

(19) **DANMARK**

(10) **DK/EP 3623533 T3**



(12)

Oversættelse af europæisk patentskrift

Patent- og
Varemærkestyrelsen

-
- (51) Int.Cl.: ***E 02 F 5/10 (2006.01)*** ***E 02 F 5/08 (2006.01)*** ***E 02 F 5/12 (2006.01)***
E 02 F 5/14 (2006.01)
- (45) Oversættelsen bekendtgjort den: **2022-09-26**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2022-07-20**
- (86) Europæisk ansøgning nr.: **19198557.1**
- (86) Europæisk indleveringsdag: **2017-08-18**
- (87) Den europæiske ansøgnings publiceringsdag: **2020-03-18**
- (30) Prioritet: **2016-09-08 AT 507972016**
- (62) Stamansøgningsnr: **17764317.8**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **LAYJET Micro-Rohr Verlegegesellschaft m.b.H., Ebersdorf 230, 8273 Ebersdorf, Østrig**
- (72) Opfinder: **Dunst, Wolfgang, Panoramagasse 186/1, 8224 Kaindorf, Østrig**
- (74) Fuldmægtig i Danmark: **Plougmann Vingtoft A/S, Strandvejen 70, 2900 Hellerup, Danmark**
- (54) Benævnelse: **KABELLÆGNINGS-INDRETNING OG -FREM GANGSMÅDE**
- (56) Fremdragne publikationer:
EP-A1- 0 585 188
EP-A1- 2 239 377
FR-A1- 2 722 809
US-A- 4 812 078
US-A1- 2010 104 374

The present invention relates to a labour- and cost-effective device for the underground laying of cables, line, cable-drawing hoses, fluid hoses and/or the like.

For many reasons, there has long been a tendency for the avoiding laying of
5 cables, lines or hoses above ground or via masts, but to lay them in the ground.

In this way, the advantage arises that no mast substructure foundations, for example, which have a hindering effect on agricultural activity, no masts and overhead lines which disturb the view and landscape are necessary anymore and the increasingly intensive requirements of environmental protection for the reduction of electrosmog can
10 be met.

Obviously, the underground laying of, for example, high-voltage cables entails not inconsiderable increases in costs, and accordingly there is no lack of attempts to keep them under control by rationalising the method of laying cables, in particular by reducing the amount of human labour hitherto required.

Regarding the topography of the routing of lines, in particular light guide cables, in rural areas, it has proved to be advantageous, particularly in terms of avoiding excavation and construction work which interferes with field work on the one hand and the most effective possible method on the other, to lay cables and lines below the verges running alongside roads and paths, which in itself has the inherent disadvantage that the
15 laying distance is usually greater, but ultimately the main advantage is that it is possible to work with conventional street-legal vehicles which can move on or along the roads without having to leave them.

When laying cables and/or the like below the verges running alongside traffic routes, there is no need for the opening and restoration of the road surface itself, the
20 vehicles with the laying equipment move slowly along the roadside and thus only minimally obstruct normal road traffic during cable laying work.

The hitherto usual procedure for subsoil cable-laying essentially consists of cutting a narrow trench with the required or desired laying depth into the subsoil by means of a wheel milling cutter, depositing the ground surface material milled out in this
30 connection laterally and the cable and/or the like, preferably together with a warning tape, is laid the trench in the correct position, after which first cable sand is introduced into the trench with the embedding of the laid cable and/or the like, and then the milled ground surface material previously deposited laterally to the trench is reintroduced into

the trench, and optionally at least compacted from above.

Hitherto, the creation of the cable trench, e.g. by means of an excavator shovel and the lateral deposition of the incidental ground surface material have been carried out separately first, after which the cable drum, which has been brought up on a vehicle, is mounted on an unwinding frame positioned above the trench and is pulled out from there by the cable laying team and laid in the trench, then the cable is embedded in the trench by means of mostly manual shovelling of cable sand and finally the open trench is filled in with the previously excavated ground surface material by means of shovels, also manually.

The following documents are mentioned in this field in the state of the art:

FR 2 722 809 A1, EP 2 239 377 A1, US4812078 A, US3203188 A, US5743675 A, DE 2504598 A1, US2010104374 A1, US3332249 A, GB410900 A, US6189244 B1, US4871281 A, US6457267 B1, DE 102014105577 A1, US2015252551 A1 and JP S5829924 A.

The basic aim of the invention is to conduct the described steps of cable laying as part of a continuous laying process with as little manual labour as possible and with comparatively considerably less expenditure of time and physical effort.

One of the main aims of the present invention is to create a fast, highly flexible and at the same time compact cable-laying device which, for the first time, makes it possible to practically lay cables and/or flexible lines, along every traffic route of any, in particular winding, course, below their mostly narrow road strips or verges which do not pertain directly to the roadway, with precision and with as little expenditure as possible in terms of time and labour, but which, however, absolutely does not, in this connection, impair or otherwise damage the roadbed and the traffic surface, in particular the road surface.

Hence, the object of the invention is a drivable device for laying at least one (flexible) line, a cable of this type, a cable-drawing empty conduit or a fluid transport hose underground, below the traffic routes or verges or strips running alongside roads, wherein a narrow trench respectively having a desired laying depth can be cut into the ground surface of the verge by means of a wheel milling cutter of a milling unit, the ground surface material milled out in the process is removed laterally, the cable or cables and the warning tape can be laid in the trench in the correct position, wherein fine particulate ground surface material or cable sand is introduced into the trench for embedding the introduced

line/cable or the like, and the milled-out ground surface material previously removed laterally can then be reintroduced into the latter and compacted,

- wherein the cable to be laid can be drawn out by a vehicle driving at low speed and can be inserted into the cable trench just created synchronously with the driving speed of the front vehicle, and

- wherein a quantity of fine particulate material or cable sand, matched to the respectively current driving speed, can be introduced into the cable trench continuously via an ejected ditch or channel routed above the cable trench, which is characterized,

- in that - in particular for laying cables along a curved traffic route - the front vehicle which is designed as a carrier vehicle having a rear-side support or support frame which has a side extension unit having a milling unit with cutting wheel articulately connected to it and a trailing formwork and cable laying unit following the latter overall forms a drivable, curved, mechanical complete or compact unit,

within which the milling unit and with it the cutting wheel are laterally outwardly offset relative to the front vehicle, thus can be positioned laterally protruding over the lateral contour of the front vehicle, is laterally pivotably connected to the front vehicle or to its support via a first articulation or a swivel joint on a side extension unit with a substantially vertical axis of rotation relative thereto, laterally pivotable towards both sides, respectively at an angle of up to $\pm 25^\circ$, in particular up to $\pm 20^\circ$,

- wherein the trailing formwork and cable insertion and cable sand introduction unit following the milling unit is in turn also connected to the milling unit via a second articulation or a swivel joint having a substantially vertical axis relative thereto, laterally pivotable towards both sides, respectively towards both sides at an angle of up to $\pm 25^\circ$, in particular up to $\pm 20^\circ$.

In order to keep the traction vehicle, i.e. the front vehicle with all its wheels, securely on the fixed roadbed and, in particular, fully on the road surface during the laying process, and thus to protect it safely, but at the same time to cut in the cable trench into the verge, it is advantageously provided that the milling unit with cutting wheel, which can be pivoted laterally at an angle, is connected to a side extension unit connected to the front vehicle or its support frame, and can be adapted, preferably hydraulically, to the topographical conditions predetermined by the current verge to be cut out, and is linearly laterally displaceable with respect to the front vehicle - at least towards one side.

For the secure stability maintenance of the actual roadway substructure on the one hand and the cable trench itself during the laying process on the other hand, it has proved to be particularly beneficial to ensure that, in particular for the stabilisation and stability maintenance of the walls of each recently created trench, the trailing formwork and cable
5 insertion unit is equipped with bilateral formwork plates, which can optionally be configured to respective trench width in their distance from each other, and extends towards the cutting wheel of the milling unit, upwardly inclining in a concave curve, preferably up to approx. 10 cm, to the cutting wheel.

