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Applicant: **ING. GIOVANNI RODIO & C.
IMPRESA COSTRUZIONI SPECIALI S.P.A.
5, Via Pandina
I-20070 Casalmaiocco (Milan)(IT)**

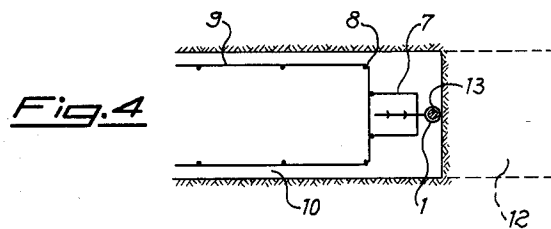
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Inventor: **Miatello, Adelchi
Via Quarto Dei Mille, 5
I-22070 Albiolo (CO)(IT)**

Representative: **Marietti, Giuseppe
STUDIO ASSOCIATO MARIETTI & PIPPARELLI
Viale Caldara 38
I-20122 Milano (IT)**

Sealing joint in diaphragms formed by concrete panels cast in situ and a process for building said diaphragms.

A sealing joint in diaphragms formed by concrete panels cast in situ particularly useful for the preliminary operations of foundation works. The joint comprises two separate members (1) that can be sealingly coupled and occupy only the outmost portion of the associated adjoining panels (10) so that the connection members are located in correspondence of the junction surface between two adjoining panels. The first joint member is located into the excavation through a supporting and positioning structure (7). It is further disclosed a process by which said panels with such joints can be built.



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The invention relates to a sealing joint which is located in buried walls formed by concrete panels and a process for building such walls. Such walls are known in the art as diaphragms and are used particularly in the operations preceding the foundation works in case there are required works to support the soil and/or for hydraulic partitions.

To prevent altering the statics of the soil, it is not possible to dig a single excavation which is as long as the wall to be built in; thus it is preferred to carry out the excavation in a number of steps and to build the wall by means of single panels having a length comprised between 2 and 6 meters, located adjacent one after the other with their minor edges in contact. Depending on the situations one can use either precast panels or panels of reinforced concrete that are built in situ by casting concrete after a reinforcement has been placed in the excavation. More precisely the excavation, and therefore the building of the whole wall can be carried out according to two different techniques: either through successive excavations, that is by digging a first excavation, casting the concrete thereinto, then digging a second excavation adjacent to the former one and casting the concrete thereinto and so on; or by means of alternating excavations, that is digging a first series of excavations arranged along the same direction and spaced among them, and forming in situ a series of primary or main panels therein, and then digging a second series of excavations in the intermediate sections, in which secondary or connecting panels are formed in situ.

Of course the technique of building the whole wall through a number of concrete panels requires that an appreciable continuity of the structure has to be achieved. For obtaining a perfect connection between two adjoining panels there is used a so called guide tube or forming tube which is located at the end of the excavation, in correspondence with the junction surface of the panel connection, before casting the concrete. After casting the concrete, the tube is removed, preferably before the concrete has completely set. Thus the removal of the guide tube leaves a smooth contact surface that will be the junction or connection surface of the adjoining panel. Of course, in case diaphragms are used as a protection against water infiltration, there is further to solve the problem of sealing or rendering waterproof the wall at the discontinuities, i.e. at the panel connections. In order to achieve such sealing there are used so called sealing joints, also known as water-stop devices, which are sheets (or septa) of an elastically deformable material located internally to the walls and extending for the whole height thereof and transversally to the line of junction between adjoining panels and astride this line. The water-stop device is posi-

tioned transversally to the direction of water penetration, thus ensuring a hydraulic seal.

However the insertion of the water-stop device in the junction zone between two adjoining panels is a delicate operation interfering with the digging operations and the casting of concrete when the panels are built in situ.

To solve this problem recourse is presently made to the already mentioned guide tube or shoulder-tube, positioned at the end of the excavation which, in addition to ensure the surface regularity of the junction as already pointed out, accomplishes the task of inserting and positioning the water-stop device. In some cases it has a shape such as to provide a guide surface for the bucket digging the adjoining excavation so that these latter result in being even as much as possible.

Nevertheless there is a serious technical problem arising from the removal of the guide tube, especially in respect of the particular type of connection that is possible with the water-stop devices actually on the market. More precisely, during the setting of the concrete there is a time interval in which the guide tube can be easily removed along a vertical direction without damaging the stability of the water-stop device within the diaphragm.

