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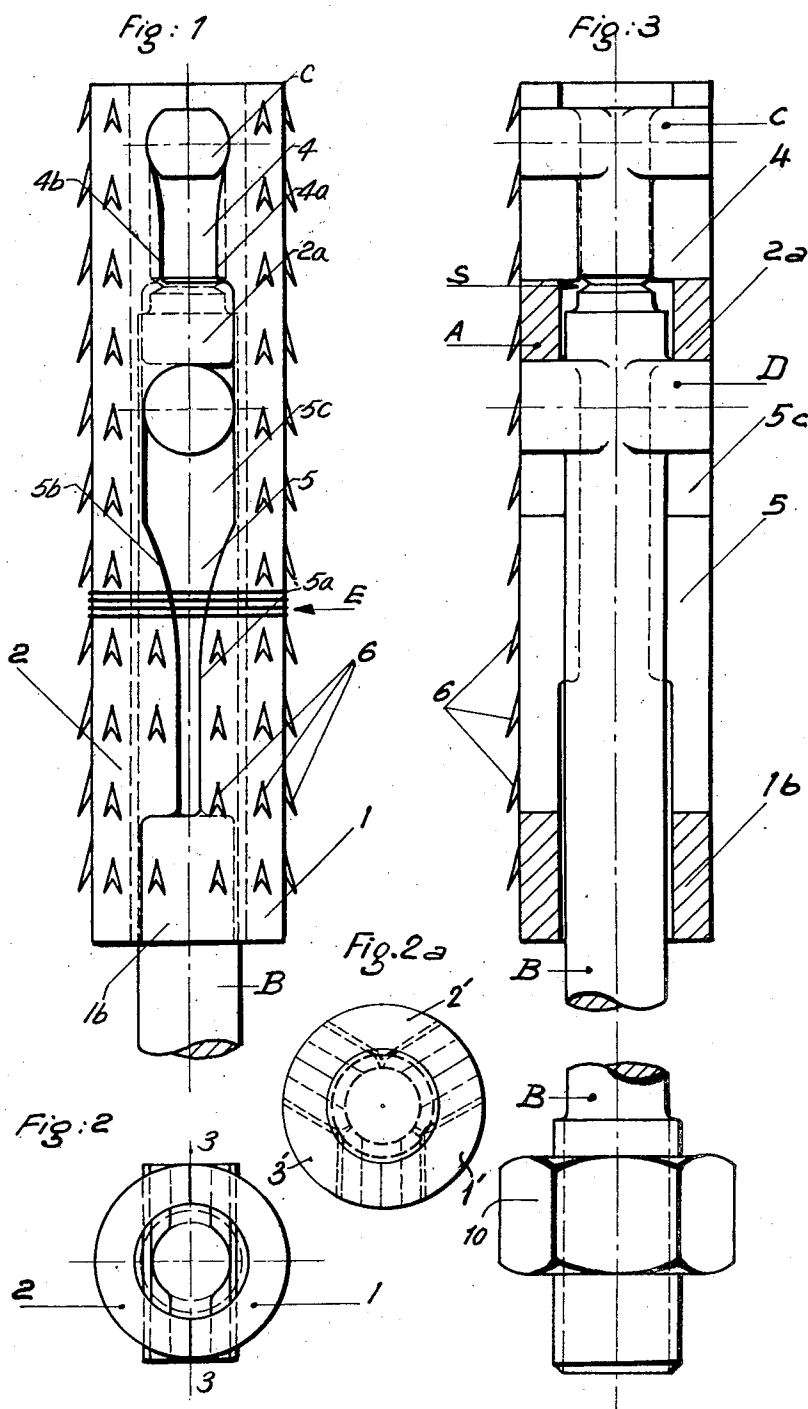
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2,589,484

