United States Patent [19]

Zochil

[11] **3,791,754**

[45] **Feb. 12, 1974**

[54] **TROWELLING MACHINE**

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[52] **U.S. Cl.** **404/112**

[51] **Int. Cl.** **F01c 19/22**

[58] **Field of Search** 404/112; 15/235.4, 235.8

[56] **References Cited**

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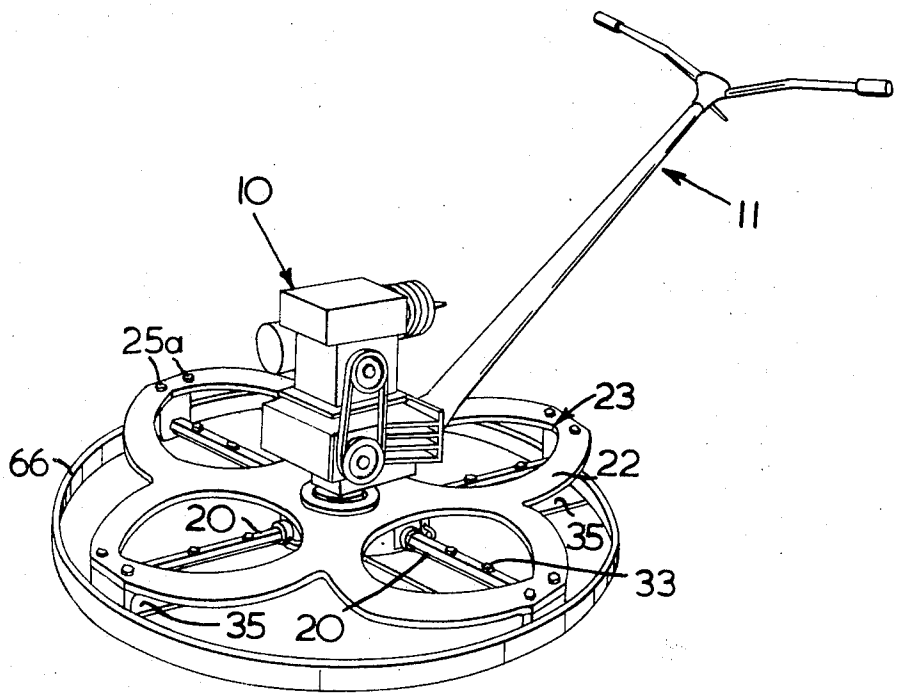
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Primary Examiner—Marion Parsons, Jr.

[57] **ABSTRACT**

A trowelling machine, for finishing cementitious surfaces, of the type having a central hub rotatable by an engine mounted above the hub, the hub having radial carriers which support trowelling blades. In accordance with the invention the outer ends of the trowelling blade carriers are supported by a blade support assembly including a cast steel support member which member is specially designed to resist upwards deflection of the outer ends of the blade carriers.

10 Claims, 5 Drawing Figures



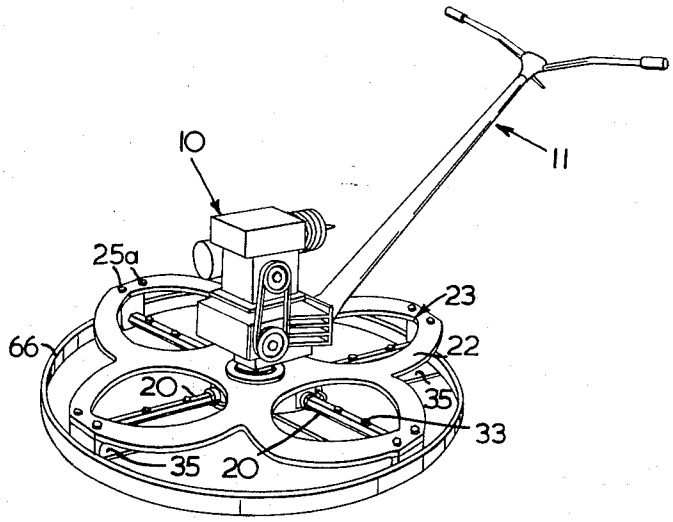

10
11
25a
23
66
22
20
35
33
35
20

FIG.1

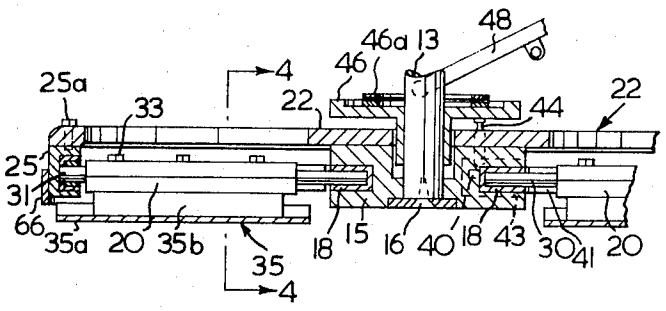

48
46a
13
46
4
25a
33
22
44
22
25
31
66
35a
20
35b
35
4
18
15
16
40
18
43
30
41
20

