Nov. 22, 1938. K. BÖLL ET AL 2,137,261

METHOD OF AND DEVICE FOR FLUSHING-IN BLASTING CHARGES

Filed April 1, 1937 3 Sheets-Sheet 1

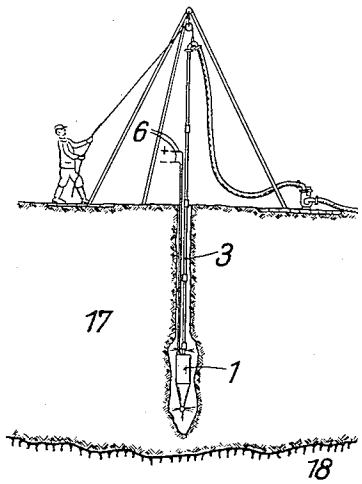


Fig. 1

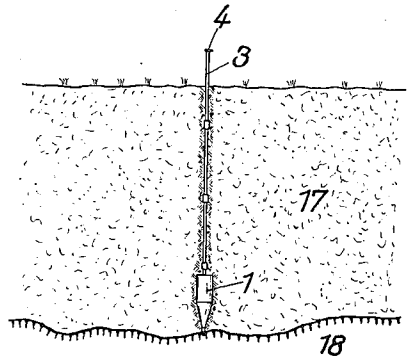


Fig. 2

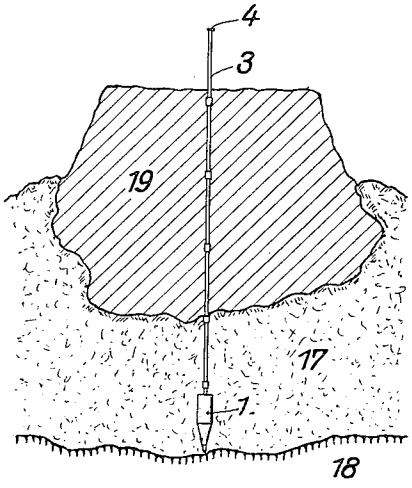


Fig. 3

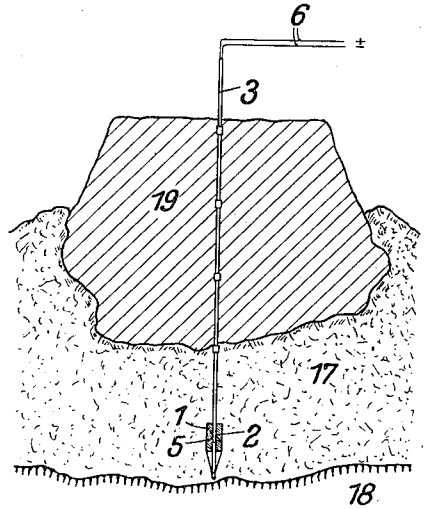


Fig. 4

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METHOD OF AND DEVICE FOR FLUSHING-IN BLASTING CHARGES

Filed April 1, 1937 3 Sheets-Sheet 2

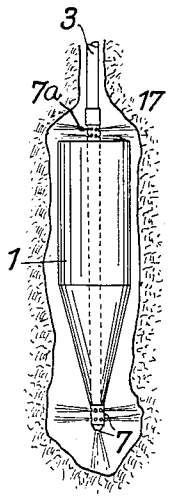


Fig. 5

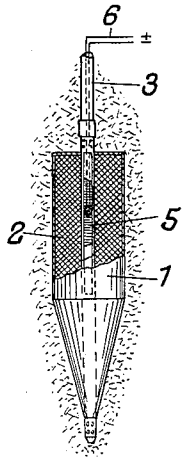


Fig. 6

