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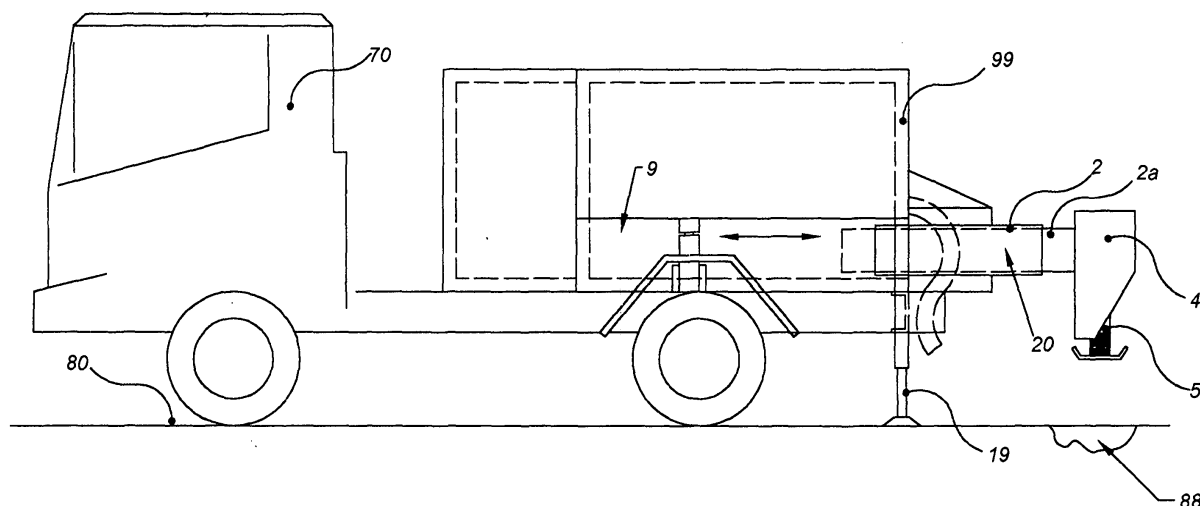
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(54) **Apparatus for closing potholes, cracks and/or openings of the road surface**

(57) The proposed apparatus (100) for closing cracks, potholes and/or openings (88) includes: a series of tanks (1a, 1b, 1c) containing filling material; a working arm (2) aimed at supporting removably a working head (4); actuator means for moving the working arm (2) and

determining a correct positioning of the working head (4) with respect to the cracks, potholes and/or openings (88) being closed; compacting means (5), supported by the working head (4) and aimed at compacting the filling materials put inside the (88).

Fig.1



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Description

[0001] The present invention relates to the technical field concerning working machines for road surface maintenance.

[0002] At present, the potholes formed in the road surface are closed by groups of workers, usually equipped with manual and/or pneumatic tools.

[0003] The workers close the potholes by first filling them with gravel and/or crushed stone, spreading them with a substantially uniform film of tar and/or bitumen and then compacting manually the so obtained mixture, usually with shovels.

[0004] In some cases, the mixture is compacted by vibration compactors, operated manually by the workers.

[0005] The maintenance of the road surface according to these known techniques, is not particularly efficient and lasting, mainly because of insufficient compacting of the mixture gravel (and/or crushed stone) - tar (and/or bitumen), which does not allow to eliminate completely the empty spaces present in the mixture and does not ensure best anchorage of the mixture to the potholes edges, thus requiring frequent maintenance operations.

[0006] Another method for closing potholes uses mechanical compactors, usually vibrating rolls, which improve the duration of the closing work.

[0007] However, this working procedure uses different vehicles, in particular one for transporting bitumen/ gravel, another for transporting the emulsion and a further for transporting the vibrating compacting roll, which consequently requires a lot of people and vehicles.

[0008] The document WO 90/02844 proposes an apparatus, supported by a working vehicle, equipped with tanks of bitumen, gravel and other materials for filling the potholes.

[0009] These tanks are connected, by corresponding pipes, with a working head, situated in front of the vehicle, equipped with pad or roll compacting means.

[0010] The head is also equipped with cutting means, aimed at trimming the edges of the potholes before their filling, and with corresponding means for removing the wastes remaining after the trimming.

[0011] Likewise, the document EP 0.560.021 proposes an apparatus supported by a working vehicle, which includes: a plurality of tanks, aimed at discharging filling materials in front of the vehicle; scattering means, for distributing the filling materials near the potholes in the road surface; compacting means, for compacting materials positioned in the potholes.

[0012] The object of the present invention is to propose an apparatus for closing cracks, potholes and/or openings present in the road surface, which is able to compact and amalgamate the mixture for filling the cracks, potholes and/or openings, so as to reduce considerably the empty spaces in the mixture and assure its lasting anchorage to the walls of the cracks, potholes

and/or openings.

[0013] Another object of the present invention is to propose an apparatus, which can close the cracks, potholes and/or openings in the road surface in a substantially rapid and particularly efficient way, using a minimum number of workers and working vehicles.

[0014] A further object of the present invention is to propose an apparatus, which can close the cracks, potholes and/or openings in a wide range of different dimensions and present in the road surfaces characterized by different inclinations, ensuring high reliability and productivity standards in any working conditions.

[0015] The above mentioned objects are obtained in accordance with the contents of the claims.

[0016] The characteristic features of the invention will be pointed out in the following description of some preferred, but not exclusive embodiments, with reference to the enclosed drawings, in which:

- Figures 1, 2 are schematic correspondingly lateral and top view of a working vehicle equipped with the proposed apparatus;
- Figures 3, 4 are schematic, enlarged lateral and top views of the apparatus proposed by the present invention in some particularly significant working steps;
- Figures 5, 6 are schematic lateral views, in different scale, of a feeding system of the proposed apparatus according to two corresponding embodiments;
- Figure 7 is a schematic enlarged view of the particular W shown in Figure 6;
- Figure 8 is a schematic section view taken along the line A-A of Figure 7;
- Figures 9a, 9b are schematic front views of the feeding system in two particularly significant working configurations;
- Figures 10a, 10b are schematic lateral and top views of equipment of the apparatus proposed by the present invention;
- Figures 11a, 11b are schematic lateral views of another equipment of the apparatus proposed by the present invention;
- Figures from 12 to 16 are schematic perspective views of as many embodiments of the apparatus proposed by the invention.

[0017] With reference to the above figures, the general reference number 100 indicates the proposed apparatus for closing cracks, potholes and/or openings present in the road surface 80.

[0018] The apparatus proposed by the present invention, which can be mounted on a trailer or removably associated to a lorry, indicated with the reference 70 in the Figures, substituting the original loading platform/container, includes a plurality of tanks 1a, 1b, 1c, which are supported by a framework 99, and which contain materials for closing the cracks, potholes and/or openings 88.

[0019] Feeding means 10 are connected to the tanks 1a, 1b, and aimed at conveying the materials contained therein to the cracks, potholes and/or openings 88.

[0020] For example, the tank 1a, the biggest one, contains filling material of bigger grain, characterized by low percentage of tar, while the tank 1b, the smallest one, contains filling material of fine grain, for closing surface layer, with a high percentage of tar, consequently characterized by optimum compactness and stability.

[0021] Thus, there are two different tanks 1a, 1b containing filling materials characterized by different granule size, in function of their use.

[0022] The tank 1c, connected to a corresponding pump, contains tar emulsion, necessary for final covering of the cracks, potholes and/or openings 88, being closed.

[0023] The tar emulsion is usually spread by an operator by corresponding nozzle (Figure 2).

[0024] The means 10 for feeding tanks 1a, 1b include conveying means 11, which are situated near the bottoms of the tanks 1a, 1b, and which withdraw filling materials contained in the tanks

[0025] The feeding means 10 include also sorting means 13, which are situated downstream of the conveying means 11, and which allow the withdrawn filling materials to flow and which release them in the region of the cracks, potholes and/or openings 88 present on the road surface 80.

[0026] Means 14 for choking the flow of the filling materials, are situated between the conveying means 11 and the sorting means 13, so as to regulate the delivery rate of the filling materials to cracks, potholes and/or openings 88 (Figure 7).

[0027] The conveying means 11 are preferably formed by an Archimedean screw 11a, operated by corresponding activating means 12a, 12b, for example hydraulic, situated at one or the other end of the Archimedean screw 11a.

[0028] As shown in Figures 5, 6, the sorting means 13 are respectively formed by sloping chutes 13b and pipes 13a, for example rigid or semi-rigid, opening above, preferably near cracks, potholes and/or openings 88 to be closed.

[0029] With reference to Figures 7, 8 the choking means 14 include shutters 14a, which are operated automatically or manually by an operator, and which are aimed at adjusting the delivery rate of the filling materials coming from the tanks 1a, 1b.

[0030] Advantageously, the tanks 1a, 1b have moving walls 34, 35, which move continuously between inter-

mediate configurations included between two extreme configurations: of maximum opening R (Figure 9a), in which the walls define sections converging in direction of relative bottoms and allow the flow of filling materials; and closing configuration S (Figure 9b), in which the walls touch each other so that the tanks 1a, 1b get empty completely.

