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Cable-laying device

The present invention relates to a new 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 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 be met.

It goes without saying that the underground laying of high-voltage cables, for example, 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 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 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 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: EP 2 239 377 A1, US 4812078 A, US 3203188 A, US 5743675 A, DE 2504598 A1, US 2010104374 A1, US3332249 A, GB410900 A, US 6189244 B1, US 4871281 A, US 6457267 B1, DE 102014105577 A1, US 2015252551 A1 and JP S5829924 A.

The basic aim of the invention is to carry out 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 this 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.

The object of the invention, as defined in claim 1, is thus a new 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 front 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 and wherein,
- 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 insertion 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 ± 25°, in particular up to ± 20°,
- 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 ± 25°, in particular up to ± 20°.

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, the inventive device provides 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 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 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 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.

According to the invention, if a parallelogram mechanism for lowering or lifting the trailing formwork and cable insertion unit, in particular for lifting the milling 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, of particular value is an embodiment of the new device according to which a conveyor belt to be loaded with the excavated trench material is 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 excavated by the cutting wheel, backwards for the final backfilling of the cable trench just created.

In this connection, it is preferably provided 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.

A favourable arrangement is 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 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 been proven to be advantageous 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 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, but not of the invention 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 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 new cable-laying compact unit render the laying of lines along the 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 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.
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.

The object of the present disclosure but not of the invention is a new cable laying method of the kind described at the beginning, which has not yet been perfected,

- wherein 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,
- 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,

- wherein 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,
- wherein 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,
- 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,
- wherein 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.

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 carried out and the restoration of its original state.

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 of the invention 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, 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 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 invention 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 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.

The object of the present disclosure, but not of the invention, is also a cable-laying train, wherein 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
- wherein 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 new 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 invention and the initial invention in more detail:

Figs. 1 to 4 show the structure of the new cable laying compact device according to claims 1 to 9 by means of views from above from both sides and from behind, and Figs. 5 and 6 explain in more detail the second essential object of the invention according to claims 10 to 15.

Fig. 1 shows the inventive new laying device in plan view, Fig. 2 shows it in side view from the street, Fig. 3 shows this device in side view from the outside towards the street and Fig. 4 in rear view and Fig. 5 and 6 explain the second object of the invention from which the present invention originates.
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 Fb, 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.

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.

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.

On the right, along the new inherently doubly pivotable overall or compact laying unit 10 of the new 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 Kmg + kmf = Km 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 Kmf is separated from the coarse trench material Kmg,
wherein the fine-grained trench material Kmf 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 Kmg remains on the star screen 55 and is also transported backwards.

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

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 Km 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 55.

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 new 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 new 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 new components of the inventive 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.

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

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.

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.

d) Trailing formwork and cable insertion unit 4:

This unit 4 fulfils three tasks:
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.

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 Kmf and Kmg. 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 Kmg 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.

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.

The screened trench fine particulate material Kmf is deposited in a first channel in the direction of travel, and the coarse material Kmg 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 Kmf into the trench K via a cavity in the trailing formwork unit 4. Excess fine particulate material Kmf is fed through the deflector plate into the second channel where it mixes with the coarse material Kmg. The trench K is ultimately sealed with this grain mixture produced in the manner described above.

f) Carrier or front vehicle 1:

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.

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 Fb of a road. This applies to the fullest extent, in particular in the curve areas of roads and their verges.

