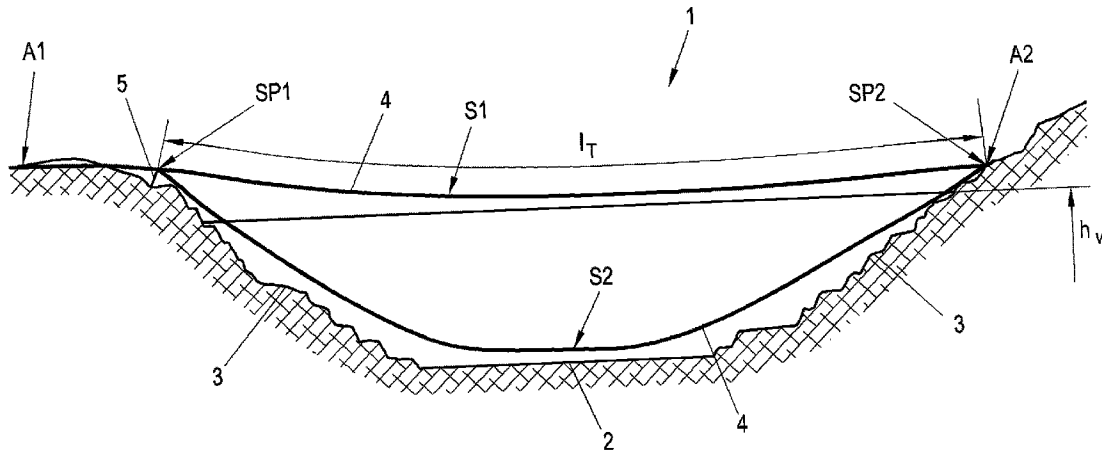




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(57) **Abrégé/Abstract:**

In order to permit flexible, simple removal of solid conveyed material from a hollow (1), or flexible, simple filling of a hollow (1) with solid conveyed material (6), it is provided that at least one load-bearing cable (4) is strung, between two anchor points (A1, A2), over the hollow (1) and the at least one load-bearing cable (4) sags between two support points (SP1, SP2) in the shape of a catenary, wherein a conveying device (10) for conveying the conveyed material (6) is arranged suspended from the at least one load-bearing cable (4), wherein a load-bearing cable length (L_r) of the at least one load-bearing cable (4) between the two support points (SP1, SP2) is longer than a conveying length (L_c) of the conveying device (10) between the two support points (SP1, SP2), and wherein at least one anchor point (A1, A2) there is provided a cable adjustment device (46) for adjusting the load-bearing cable length (L_r) of the at least one load-bearing cable (4) between the two support points (SP1, SB2).

Abstract

In order to permit flexible, simple removal of solid conveyed material from a hollow (1), or flexible, simple filling of a hollow (1) with solid conveyed material (6), it is provided that at least one track rope (4) is fixed, between two anchor points (A1, A2), over the hollow (1) and the at least one track rope (4) sags between two support points (SP1, SP2) in the shape of a catenary, wherein a conveying device (10) for conveying the conveyed material (6) is arranged suspended from the at least one track rope (4), wherein a track rope length (l_T) of the at least one track rope (4) between the two support points (SP1, SP2) is longer than a conveying length (l_F) of the conveying device (10) between the two support points (SP1, SP2), and wherein at at least one anchor point (A1, A2) there is provided a rope adjustment device (46) for adjusting the track rope length (l_T) of the at least one track rope (4) between the two support points (SP1, SP2).

Apparatus and method for conveying into and out of a hollow

The present invention relates to an apparatus and a method for filling a hollow with solid conveyed material or for removing solid conveyed material from a hollow.

5 In surface mining, natural resources such as ores, stone, sand, gravel or coal are extracted from layers close to the surface. Mining is carried out with excavators or bucket wheel excavators, and by blasting, milling, etc. The material extracted is often removed from the mining site for further processing by belt conveyor systems. Surface mines can also reach great depths, which can make removal with belt conveyor systems complex, because the belt conveyor system often has to be moved and adjusted in length.

10 Conventional belt conveyor systems with a driven, endless conveyor belt, which is deflected via deflection rollers at both ends of the belt conveyor system, can be used as conveying devices for conveying the material to be conveyed. A plurality of support rollers are generally provided between the deflection rollers in order to support the conveyor belt, in particular the run in which the material is conveyed. Conveying devices are also known with a conveyor
15 belt on which a plurality of support rollers are arranged, which are distributed over the length and which roll on fixed track ropes. Examples of this can be found in EP 2 460 744 B1 or EP 2 030 919 B1. Furthermore, a known aerial cableway designed as a reversible aerial tramway for transporting conveyed material, such as bulk material, can also be used as the conveying device. A material bucket for receiving the material to be conveyed is arranged on a
20 hanger of the reversible aerial tramway. The hanger is suspended from a running gear with a number of support rollers on a track rope (or a plurality of track ropes) and is usually moved back and forth between two stations with a pull cable attached to the running gear.

Surface mining sometimes also leaves very spacious and/or deep hollows in the landscape. It is often a desire or a requirement to backfill such hollows with material after the surface
25 mine has been abandoned, for example because the deposit has been exhausted. Hollows to be filled can of course also be created in other ways than through the extraction of natural resources. Hollows are often filled with conveying devices in order to transport the filling material to the right place. This is also complex because the conveying device often has to be relocated and its length adjusted. The above-mentioned conveying devices can also be used
30 for this purpose.

It is an object of the present invention to provide an apparatus and a method that permit flexible, simple removal of solid conveyed material from a hollow or flexible, simple filling of a hollow with solid conveyed material.

35 According to the invention, this object is achieved with at least one track rope which is fixed between two anchor points over the hollow and which sags between two support points in

the shape of a catenary, wherein a conveying device for conveying the conveyed material is arranged suspended from the at least one track rope, wherein the anchor points are each arranged above a desired filling height in the region of the respective anchor point and a track rope length of the at least one track rope between the two support points is longer than a
5 conveying length of the conveying device between the two support points, and wherein at at least one anchor point there is provided a rope adjustment device for adjusting the track ropes between the two support points. This means that the track rope can be pulled at certain times in order to shorten the track rope length between the two support points while at the same time the at least one track rope with the conveying device suspended therefrom is
10 moved upwards, or the track rope can be slackened at certain times in order to extend the track rope length between the two support points while at the same time the at least one track rope with the conveying device suspended therefrom is moved downwards. In this way, the sag of the track rope in the hollow can be adapted to the hollow, so that the conveying device can always be kept at the required or desired distance from the hollow base. A reloca-
15 tion of the conveying device or of anchor points or of support points is therefore no longer necessary, which considerably simplifies the effort required to convey into or out of the hollow.

A transfer station for loading onto the conveying device or for unloading from the conveying device is preferably provided in the region of an anchor point and the rope adjustment device
20 is provided at the opposite anchor point. In this way, the end of the track rope on which the conveying device is not suspended can be adjusted, so that an adjustment of the suspension points of the conveying device on the track rope that may otherwise be necessary can be dispensed with. This simplifies the use of the apparatus.

