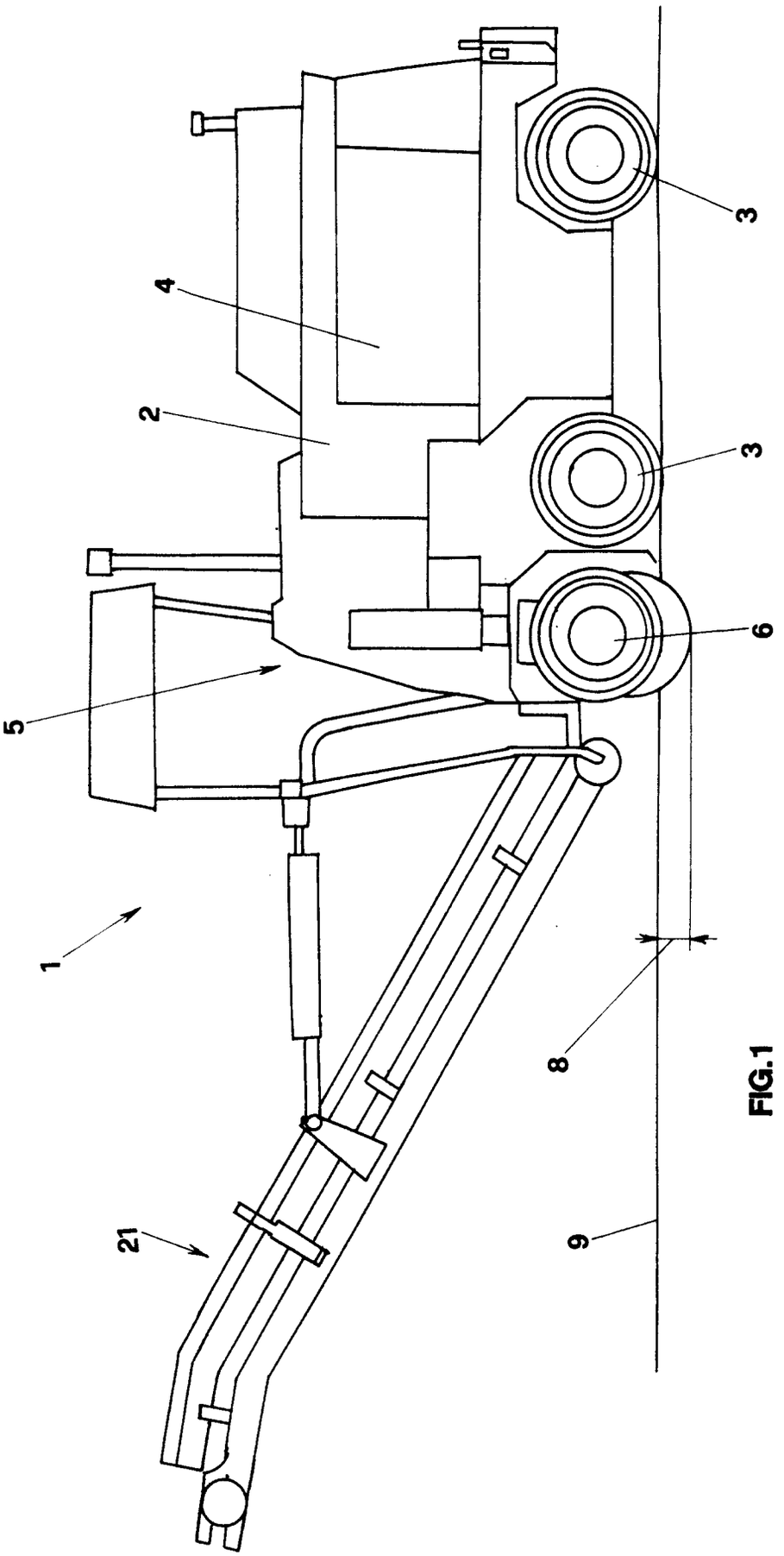

FIG.1

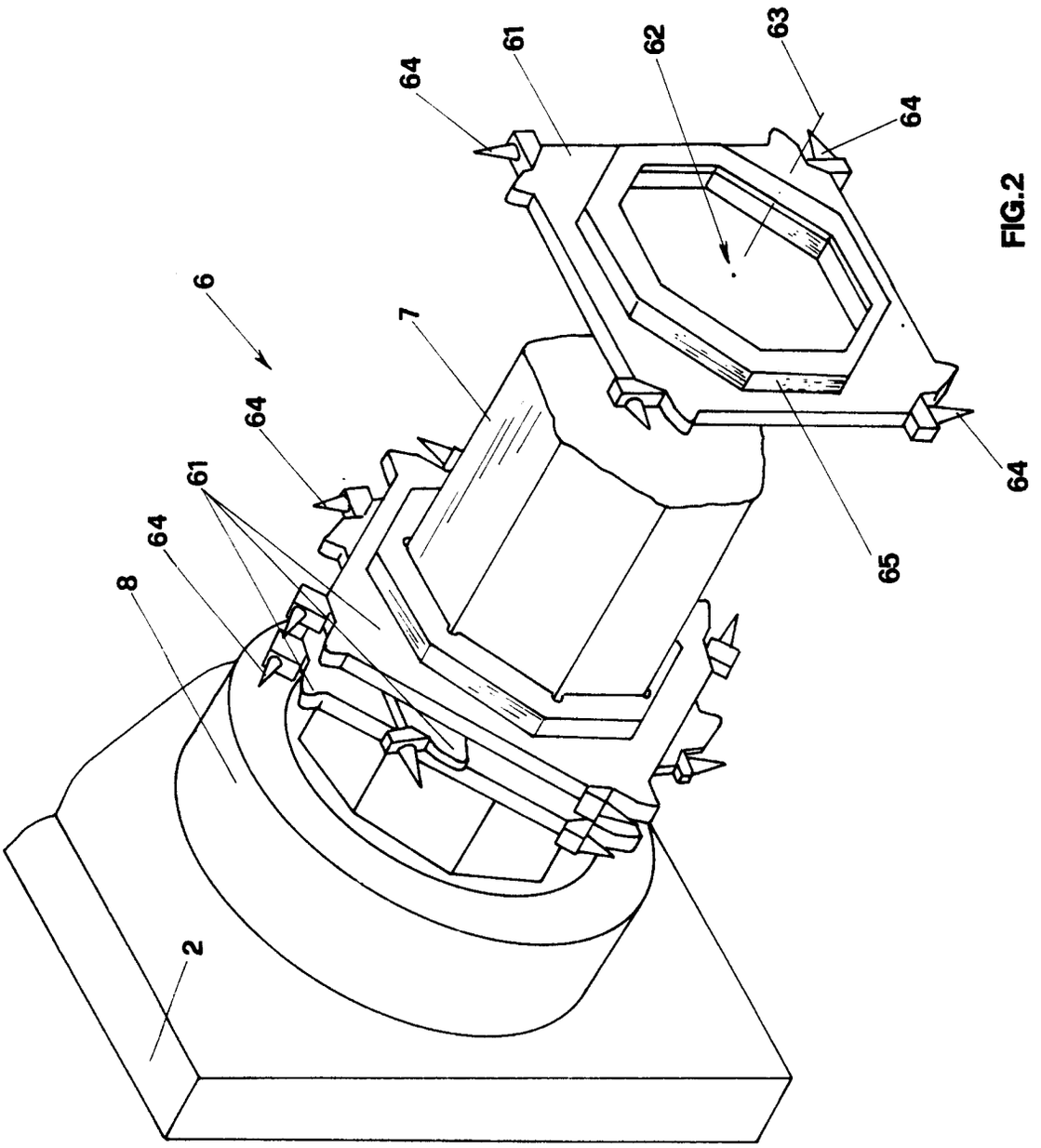