Fig. 5 which illustrates the original invention, i.e. the second essential object of the present invention, shows how a first vehicle 100, formed by a specially equipped tractor 100, moving forwards vo at a speed v1 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 backwards at the same, but oppositely directed speed minus v1 (-v1) 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 new 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 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 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 trench, by means of which the cable 3 and the warning tape 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 ru at the speed minus v1 (-v1) opposite to the forward driving speed v1 of the tractor 100 and deposited not to the side of the trench 70 in the course of the milling out of the cable trench 70 using the trench milling machine 40

and the conveyor belt 45 laterally associated therewith is immediately reintroduced into the trench with the cable (fine particulate) sand via the discharge chute 41 of the backwards ru 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 through the approximately funnel-like sand ejection ditch 50 attached to the rear of the tractor 100, a second vehicle 200 is used for this, which moves forwards vo at the same speed as the driving speed v1, 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 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 v2 = v1 move forwards vo at a speed of 0 to about 4 km/h in the course of the new cable laying. In order to guarantee the constant and synchronous low and regulated driving speed v1 = v2 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 o 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.

Patentkrav

1. Transportabel indretning (100) til underjordisk lægning af mindst en fleksibel ledning, et kabel, et tomt rør til kabeltrækning eller en fluidtransportslange, fortrinsvis sammen med et advarselsbånd, især under rabatter eller vejkanter på siden af færdselsveje eller gader, idet der i rabattens underbund ved hjælp af en fræseenheds hjulfræser kan uddybes en smal rende med den i hvert tilfælde ønskede læggedybde, det herved udfræsede 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 findelt underbundsmateriale eller kabelsand, hvorefter det i forvejen sideværts fjernede udfræsede underbundsmateriale atter kan indføres i renden og komprimeres,

- idet det kabel, som skal nedlægges, kan trækkes af et med ringe hastighed kørende frontkøretøj og lægges ned i den netop tilvejebragte kabelrende synkront med frontkøretøjets kørehastighed, og
- idet en til den i hvert tilfælde øjeblikkelige kørehastighed afstemt mængde findelt materiale eller kabelsand løbende kan indføres i kabelrenden via en over kabelrenden ført udkastningstragt eller lign.,
- idet - især til kabellægning langs en krummet færdselsvej - det som bærekøretøj udformede frontkøretøj (1) med bæreramme (20) bagest med sideudkastenhed (2) med en fræseenhed (3) med fræsehjul (31) og en denne følgende slæbeforskallings- og kabelindlægningsenhed (4) tilsammen danner en transportabel, kurveegnet, mekanisk total- eller kompaktenhed (10),
inden for hvilken fræseenheden (3) og med den fræsehjulet (35) er forskudt sideværts udadtil i forhold til frontkøretøjet (1), således at den kan placeres ragende sideværts ud over frontkøretøjets (1) kontur, er forbundet med frontkøretøjet (1) over en første ledforbindelse eller et drejeled (230) på sideudkastenheden (2) med i det væsentlige lodret omdrejningsakse i forhold til denne, således at den kan svinges ud til begge sider i hvert tilfælde i en vinkel på indtil ± 25°, og
- idet den på fræseenheden (3) følgende slæbeforskallings- og kabelindlægnings- 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 sidelæns ud til begge sider - i hvert tilfælde i en vinkel på indtil ± 25°, **kendetegnet ved,**

- **at** der på drejeleddet (340) til slæbeforskallings- og kabelindlægningsenheden (4) på fræseenheden (3) eller på dens hus (31) på begge sider er forbundet en parallelogram-mekanik (400) med en første hydraulikcylinder (405) til at sænke eller løfte slæbeforskallings- og kabelindlægningsenheden (4), især til at løfte fræseenheden (3), eventuelt sammen med fræsehjulet (3), ud af renden (K) i tilfælde af en blokering af denne.

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

3. Indretning ifølge krav 1 eller 2, **kendetegnet ved, at** slæbeforskallings- og kabelindlægningsenheden (4), især til stabilisering af væggene og opretholdelse af deres stabilitet i den pågældende netop tilvejebragte rende (K), er udstyret med eventuelt i deres indbyrdes afstand efter den pågældende rendebredde (Kb) indstillelige forskallingsplader (41) på begge sider, stiger hen imod fræseenhedens (3) fræsehjul (31), konkavt-krummet og så vidt muligt knapt, fortrinsvis på nær ca. 10 cm, når hen til denne.