[0031] This conformation of the tanks 1a, 1b allows a maximum capacity for the tanks when the moving walls 34, 35 are in their maximum opening configuration R; while during the discharging of the materials contained in the tanks, the walls 34, 35 gradually move close to each other until they reach the closing configuration S, so as to avoid the so-called "tunnel effect" of the Archimedean screw 11a, and to assure the correct feeding of the latter.

[0032] Moreover, the apparatus 100 includes a working arm 2, carried by the framework 99, which supports removably a working head 4, to which means 5 are connected for compacting filling materials inside the cracks, potholes and/or openings 88.

[0033] The terminal sections of the pipes 13a and of the sloping chutes 13b can be supported or not by the working head 4, so that the latter controls or does not control their path during the discharge of the filling materials.

[0034] Likewise, the working head 4 can removably support also the nozzle 19a distributing the emulsion, in order to reduce the work for the operator.

[0035] The working arm 2 is operated to translate and/or to rotate with respect to the framework 99, by corresponding activating means, for example hydraulic, so as to allow correct positioning of the working head 4 and of the compacting means 5 with respect to the cracks, potholes and/or openings 88 being closed.

[0036] The framework 99 is equipped with stabilizing means 19, advantageously situated near the working arm 2, and aimed at dampening vibrations, to which the framework 99 and a lorry 70, connected thereto, are subjected during the working of compacting means 5, usually vibrating compactors.

[0037] The working head 4 is advantageously equipped with cutting means 6 and brush means 7, which allow perfect profile definition of the cracks, potholes and/or openings 88, which is advantageous for their correct and long lasting closing.

[0038] In particular, the cutting means 6, removably connected to the working head 4, or to the vibrating compactor 5, allow trimming of the edges of the cracks, potholes and/or openings 88 before their closing (Figures 10a, 10b).

[0039] More in detail, the cutting means 6 are fastened to the working head 4 during trimming of the edges of the cracks, potholes and/or openings 88, and subsequently, they are removed during the vibrating compactor 5 working step.

[0040] The brush means 7 have the task of removing the wastes remaining after the trimming in the cracks,

potholes and/or openings 88 before their closing, or of uniformly spreading sand on the last compacted layer, after the cracks, potholes and/or openings 88 have been closed.

[0041] With reference to Figures 11a, 11b, the brush means 7, advantageously hinged to the working head 4, are equipped with actuator means 40, for example hydraulic, hinged to the working head 4 and moving the brush means 7 from an operative configuration E, in which the latter act on the road surface (removal of wastes and/or spreading of sand), to an inoperative position F, in which the brush means 7 are deactivated and remain far from the road surface 80, by for example being arranged orthogonal with respect to the vibrating compactor 5.

[0042] With reference to the embodiment shown in Figures 3, 4, the free end 2a of the working arm 2 is rigidly fastened to a support plate 3, on which the working head 4 is mounted slidingly.

[0043] The working head 4 is operated for vertical movement with respect to the support plate 3, by corresponding actuator means 8, for example hydraulic means.

[0044] The framework 99 features also a guiding cylinder 20, articulated thereto, inside which the working arm 2 slides freely and is displaced and/or rotated by the above hydraulic actuator means, preferably formed by hydraulic jacks (7a, 7b) connected to the guiding cylinder 20.

[0045] The first jack 7a, fastened to the cylinder 20, moves the support plate 3, so as to make the hinged arm 2 to translate rigidly with respect to the framework 99.

[0046] The second jack 7b, hinged to the framework 99, drives the cylinder 20 into rotation, so as to make the hinged arm 2 to translate rigidly with respect to the framework 99.

[0047] As it is clearly seen from Figure 1, an internal chamber 9 is situated below the tanks 1a, 1b, 1c, containing the filling material.

[0048] The internal chamber 9 is aimed at receiving the working arm 2 during the translation and/or rotation of the latter with respect to the framework 99.

[0049] Otherwise, the working arm 2 can be telescopic, so as to avoid the presence of the internal chamber 9 and consequently to increase the space for the tanks 1a, 1b, 1c, which in this way can be more capacious without increasing the overall dimension of the apparatus.

[0050] According to other embodiments shown in Figures from 12 to 15, in which there is no internal chamber 9, a main upright 140 can be provided, connected to the framework 99 and operated into rotation, manually or by corresponding actuator means, for supporting rotatively the working arm 2.

[0051] With reference to the embodiments shown in Figures 12, 13, a capstan 15 is slidingly connected to the working arm 2 and its rope 15a is connected to the

vibrating compactor 5.

[0052] The capstan 15 is operated in such a way, as to maintain its rope 15a tense during the inoperative step of the vibrating compactor 5, as to support the latter, and to leave the rope 15a loose (indicated with broken line in Figure 12) during the operative step of the vibrating compactor 5, in order to avoid transmission of vibrations to the framework 99.

[0053] In the above embodiments, the task of the capstan 15 is obviously to support the weight of the vibrating compactor 5 during its inoperative step.

[0054] According to the same embodiments, the vibrating compactor 5 includes a control handle 5a, which allows an operator to activate the vibrating compactor 5, when the rope 15a is loose.

[0055] The handle 5 features controls, of hydraulic type, of forward and backward movement of the capstan 15 with respect to the working arm 2, as well as controls of lowering and raising of the rope 15a connected to the vibrating compactor 5.

[0056] According to the embodiment shown in Figure 13, the working arm 2 is made in one body, which allows a particularly wide action range, while in case shown in Figure 12, the working arm 2 is telescopic and is operated, by a third hydraulic jack 16, to extend and/or shorten, thus allowing a smaller dimension in case of non-use.

[0057] In any case, the capstan 15 is made slide inside a relative guide formed in the working arm 2, by manual control or automatically.

[0058] With reference to the embodiment shown in Figure 14, the working arm 2 carried by the main upright 140 includes a pair of stubs, first 2a and second 2b, hinged to each other, one of which being hinged to the main upright 140 and the other supporting the vibrating compactor 5, in this case without the control handle 5a.

[0059] In this case, actuator means 17, 17a, 17b, for example hydraulic, are connected respectively to the pair of stubs 2a, 2b, to the first stub 2a and to the vibrating compactor 5, and to the second stub 2b and to the main upright 140.

[0060] The actuator means 17, 17a, 17b generate rotations between the corresponding elements.

[0061] This embodiment allows the apparatus to be easily handled within small and medium action ranges, and allows it also to adapt to the conformation of the road surface 80.

[0062] With reference to the embodiment shown in Figure 15, the working arm 2 is hinged at one side to the main upright 140 and on the other side to the vibrating compactor 5.

[0063] Actuator means 18, 18a, for example hydraulic, operate the working arm 2 to rotate with respect to the vibrating compactor 5 and the main upright 140.

[0064] In this embodiment, the working arm 2 is telescopic, but it can also be made in one body.

[0065] This embodiment allows a wide intervention area and allows the apparatus to adapt to the road sur-

face 80 conformation.

[0066] With reference to the embodiment shown in Figure 16, the lorry 70, on which the apparatus 100 is mounted, is equipped with a vibrating roll 50, in this case situated in the lorry fore part, connected to the lorry structure and positioned near the road surface 80.

[0067] The vibrating roll 50, which extends preferably along the whole length of the lorry 70, is coupled to a support plate 51, fastened in its fore part to the supporting longitudinal rods of the lorry 70.

[0068] The roll 50 is operated hydraulically and can be completely controlled from the lorry 70 cabin.

[0069] The roll 50, suitably equipped with a lifting system for inoperative transfers on the road, allows to compact the cracks, potholes and/or openings 88 of considerable dimensions, or tracks with substantially longitudinal extension.

[0070] It is easily understood from the above description of the embodiments shown in Figures from 12 to 16 that the absence of an internal chamber 9, which is not necessary for correct working of the working arm 2, allows to increase the room for tanks 1a, 1b, 1c, which in this way can be more capacious without increasing the overall dimension of the apparatus.

[0071] In order to improve the performance and automation of the proposed apparatus 100, there can be electronic map means, aimed at detecting and storing the forms of the cracks, potholes and/or openings 88 present on the road surface 80, so as to control the distribution of the filling materials contained in the tanks 1a, 1b, 1c, and consequently to close the cracks, potholes and/or openings.

[0072] One of the possible sequences of working steps for closing cracks, potholes and/or openings 88 on the road surface 80 will be described briefly, as an example, in the following.

[0073] First, the cutting means 6 are activated and possibly also the brush means 7 for removing the produced wastes, then the tar emulsion contained in the tank 1c is applied for the first time on the walls and on the bottom of the pothole 88 by the corresponding nozzle 19a.

[0074] Afterwards, most of the pothole 88 is filled with the filling material of bigger grain, contained in the tank 1a, and then the tar emulsion is applied for the second time by the nozzle 19a fed by the tank 1c, and preliminary compacting by the vibrating compactor 5 follows.

[0075] Then, the pothole 88 is entirely filled with the filling material with fine grain contained in the tank 1b, and then, the tar emulsion is applied for the third time and later, the final compacting by the vibrating compactor 5 follows.