Since the composition and subsoil structure of the verges running alongside the
10 traffic routes is not known from the outset, and since severely disruptive blockage of the cutting wheel in the laying operation in the course of the milling-out of the trench, e.g. by boulders, rock, buried objects or the like, it is a significant advantage within the scope of the invention when the milling unit and/or its cutting wheel can be lifted, e.g. in the event of its being blocked by unyielding ground surface material, without the trailing formwork
15 and cable insertion unit, which is connected laterally pivotably with the milling unit, and which has its bilateral formwork plates which practically continuously secure the stability of the trench, having to change its height position in the trench.

In this case, it is most advantageous if a parallelogram mechanism for lowering or lifting the trailing formwork and cable insertion unit, in particular for lifting the milling
20 unit, optionally together with the cutting wheel, out of the trench in the event of a blockage, is connected to the rotary joint for the trailing formwork and cable insertion unit on the milling unit or on its housing on both sides.

In order to save on material and repair costs, it is provided according to the invention that a conveyor belt to be loaded with the excavated trench material is
25 associated with the cutting wheel of the milling unit laterally of the milling housing, which conveyor belt is followed by an elongated star screen, preferably obliquely upwardly inclining, having a plurality of freely rotating screening stars, arranged at different distances from each other, mounted on axes of rotation transverse to its transport direction, for the further transport of the verge ground surface, i.e. the trench material
30 excavated by the cutting wheel, backwards for the final backfilling of the cable trench just created.

In this connection, it is provided according to the invention that a conveyor belt for the removal of the trench fine particulate material separated from the trench coarse-

grade material by means of the star screen is arranged rearwards below the elongated star screen.

According to the invention, it is also provided that a fine sieve can be supplied with the fine particulate excavated material by means of the conveyor belt arranged below the star screen, and that the fine particulate trench material separated there, in particular
5 fine or ultrafine substantially sand-like, fine particulate trench material, can be used to supplement at least partially in place of separately supplied cable sand or in addition thereto for the embedding and reburial of the cable and/or line laid in the cable trench.

In order to enable a driving speed-adequate and synchronous introduction into the trench of ultrafine, trench sand-like cable and embedding material from the trench, it has
10 been proven to be advantageous according to the invention to ensure that the chute or ejected ditch guided via the trench for this in particular fine particulate, substantially sand-like trench particulate material, a height-adjustable underside opening bridging the cross-section of the chute, said opening being variable in its height, can be freely adjusted
15 in its height according to the requirement for fine particulate material per linear metre of trench and cable respectively for the embedding and reburial of cable per linear metre of trench and cable and/or line.

The object of the present disclosure is thus a device by means of which cables and various lines can be laid in the clearance space of a road without, for example, damaging
20 the asphalt roadway or rendering the road body unstable in any way in so doing.

This is achieved due to the usually narrow construction width in the range of approx. 30 cm as well as a trench width of for example 13 to 17 cm with the best possible protection of the lateral road guidance devices, e.g. reflector posts and road panels. The two swivel joints in the cable-laying compact unit render the laying of lines along the
25 curves of any road constructed in accordance with the guidelines easy.

The lateral extension of the milling unit and with it the entire compact unit over and onto the verge ensures that the front or carrier vehicle always moves on the load-bearing road body, while the lateral edge strip, i.e. verge, can be excavated. The attached trailing formwork unit, which is preferably connected via a parallelogram mechanism on
30 the swivel joint to the housing of the milling unit directly behind the cutting wheel, ensures that the road body cannot trickle out laterally and thus remains fully load-bearing and stable during the entire laying process.

In addition, the guide rollers inside the trailing formwork unit ensure the kink-free

laying of the cables or lines and ultimately enable the covering of the cables and/or lines through the introduction of sufficiently fine-grained excavation material and/or cable sand into the trench.

5 The milled-out material is deposited laterally on a two-part conveyor belt and re-introduced into the trench immediately behind the trailing formwork unit, whereby the trench is immediately closed again after the cable has been laid. This ensures that the stability of the road body is fully maintained throughout the laying process. Due to the screening of fine material, grains suitable for road construction can be produced on site, depending in each case on the material to be processed in each case.

10 The starting point and the further object of the disclosure is a cable laying method of the kind described at the beginning, which is characterized,

- in that a cable-laying train comprising two vehicles driving one behind the other at a small distance from each other, is moved forward along a stipulated cable laying section at any time, in particular along a street verge,

- 15 - wherein the first vehicle of which, driving at low speed, carries the cable drum supplying the cable and/or the like, and in this connection, excavates the cable trench by means of a trench milling cutter drive-connected to it, wherein the milled-out excavated material in each case is conveyed backwards by means of a conveyor belt laterally associated with this trench milling cutter,

- 20 - in that the cable and/or the like which is to be drawn off or drawn off from the cable drum synchronously with the travel speed of the first vehicle is laid in the cable trench just created,

- in that via an ejected ditch of the first vehicle, which is arranged at the rear and which is guided by the same with precision above the cable trench just created and the cable and/or the like laid therein,

- 25 - quantities of cable sand per linear metre of route section matching the current driving speed are continuously introduced through the ejected ditch in a manner lodging and embedding the cable and/or the like by the second vehicle - which follows the first vehicle at a preferably constant distance and has a driving speed synchronous with its driving speed - and is equipped with a forwards-conveying sand conveyor belt or sand conveyor hose ending above the ejected ditch of the first vehicle,

- 30 - in that immediately thereafter the excavated material which is continuously conveyed rearwards by means of the conveyor belt which is associated with the trench

milling cutter reintroduced into the cable trench via an outlet chute of this conveyor belt
- backfilling the latter.

5 This cable-laying method is characterised in particular by the rapid progress of the work that can be achieved with it and, although the technical effort may appear relatively high at first glance, it is more than compensated for by the cleanliness of the method and the comparatively high speed with which it is conducted and the restoration of its original state.

10 In the context of the disclosure, in particular within the meaning of the achievement of a high degree of cleanliness in its implementation, an embodiment has proved to be favourable, according to which it is provided that instead of the supply of cable sand with sand ejected ditches on the first vehicle and sand conveyor belt on the second vehicle - a sand conveyor hose is provided, which is carried along by the latter, and is aligned with its outlet end directly into the cable trench just milled out from above,
15 by which the cable sand is blown directly onto and around the cable and/or the like just laid in the cable trench. This ensures that practically no part of the cable sand ends up anywhere else than in the cable trench and there is practically no need for cleaning after the cable laying.

In the course of earth cable laying, it is now common practice to place a warning
20 tape above the cable in laid the trench to protect the cable and/or the like below it as much as possible from damage or even breakage in the event of subsequent excavation, renovation or supplementary work with mini excavators or the like.

Accordingly, in the context of the disclosure at issue here, it is preferable to ensure that the warning tape is inserted into the cable trench above the cable and/or the like in
25 the correct position in the cable trench by the first vehicle of the cable-laying train substantially synchronously with the cable and/or the like - preferably in the course of the introduction of the cable sand from the second vehicle, or directly following this introduction - and before the re-introduction of the milled-out loose ground surface material from the conveyor belt of the trench milling machine of the first vehicle.

30 A very essential component in the implementation of this cable-laying method, is a cable-laying train, which is characterized,

- in that the cable-laying train is drivable overall at low speed, is formed by a front, first vehicle, in particular a tractor, from the cable drum of which, is preferably

suspended at the front side in a mounting bracket, and, preferably via guide rollers arranged above and at the rear side of the same, the cable and/or the like to be laid can be drawn out from the cable drum at a speed matching the respective current driving speed and can be inserted into the cable trench just excavated by means of a trench milling machine also arranged on the first vehicle,

- wherein a conveyor belt for the conveying of the just milled-out loose ground surface material backwards is arranged laterally to the trench milling machine, and

- wherein furthermore the first vehicle carries at the rear a sand ejected ditch which can be continuously carried along in each case above the cable trench, and

- in that the cable laying train comprises a second vehicle, which follows the front, first vehicle at a, preferably constant, small distance, which is suitable for receiving and transporting cable fine particulate sand, in particular a lorry with a transport skip, with its sand discharging and metering device equipped with a sand conveyor belt or sand conveying hose which starts from the sand discharging and metering device and is to be positioned there with its free discharge end projecting forwards above the sand ejected ditch in the rear region of the first vehicle for the conveyance of the cable sand and its introduction through the sand ejected ditch into the cable trench,

- wherein the previously milled out, loose ground surface material can be reintroduced into the cable trench from the discharge chute of the conveyor belt of the trench milling machine of the first vehicle, which is arranged lagging behind the sand ejection chute.

