March 29, 1960 H. S. V. JÄRUND 2,930,199

METHOD OF ANCHORING BOLTS

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Fig. 1

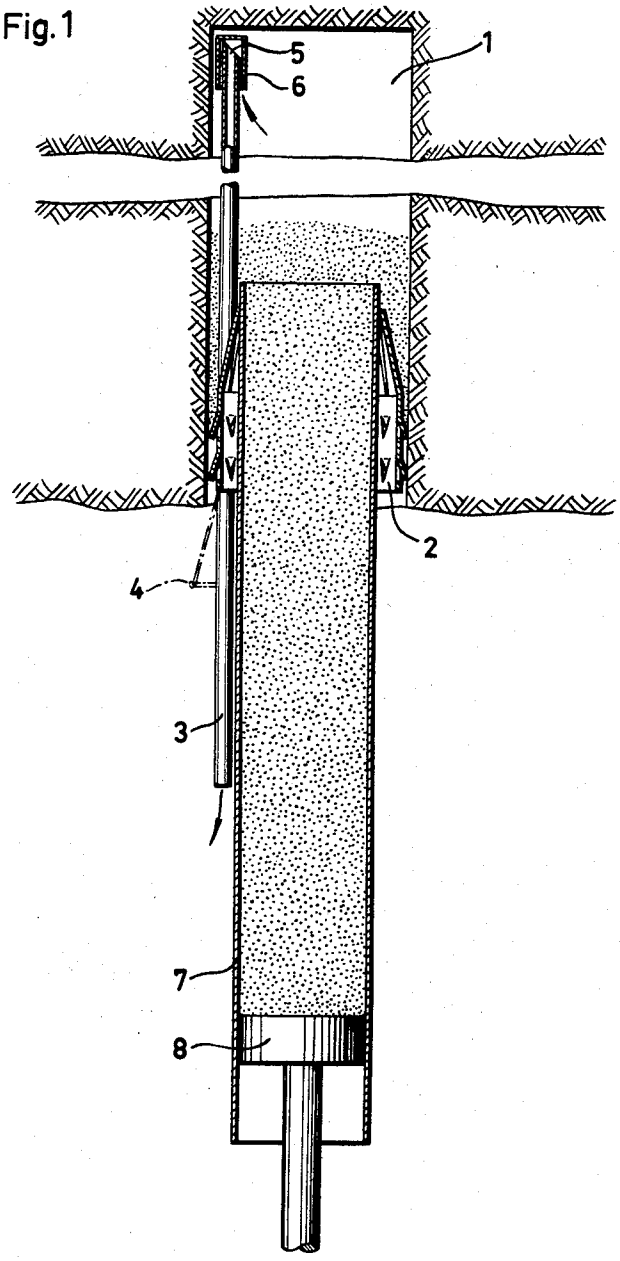

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Fig.2

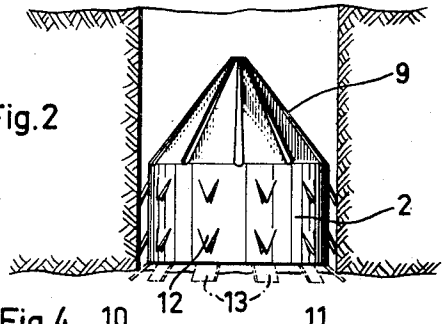


Fig.3

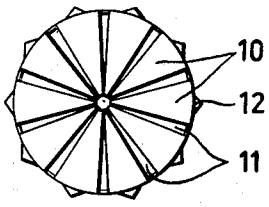


Fig.4

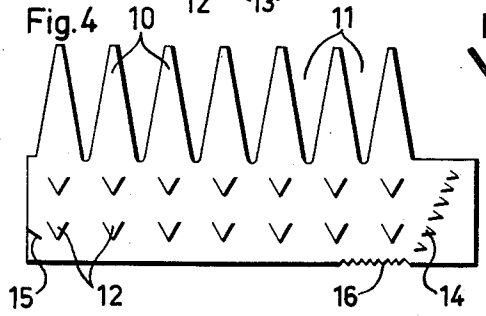


Fig.5

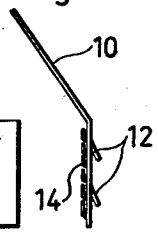


Fig.6

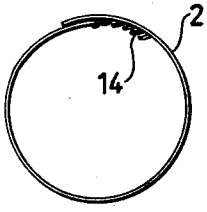


Fig.7

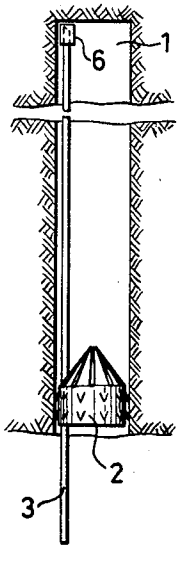


Fig.8

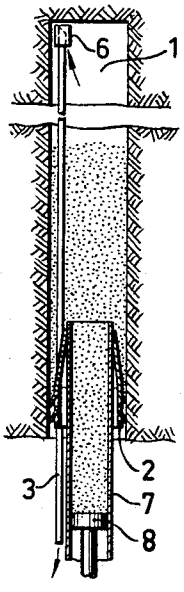


Fig.9

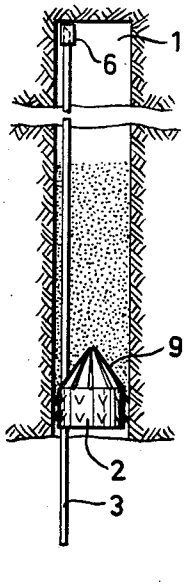
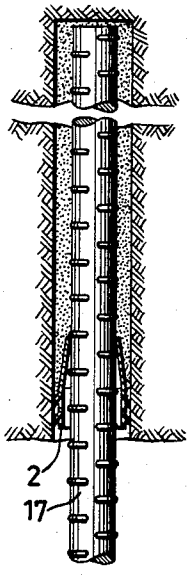


Fig.10



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METHOD OF ANCHORING BOLTS

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Application December 5, 1955, Serial No. 551,141
Claims priority, application Sweden March 24, 1955
3 Claims. (Cl. 61—45)

The present invention relates to methods of anchoring bolts or the like in channels opening out downwardly.

In tunnel blasting and the like, it often proves necessary to anchor reinforcing bolts in bores. Such anchoring causes no particular difficulties in bores opening upwardly as the casting compound, i.e. usually concrete, can be put into such bores under the influence of gravity. In casting in bores the mouth opening of which is at a higher level than the bottom thereof, there arise some problems which have hitherto substantially complicated the anchoring of reinforcing bolts or the like.

