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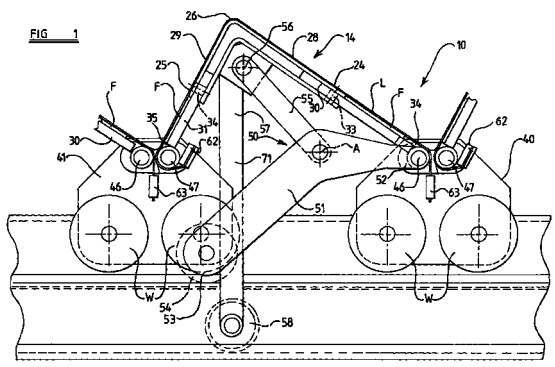
(54) Apparatus for moulding a staircase

(57) An apparatus for moulding a staircase includes a plurality of tread and riser mould part assemblies (14) arranged along the apparatus (10), each tread mould part (24) of each assembly (14) extending downwardly from a connection (26) with the riser mould part (25) of the assembly (14), which riser mould part (25) also extends downwardly at an opposite side of the connection (26), the lengths of each of the tread and riser mould parts (24, 25) from their respective connections (26) being adjustable, and the apparatus (10) further including a support structure (16, 17) characterised in that the tread mould part (24) of a first assembly (14) and the riser mould part (25) of an adjacent second assembly (14) are connected to a first bogie means (40) which is movable along the support structure (16, 17) of the apparatus (10), and the riser mould part (25) of the first assembly (14) and the tread mould part (24) of a third adjacent assembly (14) are connected to a second bogie means (41) which is movable along the support structure (16, 17) of the apparatus (10), the lengths of the tread and riser mould parts (24, 25) of the first assembly (14) and of the riser mould part (25) of the second assembly and of the tread mould part (24) of the third assembly (14) being adjustable as the first and second bogie means (40, 41) are moved towards or away from one another.

FIG 1



EP 1 033 215 A2

Description

[0001] This invention relates to an apparatus and method of moulding a staircase in using a castable material such as concrete.

[0002] Moulds for staircases are already known. Prior European Patent 0191711 describes one such mould in which the lengths of tread and riser mould parts in the mould are adjustable so that the treads and risers of the staircase can have desired dimensions. The treads and risers are provided as modular assemblies and the treads and risers of the individual modules are independently adjustable This is a very time consuming and skilled process because, to ensure that in the resulting staircase, all of the treads and risers respectively, are of a consistent length and comply with accepted building standards, it is necessary to perform detailed calculations and then accurately to perform adjustments to each module. The mould is lined in this proposal, with a continuous liner wrapped around rollers to ensure that the liner is kept taught, which complicates the adjustment process.

[0003] A modified arrangement is described in our prior International patent application WO97/3163 in which each of the modules has its own liner, and the connection between the tread and riser mould parts of each module is of fixed angle, which simplifies mould adjustment, but nevertheless, each module requires individual adjustment and again detailed calculations are required.

[0004] According to a first aspect of the invention we provide an apparatus for moulding a staircase including a plurality of tread and riser mould part assemblies arranged along the apparatus, each tread mould part of each assembly extending downwardly from a connection with the riser mould part of the assembly, which riser mould part also extends downwardly at an opposite side of the connection, the lengths of each of the tread and riser mould parts from their respective connections being adjustable, and the apparatus further including a support structure characterised in that the tread mould part of a first assembly and the riser mould part of an adjacent second assembly are connected to a first bogie means which is movable along the support structure of the apparatus, and the riser mould part of the first assembly and the tread mould part of a third adjacent assembly are connected to a second bogie means which is movable along the support structure of the apparatus, the lengths of the tread and riser mould parts of the first assembly and of the riser mould part of the second assembly and of the tread mould part of the third assembly being adjustable as the first and second bogie means are moved towards or away from one another.

[0005] Thus whereas in the previous proposals described, the tread and riser assemblies have been provided as individual modules, in the apparatus of the invention, the tread and riser assemblies are interconnected via the bogie means. Thus the tread mould part of the second assembly is preferably connected to a further bogie means as is the riser mould part of the third assembly, all of the bogie means being moveable along the support structure whereby the lengths of all of the tread and riser mould parts may be adjusted upon relative movement of the respective bogie means.

[0006] To enable adjustment to be more easily performed, preferably each tread and riser mould part assembly has an associated linkage mechanism including an adjustment member, the adjustment member being moveable to cause relative movement between the pair of adjacent bogie means to which the tread and riser mould parts are connected, or being moveable in response to relative movement between the pair of adjacent bogie means to cause adjustment of the length of at least one of the tread and riser mould parts.

[0007] For example each linkage mechanism may include an adjustment member which is pivotally connected to one of the bogie means of the pair, and a link element which extends between and is pivotally connected to each of the adjustment member and a point adjacent to the tread and riser mould part connection.

[0008] To ensure that the treads and/or risers respectively of the staircase are of a consistent length along the staircase, preferably the adjustment members of each of the linkage mechanisms of the apparatus are moveable together whereby the lengths of all of the tread and/or riser mould parts of the apparatus may simultaneously adjust generally equally with the other respective tread and riser mould parts.