It is advantageous in the sense of optimising cable sand consumption if the sand discharge and metering device of the second vehicle is equipped with a metering device, which can preferably be controlled from the same, for which a driving speed-dependent or synchronous regulation of the cable sand discharge quantity per linear metre of the respective laying distance covered.

Regarding the maintenance of the constant distance between the first and second vehicles, it has proved to be advantageous to ensure that at least one of the two vehicles, preferably both vehicles, is/are each equipped with an infinitely variable (hydraulic) or hydrostatic drive, preferably controllable from the second vehicle.

In order to restore the original condition to practically full after the cable has been laid, it is preferably provided that the second vehicle is equipped with a vibrating and

ramming device for the compaction of the previously milled-out, loose ground surface material that has been re-conveyed into the cable trench previously created.

A computer-controlled drive speed-synchronising device - preferably arranged in the second vehicle - ensures that the constant distance between the first and the second vehicle is maintained during their synchronous forward movement at low speed, and the meterable discharge of the cable sand per linear metre of cable laying section from the skip of the second vehicle into the cable trench can also be regulated by means of this computer-controlled drive speed-synchronising device. The cable laying train naturally has at least one GPS probe, so that the topographic course of the laid cable and/or the like can be precisely determined and registered, so that it can be reconstructed and reproduced for subsequent adaptation processes or the like without any problems.

The drawing explains the device according to the invention and the cable-laying method in more detail:

Figs. 1 to 4 show the structure of the cable laying compact device by means of views from above from both sides and from behind, and Figs. 5 and 6 explain in more detail the method.

Fig. 1 shows the laying device according to the invention in plan view, Fig. 2 shows it as a side view from the street, Fig. 3 shows this device as a side view from the outside towards the street and Fig. 4 in rear view and Fig. 5 and 6 explain the method.

Fig. 1 shows how a trailing vehicle 1, for example a tractor, which is only schematically indicated as such, moving in the direction of travel, remaining strictly on the road surface F_b , is fastened to a carrier or support frame 20 with a side extension unit 2, which, as indicated by a double arrow, is laterally displaceable linearly in both directions.

With two projections projecting backwards from the extension unit 2 and spaced apart from one another, of which only the upper one is visible here, an articulation formed with the first swivel joint 230 and having a substantially vertical axis is supported, about which the trench milling unit 3 with its housing 31 and the trench cutting wheel 35 are laterally pivotable to the right or to the left at an angle, as indicated by the curved double arrow.

The lateral pivot angle can be adjusted according to the curve by means of hydraulic cylinder 23 attached to the extension unit 2 and to the milling unit housing 31.

At the rear of the milling unit 3, there is a second articulation formed with a swivel

joint 340, by means of which the trailing formwork and cable insertion unit 4 immediately following the milling unit 3 is also laterally pivotable at an angle to the right and to the left relative to the milling unit 3. This lateral pivotability is also indicated by a curved double arrow.

5 The rollers 43 arranged inside the trailing formwork and cable insertion unit 4 for a kink-free guiding of the cable L to be laid, which is not shown here, from above the units 3 and 4 downwards into the cable trench K, just created by the cable laying device 100 or its milling unit 3 and cut into the verge B, are clearly visible.

10 The trailing formwork and cable insertion unit 4 can be lowered relative to the milling unit 3 by means of the two-parallelogram mechanics 400, is supported on the trench base and raises the milling unit 3.

15 On the right, along the inherently doubly pivotable overall or compact laying unit 10 of the cable-laying device 100, formed with side extension unit 2, milling unit 3 and trailing formwork unit 4, a first conveyor belt 50, which transports rearwards coarse to fine-grained trench material $K_{mg} + k_{mf} = K_m$ excavated by the trench cutting wheel 35 and ejected continuously laterally to the right through an ejection opening 36 in the milling unit housing 31 is arranged, to which an elongated star screen 55 connects, by means of which the fine-grained trench material K_{mf} is separated from the coarse trench material K_{mg} ,

20 wherein the fine-grained trench material K_{mf} falls downwards between the screening stars 51 onto a second conveyor belt 56 not visible here and is also transported backwards by the latter and while the coarse-grained trench material K_{mg} remains on the star screen 55 and is also transported backwards.

25 Within the housing 6, the two material flows K_{mf} and K_{mg} reach two discharge chutes 62, 63, wherein the fine particulate and ultrafine material K_{mf} reaches the trench K locally and temporally before the coarse material K_{mg} and embeds and reburies the cable laid there, and only thereafter does the final filling of the trench K with coarse material K_{mg} , which may also additionally contain excess fine particulate material K_{mf} , take place.

30 Fig. 2 clearly shows - with otherwise constant reference meanings - in relation to the direction of travel F of the overall installation unit 10 in view from the right, the cutting wheel 35 with the carbide-tipped milling pins and the ejection opening 36 in the housing 31 of the milling unit 3, through which the entire trench excavated material K_m passes

onto the first conveyor belt 50 and then ascending from there onto the star screen 55 with the plurality of rotatable screening stars 51.

Below the star screen 55, a second conveyor belt 56 runs parallel to the star screen.

While the coarse material Kmg from the star screen 55 is transported upwards to the rear, the fine particulate material Kmf falls through the star screen 55 onto the conveyor belt 56 and both material streams reach the discharge box or enclosure 6 with quantity division flap 64, from where, via the divided chutes 62, 63, see Fig. 1 in this regard, the fine material Kmf reaches the trench K in which the cable L is already deposited locally and temporally before the coarse material Kmg.

The cable L is fed above the laying unit 10, which cable is led downwards via cable reels 75 and finally reaches the trench K via guide rollers within the trailing formwork unit 4, which are not visible here. The hydraulic cylinder 405 of the parallelogram mechanism 400 for the lowering of the trailing formwork unit 4, which can, for example, be used to raise the milling unit 3 if it is blocked, is still clearly visible here.

The side view of the inherently movable cable-laying compact unit 10 shown from the left in Fig. 3 clearly shows - with otherwise constant reference meanings - the mechanics 300 with hydraulic cylinder 305 for the depth adjustment of the cutting wheel 35 in relation to the milling unit 3.

The parallelogram mechanism 400 with hydraulic cylinder 405 for the relative height adjustment of milling unit 3 and trailing formwork unit 4 to each other is shown very clearly.

Furthermore, the path of the cable L to be laid over the upper roller 75 downwards through the trailing formwork unit 4 and below its guide rollers 43 is clearly shown.

In addition, the unwinding drum 80 and the warning tape guide channel 81 for laying the cable warning tape W above the cable L already laid in the trench K are shown there.

Fig. 4 shows - with otherwise constant reference meanings - the parallelogram mechanics 400 on both sides of the milling unit 3 and the trailing formwork and cable laying unit 4 for the mutual relative raising or lowering of these two units 3 and 4 as well as their hydraulic cylinders 405, and it also shows the cable L, which is guided above the top-side rollers 75, downwards through the unit 4 and is deposited between the two formwork plates 41 at the bottom of the trench K.

Furthermore, the discharge chute 66 for the trench coarse material and fine

particulate material separated therefrom are shown there.

The two rails of the support frame 20 for the side extension unit 2 are clearly visible here, as is the actual edge of the roadway Fb, which is absolutely not to be touched or is untouched by the cable laying compact unit 10, and is certainly not damaged thereby, e.g. the asphalt surface of the road along which the cable L is laid in the trench K produced in the verge B.