In order to be able to make the conveyance of conveyed material into the hollow more flexible, a distribution conveying device can be arranged suspended from the at least one track
25 rope in the region of an end of the conveying device in the hollow, wherein the conveying device conveys the conveyed material onto the distribution conveying device. By appropriately designing the distribution conveying device, the distribution of conveyed material in the hollow can easily be adapted to the respective requirements and circumstances. It is particularly
30 advantageous if the distribution conveying device is designed as a distribution belt conveyor system that can be operated in both conveying directions. In this way, conveyed material can be unloaded at two different points in the hollow in a simple manner, which supports the further distribution of the conveyed material in the hollow.

Accordingly, in one aspect there is provided a method for filling a hollow with solid conveyed
35 material which is transported to the hollow by means of a conveying device, wherein the conveying device is suspended from at least one track rope which is fixed between two anchor

points over the hollow, wherein the at least one track rope sags between two support points in the shape of a catenary and the track rope length of the at least one track rope between the two support points is longer than the conveying length of the conveying device between the two support points, the method comprising: pulling the at least one track rope at at least one anchor point at certain times in order to shorten the track rope length between the two unaltered support points, by which at the same time the at least one track rope with the conveying device suspended therefrom is moved upwards.

In another aspect, there is provided a method for removing solid conveyed material from a hollow by means of a conveying device, wherein the conveying device is suspended from at least one track rope which is fixed between two anchor points over the hollow, wherein the at least one track rope sags between two support points in the shape of a catenary and the track rope length of the at least one track rope between the two support points is longer than the conveying length of the conveying device between the two support points, the method comprising: slackening the at least one track rope at at least one anchor point at certain times in order to extend the track rope length between the two unaltered support points, by which at the same time the at least one track rope with the conveying device suspended therefrom is moved downwards.

In still another aspect, there is provided an apparatus for filling a hollow with solid conveyed material or for removing solid conveyed material from a hollow, wherein at least one track rope is fixed between two anchor points over the hollow, and in that the at least one track rope sags between two support points in the shape of a catenary, wherein a conveying device for conveying the conveyed material is arranged suspended from the at least one track rope, wherein a track rope length of the at least one track rope between the two support points is longer than a conveying length of the conveying device between the two support points, and wherein at at least one anchor point there is provided a rope adjustment device for adjusting the track rope length of the at least one track rope between the two support points, wherein the rope adjustment device pulls on the at least one track rope at at least one anchor point at certain times in order to shorten the track rope length between the two unaltered support points and to move the at least one track rope with the conveying device suspended therefrom upwards at the same time or wherein the rope adjustment device slackens the at least one track rope at at least one anchor point at certain times in order to extend the track rope length between the two unaltered support points and to move the at least one track rope with the conveying device suspended therefrom downwards at the same time.

In the following, the present invention is described in greater detail with reference to Fig. 1 to 6 which, by way of example, show schematic and non-limiting advantageous embodiments of the invention. In the drawings:

Fig. 1 is a cross-section through a hollow with a track rope fixed over it,
 Fig. 2 is an embodiment of a conveying device for conveying into and/or out of the hollow,
 Fig. 3 shows an end of the conveying device in the region of an anchor point of the
 5 track rope,
 Fig. 4 shows an end of the conveying device in the hollow,
 Fig. 5 shows an end of the conveying device in the hollow with a distribution conveying
 device, and
 Fig. 6 shows an anchor point with an embodiment of a rope adjustment device.

10 The invention is described below primarily using the example of filling a hollow with conveyed material, in particular bulk material. The conveyed material is removed from a hollow in an analogous manner in the opposite direction.

Fig. 1 is a cross-section through a hollow 1, which can typically reach a depth in the range of a few tens of meters to a few hundred meters, shallower or even deeper hollows being of
 15 course also conceivable. The width and length, or approximately a diameter, of the hollow 1 can be in the range of a few hundred meters, with smaller and larger dimensions also being conceivable. The hollow 1 has a hollow base 2, from which the hollow slope 3 extends upwards all around with a slope angle. Of course, the hollow 1 does not have to be symmetrical, nor does it have to have the same slope angle on all sides. The hollow slope 3 can also
 20 be created in the form of steps. The shape and the dimensions of the hollow 1 are ultimately secondary to the invention. For filling, conveyed material is transported onto the hollow base 2 in order to fill the hollow 1, whereby the hollow base 2 rises. Conversely, conveyed material obtained in the hollow 1 is removed from the hollow base 2, whereby the hollow base 2 can sink further.

25 At least one track rope⁴ is fixed over the hollow 2 between two anchor points A1, A2. A plurality of track ropes⁴ can also be fixed, wherein the number of track ropes required naturally depends on the span and the load to be supported. The at least one track rope 4 is suspended over the hollow 1 between two support points SP1, SP2 in the shape of a catenary, which results in a track rope length l_T as the length of the catenary between the two support
 30 points SP1, SP2. The catenary results as a function of the span, the arrangement of the support points SP1, SP2 and the load on the at least one track rope 4. A support point SP1, SP2 can be an anchor point A1, A2, for example the anchor point A2 in Fig. 1, or a support for the track rope 4, for example on a support pole 5, for example on a support pole 5 in Fig. 1. The track rope length l_T between the two support points SP1, SP2 does not have to correspond to
 35 the actual length of the at least one track rope 4 between the two anchor points A1, A2, depending on the specific design. In an advantageous embodiment, the two support points SP1, SP2 coincide with the anchor points A1, A2.

If the topology of the hollow 1 and/or the arrangement of the anchor points A1, A2 requires it, a support pole 5 (or a plurality of support poles) for the at least one track rope 4 can also be provided at a suitable location.

The support points SP1, SP2 are preferably arranged above the desired filling height h_v in the region of the respective support point SP1, SP2, i.e. at a higher level. The filling height h_v is the level of the hollow base 2 after filling. In the case of mining, the filling height h_v corresponds to the initial height, i.e. the hollow base 2 at which mining begins. In the case of inclined filling, however, one support point SP1, SP2 could, for example, be arranged lower than the other support point SP1, SP2 and also lower than the filling height h_v in the region of the other support point SP1, SP2, although the lower support point SP1 would nevertheless preferably be higher than the filling height h_v in the region of the lower-lying support point SP1. It can thus be achieved that the at least one track rope 4 always runs above the respective hollow base 2 without providing any further supports. Depending on the topology of the hollow, it is therefore not absolutely necessary to strive for horizontal filling.

Depending on the track rope length l_T , the track rope 4 sags to a greater or lesser extent between the anchor points A1, A2 and there is maximum sag. An upper tensioning position S1 is shown in Fig. 1, in which the track rope 4 sags only slightly and in particular runs above the filling height h_v . In a lower tensioning position S2, the track rope length l_T is greater and the track rope 4 sags to a greater extent, in particular just above the hollow base 2, usually in the range from a few meters to a few tens of meters.