[0009] Thus as one of the tread and riser mould part assemblies is adjusted, each of the other tread and riser assemblies will be caused to be adjusted. Hence there is no need for individual assemblies to be adjusted, and furthermore because the assemblies are interconnected, if the end closures of the apparatus are set in positions to provide a staircase of a desired length, the lengths of the treads and/or risers will automatically be set and accordingly much simpler calculation than with the previous proposal is required, it only being necessary to determine the number of steps required along the staircase for a given staircase length.

[0010] Thus the invention enables a variety of staircases to be produced using the apparatus, faster and with less skill than hithertofore.

[0011] Although various means of operating the linkage mechanisms may be designed, in one embodiment the adjustment members may each be moved in response to movement of an actuating means with which each of the adjustment members is engaged.

[0012] Although many different geometries of linkage mechanisms may be provided, in one embodiment the link element is connected at or towards one end to the point adjacent to the tread and riser mould part connection and at or towards the opposite end to the adjustment member intermediate the ends of the adjustment member. To suit a particular support structure, the

adjustment member may be cranked along its length and the link element may be connected to the adjustment member in the region of the crank.

[0013] Each linkage mechanism may include a further link fixed at or close to the point adjacent to the tread and riser mould part connection, which link is moveable independently of the adjustment member to cause adjustment of the length of the riser and/or tread mould part.

[0014] Thus the length of e.g. the treads may be adjusted by adjustment member movement, as a result of relative movement between the bogie means, and the lengths of the riser may be adjusted by movement of the further link.

[0015] Although the bogie means may comprise a single bogie, which for a large staircase may entail additional support for the tread and riser mould part assemblies, preferably each bogie means includes a pair or pairs of bogies spaced laterally of the apparatus so that the assemblies are supported adequately across substantially their entire widths by the bogies.

[0016] The bogies may comprise simple sliding members, but preferably each bogie has a pair of wheels or rollers which roll along a support rail of the support structure, to facilitate movement.

[0017] Each tread and riser mould part assembly may include a liner which provides an interface between the tread and riser mould parts and the material to be cast into the mould, the liner extending over the connection between the tread and riser mould parts and being fixed with respect to either the tread or riser mould part of the assembly and being adjustable with respect to the riser or tread mould part to accommodate tread and riser mould part length adjustments. For example, the liner may extend downwardly between a riser mould part of one assembly and the tread mould part of an adjacent assembly, and may be biased downwardly so that the liner remains taught during tread and riser mould part length adjustment.

[0018] In one arrangement each of the adjacent tread and riser mould parts of adjacent assemblies, are connected to the bogie means by a generally cylindrical connecting member which extends laterally of the apparatus, the liners of each of the adjacent tread and riser mould part assemblies passing extending around a respective cylindrical connecting member.

[0019] It will be appreciated that between the cylindrical connecting members of the tread mould part of one assembly and the riser part of the adjacent assembly a step nosing is formed. To improve the shaping of the step nosings, there may be provided a nosing insert, the insert including an upper part having a concave configuration which upper part spans any gap between the adjacent connecting members and partially overlaps the uppermost lined surfaces of the adjacent tread and riser mould parts, the nosing insert also having a lower part which extends downwardly from the upper part and is configured to engage the adjacent cylindrical members of the adjacent connecting members.

[0020] According to a second aspect of the invention we provide a method of moulding using an apparatus according to the first aspect of the invention characterised in that alternate bogie means are moved towards or away from adjacent bogie means to adjust each of the tread and riser mould parts to a desired length, and the mould is closed to provide a moulding cavity between side and end mould closure members and a mould bottom formed by the plurality of tread and riser mould part assemblies, and moulding material is cast into the moulding cavity and permitted to harden.

[0021] If desired, reinforcement elements may be provided which extend from one end of the apparatus to the other, and may be pre-stressed so that stress may be applied to the cast concrete when hardened.

[0022] The invention will now be described with reference to the accompanying drawings in which:-

FIGURE 1 is a side view of part of an apparatus in accordance with the invention showing a tread and riser assembly with tread and riser mould parts adjusted to a maximum length;

FIGURE 2 is a view similar to figure 1 but showing the tread and riser mould parts adjusted to a minimum length;

FIGURE 3 is an end view of the apparatus of figures 1 and 2 but with parts omitted for clarity;

FIGURE 4 is an illustrative view of a tread and riser assembly of the apparatus of figures 1 to 3, showing how a liner therefor is kept taught;

FIGURE 5 is a detailed view of a nosing insert for use with the apparatus of figures 1 to 3.

[0023] Referring to figures 1 to 3 of the drawings, there is shown an apparatus 10 for moulding a staircase in e.g. concrete or other settable/hardenable material, which concrete etc. may be reinforced as desired and as is well known in the art, or as described hereinafter.

[0024] The moulding apparatus 10 has a moulding cavity defined between side closure members 12, 13, end closure members (not seen) and a bottom wall provided by a plurality of tread and riser mould part assemblies 14.

[0025] The side 12, 13 and end closure members and the assemblies 14 are supported by a support structure which includes bracing to hold the closure members rigid. A filler (not shown) may be positioned between the side closure members 12, 13 at any desired position laterally of the apparatus 10 to enable staircases of varying width to be produced. The support structure also enables the overall length of the moulding cavity between the end closure members to be adjusted, so that a staircase of a desired length may be produced. The number of steps of the staircase can be changed by adding/removing tread and riser mould part assemblies 14, and the geometry of the individual steps can be adjusted as hereinafter described, within limits,

so that the moulding apparatus 10 may be used to produce staircases of widely varying dimensions.