Each of the units 3 and 4, which are used directly for the trench excavation and the cable laying, is equipped on the underside with a trailing strip 150, which ensures the secure positioning of the units mentioned above on the verge B during the cable laying journey.

The following, summarised once again, are the essential components of the cable-laying device, wherein reference is made to Figs. 1 to 4.

- a) Support frame 20
- b) Side extension unit 2
- c) Milling unit 3 with cutting wheel 35 and housing 31
- d) Trailing formwork and cable insertion unit 4
- e) Conveyor belt 50 with screening unit 55
- f) Front or carrier vehicle 1

- a) Support frame 20:

The milling unit 3 with its cutting wheel housing 31 is connected to the support frame 20 on the carrier or front vehicle 1 via a standardised three-point suspension. All control and drive elements not shown in detail are located on the support frame 20. The side extension unit 2 is integrated in the support frame 20 in the form of a tube-in-tube system, which is mounted on rollers.

- b) Side extension unit 2:

The extension unit 2 can be laterally extended and retracted progressively by means of a hydraulic cylinder. By means of its lateral extension, it is possible for the milling unit 3 to be pulled relative to the carrier or front vehicle 1 laterally behind it and thus for the trench K to be milled precisely and without any impairment of or damage to the road

pavement Fb or the like in the lateral road strip or verge B, and thus for the road body itself not to be affected by the construction work while the carrier or front vehicle 1 is moves safely on the solid road body in driving direction F.

5 c) Milling unit 3 and its housing 31 with cutting wheel 35:

10 The milling unit 3 or the milling housing 31 is connected via the first swivel joint 230 to the side extension device 2, 20. A controllable hydraulic cylinder, which is connected to the extension device 2 and the milling housing 31, stabilises the same. The swivel joint 230 enables the milling of tight curves, as the milling housing 31 is pressed into the required curve radius by means of the hydraulic cylinder 23 of the extension device 2, 20. A drive motor attached to the milling housing 31 drives the cutting wheel 35 axially. The cutting wheel 35 is driven in the opposite direction to the direction of travel F, see arrow D there.

15 On the right front side in the direction of travel F of the milling housing 31 there is an ejection opening 36 through which the milled-out trench material Km is pressed. On the lower inner side and outer side of the milling housing 31 there are two scraper bars, which can push it downwards via two hydraulic cylinders or lift it smoothly. This allows for the infinite variation of the milling depth during milling.

20

d) Trailing formwork and cable insertion unit 4:

This unit 4 fulfils three tasks:

25 It serves as a scraper blade towards the cutting wheel 35, protects the trench K from caving in or trickling in, ensures the protected deposit of the cables and/or lines L and protects the lines L laid in the trench K from the penetration of coarse material.

30 The trailing formwork unit 4 is located or begins as directly as possible behind the cutting wheel 35 and its concave curved front surface is designed with a slightly larger radius towards it than the cutting wheel 35 itself. This shape of the trailing formwork unit 4 prevents the milled-out material on the rear side from ultimately being reintroduced into the trench K.

Two lateral steel plates 41 prevent the trench K from caving in or the trickling in of

unwanted verge subsoil or trench material Km.

Between the two lateral formwork plates 41 of the trailing formwork unit 4 there are the guide rollers 43, which ensure that the cables and/or lines L are laid without kinks. In addition, the trailing formwork unit 4 protects the freshly laid cables L against the penetration of coarse material. The height-adjustable device 80, 81 on the rear side of the trailing formwork unit 4 serves as a guide for the deposition of the warning tape W at the respective desired height above the cable L laid inside the trench K.

The trailing formwork unit 4 is connected via the parallelogram mechanism 400 to the second swivel joint 340, which is attached to the milling housing 31. The swivel joint 340 allows flexible guidance of the trailing formwork unit 4 in curves in the trench K. The two lower supports of the parallelogram mechanism 400 are provided with an elongated hole in which the ends of two hydraulic cylinders are fastened by means of a bolt. The other end of the hydraulic cylinder is attached to the right and left of the swivel joint 340.

By means of the hydraulic cylinder 405 it is possible to smoothly raise or lower the trailing formwork unit 4.

If, for example, the cutting wheel 35 comes to a standstill due to impurities in the verge substrate, it can be raised for a new start using the depth adjustment mechanism 300.

Elongated holes on the lower supports of the two-sided parallelogram mechanism 400 allow the milling housing 3 to be raised relatively without the trailing formwork unit 4 itself being raised in so doing. This effectively prevents damage to the laid cables L and the caving-in of the trench.

e) Conveyor belt 50 with screening unit 55:

The rising conveyor belt 50 is connected immediately next to the upper ejection opening 36 in the milling housing 31 of the milling unit 3, and said rising conveyor belt transports the milled-out trench material Km in the direction of the trailing formwork unit 4. The screening device starts at the end of the conveyor belt 50, said screening device being particularly preferably formed by a long elongated, further rising star screen 55.

The star screen 55 separates the trench material Km fed to it into fine particulate and coarse fractions Km_f and Km_g. The fine particles fall onto a conveyor belt 56 arranged below it and are transported further back into a pivotable discharge chute.

During the screening process, the coarse material K_{mg} is also transported backwards into the discharge chute 63 by the rotation of the screening stars 51. This pivotable discharge chute 63, which is located at the end of the aforementioned screening device, enables the flexible depositing of the milled-out trench material.

5 The discharge chute can be swivelled in the direction of trench K or in the direction of the roadway. That side of the discharge chute 63 which is inclined towards the trench K is divided into two channels.

10 The screened trench fine particulate material K_{mf} is deposited in a first channel in the direction of travel, and the coarse material K_{mg} is deposited in the second channel. A height-adjustable deflector plate at the end of the first channel allows the metered entry of the fine particulate material K_{mf} into the trench K via a cavity in the trailing formwork unit 4. Excess fine particulate material K_{mf} is fed through the deflector plate into the second channel where it mixes with the coarse material K_{mg} . The trench K is ultimately sealed with this grain mixture produced in the manner described above.

15

f) Carrier or front vehicle 1:

20 Commercially available construction machines or tractors, which are preferably equipped with a progressive travel drive, can be used as carrier or front vehicle 1. The front of the carrier vehicle 1 has a device for receiving the cable drums. Via guide rollers above the cable-laying compact unit, the cables or lines L to be laid are guided into the trailing formwork and cable insertion unit 4 and from there inserted into the trench K.

25 The combination of the described units 1, 2, 3, 4 ensures with a high degree of certainty that lines and/or cable L can be laid in the edge strip or verge B of the traffic route without damaging the roadway F_b of a road. This applies to the fullest extent, in particular in the curve areas of roads and their verges.

30 Fig. 5, which illustrates the method, shows how a first vehicle 100, formed by a specially equipped tractor 100, moving forwards v_0 at a speed v_1 in the order of 0 to about 4 km/h, carries at the front an unwinding and mounting bracket 38 with a cable drum 30 mounted on it.

From this cable drum 30, the cable 3 to be laid underground is pulled off via a roller 31 arranged above the driver's cab, then guided downwards behind the tractor 100 via a further roller 32 arranged at the rear, and is deposited in the cable trench 70 freshly

excavated immediately prior by means of the cutting wheel 40 arranged in the rear area of the tractor 100.

By means of a conveyor belt 45 laterally associated to the side of the trench milling machine 40, the ground surface material 7 excavated immediately prior is transported
5 backwards at the same, but oppositely directed speed minus v_1 ($-v_1$) and not, as before, to the side of the just excavated cable trench 70, which makes a significant contribution to the high working speed of the method.