As the casting compound cannot be put by gravity into bores opening downwardly, other expedients must be resorted to. One method is to force the casting compound into the bore by means of an injection device. Another method is to prefill a sleeve member of suitable length with casting compound and thereafter insert said charge, the sleeve member being left in the bore even after the insertion of the anchor bolt therein. Considering the volume of the anchor bolt, the bore may not be entirely filled with casting compound. Therefore, air will be enclosed between the casting compound column and the bottom wall of the bore when carrying out the two above mentioned known methods, said enclosed air in the first mentioned method often being compressed when injecting the casting compound and undergoing a further compression when the anchor bolt is inserted in the bore, and, in the last mentioned method, being compressed at least when the bolt is inserted in the bore. The resistance that the air cushion enclosed in the bore and the injected casting compound proper jointly offer to the insertion requires pneumatic tools for the insertion of the anchor bolt. Then, the enclosed air forces its way out of the bore through the casting compound proper thereby producing air pockets resulting in poor anchorage.

By the present invention, all above mentioned drawbacks are avoided. Thus, the method according to the invention is characterized essentially in that a hollow member is inserted in the mouth portion of the channel, whereafter firstly a suitable amount of a relatively viscous casting compound, preferably concrete, is injected into said channel through said hollow member and a suitable length of the anchor bolt is pushed into said channel through said hollow member, the air volume enclosed in said channel being dissipated therefrom when said casting compound is injected as well as when said anchor bolt is inserted.