However this is not possible with the water-stop devices and guide tubes of conventional design due to the particular type of connection between such two members, requiring the removal of the guide tube after a lateral detachment thereof, i.e. only after the excavation for the adjoining panel has been digged. Thus the optimum curing time before the tube extraction cannot be controlled, but rather it depends on the time required for excavating the trench for the adjoining panel which time can be quite long sometimes. Therefore the concrete will be well set over the water-stop device inserted therein with a strong adherence on the guide tube that renders difficult the tube removal.

Presently the most widespread process for realizing a sealing joint is that known as "Bachy process" or "CWS joint".

In such a process the guide tube is left in place till the end of the excavation for the adjoining panel. Such guide tube comprises a steel structure like a beam in the whole length of which there are fixed, at half of their width and perpendicularly to the "beam", a number of sheets of rubber or similar material, i.e. the above mentioned water-stop devices. After the concrete has been cast, such sheets remain half-embedded along their major axis in the so formed panel; the other half is fixed in the guide tube and is released with the removal of the guide tube, thus protruding for its whole length from the lateral face of the panel.

When casting the secondary panel, the free half is embedded into this latter and realizes a

waterproof device between the two panels that seals the so obtained junction.

The above illustrated "Bachy" method has the severe drawback of the guide tube being left in place until the end of the excavation for the adjoining panel, for being later extracted after a lateral detachment using the space formed by such adjoining excavation. These operations are complex to be performed, require long times and imply the risk of damaging the joint.

The known prior art further includes another process which is the object of DE-A-3 430 789 to ZÜBLIN.

This document discloses a joint with components extending for the whole length of the associated panel, the connection members being provided in correspondence of the junction line between the panels and being made up by parts having circular cross sections inserted one into the other.

This way the joint components form a continuous barrier, internal and parallel to the whole diaphragm. Since the joint is provided not only in proximity of the junction surfaces as in the "BACHY" process, for example, there is no longer required a supporting and positioning structure of the joint, since this latter acts as a self-supporting structure within the excavation. This way all the above illustrated problems due to the presence of the guide tube would be overcome.

However this method too has some disadvantages.

Firstly the new structure of the joint does not allow for the coexistence of a metal reinforcement that is necessary whenever panels of reinforced concrete are to be used.

Namely the method uses the known self-hardening muds for coping with the problem of joining together waterproof membranes in the excavation of a plastic diaphragm.

Moreover the the process for building the wall requires that the outermost portion of the joint lowered into a first excavation or trench be exposed to the contact with the bucket digging the adjoining trench, with the risk of breaking the joint. Finally in another step of the process it becomes quite difficult and of questionable effectiveness to carry out the full emptying of the inner connecting member immersed in a "fluid supporting the excavation". Namely the fluid pressure acting on the outer walls of the connecting members, appears such as to create infiltrations, particularly at high depths.

The object of the present invention is to overcome the above mentioned drawbacks of the prior art by providing a joint and a process as above defined that are suitable for panels of reinforced concrete, that allow for firmly positioning the water-

stop device within the concrete diaphragm and further allow for a perfectly vertical extraction of the guide tubes when these latter are provided for.

More precisely the invention concerns a sealing joint (or water-stop joint) between two adjoining panels in a diaphragm, with the joint being located at an intermediate position between said two panels and transversally with respect to their junction line, said joint comprising two separate members of an elastically deformable material wherein the first joint member is housed at least partially within said first panel, and the second joint member is housed at least partially within said second panel, characterized in that said joint members occupy only the outmost portion of the respective panel, that the first joint member is provided with means for being connected to a related support structure, and that the joint members have portions that are sealingly engageable with one another.

A further object of the present invention is a process for building two adjacent panels in a diaphragm, the panels being equipped with at least one sealing joint of the above described type, characterized in that it comprises:

- connecting one or more first joint members to said support structure;
- positioning said first joint members and the respective support structure within the excavation of a first panel;
- casting concrete or other suitable material into said excavation;
- preparing the excavation for a second panel adjacent to the first one;
- inserting and connecting the second joint members into the first members of each joint;
- casting concrete or other suitable material into said second excavation; and
- applying means adapted to realize a waterproof seal between said joint members.

The characteristics of the invention will be better understood from the following description relating to a non limiting example and with reference to the attached drawings in which:

Fig. 1 is a top view of the first member of a joint in accordance with a preferred embodiment of the invention;

Fig. 2 is a top view of the second member of the joint shown in Fig. 1;

Fig. 3 is a top view in an enlarged scale of the joint of the Figures 1 and 2;

Fig. 4 is a top view of a first embodiment of a joint supporting structure;

Fig. 5 is a top view of a second embodiment of a joint supporting structure;

Fig. 6 illustrates a process for building two adjoining panels using a structure such as the one shown in Fig. 4;

Fig. 7 illustrates a process for building two adjacent panels using a structure such as the one shown in Fig. 5; and

Fig. 8 is a top view of two diaphragms made according to two different techniques.