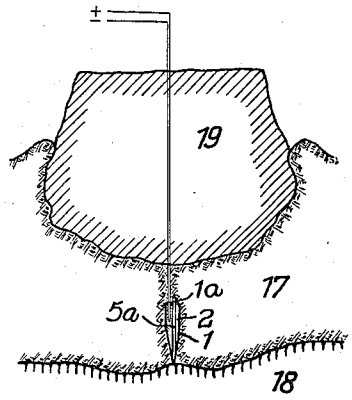


Fig. 7

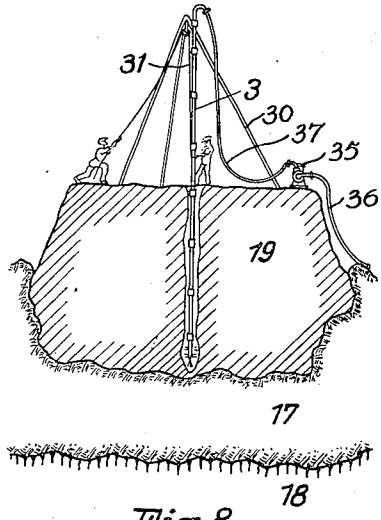


Fig. 8

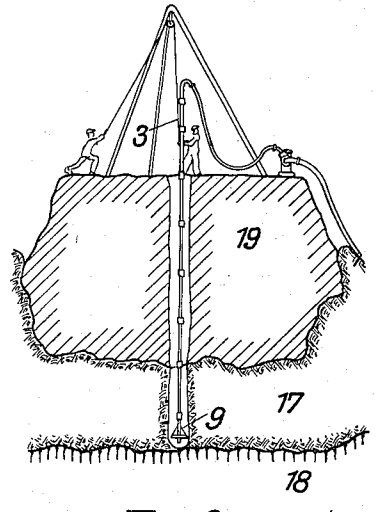


Fig. 9

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METHOD OF AND DEVICE FOR FLUSHING-IN BLASTING CHARGES

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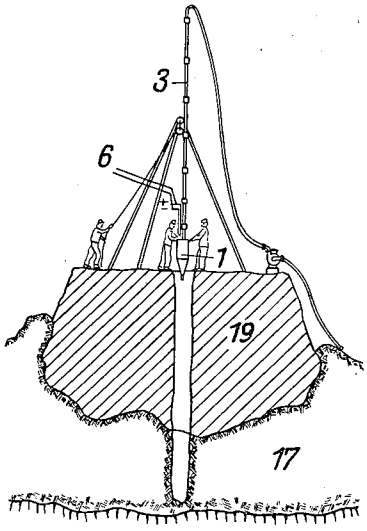


Fig.10

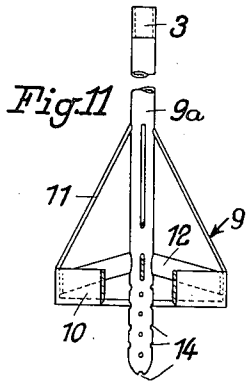


Fig.11

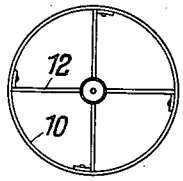


Fig.12

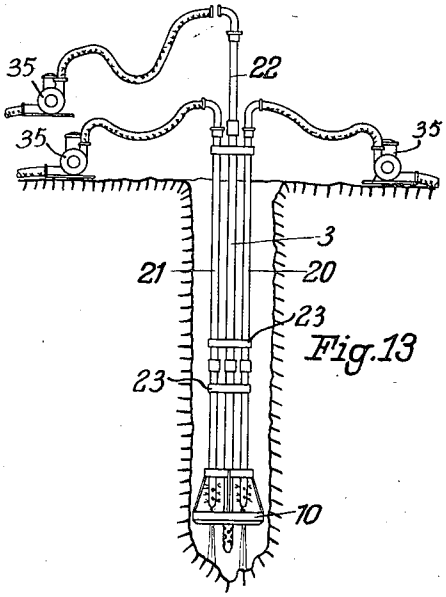


Fig.13

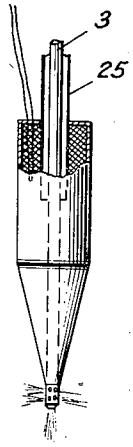


Fig.14.

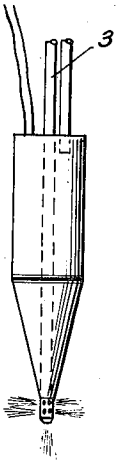


Fig.15.