[0026] The support structure includes outer main rails 16, 17 arranged at the sides of the apparatus 10, and corresponding auxiliary inner rails 18, 18a, 19, 19a the rails all being supported on a base structure 20. Side support structures 21, 22 provide for bracing of the side closures 12, 13 respectively.

[0027] The tread and riser mould part assemblies 14 each comprise a tread mould part 24 and a riser mould part 25, the mould parts 24, 25 being connected at a connection 26 at a fixed relative angle of 90° ± 15°. Each of the tread and riser mould parts 24, 25 is adjustable in length downwardly from the connection 26, by virtue of being telescopic, the mould parts 24, 25 having outer parts 28, 29 and inner relatively slideable parts 30, 31 respectively. The inner parts 30, 31 may have a slot or slots therein which receives a guide pin (or pins) 33, 34 whereby the sliding movement of the inner part 30, 31 is guided. Fillers F may be provided as necessary to fill any surface discontinuity formed as the inner parts 33, 34 are telescoped outwardly, as seen in figure 1 only.

[0028] The tread 24 and riser 25 mould parts are each connected at their ends 34, 35 to respective bogies 40, 41, at each side of the apparatus 10. The bogies 40, 41 at one side are movable along the rail 17 whereas the bogies 40, 41 at the other side are moveable along the rail 16.

[0029] The bogies 40, 41 each are connected to cylindrical formations 46, 47 at the ends of the tread and riser mould parts 24, 25.

[0030] Each bogie, for example bogie 40, has connected thereto, a tread mould part 24 of a first assembly 14, and a riser 25 mould part of an adjacent assembly 14, and by virtue of the mounting of the cylindrical formations 46, 47 relative rotation and thus variance of the angle between the tread mould part 24 and the riser mould part 25 at each bogie 40 is permitted.

[0031] Thus all of the tread and riser assemblies 14 are interconnected by the bogies 40, 41 and adjacent pairs of bogies 40 and 41 may be moved towards and away from one another along the respective rails 16, 17 to adjust the lengths of at least the tread mould parts 24 as the inner parts 30 thereof slide in or out relative to the outer parts 28. Such relative bogie movement may also cause some adjustment of the lengths of the riser mould parts 25, although in the main this is effected by other means as hereinafter explained.

[0032] The bogies 40, 41 each comprise a pair of wheels W, but could alternatively be rollers or pairs of rollers or the like to facilitate movement of the bogies 40, 41 along the rails 16, 17.

[0033] To ensure of consistent tread/riser lengths for all steps of the staircase, and to effect relative movement of the bogie 40, 41 pairs, the tread and riser mould parts 24, 25 are further interconnected by linkage mechanisms 50.

[0034] Each linkage mechanism 50 comprises, at each side of the apparatus 10, inwardly of the rails 16, 17, an adjustment member 51 which in this example is of cranked configuration, and is pivoted at one end 52 to a cylindrical formation 46 e.g. provided at the end of the tread mould part 24. At its other end 53, the adjustment member 51 has a roller 54 which is carried on a lifting mechanism 60 supported on rails 18a (or 19a) of the support structure. As lifting mechanism 60 is operated, the adjustment member 51 will be moved between the lower position shown in figure 2 and the upper position of figure 1.

[0035] Intermediate its ends 52, 53, the adjustment member 51 is pivotally connected at A to a link 55 which extends to a point 56 adjacent to the connection 26 between the tread and riser mould parts 24,25, where the link 55 is pivotally connected.

[0036] It will be appreciated that due to the geometry of the adjustment member 51 and the link 55, as the lifting mechanism 60 operates (in practice both lifting mechanisms 60 are operated in synchronism) the adjacent bogies 40, 41 of adjacent parts will be moved towards or away from one another whilst the lengths of the tread mould parts 24 at least will be adjusted. Sliding of the inner parts 30 relative to the outer parts 28 of the tread mould parts 24 will be assisted by the links 55 existing generally in the sliding direction. A yet further link 57 extends at each side of the apparatus 10, inwardly of the links 55, generally vertically downwardly to a roller 58 which is supported on a second lifting mechanism 61 of the support structure.

[0037] As the second lifting mechanisms 61 are operated, the connections 26 between the tread and riser mould parts 24, 25 will be moved upwardly or downwardly, which will cause adjustment of the lengths of the riser mould parts 25.

[0038] Of course during operation of the first lifting mechanisms 60, some riser mould part 25 length adjustment may occur, and during operation of the second lifting mechanisms 61, some tread mould part 24 length adjustment may occur but by providing both first and second lifting mechanisms 60, 61, which may be operated separately or together the tread and riser mould parts 24, 25 lengths can be relatively adjusted.

[0039] Because all of the adjustment members 51 bear on the lifting mechanism 60 and the further links 57 all bear on the second lifting mechanism 61, the tread and/or riser mould parts 24, 25 respectively will all be adjusted simultaneously as the respective lifting mechanisms 60, 61 are operated. Further the tread mould parts 24 and riser mould parts 25 respectively will be adjusted generally equally, with the result that the staircase formed in the moulding apparatus 10 will have generally equally spaced steps i.e. the tread and riser dimensions will be consistent throughout the staircase, as is demanded by accepted building standards.