[0076] When the closing is finished, the sand can be spread, possibly by the use of the brush means 7.

[0077] The proposed apparatus for closing cracks, potholes and/or openings present on the road surface, in its many described embodiments, allows compacting and mixing of the filling mixture introduced in the cracks,

potholes and/or openings.

[0078] It is also to be pointed out that this apparatus allows to reduce considerably the empty spaces in the mixture, making it more compact and resistant to mechanical and/or atmospheric stresses, and assures its lasting anchorage to the walls and the bottoms of the cracks, potholes and/or openings.

[0079] The cracks, potholes and/or openings present on the road surface can be closed in a rapid and particularly efficient way, and it requires a minimum number of workers, who can easily control each working step by a simple control board connected to the apparatus proposed by the invention.

[0080] The extreme versatility of the proposed apparatus, in its many embodiments, allows to close cracks, potholes and/or openings of dimensions variable within a wide range, also present on road surfaces characterized by different inclinations, assuring high reliability and productivity standards in any working conditions.

Claims

1. Apparatus for closing cracks, potholes and/or openings on the road surface including: at least one tank (1a, 1b, 1c), aimed at containing material for closing said cracks, potholes and/or openings (88); feeding means (10), connected to said tank (1a, 1b, 1c) for conveying the material contained in said tank (1a, 1b, 1c) to the cracks, potholes and/or openings (88); **characterized in that** it includes:

at least one working arm (2), carried by a framework (99) of the apparatus (100) for supporting removably a working head (4) for closing of said cracks, potholes and/or openings (88); actuator means, connected to said working arm (2), for driving the latter into translation and/or rotation with respect to said framework (99), to allow correct positioning of said working head (4) with respect to said cracks, potholes and/or openings (88) being closed; compacting means (5), supported by said working head (4), for compacting said materials put inside the corresponding cracks, potholes and/or openings (88).

2. Apparatus according to claim 1, **characterized in that** it includes cutting means (6), supported removably by said working head (4) for trimming the edges of said cracks, potholes and/or openings (88) being closed.
3. Apparatus according to claim 1 or 2, **characterized in that** it includes brush means (7), supported removably by said working head (4) for removing the wastes from said cracks, potholes and/or openings (88) being closed, or for spreading powder sub-

stances on the road surface (80).

4. Apparatus according to claim 1, or 2, or 3, **characterized in that** it includes a support plate (3), rigidly fastened to the free end (2a) of the working arm (2) and supporting slidably said working head (4), and **in that** the latter is operated to translate with respect to said support plate (3) by corresponding actuator means (8). 5
5. Apparatus according to claim 4, **characterized in that** it includes a guiding cylinder (20), hinged to said framework (99), with said working arm (2) sliding in said guiding cylinder (20) and being operated into translation and/or rotation by the above actuator means. 10
6. Apparatus according to claim 5, **characterized in that** said actuator means include: at least one first jack (7a), which is fastened to said cylinder (20), and whose shaft is connected to said support plate (3), so as to drive said articulated arm (2) to translate with respect to said framework (99); at least one second jack (7b), which is hinged to said framework (99) and whose shaft is articulated to said cylinder (20), so as to drive said working arm (2) to rotate with respect to said framework (99). 15
7. Apparatus according to claim 4, or 5, or 6, **characterized in that** the lower part of the framework (99) includes an internal chamber (9) for receiving said working arm (2) during the translation and/or rotation of the latter with respect to said framework (99). 20
8. Apparatus according to claim 1, or 2 or 3, **characterized in that** it includes a main upright (140), connected to said framework (99) and operated into rotation by corresponding actuator means, for supporting rotatingly the working arm (2). 25
9. Apparatus according to claim 8, **characterized in that** it includes at least one capstan (15), slidably connected to said working arm (2), with the corresponding rope capstan (15a) being connected to the compacting means (5); said capstan (15) being operated in such a way, as to maintain its rope (15) a tense during the inoperative step of the compacting means (5), as to support the latter, and to leave the rope (15a) loose during the operative step of the compacting means (5), in order to avoid the transmission of vibrations to the framework (99). 30
10. Apparatus according to claim 9, **characterized in that** it includes a control handle (5a), which is connected to said compacting means (5) and which allows an operator to activate said compacting means (5), when the rope (15a) is loose. 35

11. Apparatus according to claim 9 or 10, **characterized in that** said working arm (2) is telescopic and is operated to extend and/or shorten by at least one third jack (16). 40
12. Apparatus according to claim 9, or 10, or 11, **characterized in that** said capstan (15) is made slide, manually or automatically, inside a relative guide, made in said working arm (2). 45
13. Apparatus according to claim 8, **characterized in that** said working arm (2), carried by said (140), includes a plurality of stubs (2a, 2b), hinged one to another, with at least one of said stubs being articulated to said (140) and at least one of them carrying said compacting means (5), and **in that** it includes actuator means (17, 17a, 17b) connected respectively to adjacent stubs (2a, 2b), to one stub (2a) and to said compacting means, and to one stub (2b) and the main upright (140), with said actuator means being aimed at generating between the corresponding elements. 50
14. Apparatus according to claim 8, **characterized in that** said working arm 2 is articulated on one side to said main upright (140) and on the other side to said compacting means (5), and **in that** it includes actuator means (18, 18a), connected to said arm (2) and respectively to said compacting means (5) and to said main upright (140), said actuator means (18, 18a) being aimed at generating between the corresponding elements. 55
15. Apparatus according to claim 14, **characterized in that** said working arm (2) is telescopic.
16. Apparatus according to any of the previous claims, **characterized in that** it includes a plurality of tanks (1a, 1b, 1c), fastened to said framework (99), containing materials for closing said cracks, potholes and/or openings (88), which are to be conveyed, by corresponding feeding means (10), to the cracks, potholes and/or openings (88) in the road surface (80).
17. Apparatus according to claim 16, **characterized in that** said feeding means (10) include: conveying means (11), situated in correspondence to the bottoms of the tanks (1a, 1b) and withdrawing from the latter said filling materials for closing said cracks, potholes and/or openings (88); sorting means (13), situated downstream of the conveying means (11), and which allow the withdrawn filling materials to flow and which release them into the cracks, potholes and/or openings (88) present on the road surface (80), without interfering with said compacting means (5).

18. Apparatus according to claim 17, **characterized in that** it includes means (14) for choking the flow of the filling materials, said choking means being situated between the conveying means (11) and the sorting means (13), so as to regulate the delivery rate of the filling materials to the cracks, potholes and/or openings (88).
19. Apparatus according to claim 17 or 18, **characterized in that** said conveying means (11) include at least one Archimedean screw (11a), operated by corresponding activating means (12a, 12b), situated at one or the other end of the Archimedean screw (11a).
20. Apparatus according to claim 17, or 18 or 19, **characterized in that** said sorting means (13) includes pipes (13a) or sloping chutes (13b), opening near said cracks, potholes and/or openings (88).
21. Apparatus according to claim 18, or 19, or 20, **characterized in that** said choking means (14) include shutters (14a), which are operated automatically or manually, and which are aimed at adjusting the delivery of the materials for closing said cracks, potholes and/or openings (88).
22. Apparatus according to one of the claims from 17 to 21, **characterized in that** said tanks 1a, 1b, containing said materials for closing said cracks, potholes and/or openings (88), have moving walls (34, 35), which move according to a sequence of intermediate configurations between two extreme configurations: a maximum opening (R) configuration, in which the walls define sections converging in direction of relative bottoms and allow the flow of filling materials; and a closing configuration (S), in which the walls touch each other and allow the tanks (1a, 1b) to empty completely.
23. Apparatus according to claim 7 and 16, **characterized in that** said internal chamber (9), situated in the lower part of said framework (99), is positioned below said tanks (1a, 1b, 1c).
24. Apparatus according to claim 3, **characterized in that** said brush means (7) are articulated to said working head (4), and **in that** it includes actuator means (40), hinged to the working head (4) and moving the brush means (7) from an operative configuration (E), in which the latter remove wastes from said cracks, potholes and/or openings (88) or spread powder substances to said road surface (80); to an inoperative position (F), in which the brush means (7) are deactivated and remain far from the road surface (80), substantially orthogonal with respect to said compacting means (5).
25. Apparatus according to any of the previous claims, **characterized in that** said compacting means (5) include a vibrating compactor (5).
26. Apparatus according to claim 1, **characterized in that** it includes a vehicle (70), supporting firmly the apparatus (100), and **in that** it includes a vibrating roll (50), connected to the vehicle (70) framework and situated near the road surface (80).
27. Apparatus according to claim 26, **characterized in that** said vibrating roll (50) is situated in the fore part of said vehicle (70) with respect to the movement direction thereof..
28. Apparatus according to claim 4, or 5, or 6, or 7, **characterized in that** said working arm (2) is telescopic or made in one body.
29. Apparatus according to any of the previous claims, **characterized in that** it includes electronic map means, aimed at detecting and storing the forms of the cracks, potholes and/or openings (88) present on the road surface (80), so as to control the distribution of the filling materials from the tanks (1a, 1b, 1c) for closing cracks, potholes and/or openings (88).