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UNITED STATES PATENT OFFICE

2,137,261

METHOD OF AND DEVICE FOR FLUSHING-IN BLASTING CHARGES

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Application April 1, 1937, Serial No. 134,281
In Germany July 29, 1935

7 Claims. (Cl. 102—4)

This invention relates to a method of flushing-in blasting charges (mines) into sludgeable soil masses, especially where a moory soil is to be covered with an embankment. The invention relates further to means and devices for carrying out this method. A particular object of the invention is to insert the blasting charge, or cartridge, without producing previously thereto a separate bore hole and it presents besides the advantage that the cartridge can be brought down to the stable ground even if the layer of the soil is very thick.

The invention comprises also auxiliary means and devices for flushing-in the cartridges in cases where the moory soil or a similar sort of ground is subjected to a heavy pressure, as is the case, for instance, when an embankment has been raised and the flushing-in is to be carried out through the embankment and through and into the soil. In such a case the path for the flushing cartridge is first preliminarily produced with the aid of a particularly designed flushing bit likewise forming part of this invention, whereafter the flushing cartridge itself is flushed into the thus prepared hole. In another manner of carrying out the improved method the embankment which has been raised upon the soil is provisionally bored by means of a common flushing nozzle and only when this is no more able to proceed the flushing bit is employed. Besides this flushing bit, also the flushing cartridges are particularly designed and form parts of the invention.

It is in the above-stated way possible to effect large blasting operations, in connection with said flushing cartridges and bits, by means of hydraulic flushing prior to the raising of an embankment, as well as thereafter, the flushing taking place in the first case solely through the moory soil, in the second case through the embankment and the soil, and being extended to a great depth until stable ground has been reached, but no particularly provided bore hole being necessary as has been the case up to now.

The object in view is attained, according to this invention, by the features that the cartridge casing receiving and containing the blasting charge is combined with a flushing pipe extending water-tight into said casing, for instance in axial direction, and capable of being elongated by an extension pipe or a plurality of such pipes. Furthermore, nozzles are provided by which the water under pressure passing through the entire length of the flushing pipe suspends the loosened soil particles and whirls them upwardly on all sides along the cartridge whereby this is sunk further down into the soil to the required depth.

When the flushing is carried out after the embankment has been raised the penetration of the soil is rendered difficult owing to the pressure exerted by the embankment, especially if the layer of the soil is particularly thick. A simple flushing cartridge is, therefore, not suitable, but no difficulties are experienced if instead of the simple flushing nozzle a bit nozzle is used, which likewise forms a part of this invention. The invention comprises, besides said cutting nozzles, also cutting cartridges, all as dealt with in detail hereinafter.

When employing the flushing cartridges, the flushing edges, or a combination thereof, for depths surpassing about 8 meters it may occur that owing to the interruption of the supply of the water under pressure when another elongation pipe is attached to the flushing pipe the bore hole is choked with sand which then can be removed later on either only with great difficulties or not at all. The masses carried away normally by the water under pressure when this returns with the dissolved soil cease to move further upward as soon as the supply of the water is interrupted, either by the above-mentioned elongation of the flushing pipe or by the pump coming to a stand-still from any reason, and the suspended masses are then deposited in the bore hole on the flushing cartridge or bit, as the case may be. If the depth where that occurs is about 8 m., the further supplied water under pressure, after the interruption, is practically unable to carry the deposited masses again upwardly to the top.

In order to obviate occurrences of the just stated kind provision is made in the present invention to obtain a continual supply of the water under pressure, and we attain this object by providing, besides the flushing pipe proper at least one additional flushing pipe or a plurality of such pipes arranged parallel to said flushing pipe proper, or main flushing pipe, this additional pipe or these additional pipes extending to near the flushing cartridge or bit and ensuring the continuous removal of the loosened soil.