FIG.2

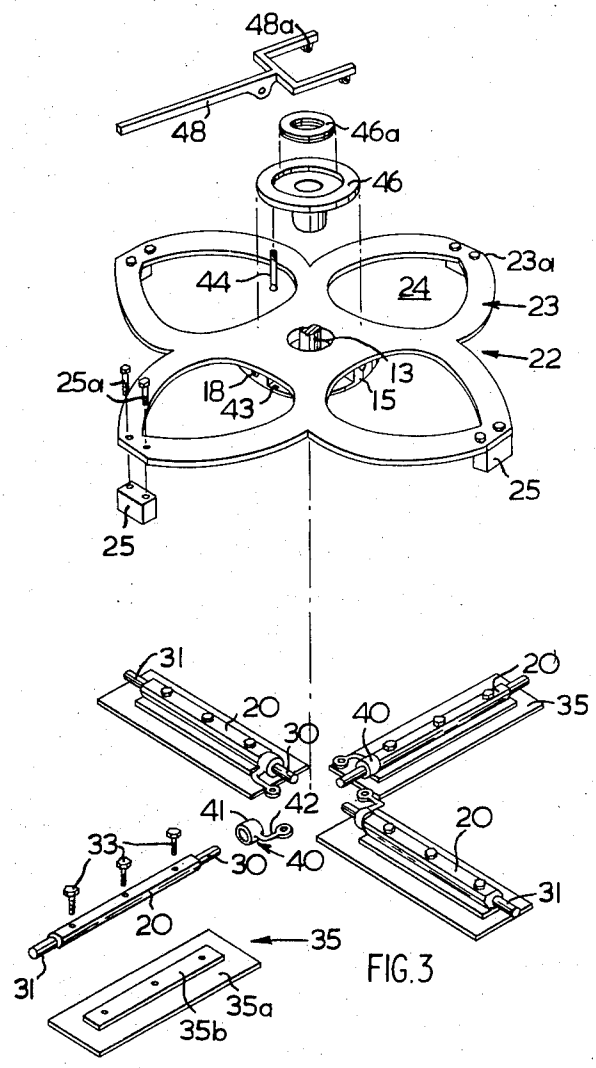

48a
48
46a
46
44
24
23a
23
22
25a
18
43
13
15
25
25
31
20
30
40
35
41
42
20
33
30
40
20
31
20
35
31
35a
35b