A conveying device 10 is suspended from the at least one track rope 4, which is explained by way of example with reference to Fig. 2. In this embodiment a total of four track ropes 4 are fixed next to one another and are at least approximately parallel. A first load-bearing structure 11 is suspended from the track rope 4 at a first height and a second load-bearing structure 12 at a second height. Of course, a plurality of such load-bearing structures 11, 12 are arranged distributed at certain intervals along the length of the belt conveyor system 10 along the track rope 4. In the embodiment shown, the first load-bearing structure 11 is designed as a U-shaped frame which is attached to the track ropes, for example by means of a clamp connection. The second load-bearing structure 12 is also designed as a frame which is attached to rods or cables, which in turn are attached to the track ropes 4, for example again by means of a clamp connection. Two guide elements 13', 13'', 14', 14'' are arranged next to one another on the load-bearing structures 11, 12 in the direction of the longitudinal extent of the conveying device 10. The guide elements 13', 13'', 14', 14'' are thus also arranged in pairs at different heights. A guide element 13', 13'', 14', 14'' can be a cable, a rod, a pipe, a rail or the like, preferably a cable. The distance between the pairs of guide elements gives the track width for support rollers 15', 15'', which are arranged on both sides of an endless, revolving conveyor belt 16 of the conveying device 10. For this purpose, cross struts 17

are arranged distributed in the longitudinal direction on the conveyor belt 16, for example by a screw or clamp connection, which protrude over the width of the conveyor belt 16 and at the axial ends of which the support rollers 15', 15'' are rotatably mounted. If there are several guide elements 13', 13'', 14', 14'' on each side of the conveyor belt 16, support rollers 15', 15'' with different track widths can also be provided on the conveyor belt 16, as in Fig. 2, which then roll on different guide elements 13', 13'', 14', 14''. At the lateral ends of the conveyor belt 16, side walls 18', 18'' can also be arranged in order to form a U-shaped receptacle for the conveyed material on the conveyor belt 16. Distributed in the longitudinal direction of the conveyor belt 16, transverse walls can also be arranged between the two side walls 18', 18'' in order to form individual receiving portions, which can facilitate the transport of conveyed material, in particular in sections of the conveyor belt 16 with an incline. The support rollers 15', 15'' roll on the respectively assigned guide element 13', 13'', 14', 14''. The conveyor belt 16 revolve on deflection rollers 19 (see Fig. 3) at the respective ends of the conveying device 10. At least one deflection roller 19 can be driven in order to drive the conveyor belt 16. This type of conveying device 10 is well known, which is why no further details need to be discussed here.

However, the conveying device 10 can also be designed differently. For example, on the at least one track rope 4, rotatably mounted support rollers distributed in the longitudinal direction can be suspended, on which the conveyor belt 16 is supported. The support rollers can also be arranged on load-bearing structures, which in turn are attached to the track rope 4. The conveying device 10 would thus be designed in the form of a classic belt conveyor system. Likewise, the conveying device 10 can be designed as a well-known reversible aerial tramway, with a material bucket which is suspended from a hanger with a number of support rollers on the at least one track rope 4, or a guide element suspended therefrom, and which can be moved back and forth thereon. The hanger with the material bucket can have its own actuator or is moved with a pull rope which is attached to the hanger.

In the region of an end of the conveying device 10, a transfer station U is arranged, which is arranged in the region of an anchor point A1, as shown in Fig. 3. In the transfer station U, either the conveyed material is loaded into the conveying device 10 (when backfilling) or conveyed material is unloaded from the conveying device 10 (when excavating or mining). For loading, the conveyed material can for example be placed on the conveyor belt 16 or filled into a material bucket. For unloading, the conveyed material can be removed from the conveyor belt, for example, or emptied from a material bucket. The way in which the transfer station U and the loading or unloading are exactly implemented is irrelevant to the invention. This one end of the belt conveyor system 10 in the region of the transfer station U is thus also arranged above the desired filling height h_v in the region of the anchor point A1 or in the region of the transfer station U. An actuator 20 for the deflection roller 19 is also indicated in

Fig. 3. It is also indicated that support rollers 21 can also be arranged in the region of the transfer station U, for example on a support pole 5 in order to guide a conveyor belt 16 in a targeted manner, for example in a section horizontally, in order to facilitate the handling of the conveyed material at the transfer station U.

5 Of course, the belt conveyor system 10 could also extend beyond the anchor point A1, depending on the arrangement of the transfer station U or the topology of the environment. In this case, for example, corresponding guide elements, also arranged in a stationary manner, on which the support rollers 15', 15'' of the conveyor belt 16 roll, could also be arranged in the region of the transfer station U. For this purpose, a suitable transfer, known per se, of the
 10 support rollers 15', 15'' of the conveyor belt 16 from the guide elements 13', 13'', 14', 14'' of the conveying device 10 to the guide elements in the region of the transfer station U could be provided.

In the case of a reversible aerial tramway as the conveying device 10, the transfer station U can be provided, for example, in a cableway station into which the material bucket enters.

15 The transfer station U, and also the anchor point A1 at the end of the conveying device 10 in the region of the transfer station U, can, however, also be provided away from the actual hollow 1. In this case, the conveying device 10 can also extend further beyond the region of the hollow 1. A configuration is therefore also conceivable in which the anchor points A1, A2 are provided in the region of the hollow 1, but the conveying device 10 extends beyond an anchor point A1.
 20

The conveying length l_F of the conveying device 10 extending along the at least one track rope 4 between the two support points SP1, SP2 is shorter according to the invention than the track rope length l_T between the two support points SP1, SP2. The conveying length l_F of the conveying device 10 between the two support points SP1, SP2 is preferably in the range
 25 of 20 to 80% of the track rope length l_T between the two support points SP1, SP2.

In Fig. 4, the other end of the conveying device 10 suspended from the track rope 4 is shown. Since the track rope length l_T between the two support points SP1, SP2 is longer than the conveying length l_F , this other end of the conveying device 10 ends between the two support points SP1, SP2, preferably in a region of the hollow base 2 that is currently being
 30 backfilled or mined. In a possible advantageous embodiment, the conveying device 10 ends in the region of the maximum sag of the at least one track rope 4.

The deflection roller 22 at this end of the belt conveyor system 10 is also arranged suspended from the track ropes 4. For this purpose, a suitable load-bearing structure 23 for the deflection roller 22 can be provided on the at least one track rope 4. The track rope 4 extends beyond the end of the belt conveyor system 10 to the support point SP2 and anchor
 35 point A2, which can coincide (as in Fig. 1). The conveyed material 6 conveyed with the

conveying device 10 into the hollow 1 is deposited on the hollow base 2 in the region of the end of the conveying device 10, for example in the form of a conical pile 24, as in the drawings. From there, the conveyed material 6 can be distributed on the hollow base 2, for example by means of further belt conveyor systems, an excavator, a bulldozer, or the like.

5 To fill a hollow 1 with conveyed material 6, the following procedure should now be followed. At the beginning of filling, the track rope 4 is in the lower tensioning position S2, i.e. the track rope 4 is so long that it sags sufficiently far to the hollow base 2, wherein it should of course be avoided that the conveying device 10 suspended from the track rope 4 touches the hollow base 2. The conveying device 10 is preferably located a few meters or a few tens of meters
10 above the hollow base 2. Conveyed material 6 is conveyed with the conveying device 10 into the hollow 1 and distributed there on the hollow base 2. This increases the level of the hollow base 2. If the distance between the conveying device 10 and the hollow base 2 gets too small, the track rope 4 is pulled at at least one of the anchor points A1, A2 in order to shorten the track rope length l_T between the support points SP1, SP2. When this happens can be
15 freely selected and also depends on the distribution system of the conveyed material 6 in the hollow 1. Thereby, the track rope 4 with the conveying device 10 attached thereto moves upwards at the same time. This is repeated until the hollow 1 is completely filled and the track rope 4 is in the upper tensioning position S1 (Fig. 1). Thereafter, the track rope 4 and the conveying device 10 can also be dismantled if necessary.