Fig. 1 is a view of the first member 1 of a joint according to the invention and comprising a flat portion 2 and a circular hollow portion 3. The circular portion 3 is interrupted by a slot 4 extending for the whole length of the joint.

The second member 5 of the joint has exactly the same shape of the first member and provides a hollow circular portion 3' that can be either expandable or solid and a flat portion 2' radially extending from the former one, as illustrated in Fig. 2. The only differences between the two members concern the longitudinal slot and the size of the circular portion. Such differences are due to the fact that the two members of the joint 1 are to be axially connected together as illustrated in Fig. 3, with the circular portion of the second joint member received within the hollow circular portion 3 of the first one.

Transverse ribs 6 are provided on the flat portions in the joint members for a better grip of the concrete.

Fig. 4 shows a first embodiment of a support structure of the joint. The above illustrated problems of the prior art techniques are due to the necessity of removing the guide tube. According to this embodiment of the invention, the problem has been solved by renouncing to the guide tube and creating a joint support means that remains fixed to the reinforcement within the concrete even after the complete setting of this latter. Such joint support means comprises a series of reticular meshes or loops 7 equally spaced along the height of the joint and hinged at 8 to the reinforcement 9 of the panel 10. The outer shaped portion of the first joint member is engaged by an extractable tubular member or core 13.

Fig. 5 shows a second embodiment of the support structure of the joint. It comprises a usual guide tube 11 having a special shape that allows to overcome the problems encountered in the prior art. More precisely it is a conventional guide tube having a different connection system with the water-stop device taking into account that the water-stop device is designed as formed by two separate members. More precisely, in the case of a water-stop device designed as the one illustrated in Fig. 3, i.e. provided with a hollow inner shaped portion 3, the guide tube provides a cylindrical "projection" or core adapted for engaging the inside of said hollow shaped portion in such a way as to be axially slidable.

Of course the number of such cylindrical "projections" 13, hereinafter called extractable supports

or cores, depends upon the number of water-stop devices which they are to engage with.

Fig. 6 illustrates the process for building two adjoining panels 10 and 12 by using the joint support structure shown in Fig. 4.

The first step provides for the anchoring of the first member of each water-stop device 1 to the metal reinforcement 9 of the panel through the meshes 7 (step A). In this step it is further provided to engage the shaped outer parts of the first joint members with extractable cores 13. Then such reinforcement, including the water-stop device, is inserted into the properly prepared excavation. As shown in step B, the joint can be retained from above thanks to connecting hinges 8 between the joint and the reinforcement, so as to reduce its dimensions during the step in which it is inserted into the excavation up to its disappearance in the cage size; then, when the reinforcement 9 reaches the bottom of the excavation, the joint is released until it comes into contact with the inner wall of the excavation. Later (step C) the casting of the concrete is carried out and thereafter the adjoining excavation is accomplished (step D). At this point the inner core 13 is extracted from each first joint member 1 (step E) to allow for the insertion of the second joint member 5 (step F). After the reinforcement 9' has been inserted into the second excavation 12 too, concrete is cast (step G) and after its setting, a sealing of the two joint members (step H) is accomplished by injecting an expandable material, e.g. a cement mixture or mortar, into the tubular central hollow core of the second joint member. As an alternative, the sealing can be obtained by injecting a bonding agent into the gap separating the outer face of the second joint member from the inner face of the first joint member. In this case the second joint member can have a solid central core.

Fig. 7 illustrates the process for building two adjoining panels in accordance with the embodiment of joint support structure shown in fig. 5.

In the first step (A) the first joint member 1 is fitted onto the shaped core projection 13 of the guide tube 11; then (step B) the whole structure is inserted into a suitably prepared excavation 10. After the casting step (step C), the guide tube can be vertically extracted (step D), of course before the concrete setting has been completed; the particular connection between the guide tube 11 and the water-stop device 1 allows the vertical extraction of the guide tube without altering the attitude of the water-stop device within the cast panel.

Unavoidably the vertical extraction of the guide tube releases also the circular hollow portion 3 of the first joint member; this requires that an extractable core 13' is inserted into the outer shaped portion (step E) to prevent that during the excava-

tion of the adjoining panel (step F) debris can obstruct the cavity of the first joint member. Then the second joint member 5 will be inserted into such cavity (step H) after that said extractable core 13' has been removed (step G). After the introduction of the second joint member, the reinforcement 9' is lowered into the second excavation 12 (step I) and concrete is cast (step L).