FIG.2

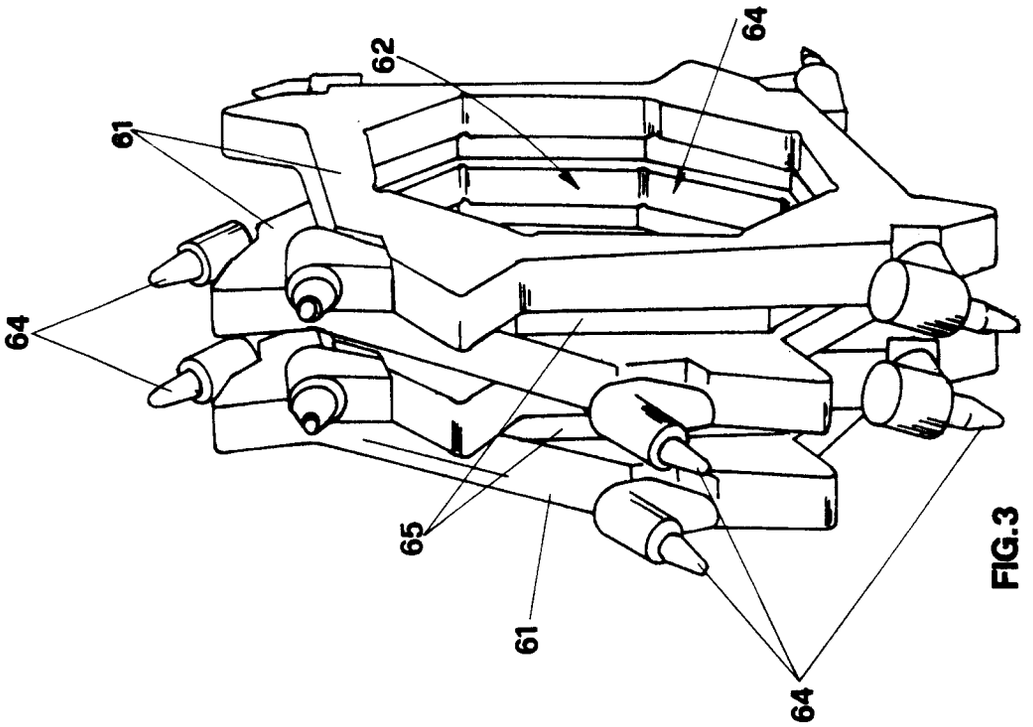

FIG.3

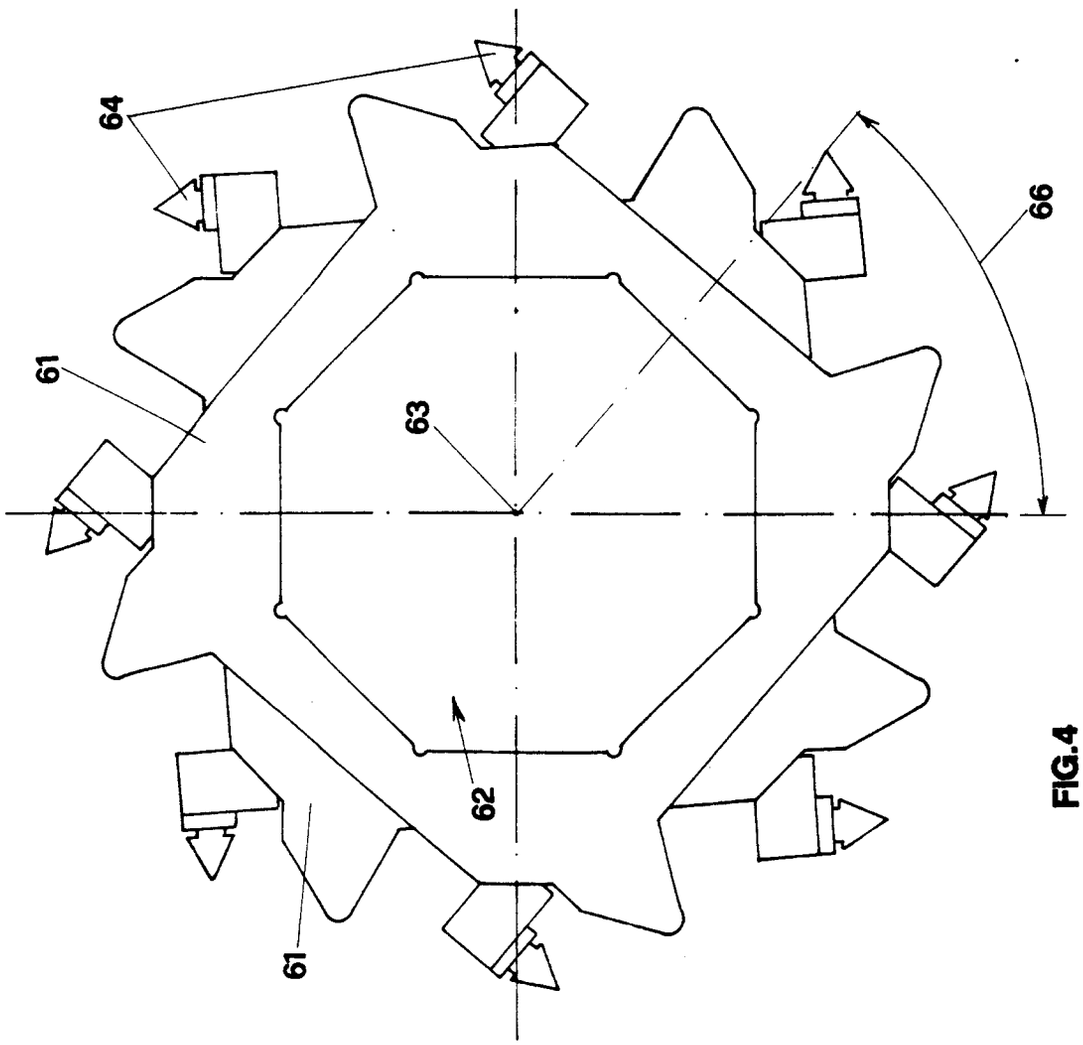