4. Indretning ifølge et af kravene 1 til 3, **kendetegnet ved, at** fræsehjulet (35) kan løftes op i forhold til fræseenheden, for eksempel i tilfælde af dennes blokering med ueftergiveligt underbundsmateriale, ved hjælp af en mekanik (300) med en anden hydraulikcylinder (305), uden at den med fræseindretningen (3) sidesvingbart forbundne slæbeforskallings- og kabelindlægningsenhed (4) med de sideforskallingsplader (41) på begge sider, der praktisk taget gennemgående sikrer rendens (K) stabilitet, skal forandres i sin højdestilling i renden (K).

5. Indretning ifølge et af kravene 1 til 4, **kendetegnet ved, at** der ved siden af fræsehuset (31) er tilføjet fræseenhedens (3) fræsehjul (35) et transportbånd (50), der skal fyldes med rendeudgravningsmaterialet (Km), og på hvilket der følger en, fortrinsvis skråt bagud stigende, langstrakt stjernesigte (55) med et stort antal på omdrejningsakser på tværs af dennes transportretning monterede, selv frit drejelige sigtestjerner (51) til transport af med fræsehjulet (35) udgravet rabat-undergrunds- eller rendemateriale (Km) bagud til den afsluttende opfyldning af den netop tilvejebragte kabelrende (K).

6. Indretning ifølge et af kravene 1 til 5, **kendetegnet ved, 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, fine rendemateriale (Kmf) bagud.

7. Indretning ifølge krav 6, **kendetegnet ved, 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 sandagtige, 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).

8. Indretning ifølge krav 7, **kendetegnet ved, at** der i den mod renden rettede fyldeslidsk til det særlig fine eller ultrafine, i det væsentlige sandartige rendemateriale (Kmf), der danner bro over en tværsnittet af den til finsigten sluttet fyldeslidsk og frigiver en i højden variabel åbning på undersiden, der 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).