The invention is illustrated diagrammatically and by way of example on the accompanying drawings in which:

Fig. 1 is a vertical section indicating moory soil into which a blasting cartridge is being sunk in accordance with the invention;

Fig. 2 is a similar section showing the blasting cartridge in its final position;

Fig. 3 is a similar section showing an embankment deposited upon the moory soil around the pipe leading from the blasting cartridge, the pipe being correspondingly elongated;

Fig. 4 is a similar vertical section in which the blasting cartridge is also shown in section, the fuse having been inserted and the electric wires leading therefrom being shown;

Fig. 5 is a detail side elevation of a flushing cartridge constructed in accordance with our invention, the cartridge being represented within a bore hole in the soil;

Fig. 6 is a side elevation partly in section of the same flushing cartridge with the primer inserted;

Fig. 7 is a vertical section of a moory soil and embankment with submerged blasting cartridge of somewhat different form;

Fig. 8 is a vertical section indicating the method of flushing a bore hole through an embankment into the moory soil;

Fig. 9 is a similar view showing the bore hole at a later stage and indicating a bit comprising a cutting edge and flushing nozzle;

Fig. 10 is a vertical section similar to Fig. 9 showing a flushing cartridge about to be introduced into the bore hole prepared in the manner shown in Figs. 8 and 9;

Fig. 11 is a side elevation with parts in section of a bit comprising a cutting edge and flushing nozzle;

Fig. 12 is a bottom plan view of the same;

Fig. 13 is a vertical section representing the method of boring a hole in the soil by the use of a flushing unit comprising a plurality of flushing pipes and a cutting bit;

Fig. 14 is a side elevation, partly in section, of a flushing cartridge having means for introducing liquid air into the cartridge; and

Fig. 15 is a side elevation of a flushing cartridge having a modified means for introducing liquid air.

Fig. 1 shows how a mine designed according to this invention is flushed into the moory soil prior to the raising of an embankment with the aid of a flushing pump and a tripod. An elongated flushing pipe **3** extends water-tight through a cartridge **1**. It is essential that the water under pressure, i. e. the flushing water leaves the pipe not only below the cartridge in axial and in radial direction, but flows out radially also above the mine, and in connection therewith it is essential that the flushing pipe serves also for manipulating the pipe whereby it is rendered possible to flush-out the cartridge again upwardly if it encounters stones or roots forming obstacles which cannot be overcome.

Figure 2 shows the initial state of the mine when it has flushed down through the soil **17** until it has reached the stable ground **18**. The upper end of the pipe **3** is closed by a cap **4**. In Figure 3 is shown the state of things after the embankment has been raised. The flushing pipe has been elongated correspondingly and its free upper end is again closed by the cap **4** so that no foreign bodies can find access into the tube. Figure 4 shows the cartridge provided with a blasting charge **2** which is enclosed in a sliding box provided with a fuse **5** connected up to electric wires **6**.

Figures 5 and 6 show in greater detail the cartridge casing **1**, the blasting charge **2**, the flushing pipe **3**, the sliding box with the fuse **5**, the electric wires **6**, and the flushing nozzles **7** and **7***a* more in detail.

In Figure 7 is shown a slightly modified constructional form of the flushing cartridge which is here also in its ultimate position on the stable ground. In this modification the cartridge casing **1** encloses water-tight the blasting charge **2**, as well as the fuse **5***a* contained therein from the beginning. The flushing pipe has been screwed off and withdrawn from the bore hole. In the middle portion of the cover of the cartridge casing there is a water-tight socket **1***a* to which the flushing pipe which has been removed was joined. Laterally from the socket **1***a* the electric wires extend water-tight through the cover of the cartridge casing and upward at one side of the bore hole. The bore hole is again filled with sand, that is to say, the blasting charge is dammed-up.