FIG.4

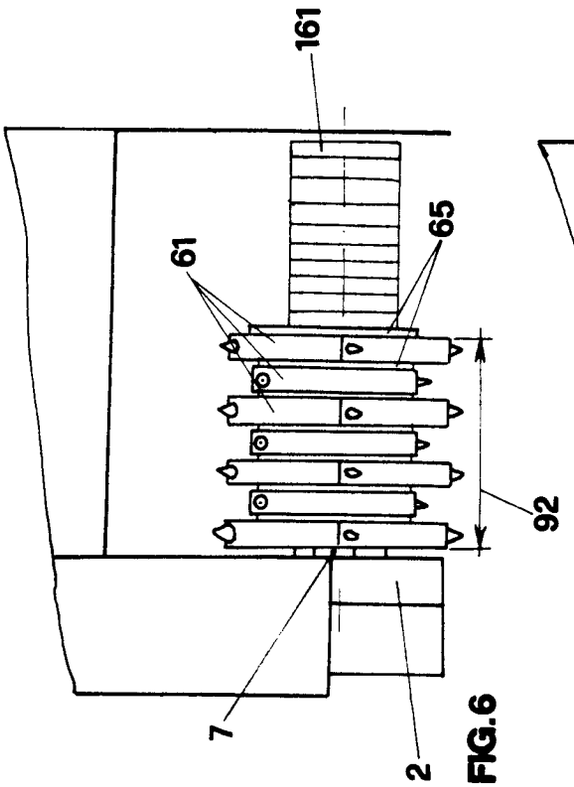

FIG.6

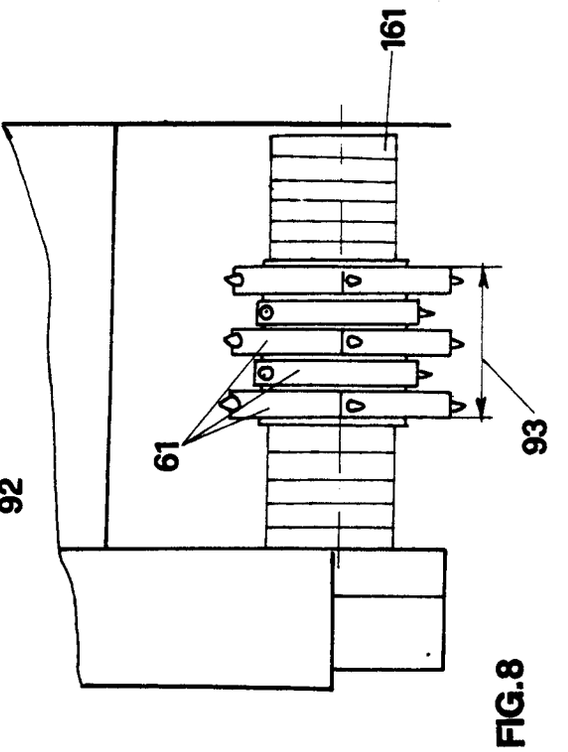