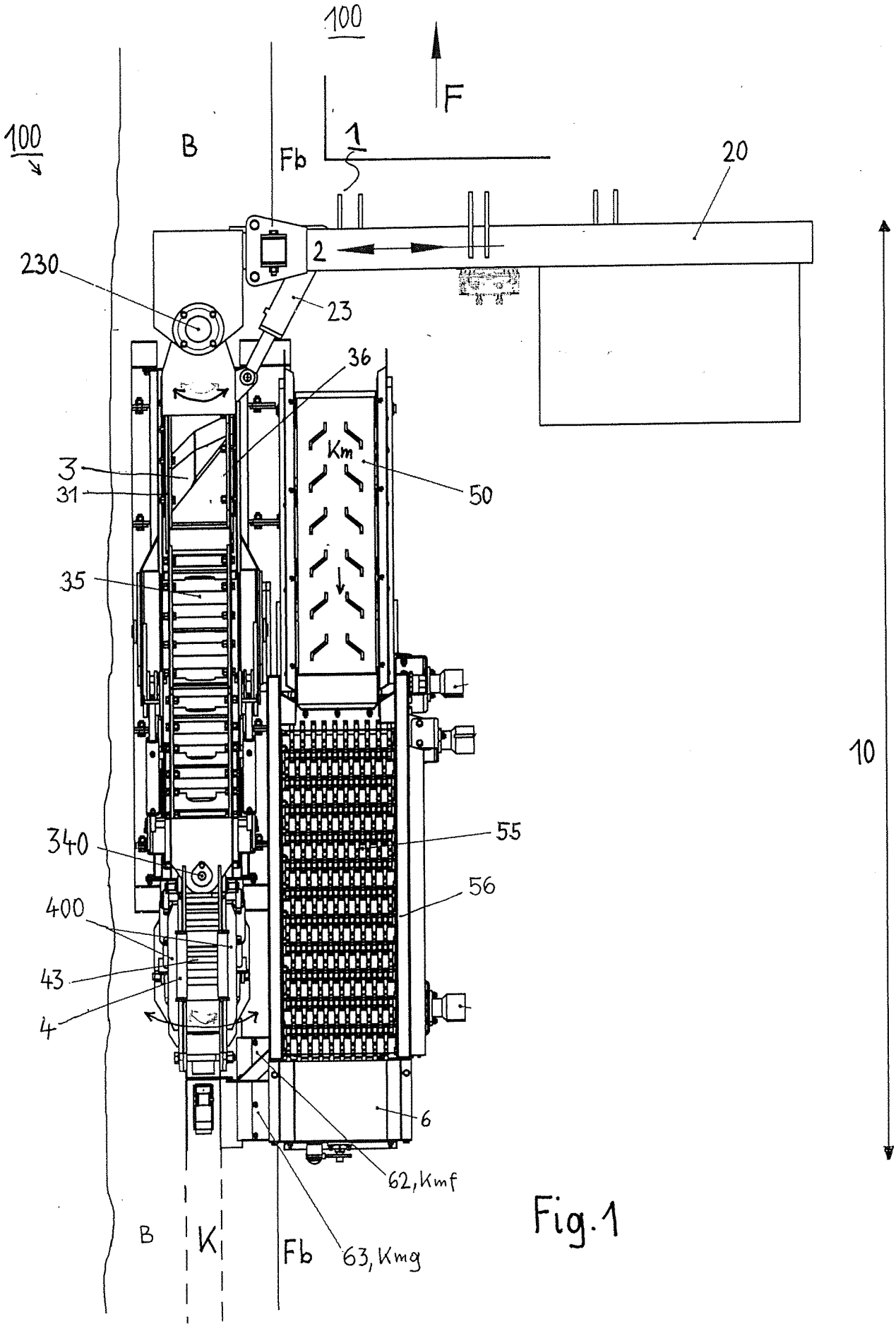
100
F
100
B
Fb
1
20
2
230
23
36
3
31
Km
50
35
10
340
55
56
400
43
4
6
62, Kmf
B
K
Fb
63, Kmg