The first member 1 is then sealingly coupled to the second member 5 of the joint, in a way similar to step H of the previously disclosed process, either by deforming or bonding the inner seat. Also in this respect there applies what has been mentioned above with reference to step H of Fig. 6.

Fig. 8 better illustrates which portions of the water-stop device are inserted into the excavations according to whether the alternating excavation technique (8A) or the consecutive excavation technique (8B) is used. Namely in the first case each excavation and therefore each primary panel carries the first joint members at both ends, whereas the secondary panels carry second joint members at their ends.

In the second case each excavation carries the second joint member at the connection end with the preceding panel, and the first joint member at the end to be connected with the subsequent panel.

It is clear that suitable modifications, additions or replacements of some components with other accomplishing an equivalent function are possible in the above described embodiments without departing from the scope of the invention.

As an example, the joint support structures shown in Figures 4 and 5 respectively, can be modified for carrying not a single joint but more joints so as to further improve the waterproof characteristic in some particular situation.

Claims

1. A sealing joint between two adjoining panels in a diaphragm, with the joint being located at an intermediate position between said two panels and transversally with respect to their junction line, said joint comprising two separate members of an elastically deformable material wherein the first joint member is housed at least partially within said first panel, and the second joint member is housed at least partially within said second panel, characterized in that said joint members occupy only the outermost portion of the respective panels, that the first joint member is provided with means for being connected to a respective support structure, and that the joint members have portions that are sealingly engageable with each other.
2. A sealing joint as claimed in claim 1, wherein both said joint members are formed by a first longitudinal portion and a second connecting portion with the other member, characterized in that each of said connecting portions of the first and second joint members comprises complementarily shaped parts that are engageable together.
3. A sealing joint as claimed in claim 2, wherein the shaped parts have substantially circular configurations and sizes such as to be insertable one into the other, the outer shaped part having at least one slot for the passage of the longitudinal portion connected to the inner shaped part which is closed, characterized in that the inner shaped part is either hollow or solid.
4. A process for building two adjacent panels in a diaphragm, the panels being equipped with at least one sealing joint according to one of the preceding claims, characterized in that it comprises:
 - connecting one or more first joint members to said support structure;
 - positioning said first joint members and the respective support structure within the excavation of a first panel;
 - casting concrete or other suitable material into said excavation;
 - preparing the excavation for a second panel adjacent to the first one;
 - inserting and connecting the second joint members into the first members of each joint;
 - casting concrete or other suitable material into said second excavation; and
 - applying means adapted to perform a waterproof seal between said joint members.
5. A process as claimed in claim 4, characterized in that it further comprises the additional steps of: inserting an extractable inner core into the outer shaped part of the first joint members before preparing the second excavation; and extracting said core(s) before inserting and connecting the second joint members.
6. A process as claimed in claim 4, characterized in that the step of performing a seal between the joint members comprises the introduction of an expanding material into the inner hollow shaped part of the second joint members.
7. A process as claimed in claim 6, characterized in that said expanding material is a cement

mixture or mortar.

8. A process as claimed in claim 4, characterized in that the step of performing a seal between the joint members comprises applying an adhesive agent in the interface between the inner and outer shaped parts of the members of each joint. 5
9. A process as claimed in claim 4, characterized in that said support structure has an end connected with one or more first joint members and can swing within the excavation, in that said structure is retained in a position in which said first joint members are kept far from the excavation wall, and in that the structure is released until the joint members contact said wall at the end of the insertion into the excavation. 10
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10. A process as claimed in claim 4, for building adjoining panels, characterized in that said support structure, at one end of which one or more first joint members are connected, is inserted as a rigid block into the excavation, and in that after said casting concrete step into said first excavation, the structure is extracted along a substantially vertical direction, together with one or more extractable supports or cores belonging to it. 25
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11. A support structure for a joint according to one or more of claims 1 to 3 for carrying out the process according to claim 9, characterized in that it comprises a plurality of meshes hinged to the metal reinforcement of said first panel, to which meshes one or more first joint members are connected. 35
12. A support structure for a joint according to one or more of claims 1 to 3 for carrying out the process according to claim 10, characterized in that it comprises a guide tube to which one or more extractable supports or cores are connected, said supports or cores being inserted into the outer shaped part of each of said first joint members. 40
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13. A waterproof diaphragm wall formed by a plurality of adjoining panels, characterized in that it is built by means of a process according to any of claims 4 to 10 and using the sealing joints according to one or more of claims 1 to 3. 50
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Fig.1