MULTIPLE STAGE ANCHORING DEVICE

Filed April 17, 1951

3 Sheets-Sheet 1



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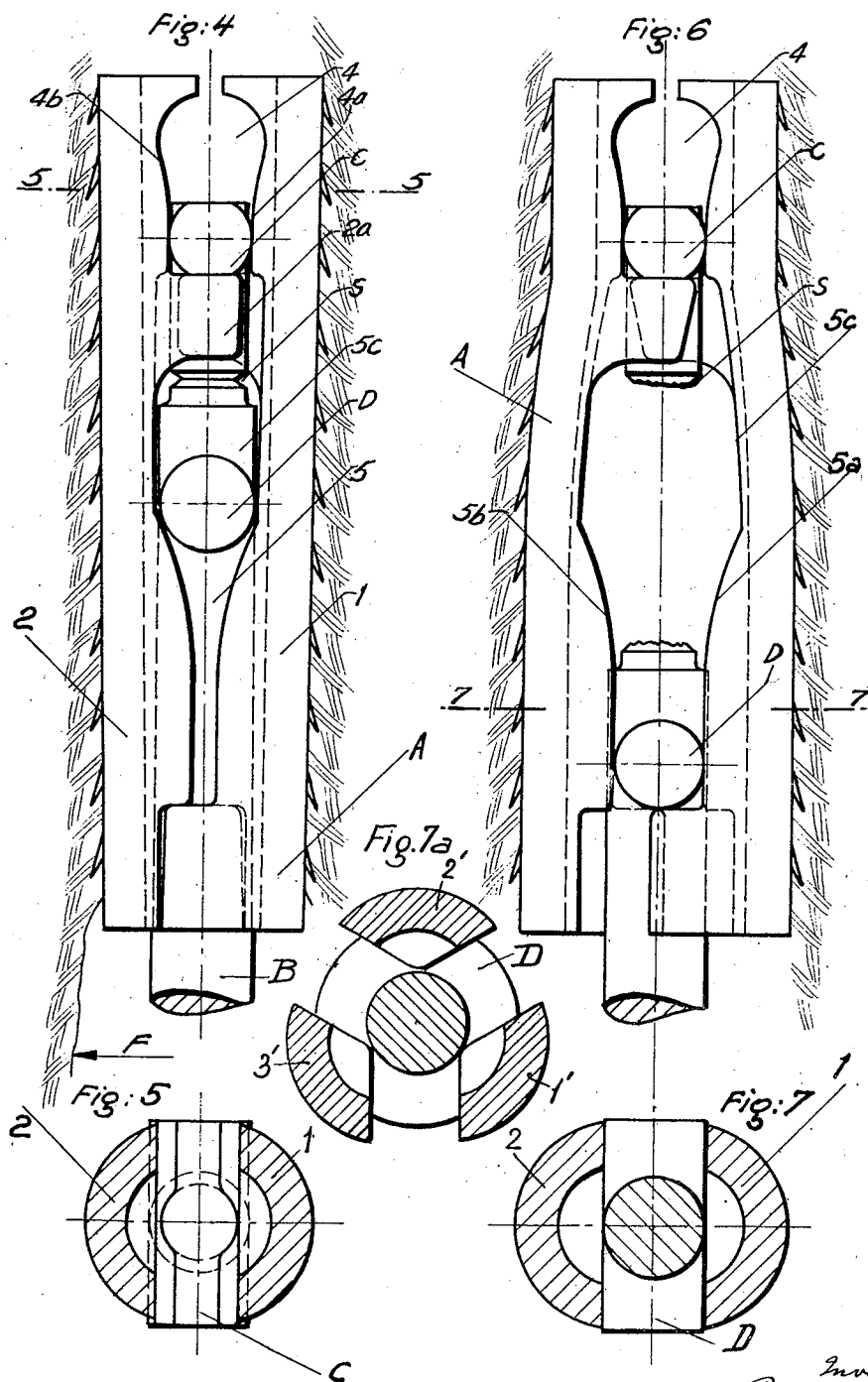
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MULTIPLE STAGE ANCHORING DEVICE