Fig. 1

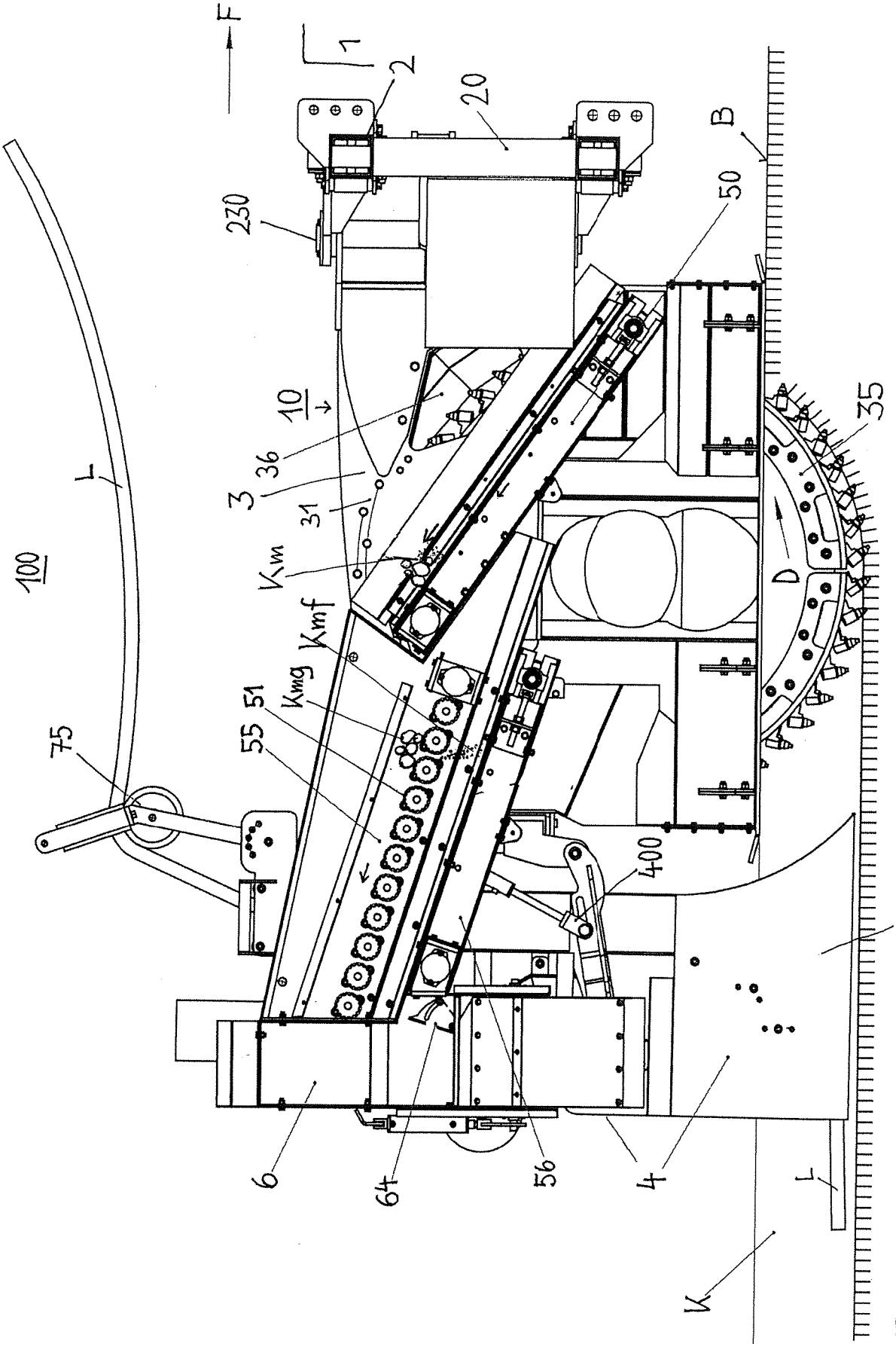
F
1
2
20
230
B
50
10
36
3
31
Kvm
Kmf
Kmg
51
55
75
100
L
35
D
400
41
6
64
56
4
L
K