Fig. 1

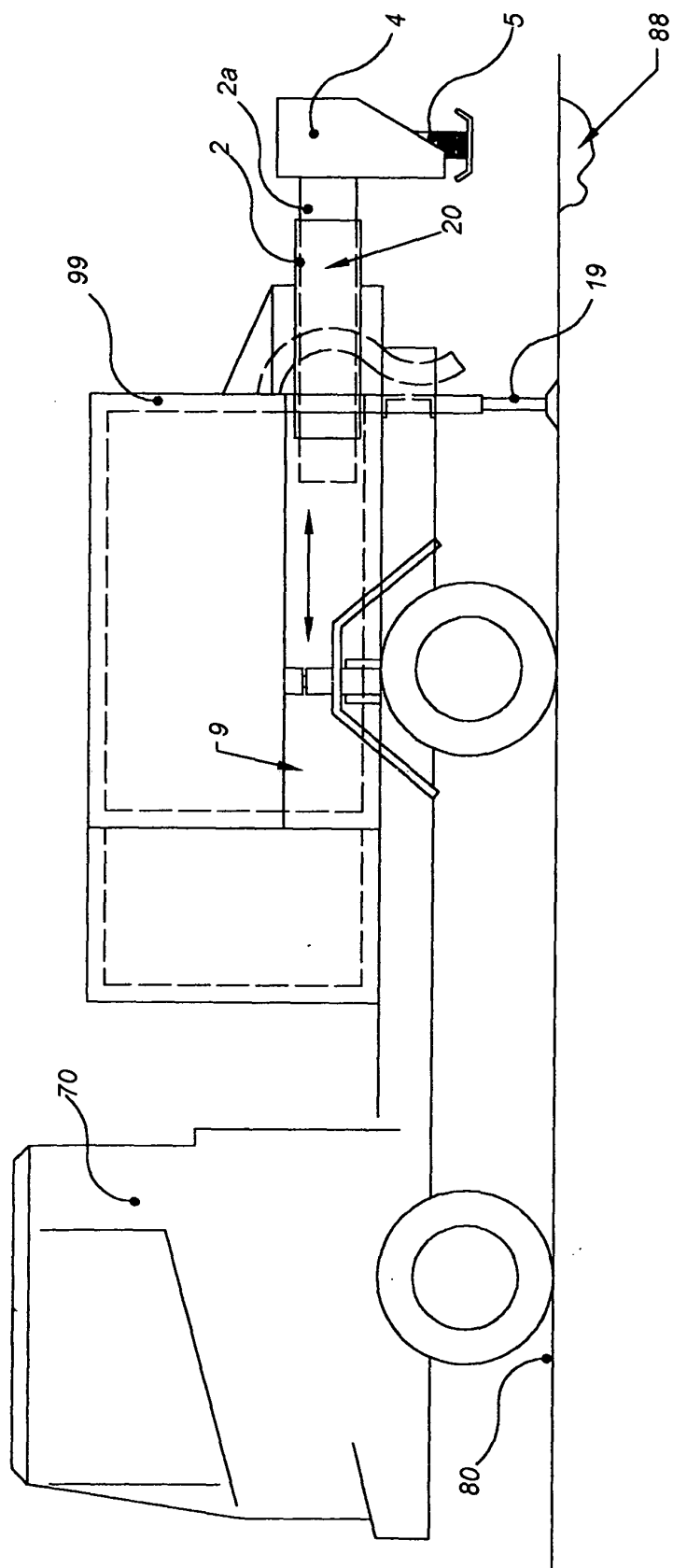
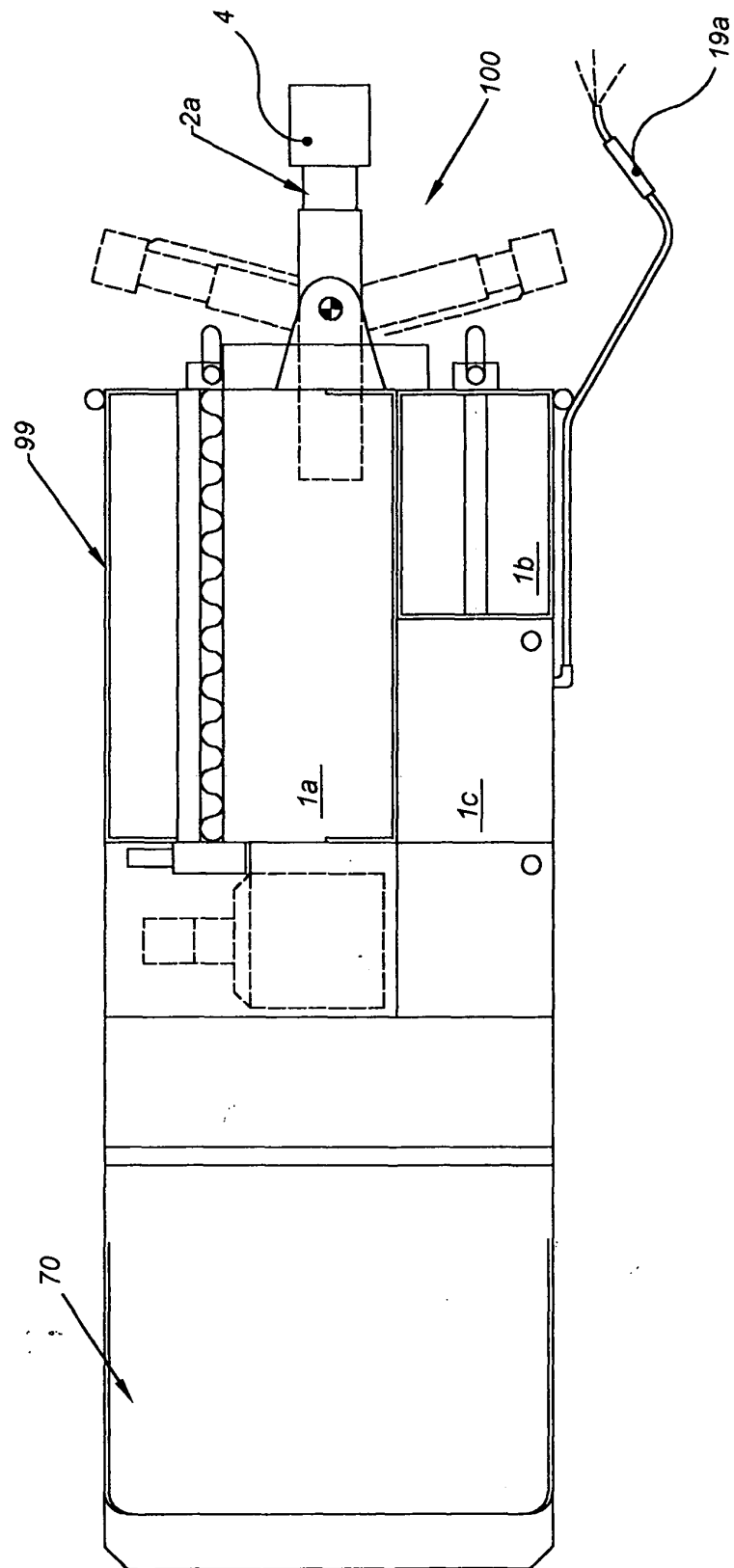