20 It is advantageous if the track rope 4 is pulled at the anchor point A2 opposite the conveying device 10 (in Fig. 1). In this case, the conveying device 10 simply moves upwards without having to alter anything in the suspension of the conveying device 10 on the at least one track rope 4. Since the track rope length l_T between the two support points SP1, SP2 is shortened, only the end of the conveying device 10 lying in the region of the hollow 1 moves in the
25 direction of the anchor point A2.

However, it is also possible to pull the track rope 4 at the anchor point A1 (in Fig. 1) on the side of the conveying device 10. In this case, however, the suspension of the conveying device 10 would usually also have to be adjusted (provided that it is not suspended in a floating manner), since the suspension points of the conveying device 10 on the track rope 4 would
30 also be displaced with the track rope 4 in the direction of the anchor point A1.

However, it is also possible to pull the track rope 4 at both anchor points A1, A2 at the same time.

In the case of mining, the process is of course exactly the reverse. It begins in the upper tensioning position S1 and the extracted material is conveyed away from the hollow base 2 with
35 the conveying device 10. If the distance between the conveying device 10 and the hollow base 2 gets too great, the track rope 4 is slackened at at least one anchor point A1, A2 in

order to extend the track rope length l_T . When this happens can be freely selected and also depends on the mine plan in the hollow 1. Thereby, the track rope 4 with the conveying device 10 attached thereto moves downwards. This is repeated until the mining is finished. Here, too, the adjustment of the track rope length l_T can take place at each of the anchor points A1, A2 or at both at the same time.

The conveying length l_F does not have to be altered, nor does the position of the anchor points A1, A2 or the support points SP1, SP2, which considerably simplifies the realization of the backfilling or mining. As a result of the tensioning or slackening of the track rope 4 during this process, only the end of the conveying device 10 displaces slightly to and fro in the region of the hollow base 2, but this is irrelevant for the realization of the backfilling or mining.

It is also evident from this that the conveying device 10 suspended from the at least one track rope 4 can also be designed differently than described with reference to the specific embodiment, for example with support rollers on which the conveyor belt is supported or with an reversible aerial tramway, since this is irrelevant to the invention.

The at least one track rope 4 is preferably fixedly fixed at one of the two anchor points A1, A2, with the result that the track rope length l_T is altered at the other anchor point A1, A2. This simplifies the design and handling of the system. But it is of course conceivable to make the track rope length l_T of the track rope 4 alterable at both anchor points A1, A2.

In Fig. 5, a particularly advantageous embodiment for filling in the region of the hollow base 2 is shown. In the region of the end of the conveying device 10 in the hollow 1, a distribution conveying device 25 is arranged suspended from the at least one track rope 4. The conveying device 10 conveys the conveyed material 6 onto the distribution conveying device 25 and is conveyed from there into the hollow 1. In the illustrated embodiment, the distribution conveying device 25 is designed as a distribution belt conveyor system, other configurations also being conceivable.

In the embodiment of the distribution conveying device 25 according to Fig. 5 as a distribution belt conveyor system, the distribution conveying device 25 has two deflection rollers 26, 27 around which an endless distribution conveyor belt 28 revolves. At least one deflection roller 26, 27 is driven by a drive 29. In this example, the distribution conveying device 25 is designed with support rollers 30 on which the conveying run of the distribution conveyor belt 28 is supported. For the support rollers 30, load-bearing structures 31 are provided, which are arranged on the at least one track rope 4. Corresponding load-bearing structures 32, which are also arranged on the track rope 4, are also provided for the deflection rollers 26, 27. The distribution conveying device 25 could, however, be designed just like the conveying device 10, i.e. with support rollers 15', 15'', which are arranged distributed along the length of the distribution conveyor belt 28, and with guide elements 13', 13'', 14', 14'', which are

arranged suspended from the at least one track rope 4, preferably on corresponding suspended load-bearing structures.

Of course, a common load-bearing structure could also be provided for the distribution conveying device 25, suspended from the track rope 4, on which the components required for the distribution conveying device 25 are arranged.

The distribution conveying device 25 in the form of a distribution belt conveyor system preferably extends along the track rope 4 in both directions from the end of the conveying device 10 in the hollow 1 and below the conveying device 10. The conveying device 10 conveys the conveyed material 6 onto the distribution conveying device 25 and is conveyed from there into the hollow 1. By changing the direction of rotation of the drive 29, the distribution belt conveyor system can convey in both directions (as indicated in Fig. 5 by the double arrow). In this way, two conical piles 24 can be heaped up onto the hollow base 2 with conveying material 6, which of course can facilitate and accelerate the filling process. For example, one conical pile can be formed while the other is being spread.

One or more unloading points located between the two ends of the distribution conveying device 25 could also be provided on the distribution conveying device 25, for example in order to form further conical piles 24, or to deposit the conveyed material 6 at other locations.

Likewise, the distribution conveying device 25 can only convey in one direction. In order to still be able in such an embodiment, or in other embodiments, to deposit the conveyed material at two points, for example two conical piles 24 as shown in Fig. 5, a switching chute can also be arranged between the conveying device 10 and the distribution conveying device 25, which either conveys the conveyed material 6 from the conveying device 10 onto the distribution conveying device 25, or from the conveying device 10 next to the distribution conveying device 25 directly onto the hollow base 2. In the latter case, the distribution conveying device 25 can also stand still. The switching chute could be arranged suspended from the at least one track rope 4 or also on a load-bearing structure of the conveying device 10 or the distribution conveying device 25.

In the above preferred embodiments, suspended is understood to mean that the at least one track rope 4 is arranged at the very top and all other components, such as the load-bearing structure 11, 12, 31, 32, guide elements 13', 13'', 14', 14'', support rollers and the distribution belt conveyor system 25, are suspended therefrom. According to the invention, suspended is understood more broadly and also includes designs in which the track rope is arranged in the middle, i.e. certain components above and certain below the track rope 4, or at the very bottom, i.e. all components above the track rope 4.

An advantageous embodiment of an anchor point A1, A2 with a rope adjustment device 46 is explained with Fig. 6. In this embodiment, six track ropes 4 are provided, the following

statements naturally being valid for any number of track ropes 4. At the ends of the track ropes 4, a first holding device 40 of the rope adjustment device 46 is fastened to the track ropes 4, for example via a clamp connection. These first holding devices 40 are supported on a first cross-member 41 through which the track ropes 4 are passed. The first holding devices 40 together with the first cross-member 41 must therefore support the entire weight of the track ropes 40, the conveying device 10 arranged thereon, and the weight of the conveyed material 6 being conveyed. At a certain distance (in the direction of the other anchor point A1) from the first holding devices 40, second holding devices 43 are provided on the track ropes 4, which can be designed in the same way as the first holding devices 40. Furthermore, a second cross-member 42, through which the track ropes 4 are passed, is arranged in a stationary manner, on which the second holding devices 43 can be supported. The first cross-member 41 is arranged displaceably in the longitudinal direction of the track ropes 4 by means of an actuator. For this purpose, a linear actuator 44, for example a hydraulic, pneumatic or electric actuator, which acts on the first cross-member 41, is arranged on a supporting element 45 of the anchor point A2. Such a linear actuator 44 is preferably provided on both sides of the track ropes 4. With the linear actuator 44, the cross-member 41 can be displaced in the longitudinal direction of the track ropes 4.