FIG.8

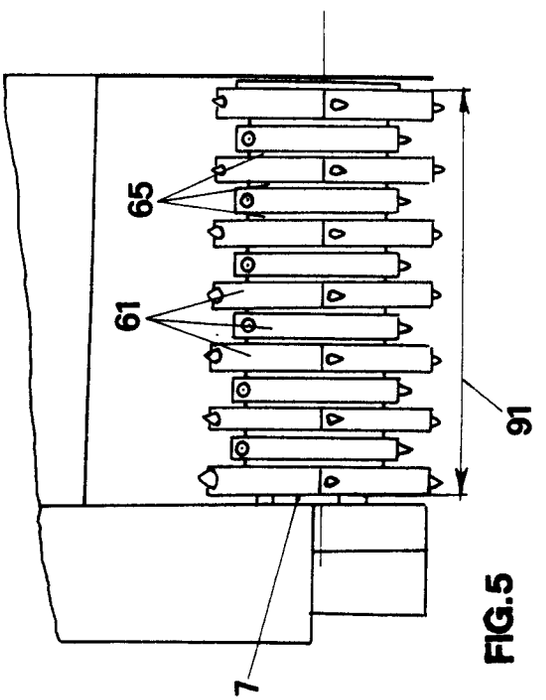

FIG.5