Fig.2



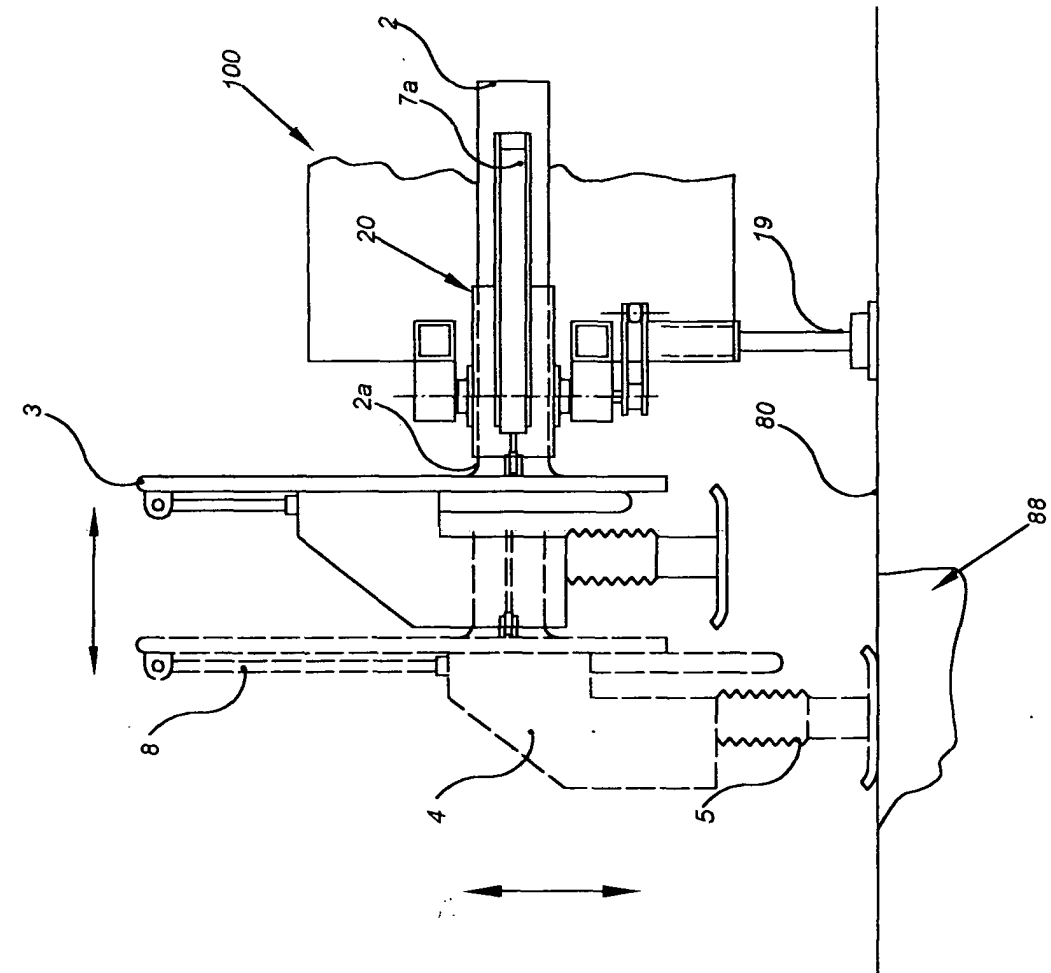


Fig. 3

Fig.4

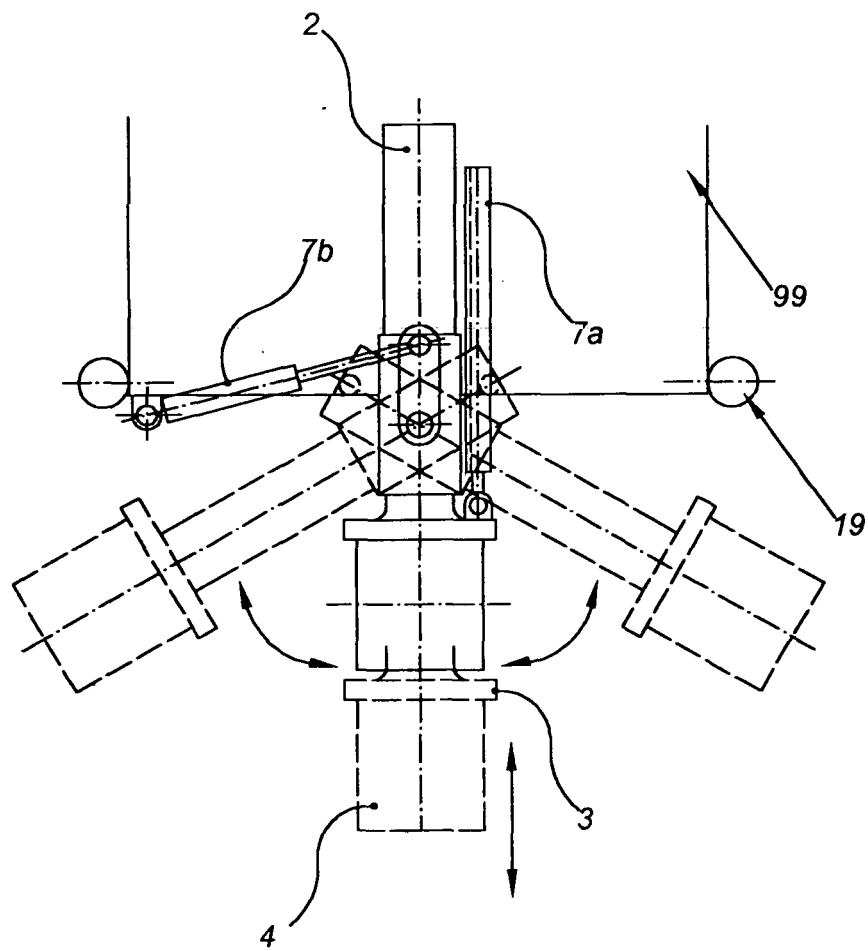


Fig.5

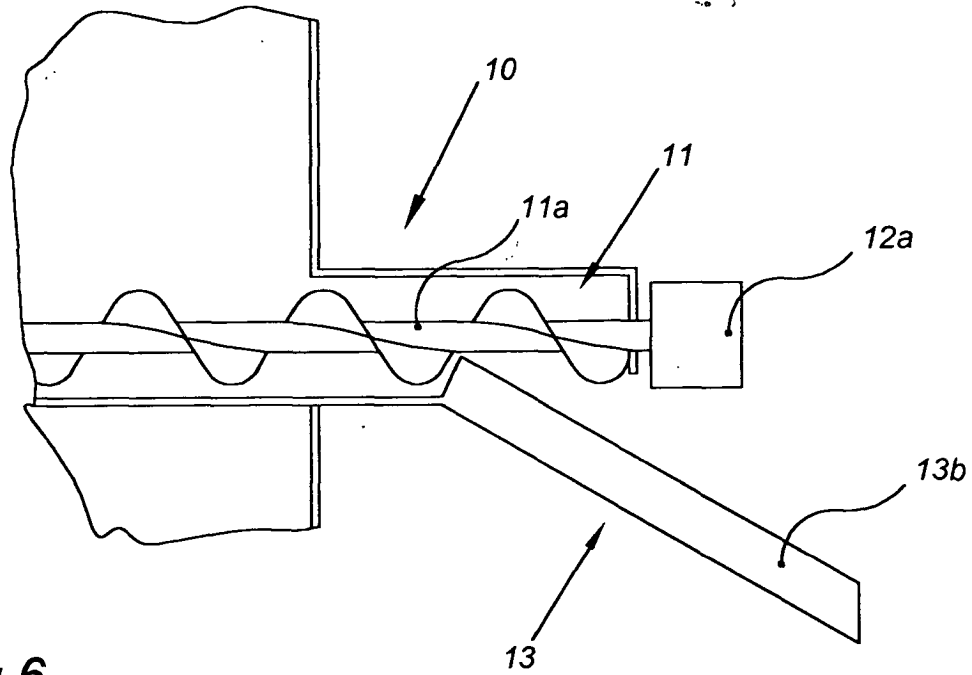


Fig.6

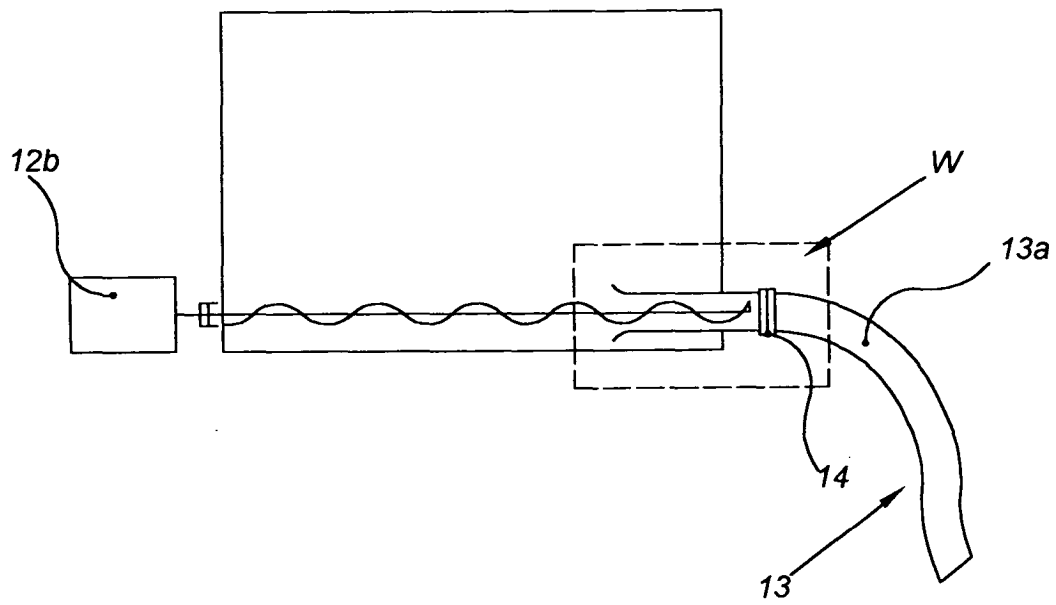


Fig.7