The invention also provides means for carrying out the method according to the invention, said means being essentially characterized by a sleeve-shaped portion to fit the mouth section of the channel wall and adapted in operative position to be retained in said channel through friction against the wall thereof, and a portion connected to said sleeve-shaped portion and adapted in operative position to permit the injection of said casting compound and the insertion of said anchor bolt in said channel as well as to operate like a non-return valve to substantially

prevent said injected casting compound from escaping said channel.

The essence of the invention will become clear from the following description with reference to the accompanying drawing illustrating different aspects and embodiments of the invention.

Figure 1 is a sectional view showing the injection of a casting compound into a dead end bore opening out downwardly.

Figure 2 is a view, partly in section, showing a hollow member in operative position.

Figure 3 is a horizontal view from above of the hollow member.

Figure 4 illustrates an embodiment of a blank for the hollow member.

Figure 5 is a cross-section of the blank shown in Figure 4.

Figure 6 illustrates how the blank shown in Figure 4 may be bent to produce the hollow member shown in Figure 2.

Figures 7 to 10, inclusive, are longitudinal sections illustrating different steps of a method according to the invention.

In accordance with the invention, a double-ended hollow member **2** is inserted into a bore, besides which a venting tube **3** is inserted into the bore along the wall thereof, so that one end **5** of said tube **3** is in the vicinity of the bottom wall of the bore, the other end of said tube **3** protruding from said bore, as shown in Figure 7. Then the nozzle portion of an injection device **7** is inserted into said bore through said hollow member **2**, as disclosed by Figure 8. By means of said injection device **7**, a suitable amount of a relatively viscous casting compound, e.g. concrete, is injected into said bore. In doing so, a space in said bore is left unfilled, said space corresponding to the displacement of the anchor bolt portion to be inserted in said bore. In the next step of the method according to the invention said injection device **7** is removed, as shown in Figure 9, said hollow member **2** operating like a non-return valve to prevent the injected casting compound from escaping from said bore.

Finally, an anchor bolt **17** is pushed into said bore through said hollow member **2**, as shown in Figure 10. Bolt **17** can be provided with surface projections. Said bolt **17** displaces an amount of casting compound corresponding to the volume of the bolt portion inserted in said bore. Said casting compound amount is prevented by said hollow member **2** from substantially escaping said bore, but is caused to fill out the bore space which is left unfilled upon the injection of casting compound in said bore. Thus, the residual air enclosed in said bore is forced out through said venting tube **3**, which may then be removed out of said bore, as shown in Figure 10. On the other hand, said hollow member **2** may be left, i.e. be anchored together with said anchor bolt **17**, in said bore without any drawbacks.

On a larger scale, Figure 1 illustrates the step of the method according to the invention in which said casting compound is injected in said bore, and is a better showing of the means by which said method is carried out. As indicated by said figure, said injection device may comprise an ordinary injection cylinder **7** having a piston **8** slidable therein. The inner end **5** of said venting tube **3** in operative position may be chamfered so as to permit said tube end **5** to engage the bottom wall of said bore **1** without any risk that said tube end **5** will get closed. To prevent the mouth of said tube end **5** from getting choked by small particles in said bore **1** a filter **6** of some kind may be provided over said tube mouth. For location in operative position said tube **3** may be suitably connected to said hollow member **2** in turn located in the bore mouth portion. In Figure 1 this is indicated

in the form of a binder 4 between said tube 3 and said hollow member 2. Of course, said injection device 7, 8 may be provided with suitable shoulder or stop means, so that it will not enter said bore more than to a determined extent when injecting said casting compound therein.