In Figure 8 is shown the preliminary flushing of a flushing hole in the embankment after this has been raised, the flushing having been effected in this case with a common flushing nozzle. The water under pressure delivered by a pump **35** which is provided with a suction hose **36** and delivery hose **37** streams through the flushing pipe **3** which is suspended from a tripod **30** by means of a rope **31**. In Figure 9 is illustrated the continuation of the flushing operation with a flushing bit **9**. Figure 10 shows the introduction of the flushing cartridge **1** by means of the flushing pipe **3** into the bore hole which extends through the embankment **19** and the moory soil **17** to the stable ground **18**, said hole having been flushed preliminarily and being partly devoid of a tubing, but being filled with mud. Portions of earth which have fallen off from the wall of the bore hole are carried away upwardly when the cartridge is being introduced with the aid of the water under pressure flushed-in. When the cartridge has arrived at the end of its path where it is to be exploded the pipe is withdrawn from the bore hole, unless it is intended to serve as a protection for the electric wires, but the bore hole is at any rate then filled up with sand.

In Figs. 11 and 12 the flushing bit **9** is illustrated in detail. It comprises a flushing nozzle **9***a* provided with vents **14** for emitting streams of water, a circular knife **10** surrounding the nozzle **9***a* and attached thereto by radial struts **11** and **12**. The radial struts **12** are designed as knives. At the upper end the nozzle pipe **9***a* is threaded for connection to the water supply pipe **3**. Another example in which two auxiliary flushing pipes **20** and **21** are arranged parallel to the main flushing pipe **3** is shown in Fig. 13.

With the cartridge shown in Figs. 5 and 6 the flushing pipe is, according to this invention, used also as guide tube for the introduction of the sliding fuse box **5** and it remains in the bore hole in order to protect the electric wires from being damaged when the bore hole is filled up with earth. As a modification thereof there is shown in Fig. 7 an arrangement wherein the fusing means are enclosed in the flushing cartridge from the beginning so that later on, when the flushing pipe sections to be used again at another bore hole are withdrawn and the bore hole has been filled up with sand only the wires remain in the moory soil and in the sand of the embankment.

When preliminary working the bore hole with the flushing bit the procedure is carried out in this way. By repeated pushing down of the bit, after a certain slight turning after every push, the hard ground is loosened by the annular knife and by the radial knives, and as the water under pressure streams from the nozzles axially

and simultaneousy therewith also radially the loosened ground is carried away. While this takes place there is formed in the raised embankment a nearly circular hole when owing to the compression due to the water under pressure can remain without a lining for some time. The blasting charge is introduced into this hole by screwing off the flushing bit from the pipe and screwing on the flushing cartridge, then flushing in the cartridge until it reaches stable ground.

When employing the constructional form shown in Fig. 13, in connection with the method appertaining thereto, each of the tubes **3**, **20** and **21** which are connected with one another for instance by collars **23**, is connected up to a separate pressure pump **35** and the implement is then flushed in at first to a depth corresponding to the length of the first piece of the flushing pipe. Now only the hydraulic pipe **3** of the flushing bit **9b**, is disconnected from its pump and the extension piece **22** is attached and connected with the pump. During this interruption the other pipes (**20**, **21**) are continually further supplied with water under pressure delivered by their pumps so that the suspended soil is carried upwardly without any interruption and without any setting. Only after the extention pipe **22** has been connected up to the pump appertaining to it, are the other pipes (**20**, **21**) successively elongated by extension pipes or, if desired, by hoses. It is obvious that no interruption whatever of the supply of water under pressure can take place.

It is suited to the purpose in view to provide several flushing pipes, so that if any of the pumps should become inoperative or a disturbance in any of the water-supplying pipes should occur, the flushing operation need not be interrupted.

In the same manner also the other additional pipes are elongated by pieces of pipe until the flushed bore has attained the necessary depth.

This apparatus is described and claimed in our divisional application, Serial No. 218,290, filed July 9, 1938.

We wish it to be understood that our invention is not restricted to the few constructional forms of the devices or to the several manners of carrying out the method, as described merely by way of example. An essential feature is that in order to be successful the shape of the cartridge casing is suitably chosen and the nozzles are suitably arranged. Thus, the lateral nozzles of the flushing cartridges can be so directed that the removal of the loosened and sludged soil around the mine is particularly promoted, which may be obtained, for instance, by directing the lateral nozzles wholly or partly obliquely upwards or arranging them in a curve so as to obtain a violent stream of the sludge water. With cartridges having a comparatively large diameter there may be employed, instead of an axially directed bore nozzle several axially acting nozzles arranged side by side in any desired manner. Furthermore, besides the radially directed nozzles, more or less strongly upwardly directed nozzzles may be provided in the tube piece above the cartridge, by which nozzles the withdrawing of the cartridge, if this should become necessary, will be materially facilitated. These nozzles are, besides, particularly suited for sludging upwardly the masses dissolved or loosened around the cartridge. In the case of the moory soil to be penetrated being particularly thick, it is, furthermore, recommendable to provide upwardly directed nozzles also at the individual elongation pieces of the flushing pipe.