FIG. 3

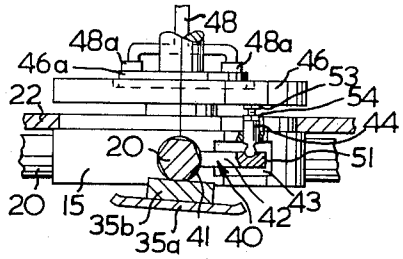

48
48a
48a
46a
46
53
22
54
44
20
51
20
15
35b
35a
41
40
42
43

FIG.4

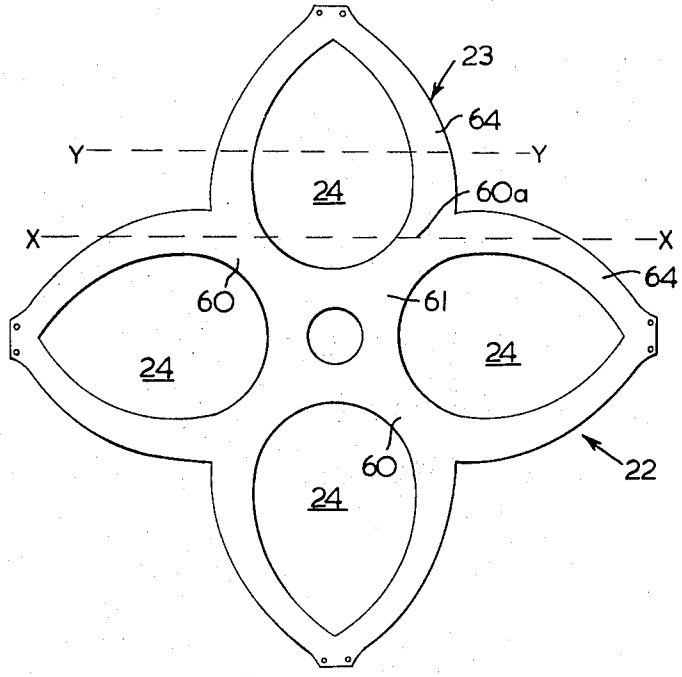

23
64
Y
Y
24
60a
X
X
60
61
64
24
24
60
22
24

FIG.5

TROWELLING MACHINE

The present invention relates to a trowelling machine for finishing surfaces, and particularly cementitious surfaces.

Known trowelling machines (also known as cement finishing machines) for finishing cementitious or other surfaces commonly have a centrally mounted power unit, such as an internal combustion engine, attached to handle means for holding and maneuvering the machine, and the power unit is connected through reduction gearing to a trowelling assembly which rotates about a vertical axis beneath the power unit. The rotatable trowelling assembly commonly comprises a hub mounted on a vertical shaft which is rotatable by the power unit, and a plurality (usually three or four) of trowelling blade carriers in the form of arms extending radially from the hub. Each carrier supports a trowelling blade, the blades extending radially and being inclined at a small pitch angle to the plane of rotation, with their trailing edges lowermost, and these blades are effective to finish smoothly a surface of wet cement or the like.

The blade carriers generally include shaft means extending radially of the hub, and having their inner ends mounted by the hub, means being provided for rotating the shaft means to a limited extent to adjust the inclination of the trowelling blades to the surface being finished.

In most such machines, a guard ring is provided which surrounds the outer edges of the blades. The guard ring may be fixed to a stationary part of the machine, or may be attached to the outer ends of the blade carriers, and be rotatable therewith. In either case, the blades are relatively unsupported at their outer ends, so that the maximum pressure on the working surfaces of the blades occurs near the hub, and this part of the blade wears much more quickly than the remainder. Also, the surface is not evenly trowelled by the blades along their length.

The present invention is based on applicant's discovery that the efficiency of the operation of a cement finishing machine and also the life of the blades can very markedly be increased by providing a support member which is attached to and is rotatable with the hub, and which supports the outer ends of the blade carriers in such manner that the pressure applied to the surface being finished is substantially uniform along the length of the blade. The invention accordingly provides a rigid rotatable support member which provide considerable resistance to upwards deflection of the outer ends of the blade carriers, but which is nevertheless reasonably light in weight.

In accordance with the invention, a surface finishing machine has a trowelling assembly comprising a central hub and a plurality of blade carriers extending radially from the hub, the carriers being supported at both ends by shaft means allowing pivotal movement of the carriers about their axes, the shaft means associated with the outer ends of the carriers being disposed outside of all the blade attachment means carried by the carriers, and being supported by a rotatable support member mounted at its centre on the hub and designed to resist vertical deflection of the outer ends of the carriers. The rotatable support member in accordance with the invention is of unitary construction and includes circumferentially spaced parts each disposed above one of said carriers and with the material thereof so distributed that the stiffness in vertical bending of a section of the member transverse to a carrier and near to the hub is greater than the stiffness in vertical bending of a similar section near to the end of the carrier.

The rotatable support member of this invention, which is preferably a casting, has a distribution of material which is specially designed so that although the member is not unduly heavy it gives a high resistance to vertical deflection at the outer ends of the carriers. This ensures that the blades wear evenly along their length, and therefore last longer, and also ensures a more efficient finishing, since the surface finished by the blades is quite level and is not higher at the outer ends of the blades, as occurs when the outer ends of the blades are unsupported.

The support member is designed so that most of the sectional area of material is situated near to the hub, where the bending moment caused by upwards deflection of the outer ends of the blades is greatest, and material is not wasted near to the periphery of the support member where the bending moment is less.

In a preferred embodiment, the rotatable support member includes a series of radial arms, the cross-sectional area of which arms decreases with increasing distance from the hub.

The support member carries bearings such as roller bearings which completely surround the ends of the shaft means associated with the outer ends of the carriers.