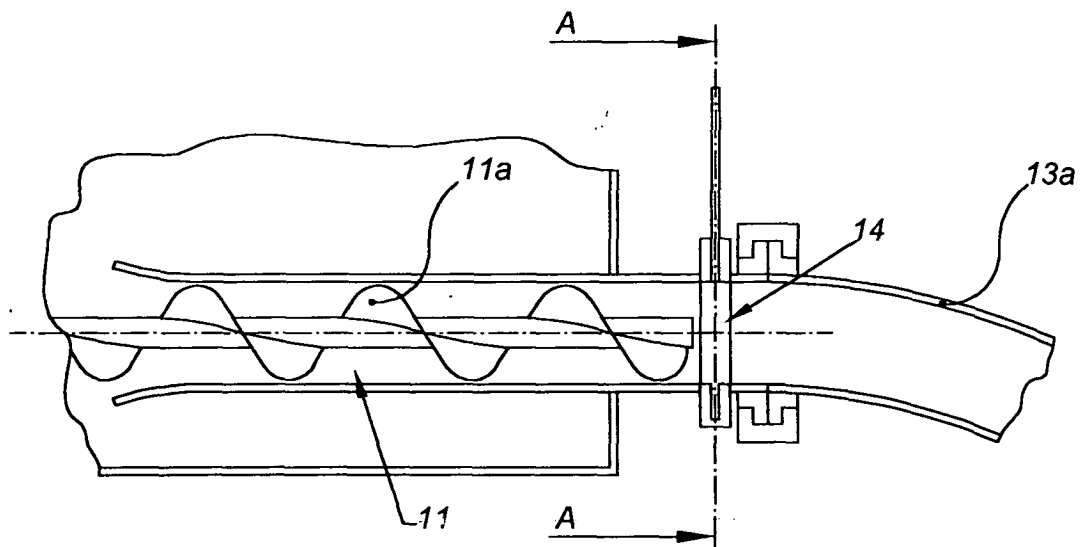


Fig.8

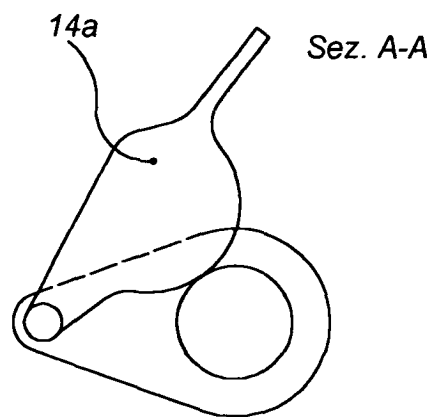


Fig.9a

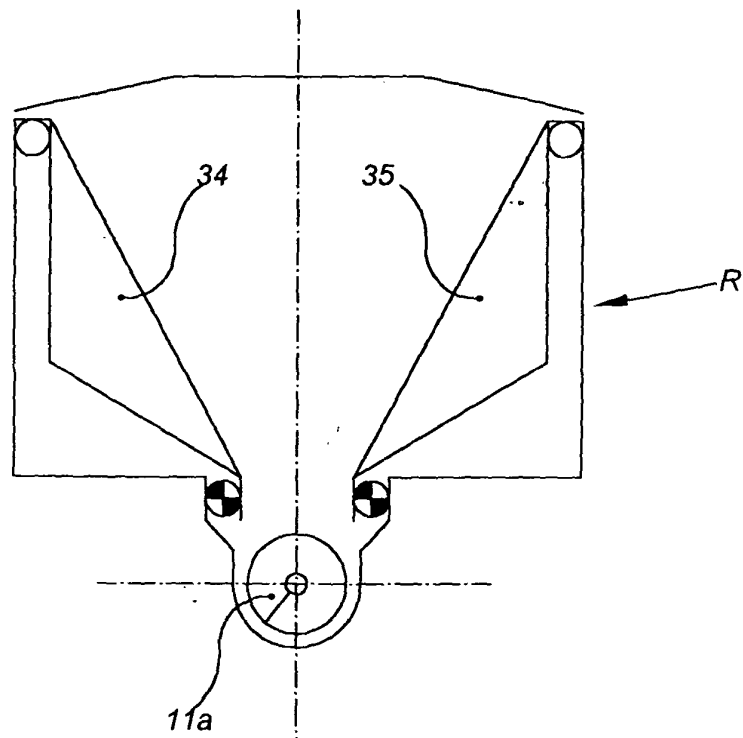


Fig.9b

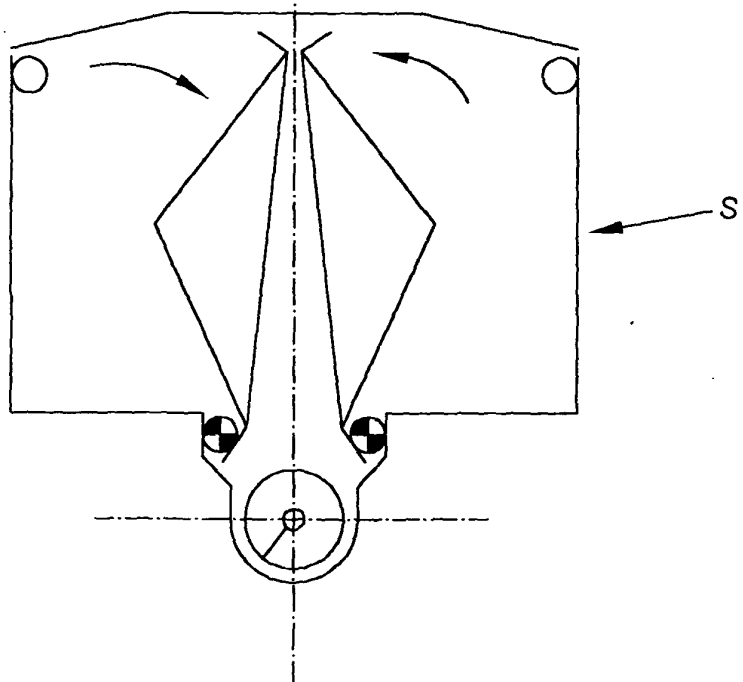


Fig.10a