In order to pull the track rope 4 upwards, the procedure according to Fig. 6 can be carried out as follows. The holding devices 40 at the ends of the track ropes 4 are fastened to the track ropes 4 and are supported on the first cross-member 41. The linear actuator 44 is fully retracted. The linear actuator 44 is now actuated, with which the cross-member 41 is displaced in the direction away from the opposite anchor point A1 - the track rope length l_T is thus shortened by the stroke of the linear actuator 44. For safety reasons, the second holding devices 43 can also be fastened to the track ropes 4, which are thus also displaced with the track rope 4. When the linear actuator 44 is extended, these second holding devices 43 are released from the track ropes 4 and displaced to the second cross-member 42. This can be done automatically or manually. If the second holding devices 43 are released from the track ropes 4 when the track ropes 4 are pulled, then under certain circumstances it is also possible to dispense with displacing the holding devices 43 to the second cross-member 42. The second holding devices 43, that abut the second cross-member 42, are fastened to the track ropes 4 (manually or automatically), with which the track ropes 4 are now supported via the second holding devices 43 and the second cross-member 42. The linear actuator 44 can now be retracted again, with the result that the first cross-member 41 is displaced again in the direction of the opposite anchor point A1. The first holding devices 40 can then be released from the track ropes 4 and displaced in the direction of the first cross-member 41 and fastened again to the track ropes 4 (manually or automatically). This can of course be repeated until the desired shortening of the track rope length l_T has been achieved.

It is of course also conceivable to dispense with the second cross-member 42 and the second holding devices 43. In this case, another suitable holding device could be provided for holding the track rope 4 during the adjustment of the first holding devices 40.

5 Of course, other configurations of the anchor point A1, A2 and/or the rope adjustment device 46 for altering the track rope length l_T are also conceivable. Another option for a rope adjustment device 46 would be, for example, a rope winch for a track rope 4 with a latch.

To extend the track rope length l_T , the process would essentially proceed in reverse order. In this case, the linear actuator 44 could normally be extended and retracted to lengthen the track rope length l_T . In order that the linear actuator 44 does not always have to be activated,
10 a releasable latching of the first cross-member 41 could also be provided in the position of the extended linear actuator 44. Alternatively, the linear actuator 44 could also be arranged differently or a different actuator could be provided.

What is claimed is:

1. A method for filling a hollow with solid conveyed material which is transported to the hollow by means of a conveying device, wherein the conveying device is suspended from at least one track rope which is fixed between two anchor points over the hollow, wherein the at least one track rope sags between two support points in the shape of a catenary and the track rope length of the at least one track rope between the two support points is longer than the conveying length of the conveying device between the two support points, the method comprising:

pulling the at least one track rope at at least one anchor point at certain times in order to shorten the track rope length between the two unaltered support points, by which at the same time the at least one track rope with the conveying device suspended therefrom is moved upwards.

2. The method according to claim 1, further comprising:

in the region of an end of the conveying device in the hollow, suspending a distribution conveying device from the at least one track rope;

conveying the conveyed material from the conveying device onto the distribution conveying device; and

conveying the conveyed material into the hollow by the distribution conveying device.

3. The method according to claim 2, further comprising:

operating the distribution conveying device in both directions in order to distribute the conveyed material into the hollow.

4. A method for removing solid conveyed material from a hollow by means of a conveying device, wherein the conveying device is suspended from at least one track rope which is fixed between two anchor points over the hollow, wherein the at least one track rope sags between two support points in the shape of a catenary and the track rope length of the at least one track rope between the two support points is longer than the conveying length of the conveying device between the two support points, the method comprising:

slackening the at least one track rope at at least one anchor point at certain times in order to extend the track rope length between the two unaltered support points, by which at the same time the at least one track rope with the conveying device suspended therefrom is moved downwards.

5. The method according to any one of claims 1 to 4, further comprising:
using at least one of the anchor points as a support point.

6. The method according to any one of claims 1 to 5, further comprising:
loading or unloading conveyed material in the region of an anchor point; and
adjusting the at least one track rope at the opposite anchor point.

7. An apparatus for filling a hollow with solid conveyed material or for removing solid conveyed material from a hollow, wherein at least one track rope is fixed between two anchor points over the hollow, and in that the at least one track rope sags between two support points in the shape of a catenary, wherein a conveying device for conveying the conveyed material is arranged suspended from the at least one track rope, wherein a track rope length of the at least one track rope between the two support points is longer than a conveying length of the conveying device between the two support points, and wherein at at least one anchor point there is provided a rope adjustment device for adjusting the track rope length of the at least one track rope between the two support points, wherein the rope adjustment device pulls on the at least one track rope at at least one anchor point at certain times in order to shorten the track rope length between the two unaltered support points and to move the at least one track rope with the conveying device suspended therefrom upwards at the same time or wherein the rope adjustment device slackens the at least one track rope at at least one anchor point at certain times in order to extend the track rope length between the two unaltered support points and to move the at least one track rope with the conveying device suspended therefrom downwards at the same time.

8. The apparatus according to claim 7, wherein the rope adjustment device is configured to repeatedly pull on the at least one track rope when filling the hollow while the support points are unaltered in order to move the at least one track rope upwards when filling the hollow or to repeatedly slacken the least one track rope when removing from the hollow while the support points are unaltered in order to move the at least one track rope downwards when removing from the hollow.

9. The apparatus according to claim 7 or 8, wherein the conveying length is in the range of 20 to 80% of the track rope length.

10. The apparatus according to any one of claims 7 to 9, wherein at least one support point coincides with an anchor point.

11. The apparatus according to any one of claims 7 to 10, wherein a transfer station for loading onto the conveying device or for unloading from the conveying device is provided in the region of an anchor point and wherein the rope adjustment device is provided at the opposite anchor point.

12. The apparatus according to any one of claims 7 to 11, wherein in the region of an end of the conveying device in the hollow, a distribution conveying device is arranged suspended from the at least one track rope, wherein the conveying device conveys the conveyed material onto the distribution conveying device.

13. The apparatus according to any one of claims 7 to 11, wherein in the region of an end of the conveying device in the hollow, a distribution conveying device is arranged suspended from the at least one track rope and in that a switching chute is provided between the conveying device and the distribution conveying device, which conveys either onto the distribution conveying device or to a hollow base of the hollow.

14. The apparatus according to claim 12 or 13, wherein the distribution conveying device is designed as a distribution belt conveyor system with a revolving distribution conveyor belt.

15. The apparatus according to claim 14, wherein the distribution conveying device comprises a distribution conveyor belt on which a plurality of support rollers are arranged distributed over the length of the distribution conveyor belt, and said support rollers roll on guide elements, and the guide elements are arranged suspended from the at least one track rope.

16. The apparatus according to claim 14 or 15, wherein the distribution conveyor belt is designed to be operable in both conveying directions.

17. The apparatus according to any one of claims 7 to 16, wherein the conveying device is designed with a conveyor belt on which a plurality of support rollers are arranged distributed over the length of the conveyor belt, said support rollers roll on guide elements, wherein the guide elements are arranged suspended from the at least one track rope.