There have previously been proposals for providing a rotatable support member for supporting the outer ends of trowelling blade carriers, but, as far as applicant is aware, none of these has the rigidity associated with the support member of this invention. For example, Canadian Pat. No. 527,236, which issued July 3, 1956 to Ytterberg, shows a welded support member comprising a guard ring supported by a series of radial arms. This does not give a distribution of material which provides a stiffness in vertical bending which is greater near to the hub than near to the guard ring, and accordingly most bending will occur near the hub and the material used in the outer parts is not efficiently used. U.S. Pat. No. 2,277,389, which issued Mar. 24, 1942 to Conway, also shows a rotatable support member, but this is not of unitary construction, and is instead formed with many screwed joints which would give the support member little rigidity.

A particular embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which;

FIG. 1 shows a perspective view of a cement finishing machine,

FIG. 2 shows diagrammatically a sectional elevation through part of the machine,

FIG. 3 shows an exploded view of certain components of the machine with which the invention is concerned,

FIG. 4 shows a partial cross-section on lines 4—4 of FIG. 2, and

FIG. 5 shows a plan view of a rotatable support member.

As shown in FIG. 1, the machine includes a centrally mounted power unit in the form of a gasoline engine 10, to which is attached a handle 11. The handle 11 has handle bars by which the machine can be held and maneuvered, and the handle bars are also provided with

control means for the machine. The engine **10** drives a transmission system which rotates a vertical shaft **13** through reduction gearing, the lower part of shaft **13** being shown in FIG. **2**. The parts of the machine so far described are common in cement finishing machines of the same general type, and therefore will not be further described.

As shown in FIG. **2**, the vertical shaft **13** has a hub in the form of a casting **15** keyed and fixed by a screw **16** to the lower end of the shaft. The hub **15** has four radial bearings **18**, which rotatably support stub shafts extending from the inner ends of four elongated trowelling blade carriers **20**, which extend at right angles to each other, radially of the hub, and which will be further described below. The hub **15** also carries a rotatable blade support member **22**, the central part of which is bolted to the top of the hub. The blade support member **22**, which will be described in more detail below, comprises a casting of aluminum having four circumferentially spaced parts in the part of lobes **23**, the outer end of each lobe providing a support for a bearing block **25** attached to the support member by bolts **25***a*. Each of the lobes **23** of the stabilizer assembly is apertured at **24** in order to minimize the weight (see FIGS. **3** and **5**). As will be clear from FIG. **2**, the blade support member **22** is disposed wholly above the carriers **20**, so that the lobes thereof do not interfere in any way with the carriers or with blades held by the carriers.

The carriers **20**, which are also shown in FIG. **3**, are in the form of hexagonal shafts having stub shafts **30** and **31** extending from their opposite ends, the stub shafts **30** fitting into the bearings **18** in the hub, and the stub shafts **31** fitting into roller bearings in the bearing blocks **25**. Each carrier **20** has three equispaced vertical bores, arranged to receive three bolts **33** by which trowelling blade members **35** are attached to the carriers. The blade members **35** include a trowelling blade **35***a* which is a substantially flat plate but has its longer edges curved upwardly (see FIG. **4**), and a block **35***b* welded to the top of the blade and having tapped holes to receive the bolts **33**. The bolts **33** are arranged to be easily removed for replacement of a worn blade member by a new one. The arrangement of these bolts makes it simple also to reverse the position of the blade member on the carrier end-for-end. In operation, the blades wear primarily on their trailing edges, and when these edges have become worn beyond a certain point it is convenient to reverse the position of the blade means on the carriers so that the edges which were formerly the leading edges become the new trailing edges. This reversal can be done simply by removing the outermost two bolts **33** and loosening the central bolt, and then pivoting the blade means **35** through 180° and replacing and tightening the bolts. This avoids the need for aligning the bolt holes, as would be necessary if the blade means were completely removed from the carrier.

It may be noted that the bearing blocks **25** carrying the stub shafts **31** are disposed outside of all the bolts **33** which constitute the attachment means by which the trowelling blades are attached to the carriers, and in fact the bearing blocks **25** are disposed outside of the large majority of the radial length of the blades, i.e., outside at least say 80 percent of these blades. This means that the trowelling blades are firmly supported against upwards deflection at their outer ends.