Immediately after the deposition of cable 3 in the cable trench 70 and the deposition of a warning tape 35 above the inserted cable 3 in the trench 70, said warning
10 tape having been drawn off by an unwinding device not shown in further detail in the rear attachment 101 of the tractor 100 and guided over the roller 33, cable (fine particulate) sand 6 is continuously fed into the trench 70 in a respectively indicated quantity per linear metre of laying distance through the approximately funnel-shaped ejected ditch 50 which is also arranged on the rear side of the tractor 100 and which is always exactly above the
15 trench, by means of which the cable 3 and the warning tape 35 deposited above it are implanted and embedded and are naturally also covered towards the top.

The trench ground surface material 7, which has been conveyed backwards at the speed minus v_1 ($-v_1$) opposite to the forward driving speed v_1 of the tractor 100, and deposited not to the side of the trench 70 in the course of the milling out of the cable
20 trench 70 using the trench milling machine 40 and the conveyor belt 45 laterally associated therewith, is immediately reintroduced into the trench 70 with the cable (fine particulate) sand 6 via the discharge chute 41 of the backwards conveying conveyor belt 45 after the cable 3 and warning tape 35 have been embedded and reburied.

Regarding the feeding and introduction of the cable (fine particulate) sand 6
25 through the approximately funnel-like sand ejection ditch 50 attached to the rear of the tractor 100 in the cable trench 70, a second vehicle 200 is used for this, which moves forwards v_0 at the same speed as the driving speed v_1 , in the present case a lorry with a skip 201 containing the cable (fine particulate) sand 6, an externally mounted, inclined upward sand conveyor belt 240, the outlet end 245 of which is continuously held exactly
30 above the sand ejected ditch 50 of the tractor 100. The intended quantity of cable (fine particulate) sand to be introduced into the cable trench 70 per linear metre of travel and thus cable laying section is applied to the conveyor belt 240 by means of the sand discharge and metering device 205 in the rear area of the skip of the lorry 200, which can

be regulated from the driver's cab.

Both the tractor 100 and the tipper lorry 200 following it at distance a with synchronous speed $v_2 = v_1$ move forwards v_0 at a speed of 0 to about 4 km/h in the course of the cable laying. In order to guarantee the constant and synchronous low and regulated driving speed $v_1 = v_2$ of the two vehicles 100 and 200, both vehicles 100, 200 are equipped with computer-controlled hydraulic or hydrostatic transmissions.

Instead of the sand conveyor belt 240 on the lorry 200, a sand conveyor hose can be used, the open end of which is guided directly above the cable trench 70 and through which the cable sand 6 can be conveyed directly into the trench 70 by means of a compressed air.

The tipper lorry 200 shown in Fig. 2 in rear and sectional view and forming the second vehicle can be a common, e.g. multi-axle transport vehicle for dry, fine-grained or powdery material, mostly building material, with transport skip 12 with flanks 11 running obliquely at an angle α downwards towards one another at whose, e.g. 60 cm narrow base, a scraper belt 13 is moved, controllable by means of motor 131, the speed of which can be regulated by means of the control unit which can be adjusted and regulated from the driver's cab of the second vehicle 200, by means of which the quantity of cable (fine particulate) sand 6 to be delivered in each case per linear metre to a conveyor channel 16 which is aligned transversely to the vehicle axis or to the direction of travel of the tipper lorry 200 and has a discharge screw 17, which for example projects laterally to the left beyond the tipper lorry 200 with an overhang.

The cable (fine particulate) sand 6 conveyed by the discharge screw 17 is transported by a kind of hopper organ 204 or a hose of this type of the sand discharge and metering device 205 onto a conveyor belt 240, which is attached to the side of the vehicle 200, ascends upwards with its front discharge end 245, via the sand discharge chute 50 of the first vehicle 100, which is only marked with interrupted lines, and falls through said chute, positioned exactly directly into the cable trench 70, which is already occupied by the cable 3.

Patentkrav

1. Transportabel indretning (100) til underjordisk lægning af mindst en fleksibel ledning, et kabel, et tomt rør til kabeltrækning eller en fluidtransportslange, især under rabatter eller vejkanter på siden af færdselsveje og gader, idet der i
- 5 rabattens underbund ved hjælp af en fræseenheds hjulfræser kan uddybes en smal rende med den i hvert tilfælde ønskede læggedybde, det herved udfræsedes underbundsmateriale fjernes sideværts, og kablet eller kablerne og advarselsbåndet lægges ned i renden i den korrekte placering, idet der til indlejring af den indførte ledning eller det indførte kabel eller lign. i renden indføres
- 10 findelt underbundsmateriale eller kabelsand, hvorefter det i forvejen sideværts fjernede udfræsedes underbundsmateriale atter kan indføres i denne og komprimeres,
- idet det kabel, som skal nedlægges, kan trækkes af et med lav hastighed kørende frontkøretøj og lægges ned i den netop etablerede kabelrende
 - 15 synkront med frontkøretøjets kørehastighed, og
 - idet til den i hvert tilfælde øjeblikkelige kørehastighed afstemte mængder findelt materiale eller kabelsand løbende kan indføres i kabelrenden gennem en over kabelrenden ført udkastningstragt eller lign.,
 - idet - især til kabellægning langs en krummet færdselsvej - det som
 - 20 bærekøretøj udformede frontkøretøj (1) med bæreramme (20) bagest med sideudkastenhed (2) med en fræseenhed (3) med fræsehjul (31) og en denne følgende slæbeforskallings- og kabelnedlægningsenhed (4) tilsammen danner en transportabel, kurvenegnet, mekanisk total- eller kompaktenhed (10),
- 25 inden for hvilken fræseenheden (3) og med den fræsehjulet (35), der kan placeres forskudt sideværts udadtil i forhold til frontkøretøjet (1), altså ragende sideværts ud over frontkøretøjets (1) kontur, er forbundet med frontkøretøjet (1), således at den over en første ledforbindelse eller et drejeled (230) på sideudkastenheden (2) med i det væsentlige lodret omdrejningsakse i forhold til denne kan svinges ud til
- 30 begge sider i hvert tilfælde i en vinkel på indtil $\pm 25^\circ$, især indtil $\pm 20^\circ$, og

- idet den på fræseenheden (3) følgende slæbeforskallings- og kabelnedlægnings- samt kabelsandindføringsenhed (4) atter er forbundet med fræseenheden (3), ligeledes over en anden ledforbindelse eller et drejeled (340) med i det væsentlige lodret akse, således at den i forhold til denne kan svinges ud til begge sider - i hvert tilfælde i vinklen på indtil $\pm 25^\circ$, især på indtil $\pm 20^\circ$,

kendetegnet ved,

- at der ved siden af fræsehuset (31) er tilføjet fræseenhedens (3) fræsehjul (35) et transportbånd (50), der skal fyldes med rendenudgravningsmaterialet (Km), og på hvilket der følger en, fortrinsvis skråt bagud stigende, langstrakt stjernesigte (55) med et stort antal på omdrejningsakser, der står på tværs af dennes transportretning, monterede, selv frit drejelige sigtestjerner (51) til transporten af med fræsehjulet (35) udgravet rabat-underbunds- eller rendemateriale (Km) bagud til den afsluttende opfyldning af den netop etablerede kabelrende (K),
- at der under den langstrakte stjernesigte (55) er anbragt et transportbånd (56) til at borttransportere det ved hjælp af dette selv fra rendens grove materiale (Kmg) skilte, findelte rendenmateriale (Kmf) bagud,
- at det findelte udgravningsmateriale (Kmf) ved hjælp af transportbåndet (56) kan tilføres en finsigte, og at det der fraskilte, særlig fine eller ultrafine, i det væsentlige sandartige, fine materiale fra renden i det mindste delvis kan anvendes i stedet for særskilt tilført kabelsand eller supplerende dette til ind- og omlejring af det/den i kabelrenden (K) nedlagte kabel og/eller ledning (L), og
- at der i den over kabelrenden førte udkastningstragt anbragte, mod renden rettede fyldeslidsk til det særligt fine eller ultrafine, i det væsentlige sandartige rendemateriale (Kmf), der danner bro over tværsnittet af den til finsigten tilsluttede fyldeslidsk, og som frigiver en i højden variabel åbning på undersiden, kan indstilles i højden til det i hvert tilfælde pr. løbende meter rende (K) og kabel (L) givne behov for fint kabelind- og

-omlejringsmateriale pr. løbende meter rende (K) og kabel og/eller ledning (L).