As previously mentioned, said hollow member is adapted to be inserted in the bore mouth portion. Figure 2 gives a better illustration thereof. Said hollow member 2 comprises a sleeve-shaped portion to fit the bore mouth section and adapted in operative position to be retained in said bore through friction against the wall thereof, and a portion 9 consisting of triangular segments hingeably adapted in operative position to permit the injection of said casting compound and the insertion of said anchor bolt 17 in said bore as well as to operate like a non-return valve to substantially prevent said injected casting compound from escaping said bore. Said hollow member 2 is of a transverse dimension adaptable to different transverse bore dimensions and is arranged to engage the bore wall through inherent resilience. To locate said gate and valve means in said bore, said hollow member 2 is provided with friction means on its side to engage the channel wall which friction means in the embodiments of said hollow member shown in the drawing comprise outwardly directed teeth or lugs 12 integral with and punched out of said hollow member 2, said lugs 12 being adapted to oppose the displacement of said hollow member out of said bore. If said hollow member is to be fixed against movement in the opposite direction, it can be provided with lugs 13 or the like cooperating with the bore mouth opening edge. Said portion 9 is connected to said sleeve-shaped portion substantially along the whole of one end edge thereof and substantially is in the form of a slotted conic shell, which is in the bore resiliently deformable from the inside substantially into the form of a broken sleeve of substantially the same transverse dimensions as the corresponding section of said bore.

Preferably, said hollow member is made of one piece of a relatively thin and inherently resilient material, e.g. steel sheet. As shown in Figure 4, said hollow member may comprise a substantially strip-shaped blank to be bent into the form intended and the transverse measure required, said blank developed in one plane comprising a rectangular portion to be bent into said sleeve-shaped portion 2, and a plurality of substantially triangular evenly spaced lugs 10 projecting from one of the two long sides of said rectangular blank portion and adapted to be bent into said portion 9. When said rectangular blank portion is developed in one plane, the plane containing said triangular lugs 10 and said first-mentioned plane define such an angle that said lugs 10 in operative condition form a conic shell, the apex of which comprises the points of said lugs 10.

Considering the difficulty in adjusting the right amount of casting compound to be injected in said bore the triangular gaps 11 between said triangular lugs 10 should be of such a form that said conic shell 9 in operative condition always is provided with corresponding slots 11 allowing for a restricted escapement of casting compound out of said bore, if the displacement of said anchor bolt 17 upon the insertion thereof in said bore should exceed the volume of said unfilled space in said bore.

If said hollow member is manufactured in the form of strip-shaped blank lengths, it will be easily adaptable to bores of different transverse dimension. The strip-shaped blank is bent in such a manner that its ends will overlap. To adjust the transverse measure required of said hollow member, the inside intended of said rectangular blank portion may be provided with embossings 14 or the like in the vicinity of one of its ends, said embossings 14 or the like being adapted to cooperate with the other rectangular blank portion end.

In order to prevent said hollow member from being deformed in such a manner upon the casting process that the two blank ends are displaced with respect to each other in the direction of the longitudinal dimension of said bore end of said rectangular blank portion may be provided with a slot 15 to accommodate the free long side of said rectangular blank portion and to cooperate with a toothing 16, if any, along said free long side.

The method according to the invention may be modified without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A method of anchoring a body in a downwardly opening cavity by the use of a double-ended hollow member having outwardly directed teeth and triangular segments hingeably positioned in the form of a cone on an end of the member comprising: inserting the member into the cavity with the segments extending furthest into the cavity with said teeth engaging the walls of the cavity to retain the member therein, inserting a tube into the cavity via the interior of the member, the tube extending past and spreading the segments, injecting a setting substance into the cavity via said tube, withdrawing the tube whereby the segments cooperatively resume the form of a cone to lock in said setting substance, and inserting said body into the setting substance via the member, the segments spreading to accommodate the body and holding the same in position while the setting substance hardens.

2. A method as claimed in claim 1 comprising inserting an additional tube into the cavity externally of the member to permit the venting of air.

3. A method as claimed in claim 1 wherein said body has projections on its surface to enhance the engagement of the body by said segments.

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