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3 Sheets-Sheet 2



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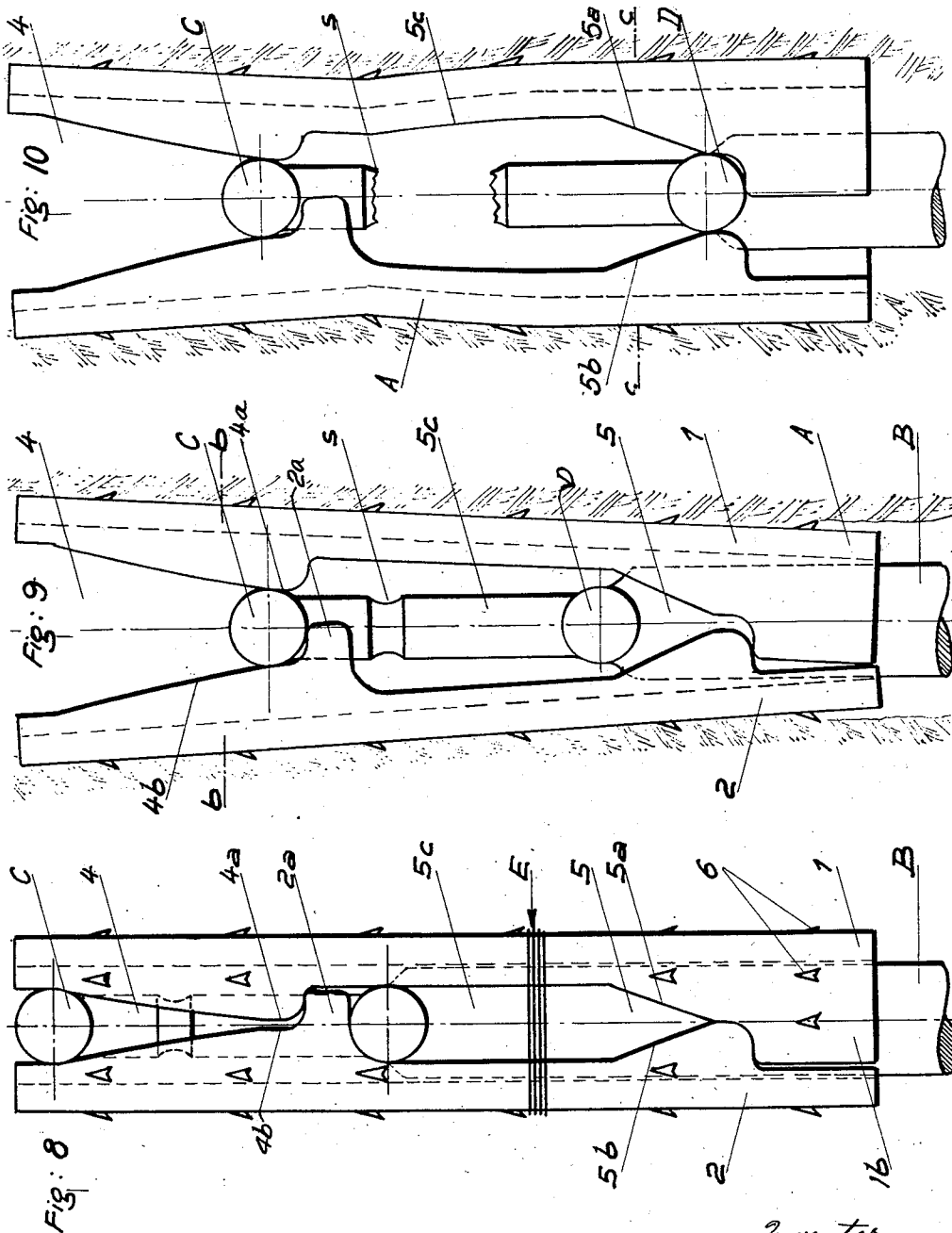
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MULTIPLE STAGE ANCHORING DEVICE

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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MULTIPLE STAGE ANCHORING DEVICE

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7 Claims. (Cl. 85—2.4)

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The object of my invention is an expanding anchoring head, or in other words, a device that has to form a fixed point at the bottom of a hole that has been drilled, particularly in rock, and generally speaking in any block of dense mineral.

Devices such as these are put to many various uses; the method of roof-bolting as used in mines may be quoted as an example, this being a technical way of strengthening the roof by means of drifts anchored in the latter that hold up through a nut a bearer plate that is screwed tight under the arch of the roof. In this case, the expanding head forms the head of the bolt, that interlocks together the roof seams that are solid and not likely to break and the seams of the roof that show a tendency to crumble and crack. The drill-holes may vary in depth according to the use for which they are made, in the same way as the length of the bolt rod. Use may be made of these devices for carrying out of timbering in levels under ground, anchorages without any sealing, bracing of towers, handling or removal of pieces of rock.