[0040] Further features of the apparatus 10 are as follows.

[0041] The lifting mechanism 60, 61 may include respective rails R on which the rollers 54/58 bear, which rails are moved up or down by one or more hydraulic or other fluid operated actuators, or by an electric or other motive means, e.g. through a transmission, as desired.

[0042] Each tread and riser assembly 14 has an associated liner L which extends over the connection 26 between the tread and riser mould parts 24, 25, and downwardly over and between adjacent cylindrical formations 46, 47 at the ends of tread and riser mould parts 24, 25. The liner L is fixed at one end, e.g. by wrapping around the cylindrical formation 47 of the riser mould part 25 and is secured to a clamp block 62, which extends from side to side of the liner L, and at an opposite end the liner L depends between the cylindrical formations 46, 47 to a free hanging connector 63. The connector 63 extends throughout the liner L width, and is connected to weights 64 as illustrated in figure 4. Thus the liner L is held taught as the bogies 40, 41 are moved along the rails 16, 17 to adjust the lengths of at least the tread mould parts 24. Of course any alternative means for maintaining the liner L taught could be employed.

[0043] It will be appreciated that between the adjacent cylindrical formations 46, 47 there will necessarily be a small gap. In the finished staircase, this gap is in the region of a step nosing. It is important that the step nosing is properly formed, or else a machining or the like operation will subsequently be required.

[0044] Accordingly, a nosing insert 70 (best seen in figure 5) is inserted in the gap, the insert 70 having an upper part with a concave formation 72 of the desired step nosing shape, the upper part having legs 74, 75 which overlap the uppermost surfaces of the tread and riser mould parts 24, 25. The insert 70 further has a lower part 76 which depends from the upper part and is configured generally to conform to the shape of the cylindrical formations 46, 47. The nosing insert 70 may have to be positioned from the side, before side closure plate 12 or 13 is in position, but preferably the insert 70 is made of a material, such as a suitable plastic or rubber which allows sufficient resilient deformation for the insert 70 to be positioned from above. In each case the insert 70 is securely held in position during casting by the legs 74, 75 and the cylindrical formations 46, 47.

[0045] Various modifications to the apparatus may be made without departing from the scope of the invention.

[0046] For example the geometry of the linkage mechanism 50 described is only an example as other geometries may be employed which permit of the simultaneous adjustment of each of the tread and/or riser mould parts 25 as described. The support structure may be adapted for a particular mould design, as may the construction and positioning of the bogies 40, 41 etc.

[0047] Although the tread and riser mould parts 24, 25 have been described as being adjustable in length by being telescopic, alternative arrangements are possible.

[0048] In the example described, as is preferred, the angle between the tread and riser mould pans 24, 25 at the connection 26 from which they each extend downwardly is fixed, but in another example, some adjustment of this angle within the range 75° to 105° may be permitted if desired.

[0049] The apparatus 10 described is particularly for casting concrete staircases, but other castable/hardenable materials could be used, in which case some modification to the apparatus 10 may thus be required or desirable.

[0050] By virtue of the rigidity of the mould design, and in particular the positive support afforded by the adjustment members 51 bearing on the lifting mechanisms 60 and the further links 57 bearing on the lifting mechanisms 61, if desired, the adjustable moulding apparatus 10 may have pre-stressed reinforcement members provided thereon, extending from one end of the apparatus to the other, e.g. as shown at M in figure 3. Thus when the concrete is hardened, and the stress on the reinforcement member M is released, stress will be applied to the concrete, In this way the mass of concrete required necessary to achieve adequate staircase strength can be substantially reduced.

[0051] The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims

1. An apparatus (10) for moulding a staircase including a plurality of tread and riser mould part assemblies (14) arranged along the apparatus (10), each tread mould part (24) of each assembly (14) extending downwardly from a connection (26) with the riser mould part (25) of the assembly (14), which riser mould (25) part also extends downwardly at an opposite side of the connection (26), the lengths of each of the tread and riser mould parts (24,25) from their respective connections (26) being adjustable, and the apparatus (10) further including a support structure (16,17) characterised in that the tread mould part (24) of a first assembly (14) and the riser mould part (15) of an adjacent second assembly (14) are connected to a first bogie means (40) which is movable along the support structure (15,17) of the apparatus (10), and the riser mould part (25) of the first assembly (14) and the tread mould part (24) of a third adjacent assembly (14) are connected to a second bogie means (41) which is movable along the support structure (16,17) of the apparatus (10), the lengths of the

tread and riser mould parts (24,25) of the first assembly (14) and of the riser mould part (25) of the second assembly (14) and of the tread mould part (24) of the third assembly (14) being adjustable as the first and second bogie means (40,41) are moved towards or away from one another.

2. An apparatus according to claim 1 characterised in that each tread and riser mould part assembly (14) has an associated linkage mechanism (50) including an adjustment member (51), the adjustment member (51) being moveable to cause relative movement between the pair of adjacent bogie means (40,41) to which the tread (24) and riser (25) mould parts are connected, or being moveable in response to relative movement between the pair of adjacent bogie means (40,41) to cause adjustment of the length of at least one of the tread and riser mould parts (24,25).