The inner ends of the carriers **20** have means for adjusting the inclination of the blades, by rotation about the carrier axis. These means include an angled arm member **40**, having a sleeve **41** which is fitted onto stub shaft **30** and secured thereto by a set screw. The arm **42** of the member **40** extends firstly radially from the sleeve **41**, and then forwardly into a recessed portion **43** of the hub. The outer end of arm **42**, which is within the hub, has a small recess for locating a ball member at the lower end of a pin **44**, which pin passes vertically through a bore extending through the top part of the hub (above recess **43**) and through the member **22**. The top end of pin **44** engages the underside of a plate **46**, which plate is keyed to rotate with the shaft **13** but is slidable axially thereon. The plate **46** is movable vertically by a lever **48**, which has two rounded lugs **48***a* engaging a roller bearing ring **46***a* which rests in a circular recessed portion of plate **46**, this lever being pivotally attached to a fixed (i.e., not rotating) part of the structure, near to the base of the handle **11**. The lever **48** is attached to operating means on the handle **11**, which are of a type known in the art, and the movement of this lever causes vertical movement of the plate **46**. This vertical movement is transmitted through pins **44** to the outer end of arm **42**, which causes simultaneous pivotal movement of the carriers **20** about their axes, and thus adjusts the inclination of the blades **35***a*.

The pins **44**, which are shown most clearly in FIG. **4**, are of novel construction and include a ball member **51** at their lower ends, locating in the recess of arm **42**, and the pins are drilled and tapped at their upper ends to receive a split machine bolt **53**. The bolt **53** can be screwed in or out to any desired position, and secured in position by locknut **54**. These pins are used to make an initial setting of the blade position, by placing the machine on a level flat surface and adjusting the pins **44** until they are just touching the underside of plate **46**. By these means, the inclination of the trowelling blades is equalized. This method of equalizing the pitch of the blades is much simpler than that of many known machines, which often requires the adjustment of two bolts.

The rotatable support member **22**, with which the present invention is particularly concerned, is shown most clearly in FIG **5**. This support member has a central portion comprising four radial arms **60** which extend at right angles to each other from a solid central ring indicated by the broken line **61**, which ring overlies the hub **15**. The width and also the thickness of the arms **60** decreases from the ring **61** to a narrow portion **60***a*, the width then increasing slightly to a point where each arm branches into two curved peripheral members **64**. The members **64** of two adjacent arms **60** form an arch in plan view, and also form the outer perimeters of the lobes **23** which surround the apertures **24**. The arms **60** and members **64** are of continually reducing thickness from hub **61** to near the outermost ends of members **64**. The apex of the arch formed by the portions **64** constitutes the outermost extremity of each of the lobes **23**, which extremities support the bearing blocks **25**. The arms **60** and members **64** are both of channel form, having a flat upper web and two depending flanges along their sides. A circular guard ring **66** (shown in FIG. **1**) surrounds the member **22** and is attached to the outer extremities of the lobes **23**.

As explained above, the special support member **22** provides a high degree of resistance to vertical deflec-

tion of the bearing blocks **25**, without being unduly heavy. The feature of the support member which largely contributes to this result is that the material is so distributed that each lobe **23** has a relatively high stiffness to vertical bending in a section transverse to the carrier axis and near to the hub (e.g., Section line XX of FIG. **5**), and has a relatively low stiffness in vertical bending in a similar section near to the end of a carrier **20**, for example on Section line YY. The nature of the casting, and in particular the channel form of the arms **60** and portions **64**, also contributes to the rigidity of the member.

The term "stiffness in vertical bending" means the stiffness at a certain cross-sectional area (e.g., on the lines XX or YY) in resisting a given vertical bending moment applied at this section. The term "stiffness" as used herein, means in technical terms the resistance to bending associated with an applied moment, and may be expressed as the product of M and R, where M is the applied moment and R is the radius of curvature produced by that moment, each quantity being measured at the relevant section line. In accordance with a well known engineering formula;

$$MR = EI,$$

Where E is Young's modulus of the material (a measure of the stiffness of the material itself), and I is the moment of inertia of a cross-section about the neutral axis of that section, this quantity I being well known to engineers and readily calculated for any cross-sectional area and shape.

In the support member **22**, the quantity I for the Section on XX is clearly greater than that on the Section YY, due partly to the reduced width of material on this latter section, and also due to the diminishing thickness of arms **60** and members **64** with increasing distance from the centre. This distribution of material is advantageous from the point of view of providing high stiffness with minimum amount of material, since the Section XX, being further spaced from the block **25** at which the vertical forces are applied, is subject to a higher bending moment than the Section YY.