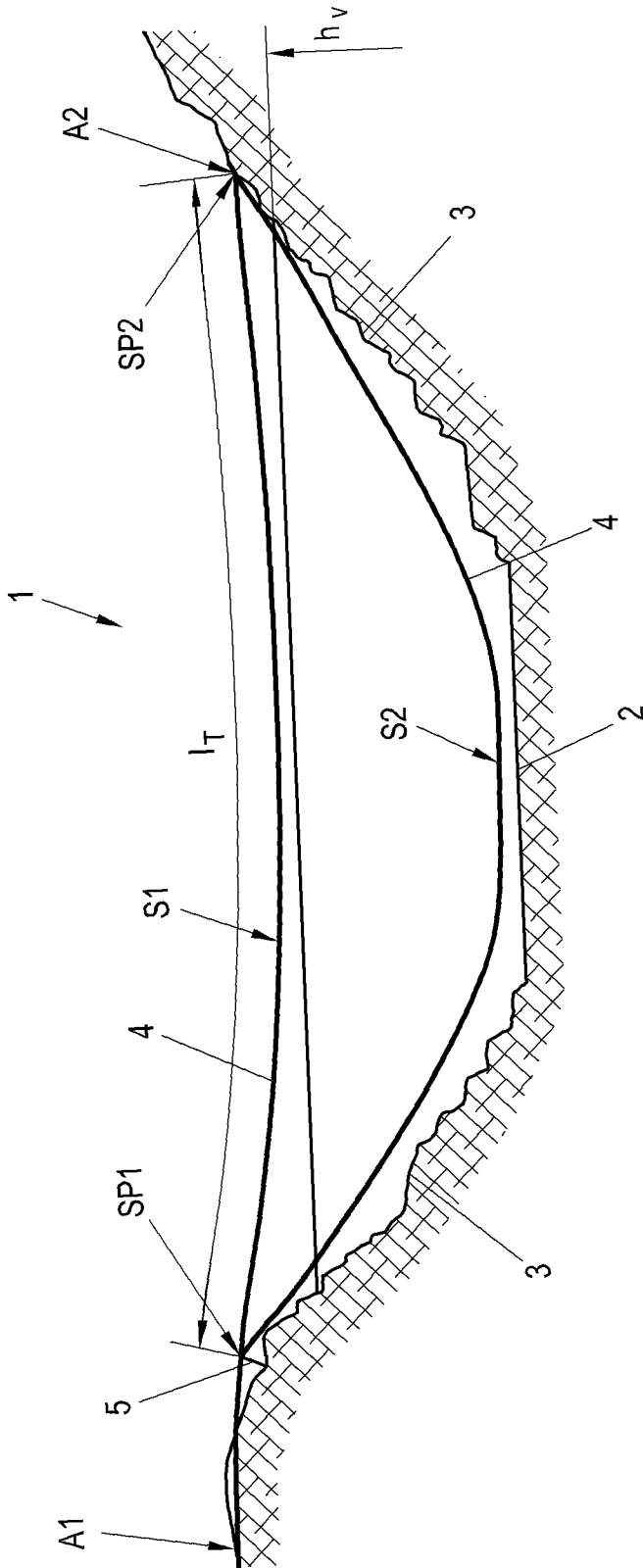


Fig. 1

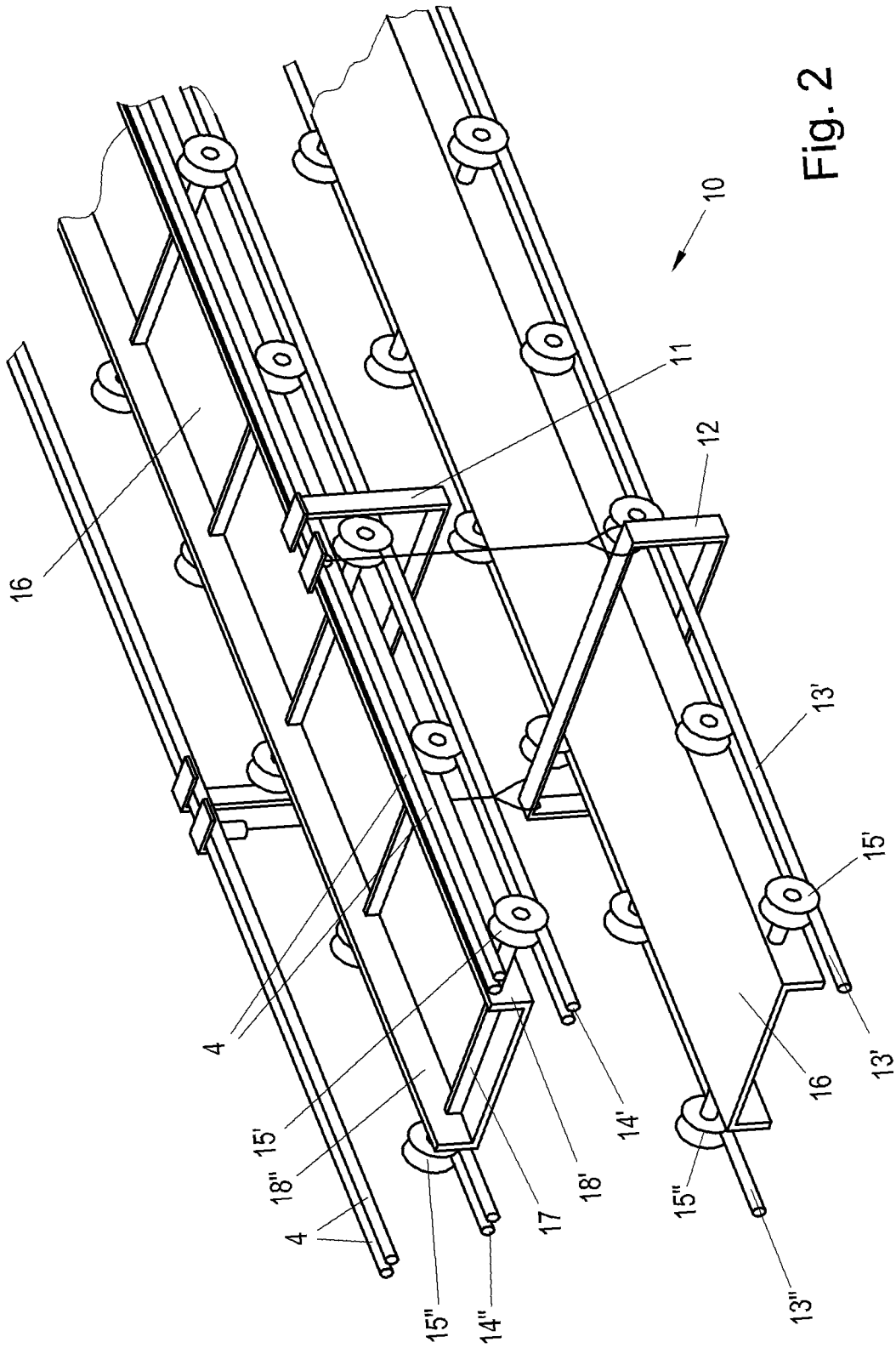


Fig. 2