Fig.2

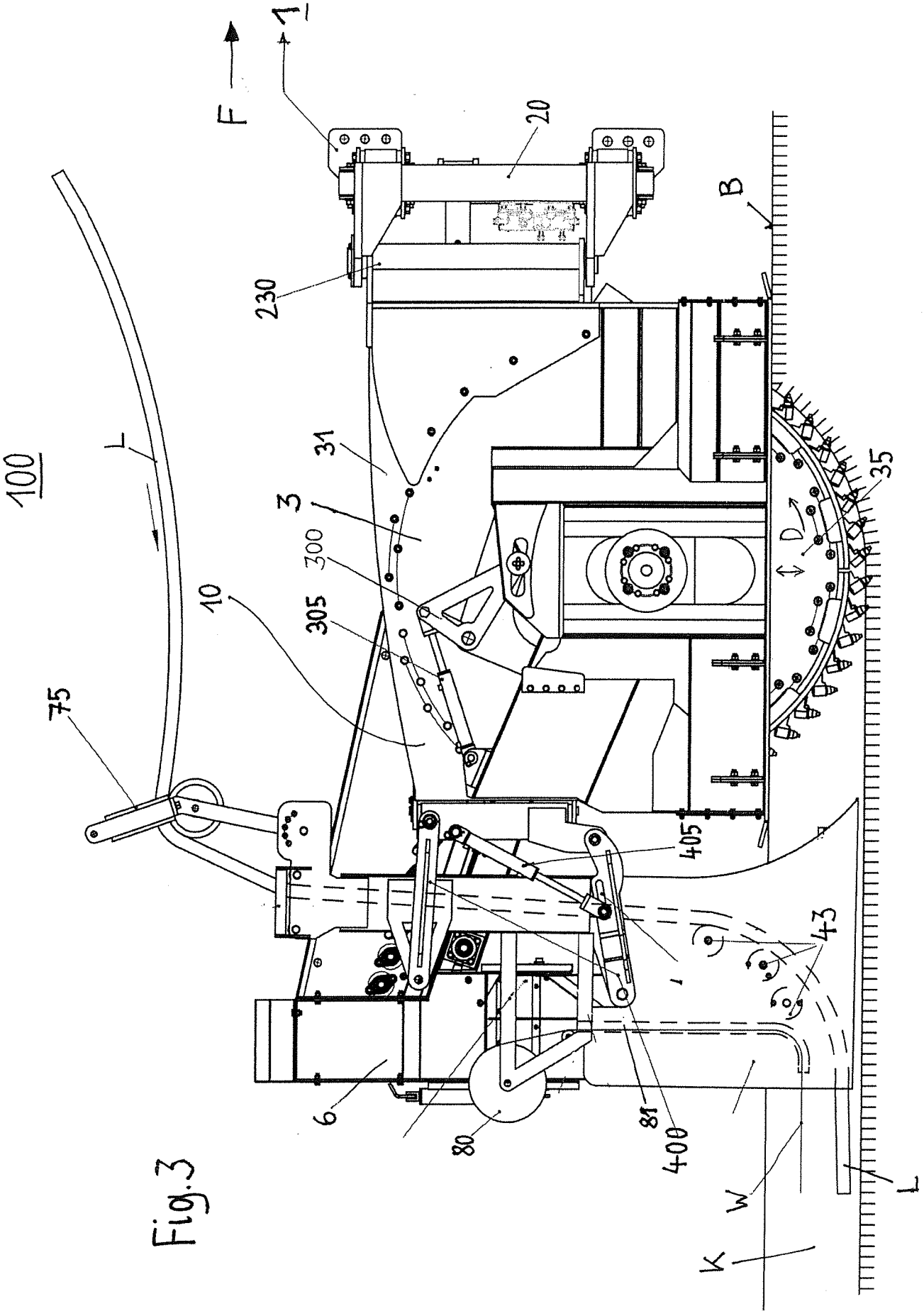

Fig.3