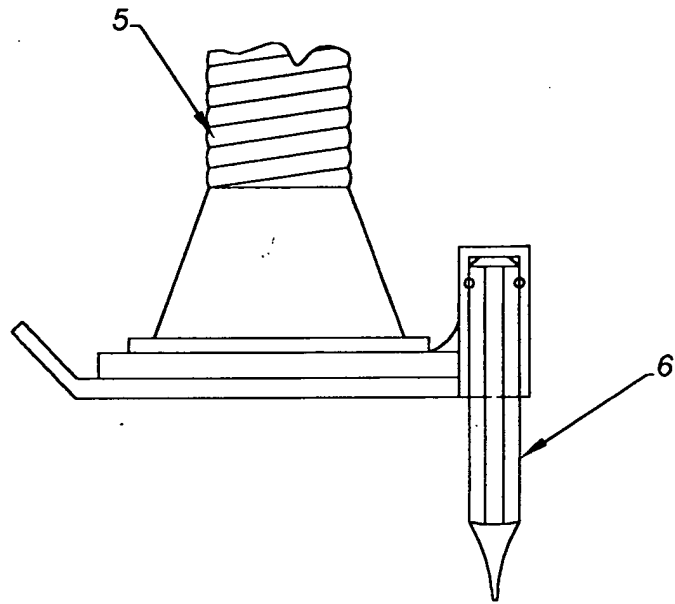


Fig.10b

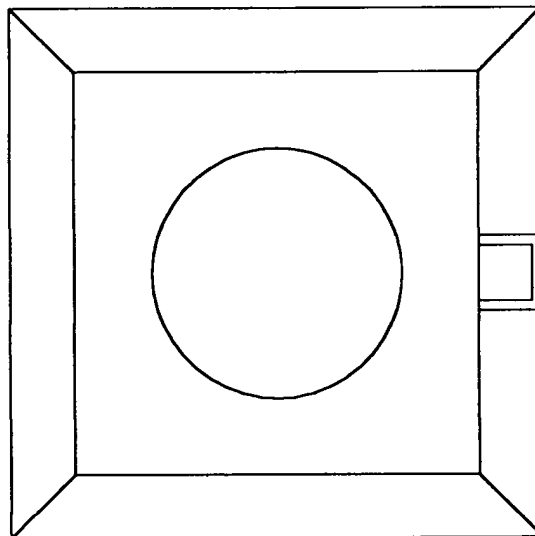


Fig. 11b

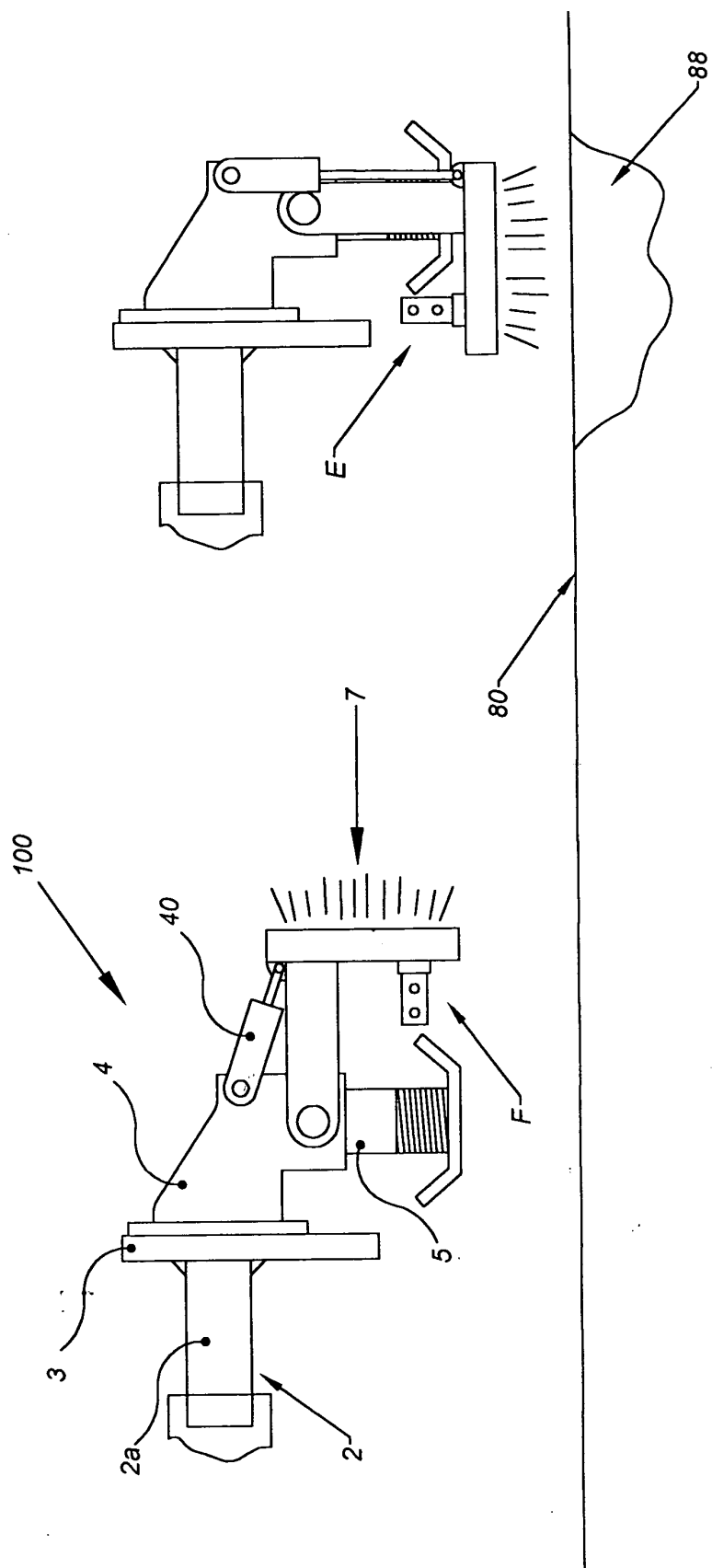
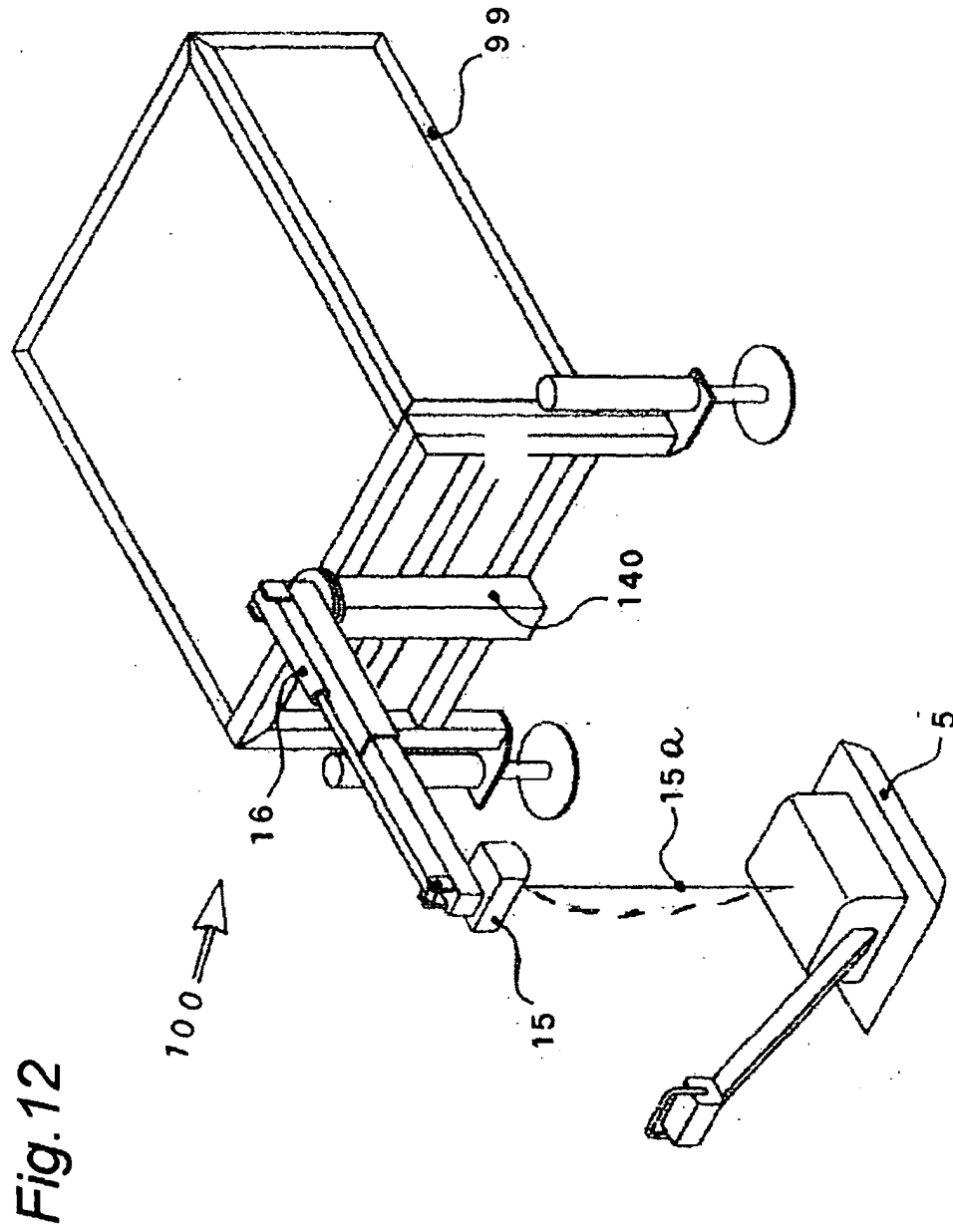
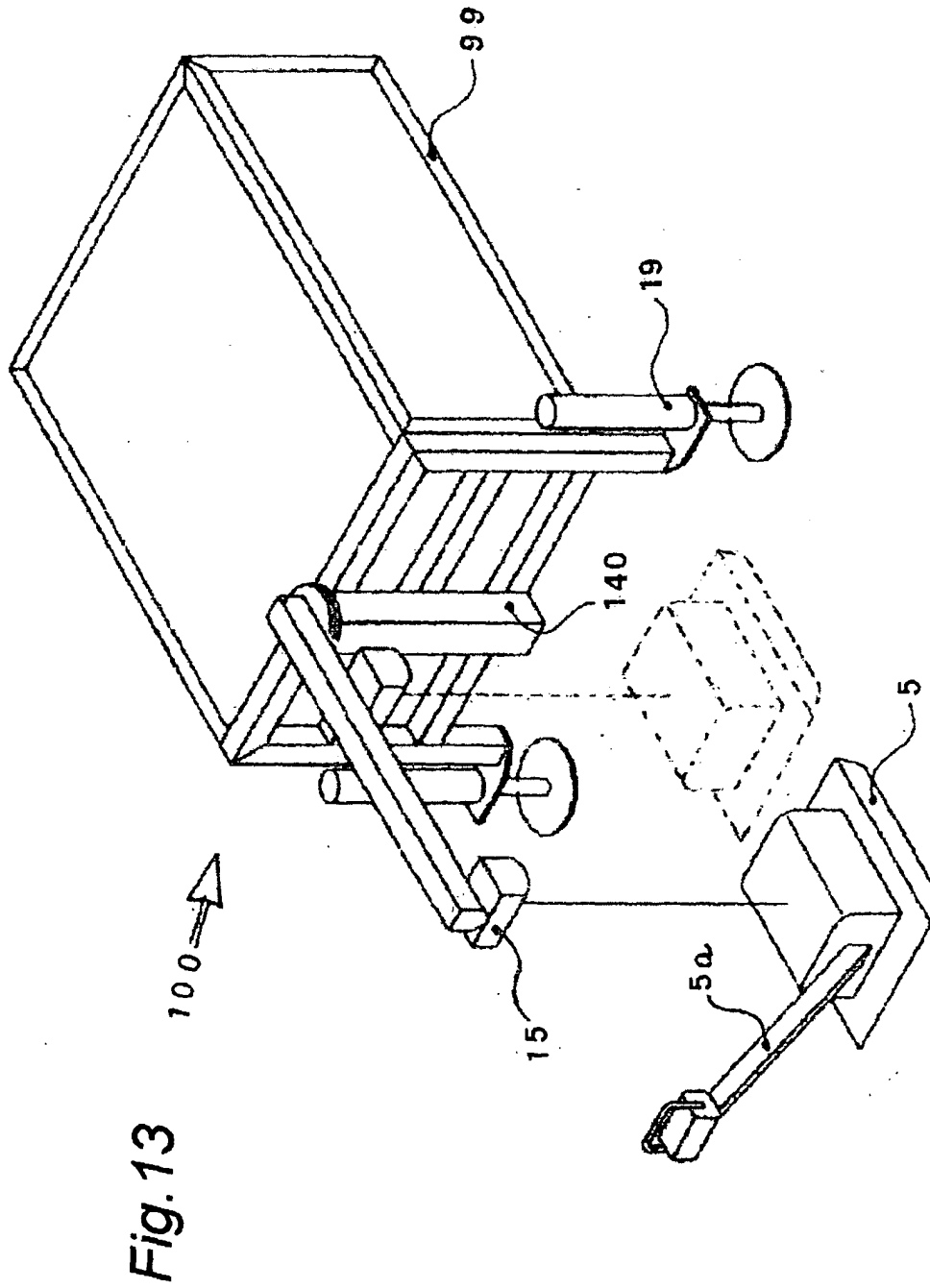