3. An apparatus according to claim 2 characterised in that each linkage mechanism (50) includes an adjustment member (51) which is pivotally connected to one of the bogie means (40,41) of the pair, and a link element (55) which extends between and is pivotally connected to each of the adjustment member (51) and a point adjacent to the tread and riser mould part connection (26).

4. An apparatus according to claim 2 or claim 3 characterised in that the adjustment members (51) of each of the linkage mechanisms (50) of the apparatus (10) are moveable together whereby the lengths of all of the tread and riser mould parts (24,25) of the apparatus (10) are simultaneously adjustable generally equally with the other respective tread and /or riser mould parts (24,25).

5. An apparatus according to claim 4 characterised in that the adjustment members (51) are moved in response to movement of an actuator means (60,61) with which each of the adjustment members (51) is engaged.

6. An apparatus according to claim 3 or claim 4 or claim 5 where dependant upon claim 3 characterised in that the link element (55) is connected at or towards one end to the point adjacent to the tread and riser mould part connection (26) and at or towards the opposite end to the adjustment member (51) intermediate the ends of the adjustment member (51).

7. An apparatus according to claim 6 characterised in that the adjustment member (51) is cranked along its length and the link element (55) is connected to the adjustment member (51) in the region of the crank.

8. An apparatus according to any one of claims 2 to 7 characterised in that each linkage mechanism (50) includes a further link (57) fixed at or close to the point adjacent to the tread and riser mould part connection (26), which further link (57) is moveable independently of the adjustment member (51) to cause adjustment of the length of the riser and/or tread mould part (25,24).

9. An apparatus according to any one of the preceding claims characterised in that each tread and riser mould part assembly (14) includes a liner (L) which provides an interface between the tread and riser mould parts (24,25) and the material to be cast into the mould, the liner (L) extending over the connection (26) between the tread and riser mould parts (24,25) and being fixed with respect to either the tread or riser mould part (24,25) of the assembly (10) and being adjustable with respect to the riser or tread mould part (24,25) to accommodate tread and riser mould part length adjustments, and the liner (L) extending downwardly between a riser mould part (25) of one assembly (14) and the tread mould part (24) of an adjacent assembly (24), and being biased downwardly so that the liner (L) remains taught during tread and riser mould part length adjustment.

10. An apparatus according to claim 9 characterised in that each of the adjacent tread and riser mould parts (24,25) of adjacent assemblies (14), are connected to the bogie means (40,41) by a generally cylindrical connecting member (46,47) which extends laterally of the apparatus (10), the liners (L) of each of the adjacent tread and riser mould part assemblies (14) extending around a respective cylindrical connecting member (46,47).

11. An apparatus according to claim 10 characterised in that between the cylindrical connecting members (47) of the tread mould part (24) of one assembly (14) and the riser part (25) of the adjacent assembly (14) there is provided a nosing insert (70), the insert (70) including an upper part having a concave configuration (72) which upper part spans any gap between the adjacent connecting members (46,47) and partially overlaps the uppermost lined surfaces of the adjacent tread and riser mould parts (24,25), the nosing insert (70) also having a lower part (76) which extends downwardly from the upper part and is configured to engage the adjacent cylindrical surfaces of the adjacent connecting members (46,47).

12. A method of moulding using an apparatus (10) according to any one of the preceding claims characterised in that alternate bogie means (40,41) are moved towards or away from adjacent bogie means

(41,40) to adjust the tread and/or riser mould parts (24,25) to a desired length, and the mould is closed to provide a moulding cavity between side and end mould closure members (12,13) and a mould bottom formed by the plurality of tread and riser mould part assemblies (14), and moulding material is cast into the moulding cavity and permitted to harden.

13. A method according to claim 12 characterised in that the method includes, prior to casting the moulding material, (10) to the other end and are pre-tensioned so that stress is applied to the cast concrete when hardened.