To be more specific, the invention aims at a device of this kind of which the working takes place in two stages.

In the first stage there is an action of incomplete expansion that enables the strata in the drill-hole to be tested and gives at least a partial anchoring, and in the case when this primary expansion has been enough to cause a locking, the second stage comes into play to push the expansion right home, the anchoring power being dependent on the strain to be put on the end nut.

The device according to the invention is formed by a hollow metallic cylinder, that is preferably of steel, split into longitudinal segments, with the provision of at least two sets of wall apertures constituting inclined planes that are located at the joints of the segments, at different levels of the cylinder, for taking corresponding cams carried by a bolt rod, the aperture sets and their inclined planes as well as the cam sets being respectively provided in order that each cam set has an idle stroke equal to the total travel of the previous cam and the rod parts dividing two cam sets are provided in order to have a resistance to pull that is less than that of the weakest portion of the rod, these resistances becoming progressively greater in the order of tightening of the cams (for instance by means of a notch or machining down at the spot or any other initial point of breakage).

The number of the apertures or cams of each set will be preferably equal to the number of the segments of the cylinder. The outer surface of the cylinder is furnished with barb-like projecting pieces that make certain that the cylinder is properly held at the bottom of the drill-hole.

The device works in the following way:

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The assembly of cylinder and rod is put in the bottom of the drill-hole, of which the diameter will preferably be intermediate between that of the actual cylinder and that of the cylinder encasing the barblike projections.

A pulling effort is then made on the rod, for instance through bolting of the end nut, which causes:

(a) The tightening of the first set of cams which allows the expansion to be partly effected and the device becomes locked if the strata of the drill-hole are in solid ground, but pulls out if the strata are weak.

(b) The breakage of the rod between the two cam sets. The first set of cams then constitutes a non-return lock to the part expansion that has taken place. This breakage, established by the operation of tightening, thus forms an indication of a firm anchorage and consequently of safety.

(c) The working of the second set of cams, and of any following sets up to complete expansion. This expansion may result, at any rate partly so, from the action of the burden carried by the bolt rod (for instance the weight of roof to be supported).

A detailed disclosure of my invention will be given in what follows taken with reference to the attached drawings, as an example, on which is shown a device set up according to the invention:

Figure 1 is an elevational view.

Figure 2 is a plan view (for a device with two segments).

Figure 2a is a plan view (for a device with three segments).

Figure 3 is a longitudinal section on line 3—3 of Figure 2.

Figure 4 is an elevational view showing first locking position.

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is an elevation view showing fully locked position.

Figure 7 is a sectional view taken on line 7—7 of Figure 6 (for a device with two segments).

Figure 7a is a sectional view along c—c of Figure 6 (for a device with three segments).

Figures 8, 9, 10 are three elevational views similar to Figures 1, 4, 6, of another embodiment of the invention.

By referring to these figures, it will be noted that the equipment consists of:

(a) A hollow metallic cylinder A made up of two segments 1, 2, at the joints of which are provided two sets of apertures 4, 5, of which the walls 4a, 4b, 5a, 5b constitute V-shaped inclined planes. This cylinder A is provided with barb-like projections 6 on its periphery.

These segments are arranged to fit in without any chance of comparative longitudinal change of position, by means of tongue pieces such as 2a, 1b, pointed in opposite directions, these tongue pieces

being used furthermore for stops of the cams C, D.

(b) A bolt rod B carrying at its end a nut 10 or any other arrangement enabling it to be screwed up, while this rod is provided with two sets of cams C, D corresponding to the apertures 4, 5, the distance between the cams C, D, being greater than that dividing the inclined planes of the apertures 4; 5. For this purpose, the aperture 5 is provided with a portion 5c with parallel walls. A notch S is arranged on the rod B between the sets of cams C, D to lessen the resistance of the rod between the cam sets.

A temporary lashing E is arranged to advantage for interlocking the cylinder segments while the device is being located in position.

The device works in the following way:

The equipment is put in position at the bottom of the drill-hole; it is held there by the barblike projections 6 of the cylinder, the drill-hole preferably having a diameter intermediate between that of the cylinder A and that of the geometric cylinder that surrounds the barbs 6.