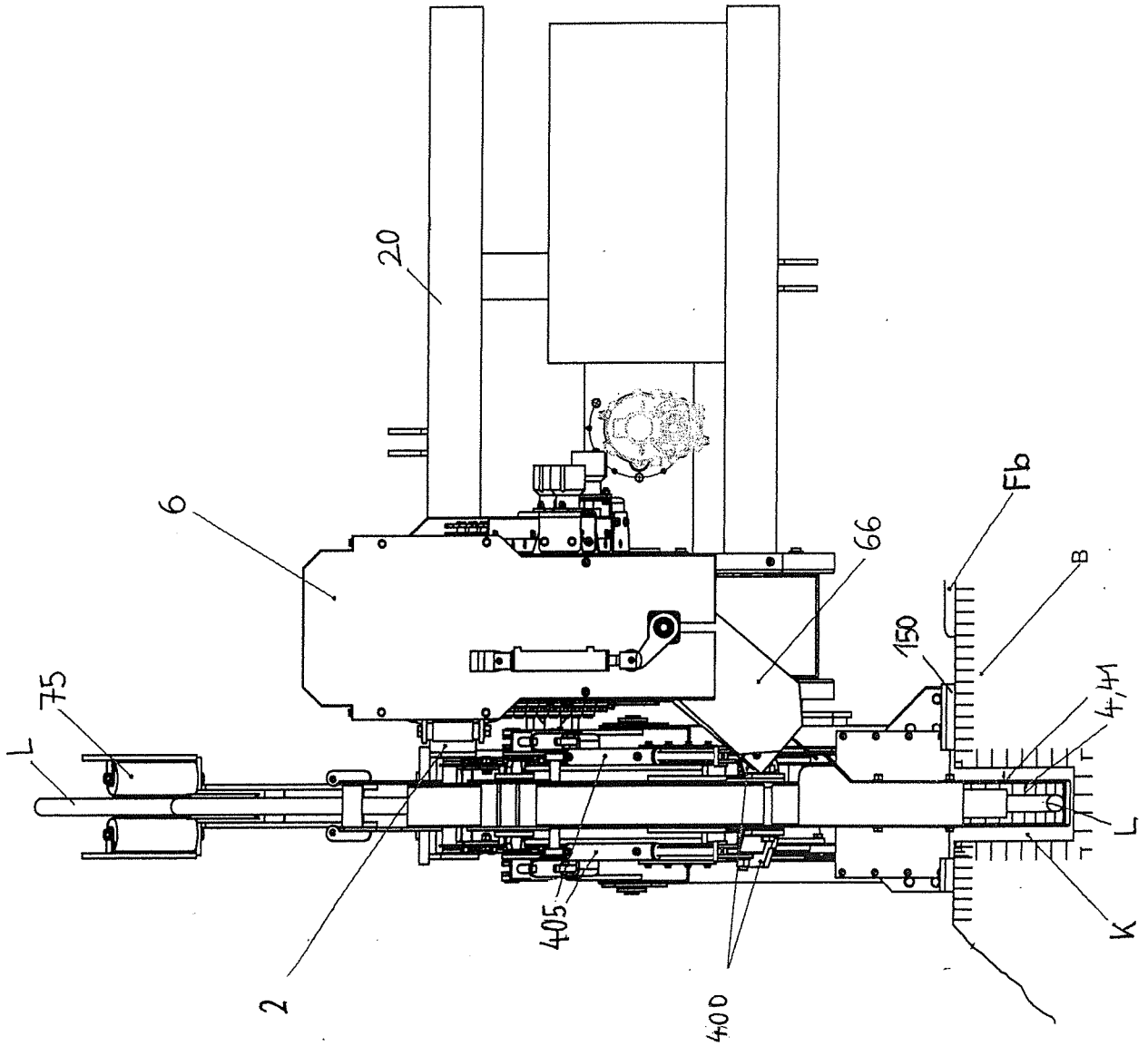

Fig. 4

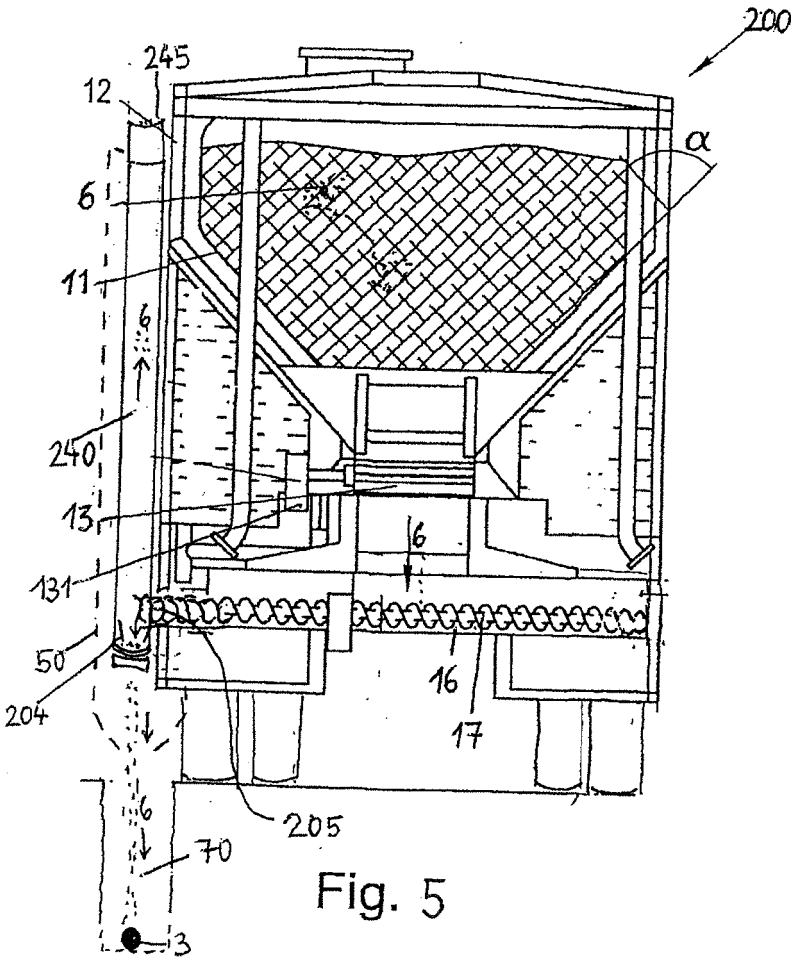