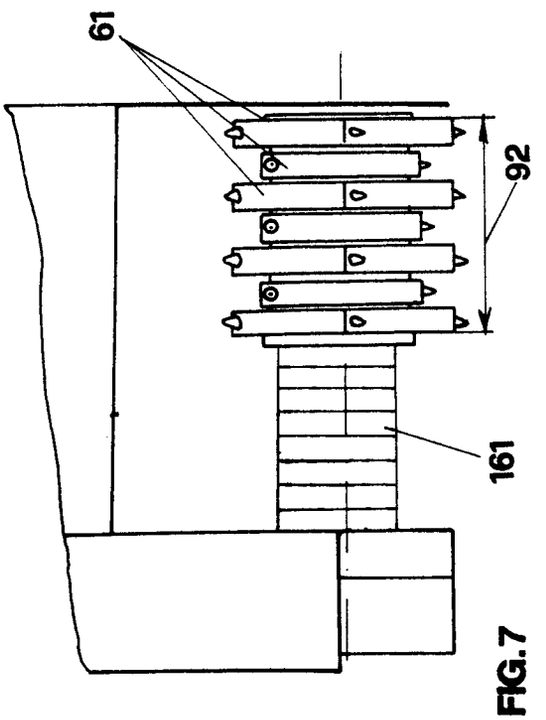

FIG.7

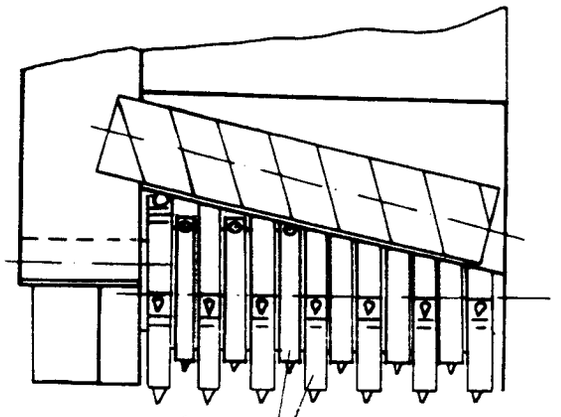

FIG.9