2. Indretning ifølge krav 1, kendetegnet ved,

- 5 - **at** udkastningstragten kan svinges i retning mod renden (K) eller i retning mod kørebanen og den side af udkastningstragten (63), der hælder i retning mod renden (K), er delt i to render, idet det frasigtede fine rendemateriale (Kmf) kan lægges i en første rende i kørselsretningen og det grove materiale (Kmg) i den anden rende, og
- 10 - **at** en i højden indstillelig afbøjningsplade ved enden af den første rende muliggør doseret indføring af det fine materiale (Kmf) i renden (K) gennem hulrummet i slæbeforskallingsenheden (4), og overskydende fint materiale (Kmf) kan ledes ned i den anden rende af afbøjningspladen og der blandes med det grove materiale (Kmg), og renden (K) kan til sidst lukkes med
- 15 denne, på denne måde frembragte kornblanding.

- 3. Indretning ifølge krav 1 eller 2, kendetegnet ved, at** den i vinklen sidesvingbare fræseenhed (3) med fræsehjul (31) er forbundet med en med frontkøretøjet (1) eller med dets bæreramme (20) forbunden udkastindretning (2) og kan forskydes
- 20 lineært sidelæns, fortrinsvis hydraulisk, i forhold til frontkøretøjet (1) - i det mindste til en side - og tilpasses til de af den bestående rabat (B), der skal underskæres, givne topografiske betingelser.

- 4. Indretning ifølge et af kravene 1 til 3, kendetegnet ved, at** slæbeforskallings- og kabelnedlægningsenheden (4), især til stabillisering af væggene og
- 25 opretholdelse af deres stabilitet i den pågældende netop etablerede rende (K), er udstyret med eventuelt i deres indbyrdes afstand efter den pågældende rendebredde (Kb) indstillelige forskallingsplader (41) på begge sider, og stiger hen imod fræseenhedens (3) fræsehjul (31), konkavt-krummet, og så vidt muligt knapt,
- 30 fortrinsvis på nær ca. 10 cm, når hen til denne.

5. Indretning ifølge et af kravene 1 til 4, **kendetegnet ved, at** fræseindretningen (3), især dens fræsehjul (35), kan løftes op for eksempel i tilfælde af dennes blokering med ueftergiveligt underbundsmateriale, uden at den med fræseindretningen (3) sidesvingbart forbundne slæbeforskallings- og kabelnedlægningsenhed (4) med de forskallingsplader (41) på begge sider, der praktisk taget gennemgående sikrer rendens (K) stabilitet, skal forandres i sin højdestillning i renden (K).

6. Indretning ifølge et af kravene 1 til 5, **kendetegnet ved, at** der til drejeledet (340) til slæbeforskallings- og kabelnedlægningsenheden (4) på fræseenheden (3) eller på dens hus (31) på begge sider er forbundet en parallelogram-mekanisme (400) til at sænke eller løfte slæbeforskallings- og kabelnedlægningsenheden (4), især til at løfte fræseenheden (3), eventuelt sammen med fræsehjulet (3), ud af renden (K) i tilfælde af en blokering.