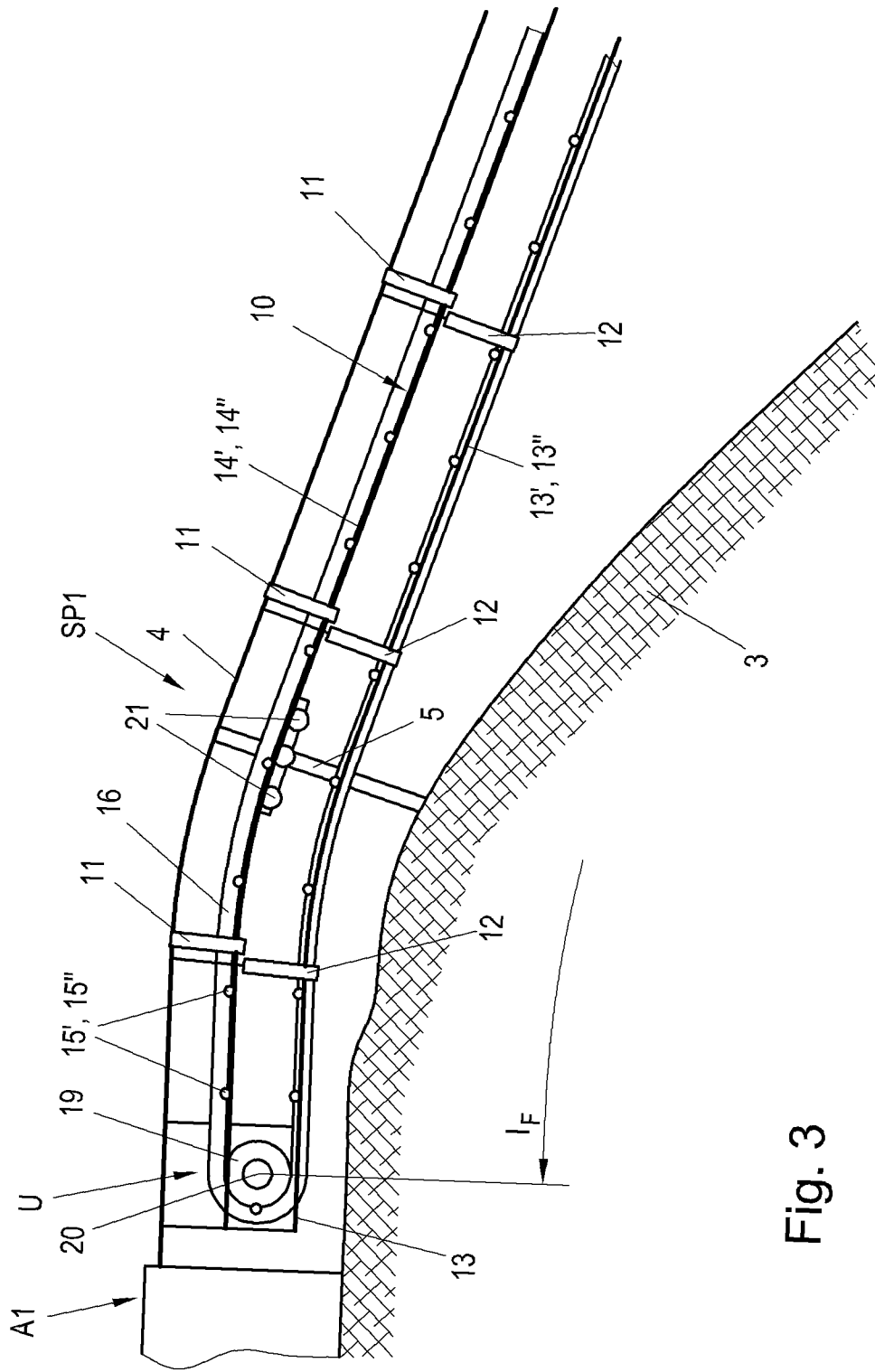


Fig. 3

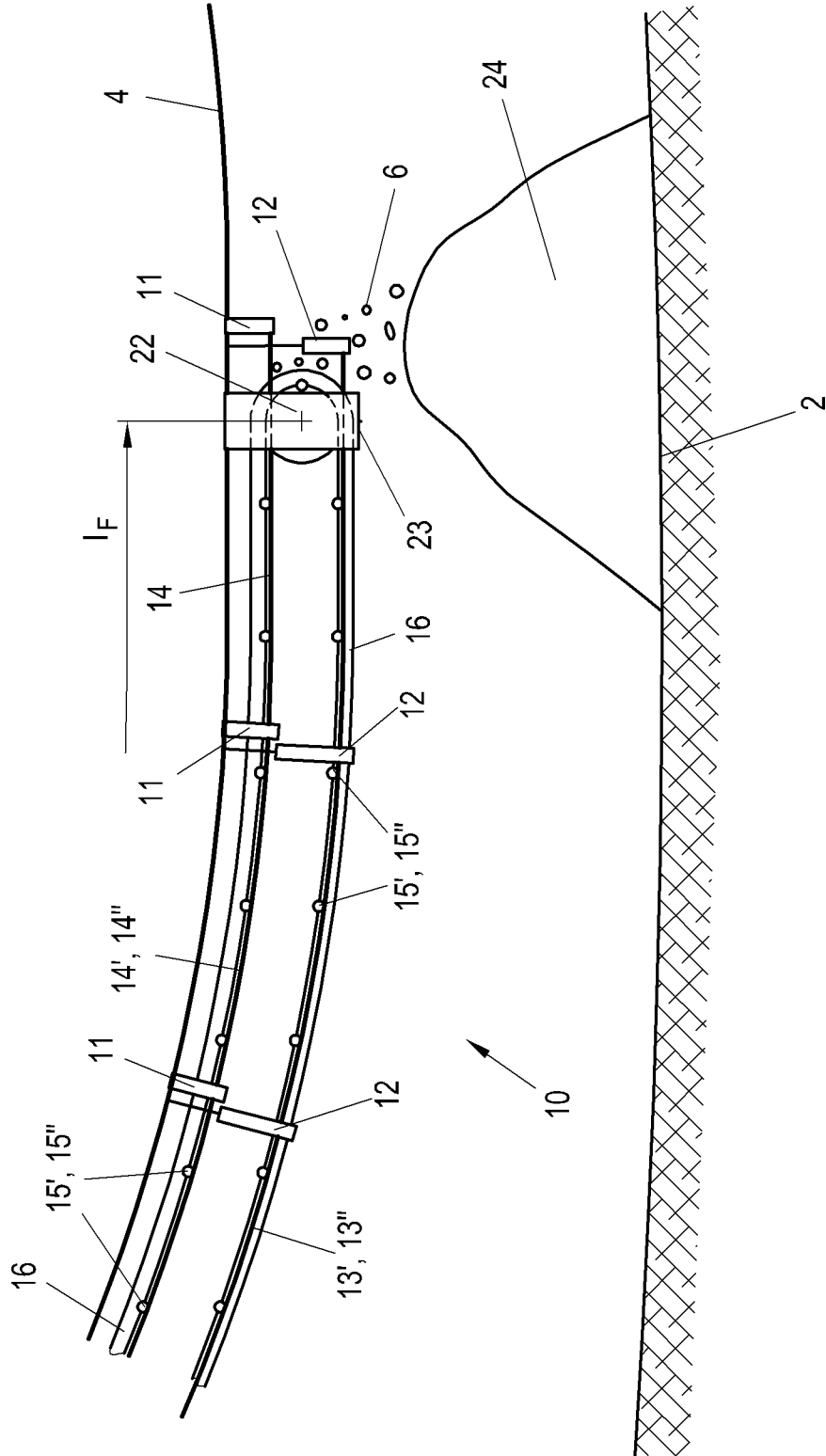


Fig. 4