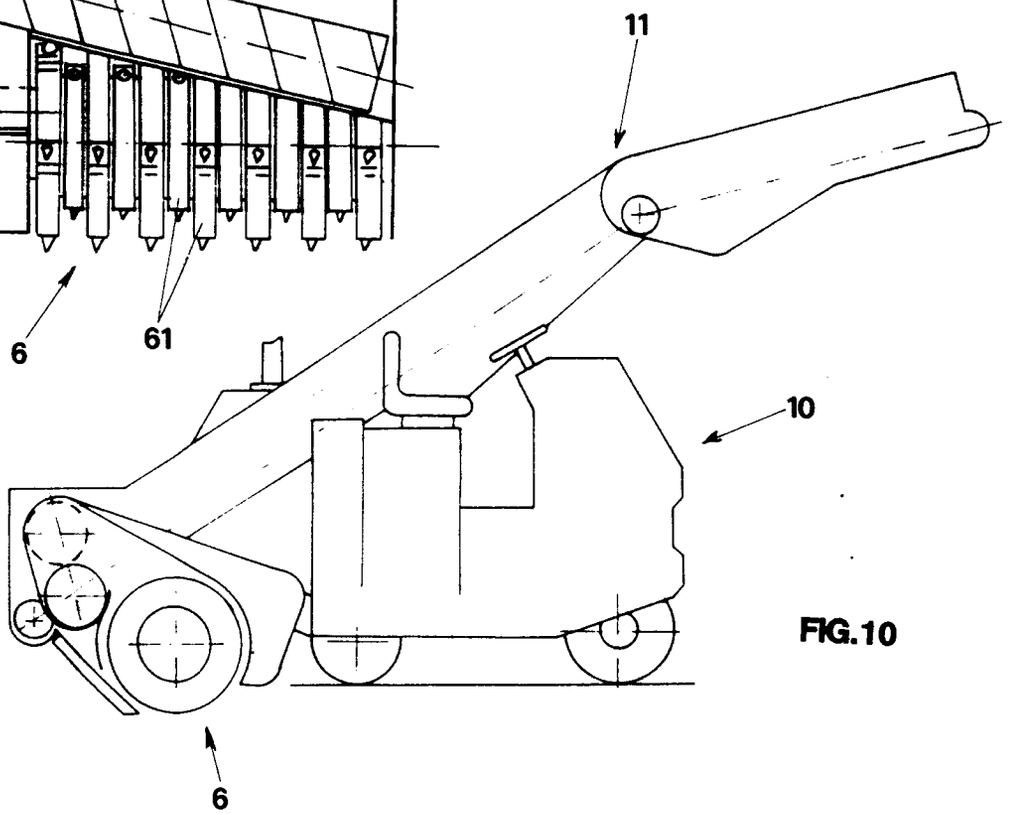

FIG.10

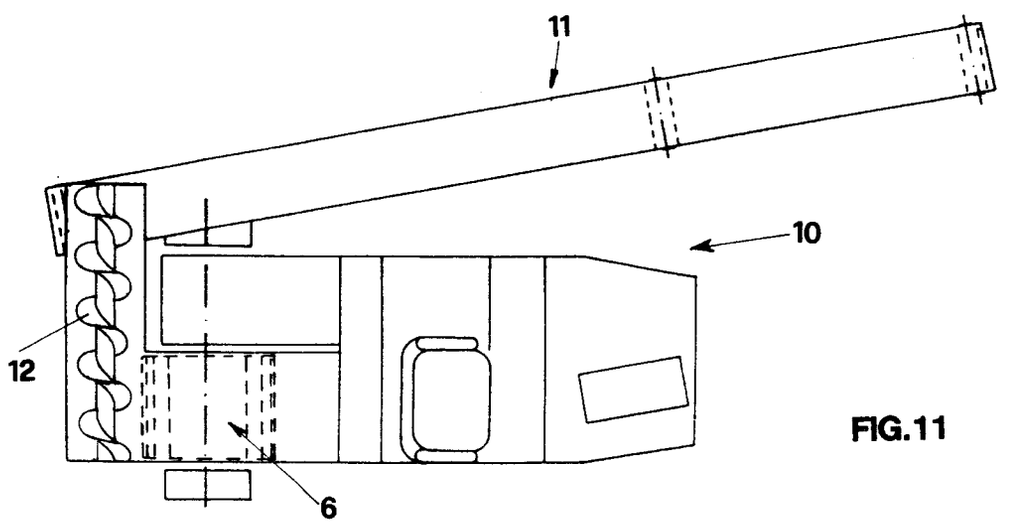

FIG.11