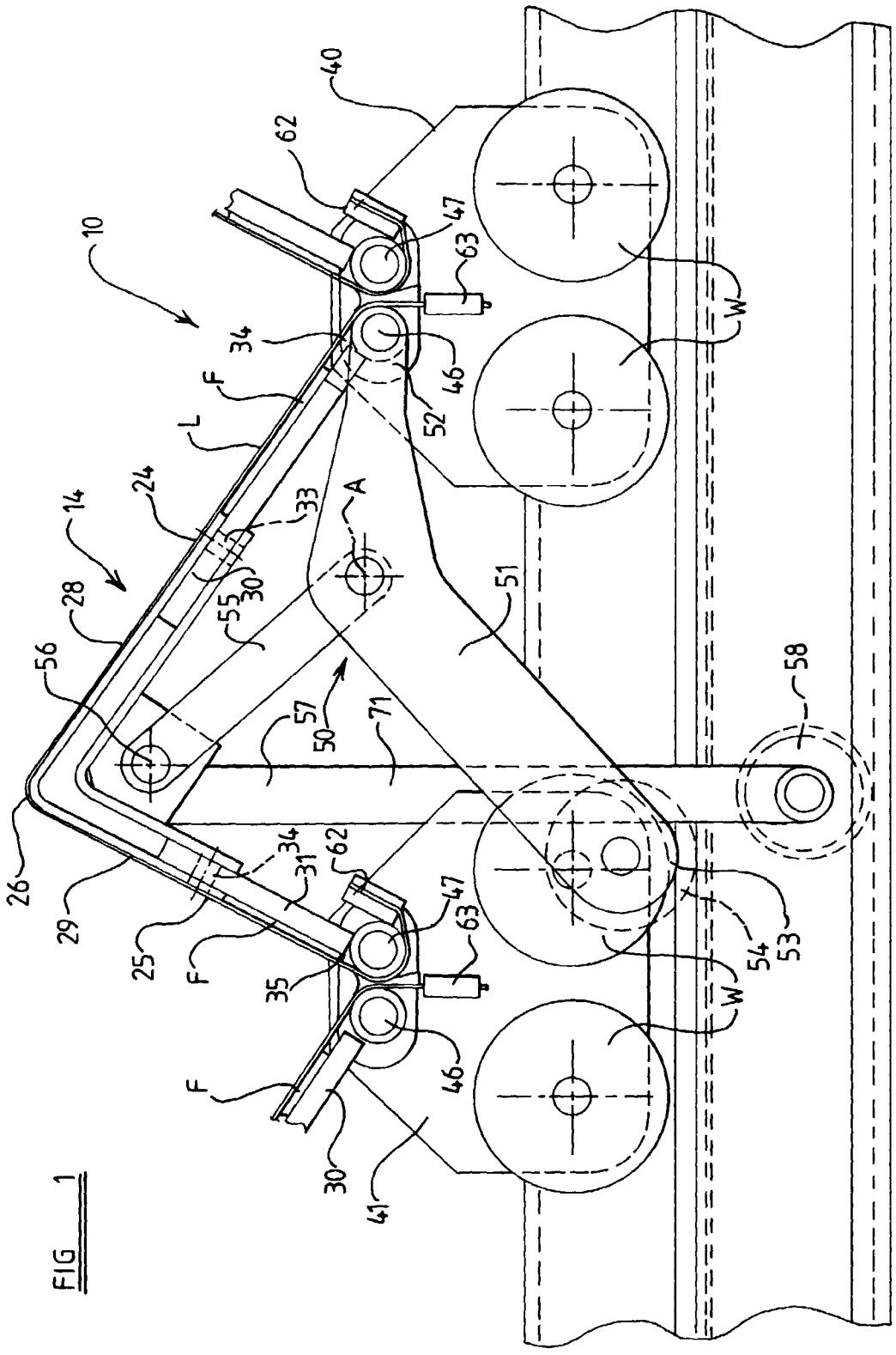

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FIG 1

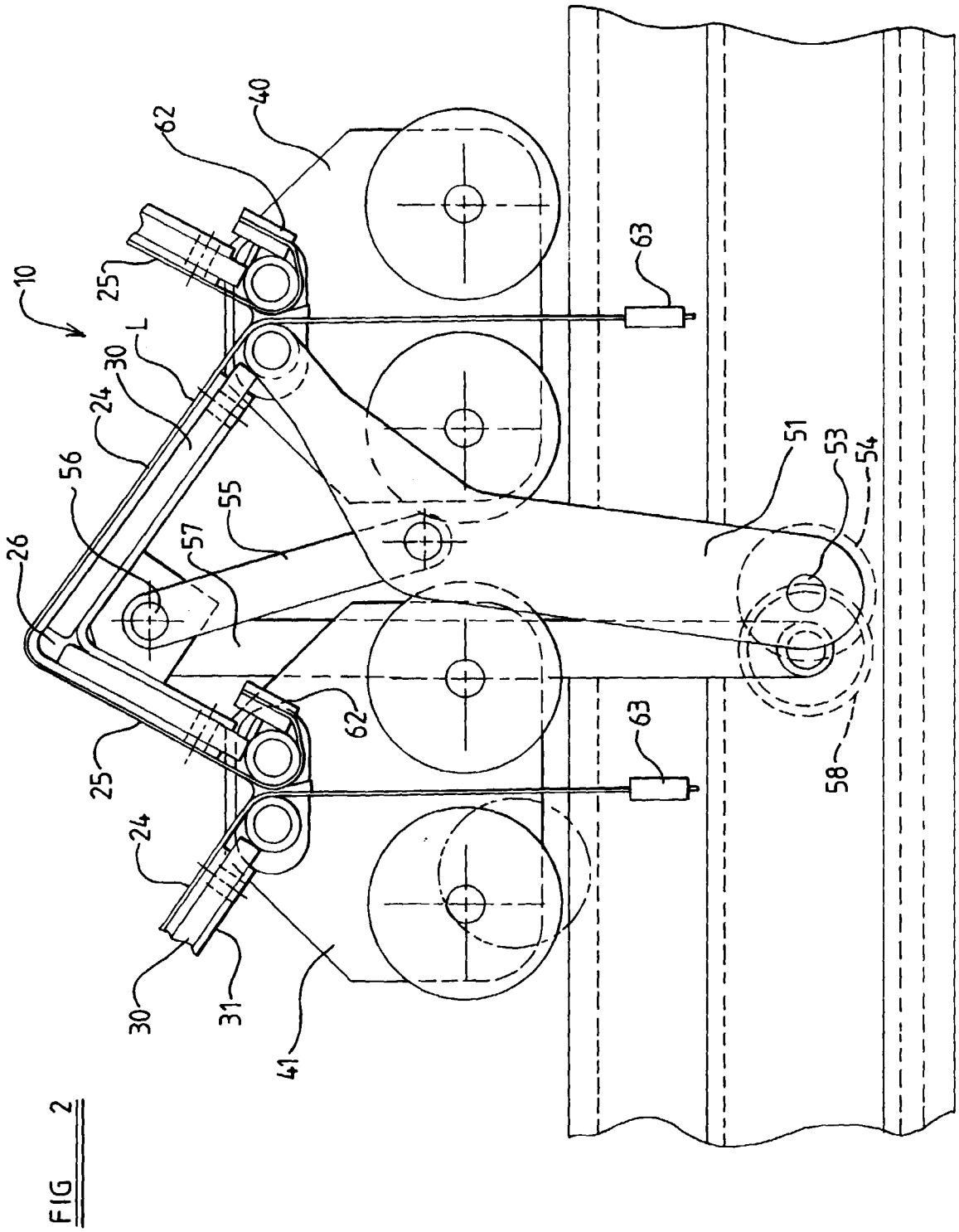