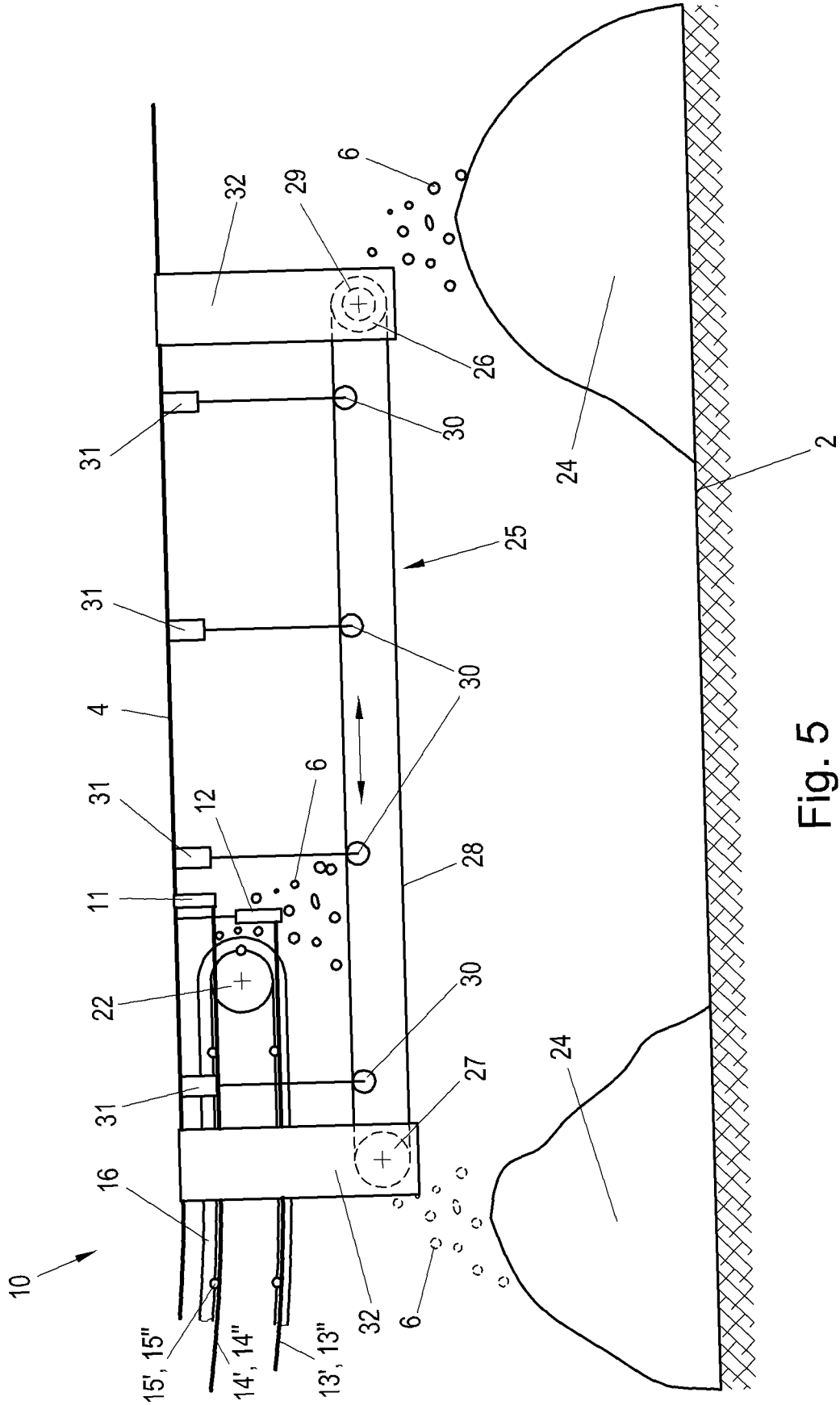


Fig. 5

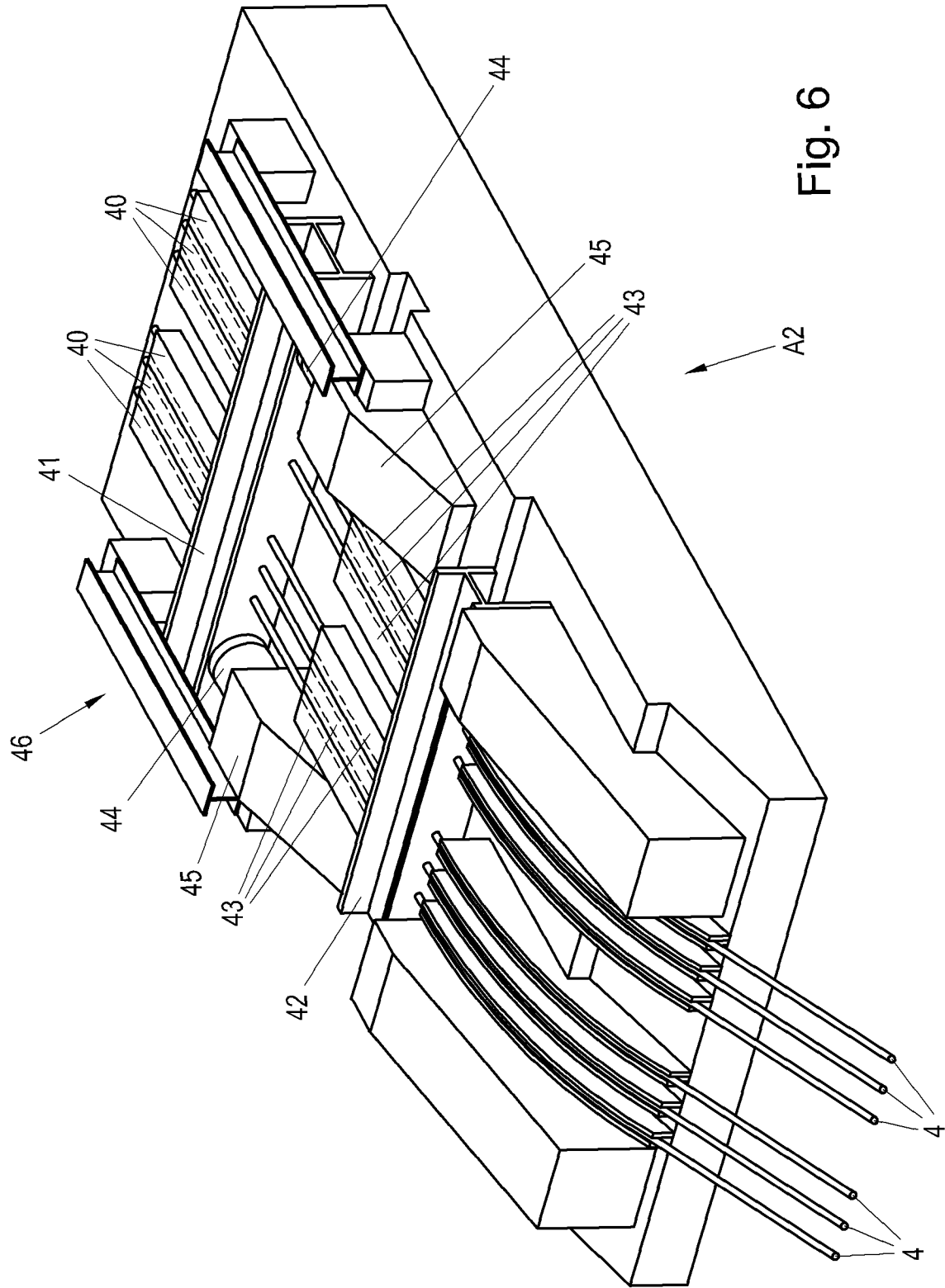


Fig. 6