Likewise the exterior shape of the cartridge is important for carrying out our improved method in such a manner as to obtain the greatest success. The shape must be such as to facilitate the penetration of the soil and of the sand as well as possible and to decrease as much as possible the resistance which the masses encounter when being upwardly removed. It has been ascertained by experience that the shape shown in the drawings is particularly suited for the purposes intended. There is a cylindrical body and an acute or conical downwardly directed extension, but also cartridges shaped about similar to a torpedo or to a rocket can be successfully used, and even drop-shaped cartridge casings or casings having a stream-line shape may be employed. They may also have special slide surfaces upon them.

Also the manner of guiding the nozzle pipe located in the cartridge is not restricted to the examples described. The nozzle pipe can extend through the cartridge axially, as well as in a direction in which the resistance to flow is the smallest possible, for which purpose it may be arranged at the outer surface of the shell of the cartridge. Besides, it is possible to arrange the pipe outside of the cartridge in a straight line or helically and to provide it also in these cases with nozzles.

It is also possible to make use of a double-walled tube serving as flushing tube, as well as guide tube, as shown in Fig. 14. An inner water pipe **3** extends entirely through the casing without communicating therewith, while an outer tube **25** communicates with the interior of the casing. By this means the improved method can be used also for making blastings with liquid oxygen, the mine vessel being used at first only as carbon-carrier and being rendered operative only immediately before effecting the blasting by means of liquid air conducted into the interior of the cartridge through the outer tube. The carbon-carrier is thus inserted into the soil down to the solid ground without the least danger, as the liquid air is added only just prior to the blasting. It is, of course, possible to provide two individual pipes, as shown in Fig. 15, instead of the double-walled pipe. The water pipe **3** extends through the casing without communicating with its interior, while the pipe **26** opens into the interior of the casing and serves for the introduction of liquid air.

We claim:

1. The method of blasting in soft or moory soil for road or dam fills and the like, which comprises attaching a casing enclosing a blasting charge to a water pipe of much smaller diameter than the casing, flushing the casing into the soil by water supplied through the pipe while guiding the casing by means of the pipe, and exploding the charge in the casing.

2. The method of blasting in soft or moory soil for road or dam fills and the like, which comprises attaching a casing enclosing a blasting charge to a water pipe of much smaller diameter than the casing, flushing the casing into the soil by water supplied through the pipe while guiding the casing by means of the pipe, detaching and withdrawing the pipe, and exploding the charge in the casing.

3. A process as described in claim 1, wherein the soil is first prepared for flushing in the casing by a combined cutting and flushing opera-

tion without casing pipe along the path through which the casing is to be sunk.

4. A process as described in claim 1, wherein the casing is flushed into the native soil without any preliminary operation on the soil.

5. In a device for sinking a blasting charge, a cartridge casing forming a water-tight enclosure for the charge, and a pipe extending through and beyond said casing, said pipe being apertured above and below said casing to emit streams of water in the vicinity of said casing.

6. In a device for sinking a blasting charge, a cartridge casing enclosing the charge of a length not substantially greater than the charge, and a piece of pipe extending through said casing and projecting at both ends therefrom, said pipe being secured to said casing and having at one projecting end means for connecting the same to a water pipe, and at its other projecting end one or more vents for emitting water.

7. In a device for sinking a blasting charge, a cartridge casing forming an enclosure for the blasting charge, a double walled pipe extending into said casing and joined thereto, the outer chamber of said pipe communicating with the interior of said casing, the inner wall of said pipe having means for connecting the same to a water supply.

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