Fig. 5

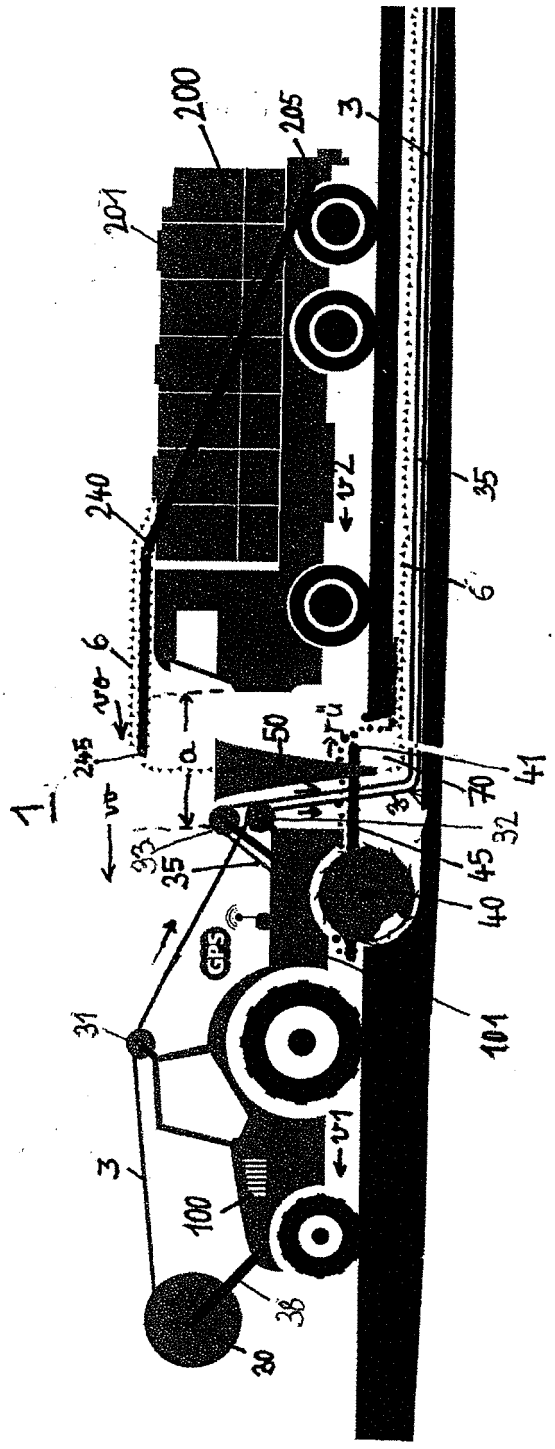

Fig. 6