Clearly, many other designs of support member could be used giving similar results. For example, the arms **60** could have a uniform width, the required characteristics being obtained by making the arms of reducing thickness towards their outer ends. Alternatively, a structure could be provided formed of welded struts, and having the same feature of material distribution as claimed. The term "unitary construction" includes a welded construction, but does not include a structure held together by bolts and screws, for example as disclosed in the U.S. patent to Conway discussed above. However, the use of a casting is particularly advantageous in allowing optimal distribution of material without high manufacturing costs.

The operation of the machine is the same as that of other well known trowelling machines. The machine is placed upon a surface to be trowelled, such as a wet surface of cement, and the operator holds the handle **11** while the engine rotates the rotatable assembly including the trowelling blade. The operator gradually moves the machine over the entire surface being finished, producing a uniform degree of trowelling over the surface. The operator can adjust the pitch of the blades in accordance with the type of surface being finished, by the handle control means which operate the lever **48**. When worn, the blades can readily be replaced in the manner described above.

Instead of the trowelling blade members **35** being attached to the carriers **20** by bolt means as shown, the blade members may be attached by means of a quick release coupling of the type described in my co-pending United States Patent application, Ser. No. 100,576 filed Dec. 22, 1970, now U.S. Pat. No. 3,475,554, issued July 11, 1972. This application describes a quick release coupling especially suitable for attaching trowelling blades to carriers, and whereby the blades can be released by loosening a knob attached to a screwed stud, and then sliding this knob sideways. Reference is made to this co-pending application for this alternative method of mounting the blade members on the carrier.

The cement finishing machine in accordance with this invention gives a substantially uniform pressure along the blades when these are operating on a flat surface, which is in marked contrast to known machines having blade carriers which are virtually unsupported at their outer ends, and in which only from one half to three-quarters of the blades are in contact with the cement. This feature of the invention allows much longer blade life, up to twice the life of blades used in many known machines. Also, the efficiency of operation is much increased, up to approximately 40 percent higher than that obtained with many known machines. Also, since the blade carriers are better supported, there is less maintenance involved on these, and the stresses on the shaft means at the inner ends of the blade carriers are reduced.

I claim:

1. A trowelling machine of the type having a trowelling assembly rotatable by a power unit, the trowelling assembly comprising central hub means and a plurality of elongated trowelling blade carriers extending radially from the hub means, said carriers being supported at both their inner and their outer ends by shaft means allowing pivotal movement of the carriers about their radially extending axes, attaching means for attaching trowelling blades to said carriers, said shaft means associated with the outer ends of the carriers being disposed outside of all the said attaching means and being supported by a rotatable support member mounted at its centre on said hub means, said support member being of unitary construction and including circumferentially spaced parts each disposed above one of said carriers and with the material thereof being so distributed that the stiffness in vertical bending of one of said parts of the member transverse to a carrier axis and near to the hub means is greater than the stiffness in vertical bending of said one part near to the outer end of said carrier.

2. A trowelling machine according to claim **1**, wherein said circumferentially spaced parts include radial arms spaced around the central hub means, the cross-sectional area of which arms decrease with increasing distance from the hub means.

3. A trowelling machine according to claim **1**, wherein said circumferentially spaced parts are lobes spaced around the central hub means, said lobes extending above said blade carriers and the ends of said lobes being associated with bearings for the outer ends of the carriers, said lobes each having a weight reducing aperture.

4. A trowelling machine according to claim 3, wherein said rotatable support member is formed as a casting, and wherein said lobes are defined partially by two adjacent radial arms extending from a central area associated with the hub and partially by two members branching from the ends of said adjacent arms, the cross-sectional area of the two arms, taken transversely to the axis of a carrier, being larger than the cross-sectional area of the said two members also taken transversely to the axis of the carrier.

5. A trowelling machine according to claim 4, wherein said arms are of channel-shaped cross section.

6. A trowelling machine according to claim 4, wherein said members are of channel-shaped cross section.

7. A trowelling machine according to claim 4, wherein said casting is of aluminum.

8. A trowelling machine according to claim 1, wherein said rotatable support member is an aluminum casting.

9. A trowelling machine according to claim 1, wherein said support member carries bearing which completely surround the ends of the shaft means associated with the outer ends of the carriers.

10. A trowelling machine according to claim 9, wherein said bearings are roller bearings.

* * * * *