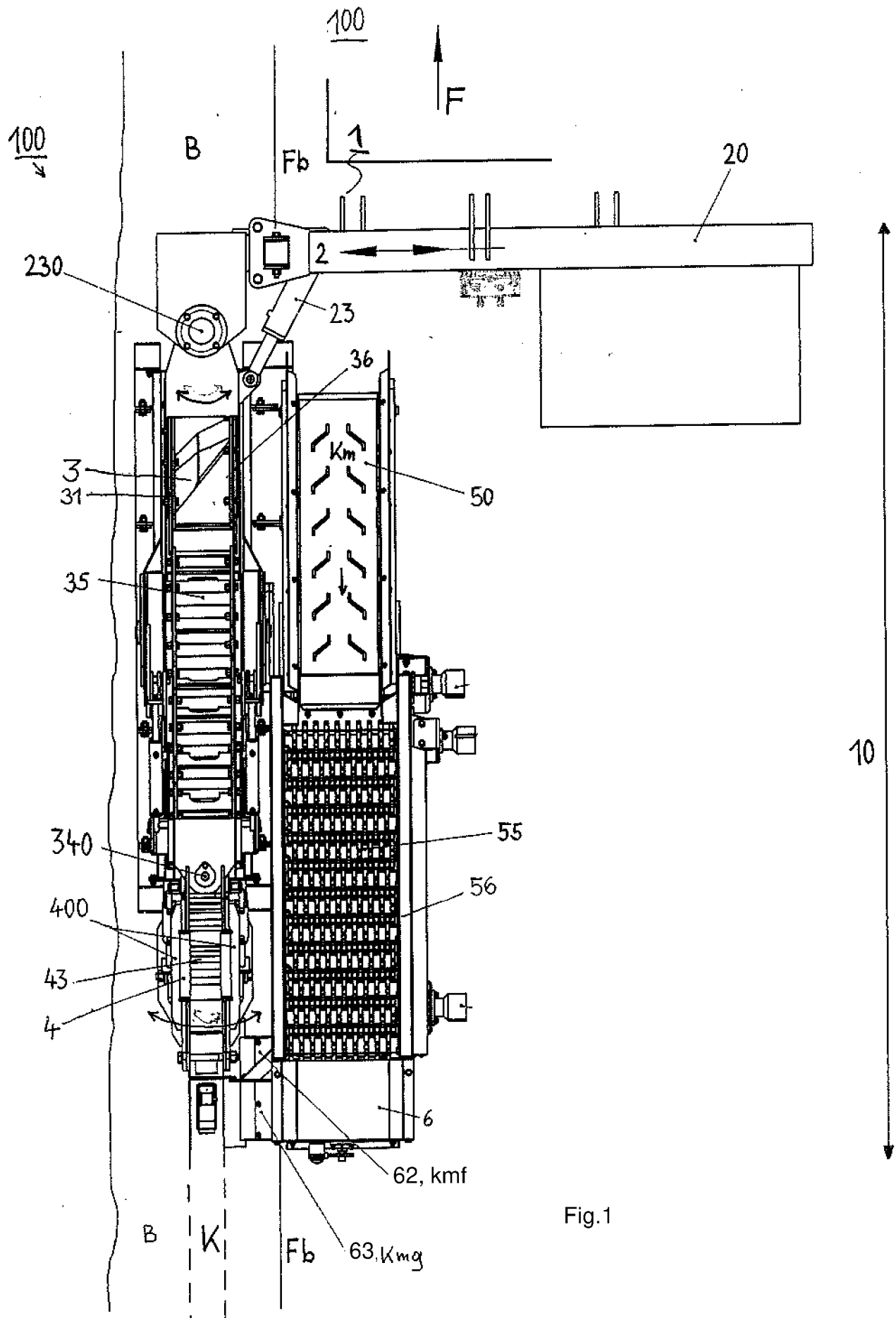


Fig.1

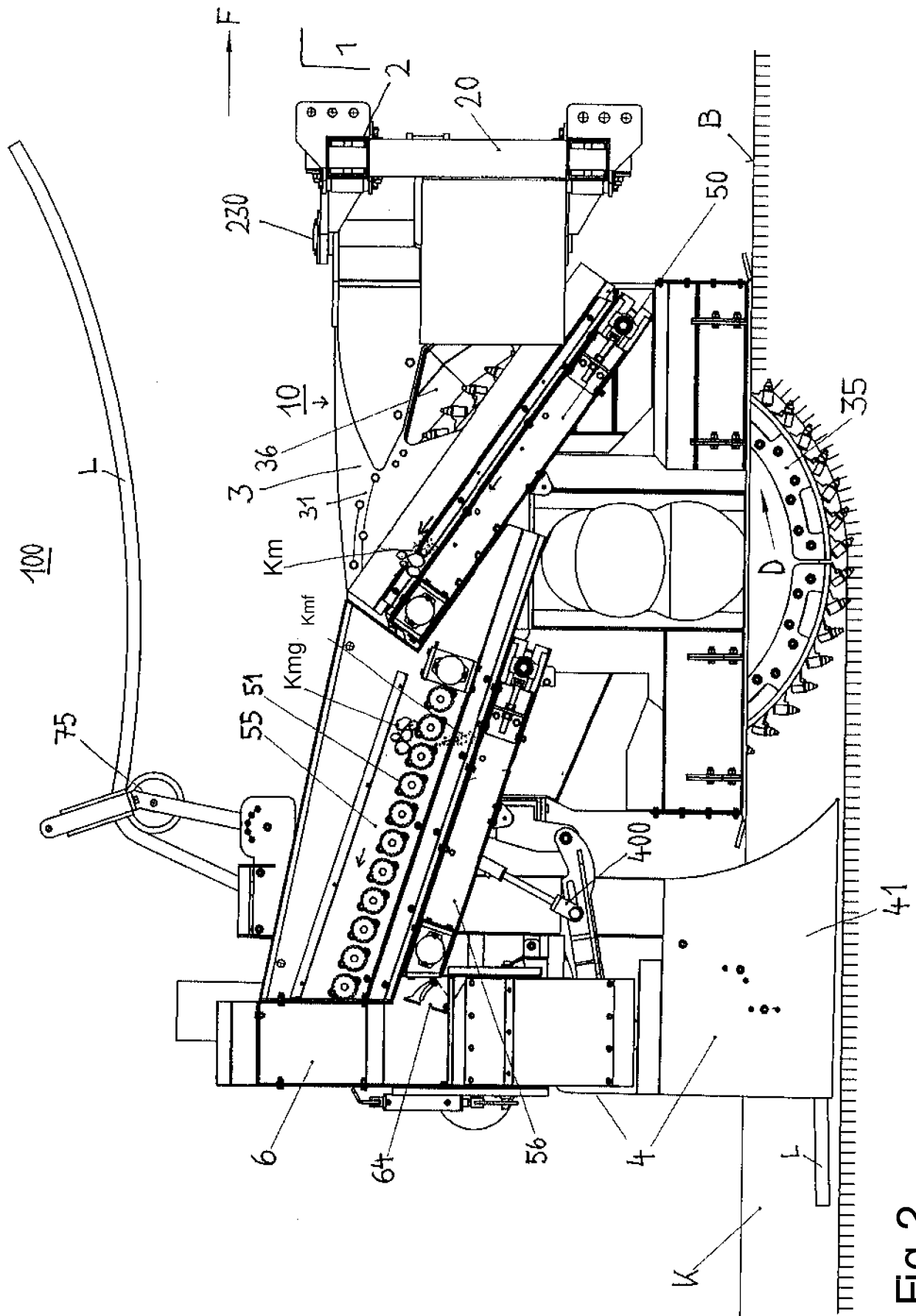


Fig. 2

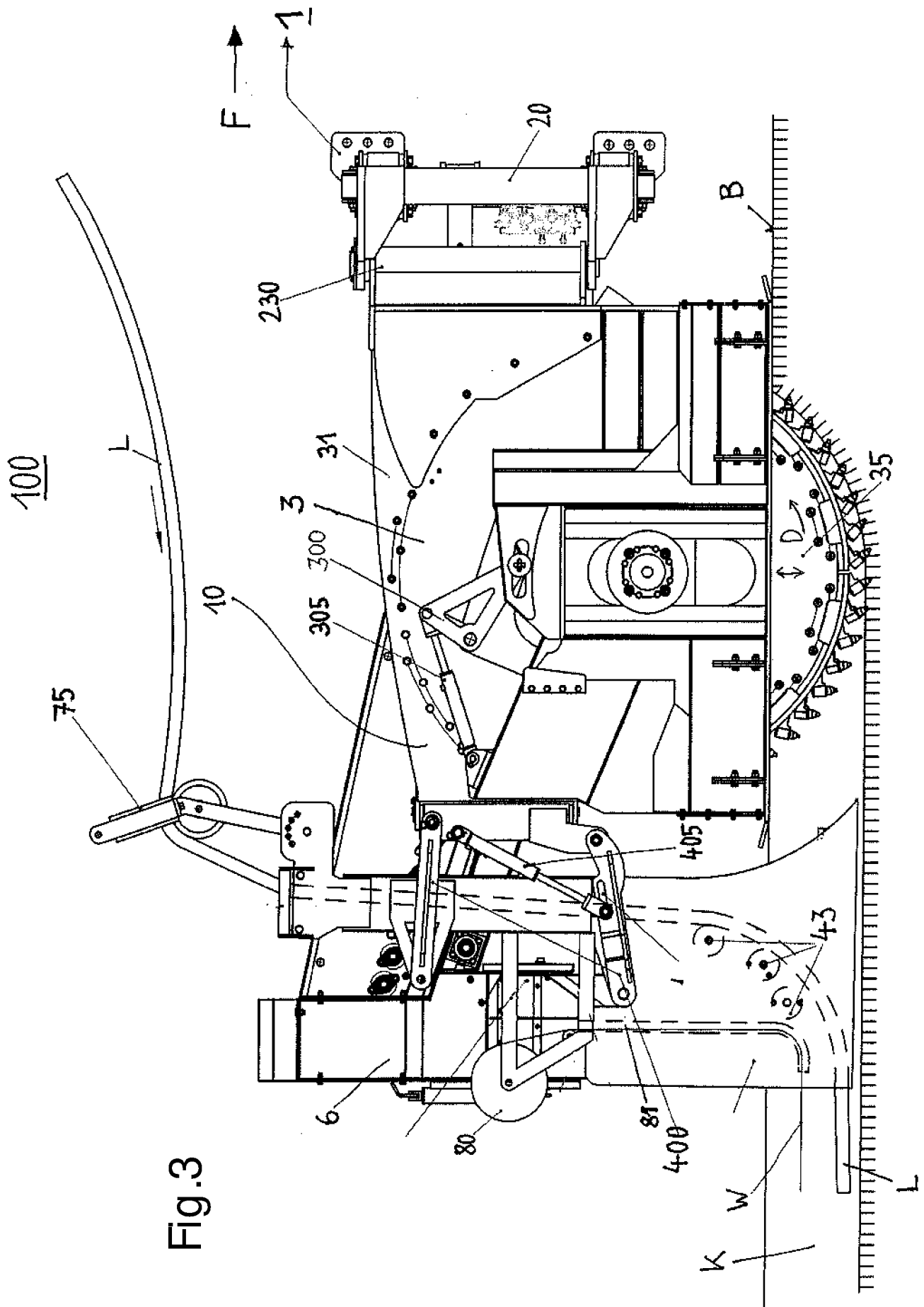


Fig. 3.