FIG 2

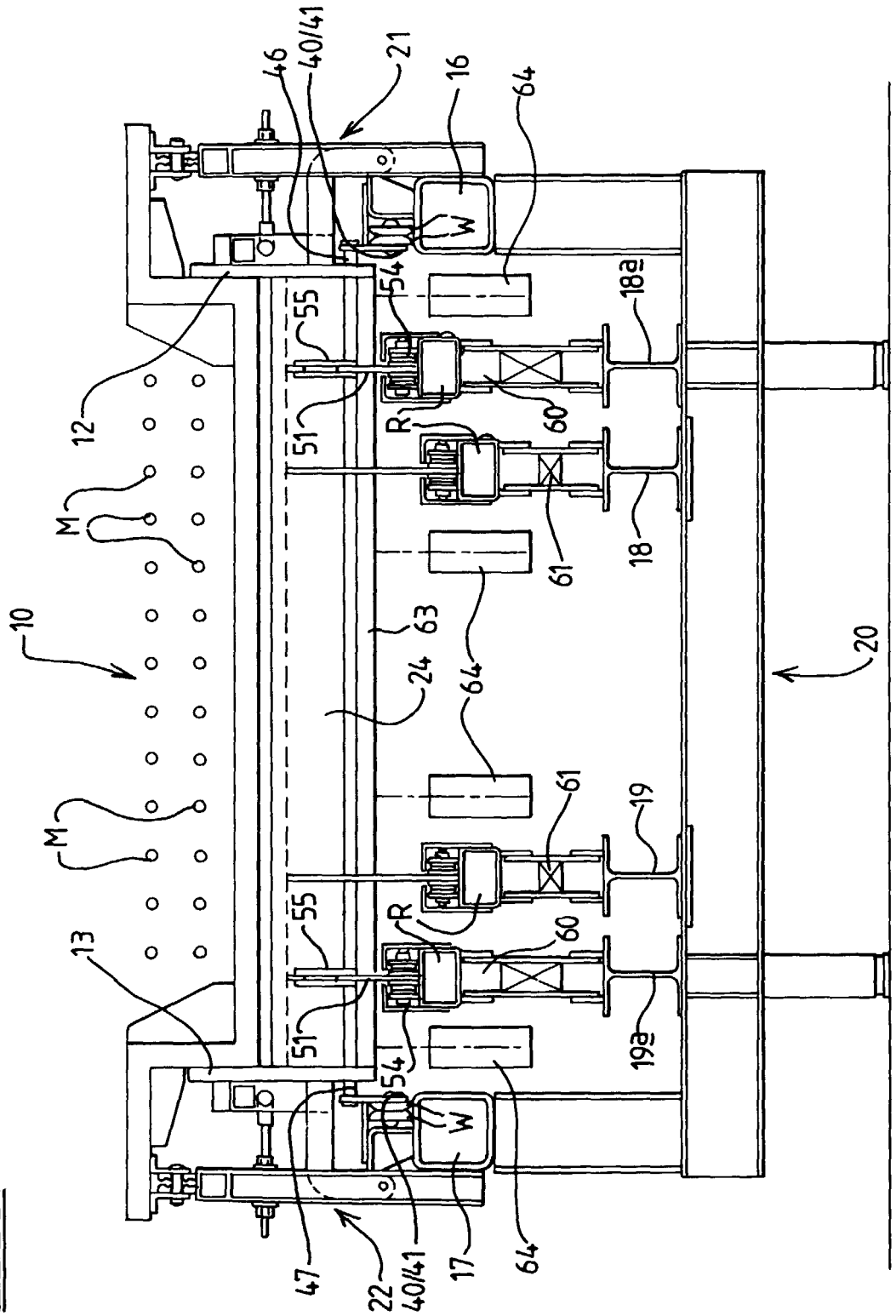
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FIG 3