The rod is drawn downwards (according to the drawing) through the tightening of the lower nut or in any other suitable way; the set of cams C, hereinafter called "safety cams" come into operation and cause the tightening of the end portion of the cylinder until it comes up against the tongue piece 2a (Figures 4 and 5).

If the strata are not tough enough, the continued pulling effort then placed on the rod B will not cause the rod to break at the notch S arranged for a fixed load, and the assembly will be withdrawn from the drill-hole.

If the strata hold properly, the safety cam C brings about the locking of the device that is followed with the breakage of the rod at the notch S. The operator who establishes this breakage of the rod is advised that the anchorage is firm enough.

The cam D has only yet traversed an idle stroke. It then comes into action on the inclined planes 5a and 5b and causes the last stage of expansion (Figures 6 and 7).

This active stroke of the cam D will be kept most frequently for the flexibility of the support; since the firmness of the anchorage is now made certain through the breakage at S of the bolt rod B, it may be more advisable in fact to retain a margin that in certain cases may lead to measurements of the load through noting the movements of the bolt rod B after placing in position the device (when there will be available fixed datum points).

The device such as disclosed above may be provided with not only two but for instance three segments. With Figures 1, 3, 4 and 6 remaining unaltered in this case, such an equipment is shown by the Figures 1, 2a, 3, 4, 6 and 7a. The segments carry the numbers 1', 2', 3'.

Within the framework of the above disclosed characteristic features, the equipment according to my invention may be carried out in the most various forms.

Such an embodiment is shown on Figures 8, 9 and 10 according to which the first stage of expansion gives a firm anchoring measured by an important breakage cross-section, the final stage of expansion comprising a travel substantially equal to that of the first stage and giving a tightening approximately the same.

It is to be noted that the sizes of the equipment, the number of longitudinal parts or segments of the cylinder body, the diameter of the

cross-section of the point of rupture, the ratio of this diameter to that of the least cross-section of the rod, the greatest safety expansion, the ultimate greatest expansion, hinge according to conditions on the use and special features of the drill-hole (character of the drilled block, depth, diameter).

Furthermore, among the changes which can be afforded without departing from my invention, it is obvious that a longer body for the equipment may be arranged, provided with two or more breakage cross sectional points in succession, for instance with gradual tightenings. There are then two or more consecutive breakages, the same number of consecutive lockings and a fixed expansion tightening. The cams are then plotted accordingly, the idle stroke of each cam being equal to the total travel of the previous cam.

In certain cases of use, specially for the anchoring of guy wires, the rod will be replaced to advantage by steel cable directly connected to the cams.

The drawings show a positive stop-check at the end of greatest expansion. This positive check may be cut out in the case when an unexpected load shock, or the equivalent, may cause on the other hand a flexible further expansion up to rupture of the pulling rod after elongation of the latter.

I claim:

1. An anchoring device comprising a hollow metallic cylinder longitudinally split to provide a plurality of lengthwise segments which are normally assembled to form the said cylinder, said segments being cut away along their adjoining edges at a plurality of vertically spaced areas to provide the cylinder wall with a plurality of apertures having downwardly tapered portions to form inwardly inclined planes, a rod disposed in the cylinder and vertically movable with respect thereto, cams on said rod spaced to correspond to said apertures and capable of downward movement therein in cooperation with said inclined planes for expanding said cylinder, the cams and apertures being dimensioned to enable each succeeding cam to have an idle movement equal to the complete distance of travel of the preceding cam and said rod being provided with a reduced and weakened portion intermediate its ends between a pair of said cams.

2. An anchoring device in accordance with claim 1 wherein the cylinder is externally provided with a plurality of spaced, barb-like projections.

3. An anchoring device in accordance with claim 1 wherein the spacing between the cams on said rod is greater than that between the corresponding apertures.

4. An anchoring device in accordance with claim 1 wherein the number of cylinder segments is equal to the number cams and apertures.

5. An anchoring device in accordance with claim 4 wherein the number of segments, apertures and cam sets is two.

6. An anchoring device in accordance with claim 1 wherein each of said apertures is configured at one end to provide a circumferentially extending stop portion.

7. An anchoring device in accordance with claim 1 wherein each of said apertures except the lowermost is configured at one end to provide a circumferentially extending stop portion.

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No references cited.