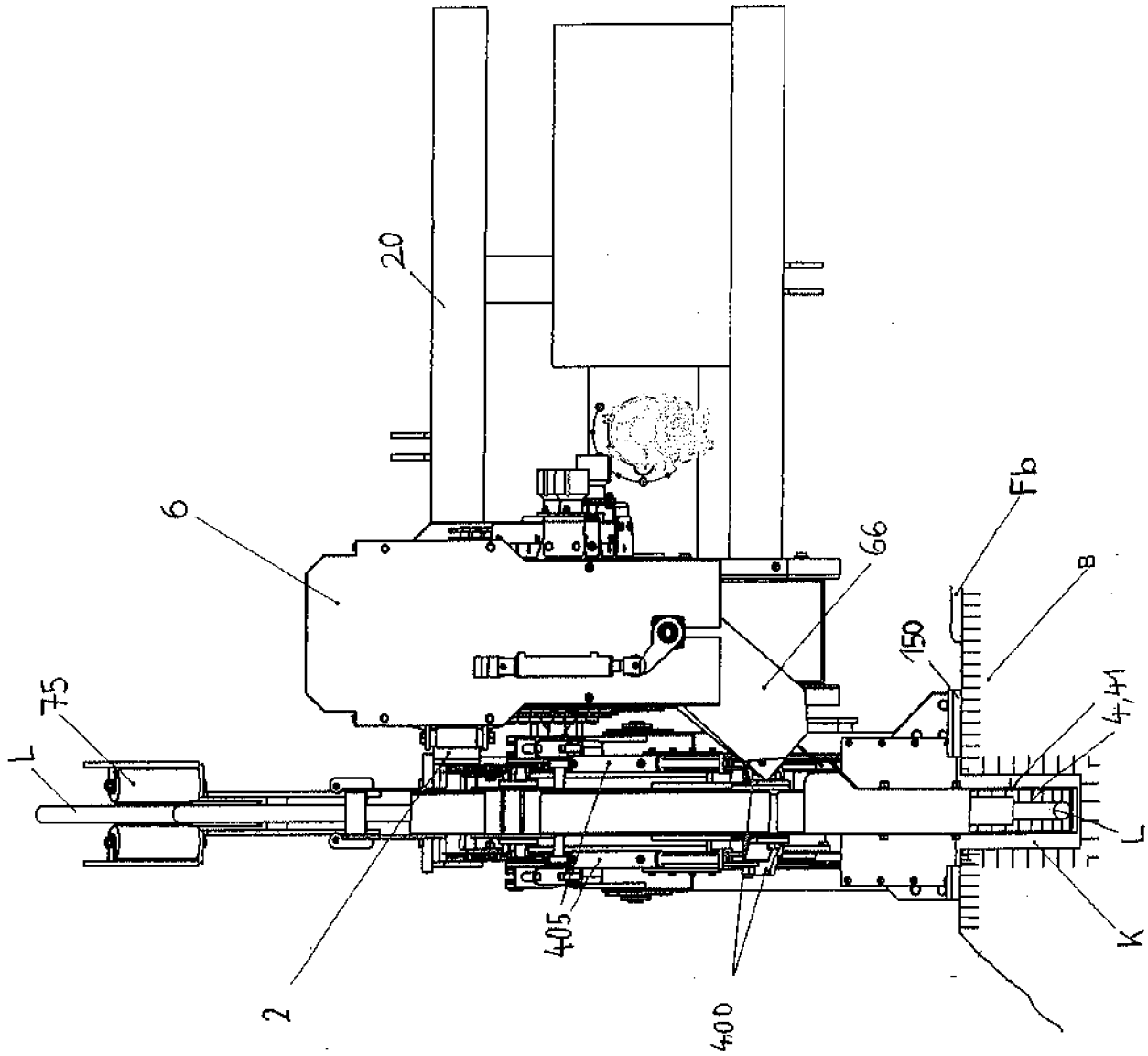
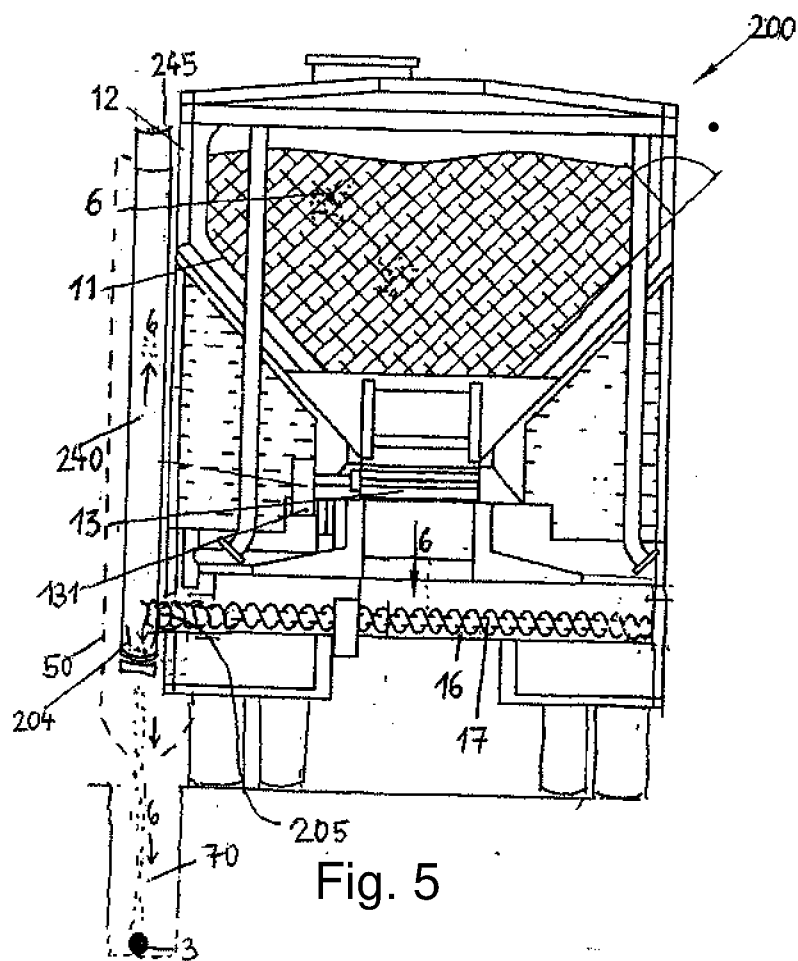


Fig.4



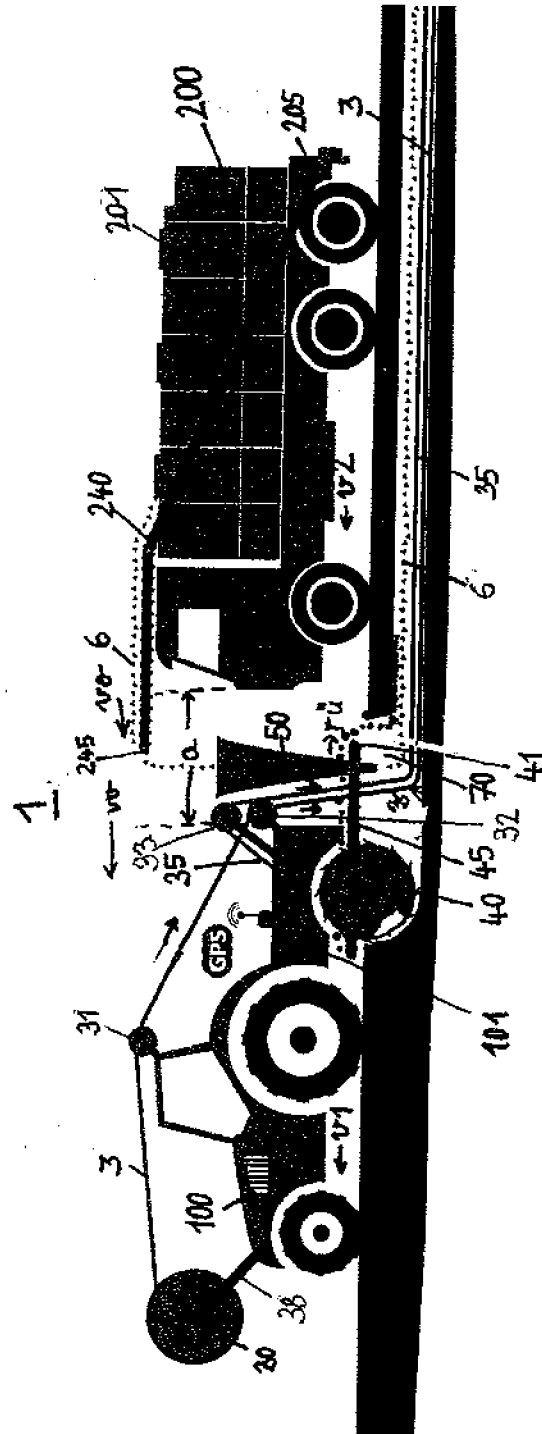


Fig. 6