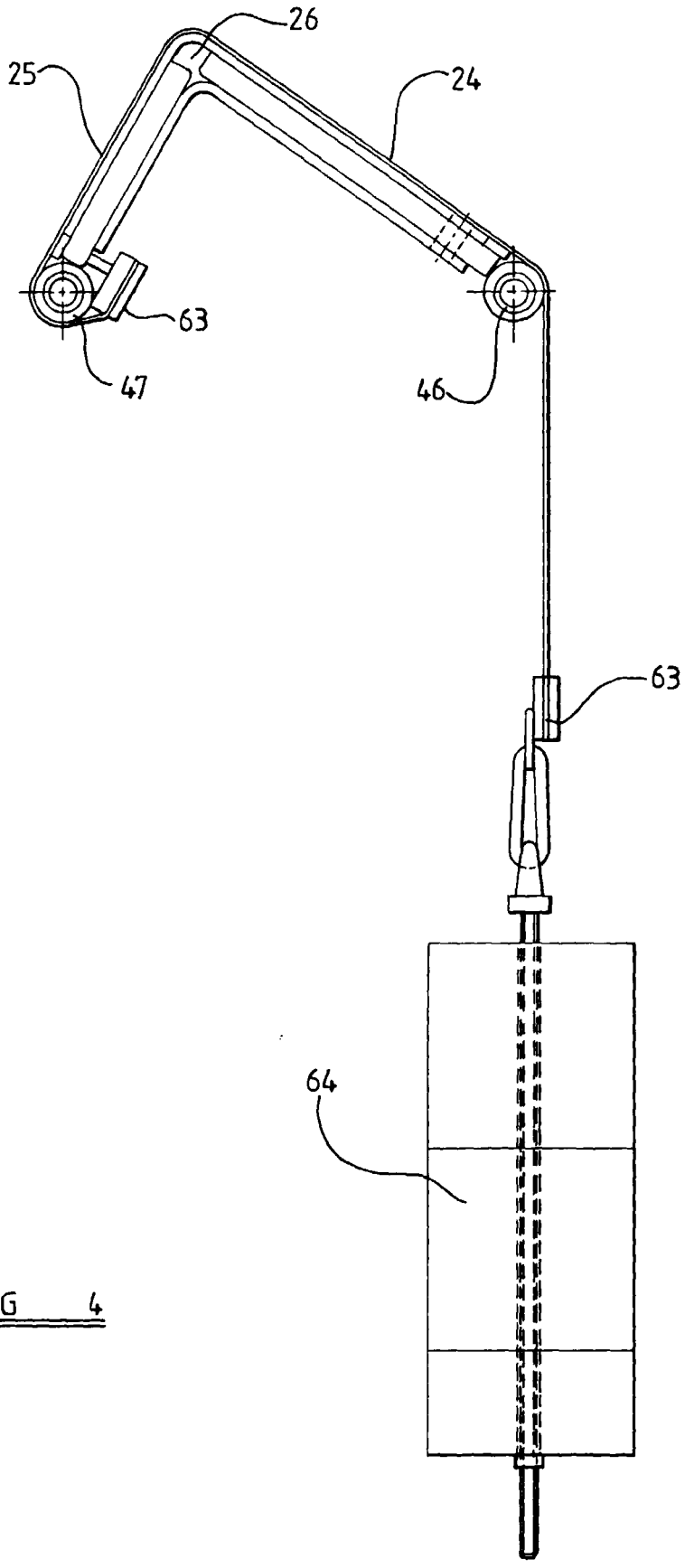

FIG 4

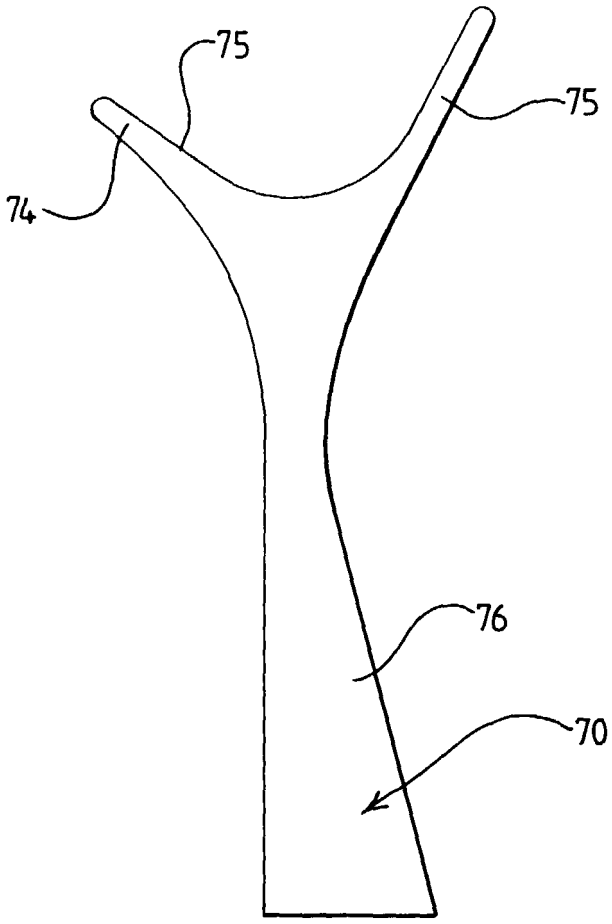

FIG 5