Fig. 11a





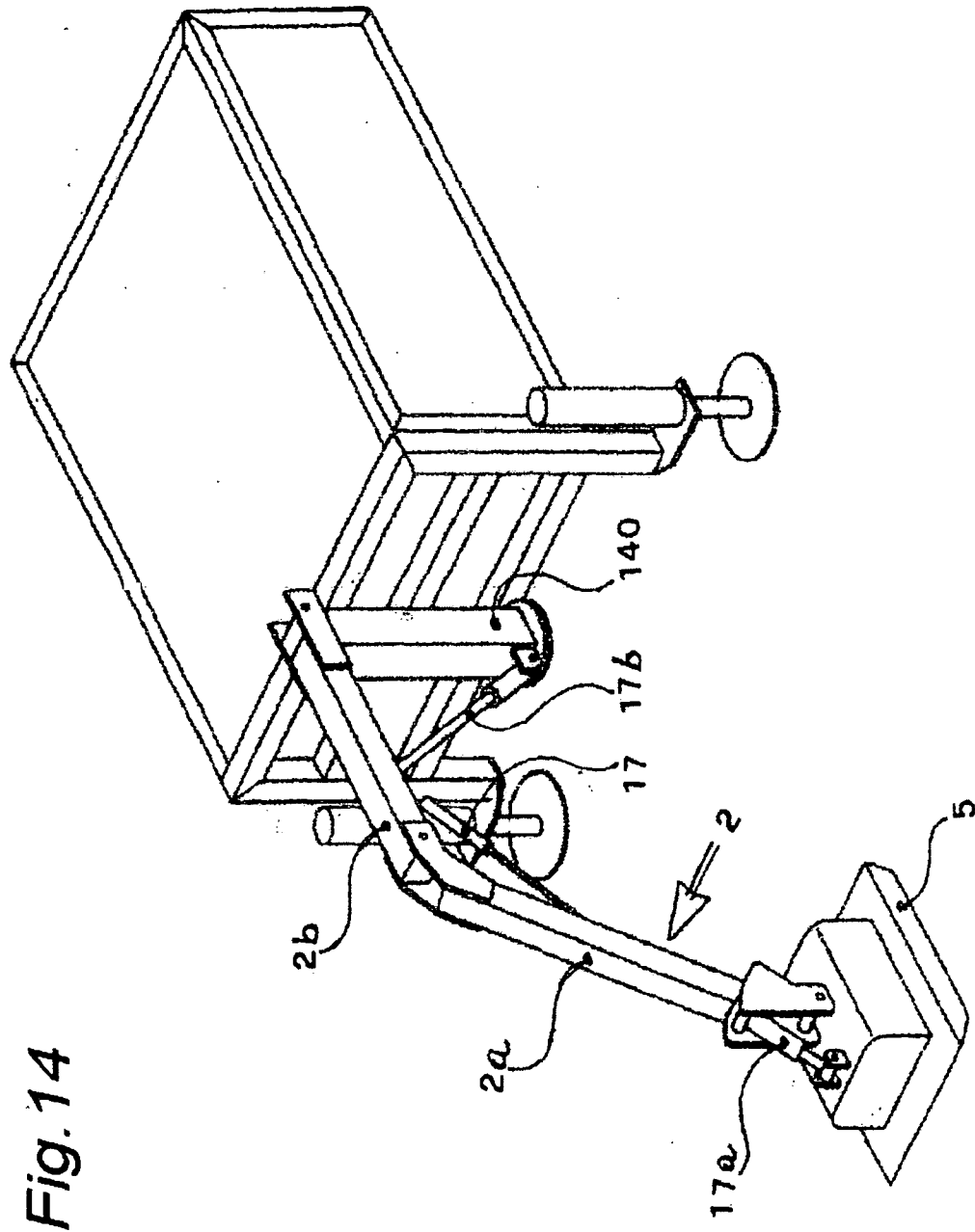


Fig. 14

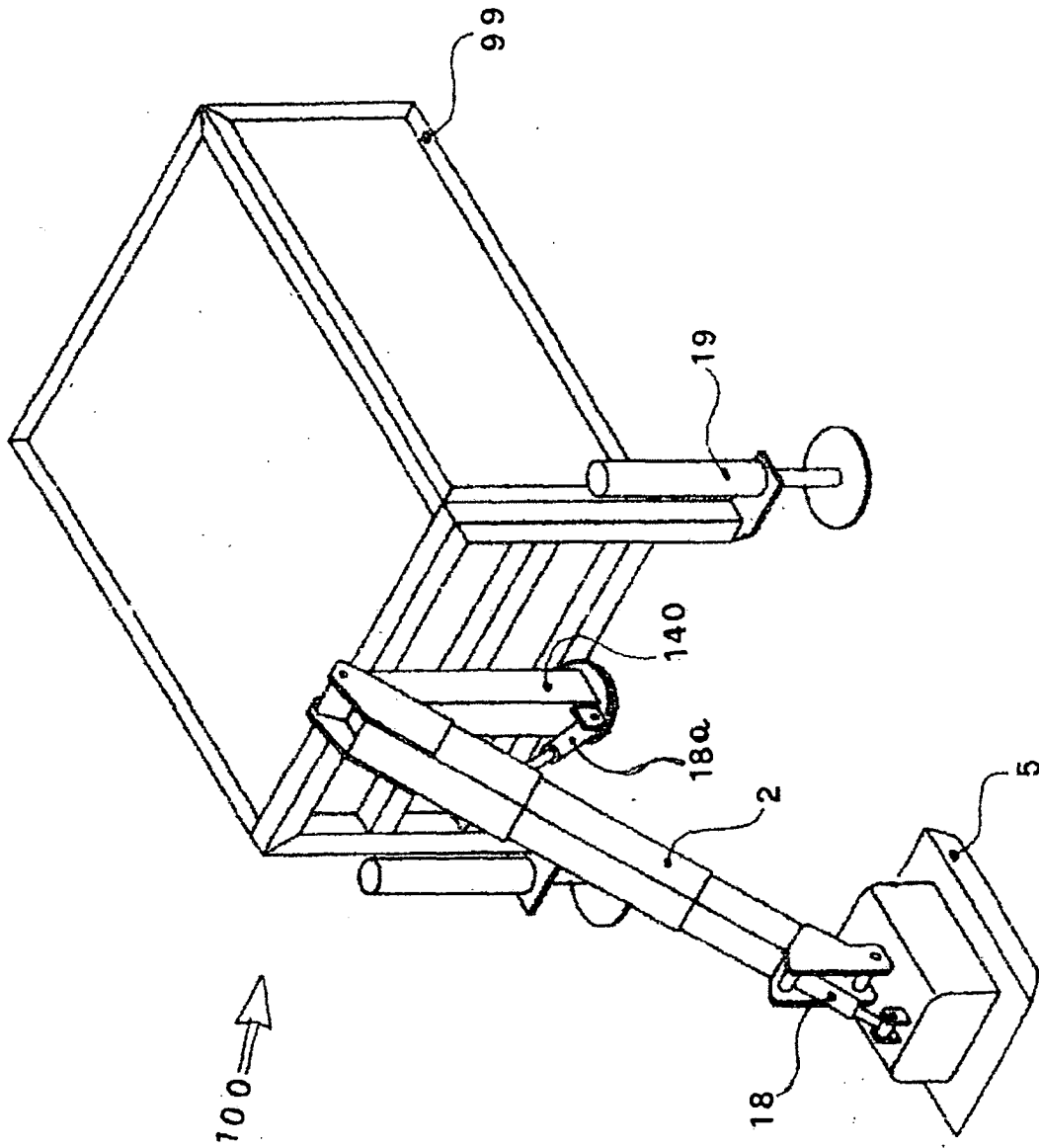


Fig. 15

Fig. 16