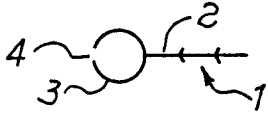


Fig.2

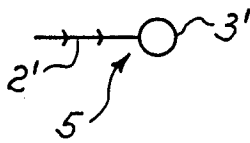


Fig.3

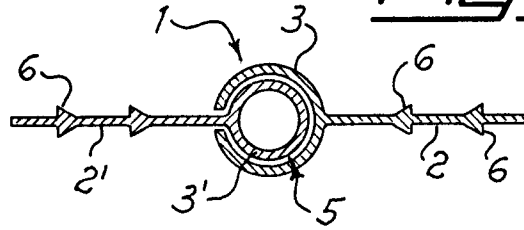


Fig.4

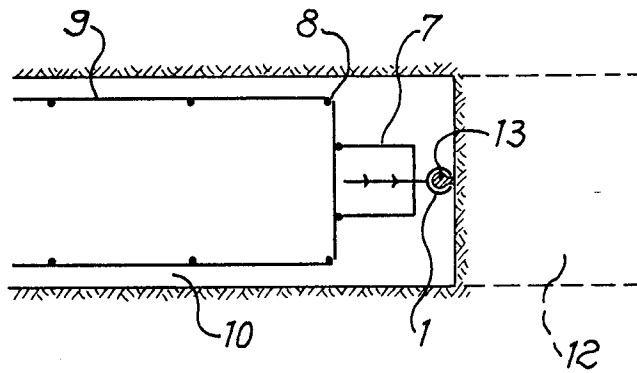


Fig.5

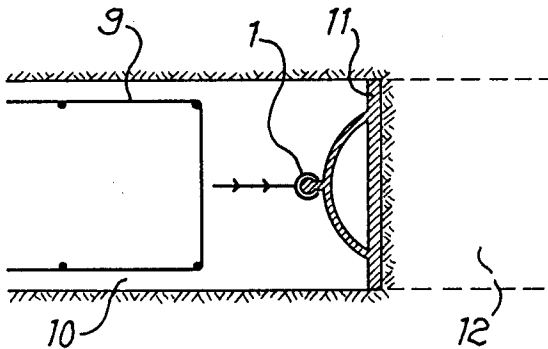


Fig.6

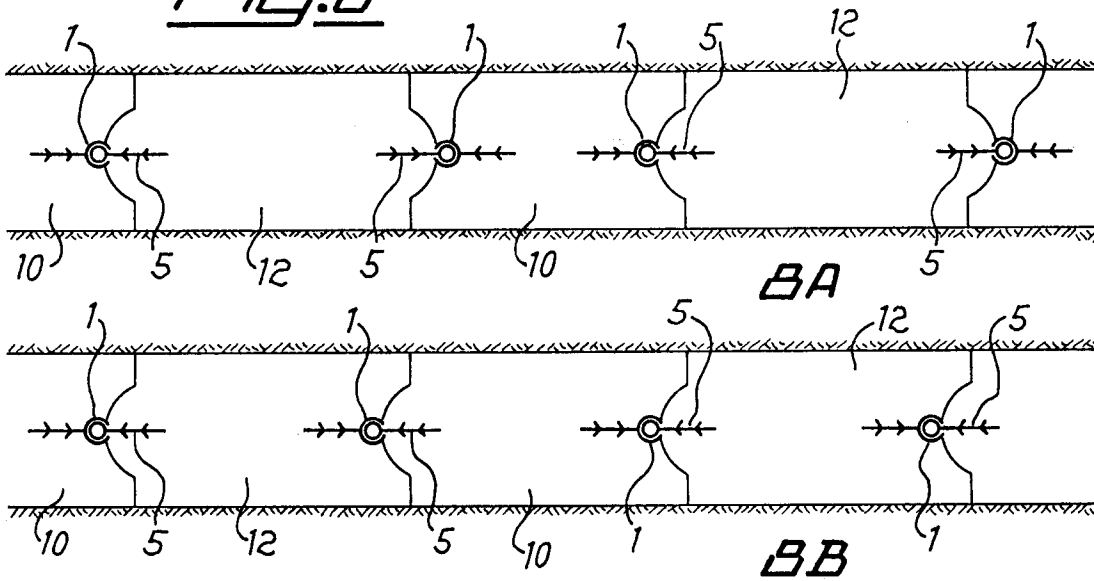


Fig. 6

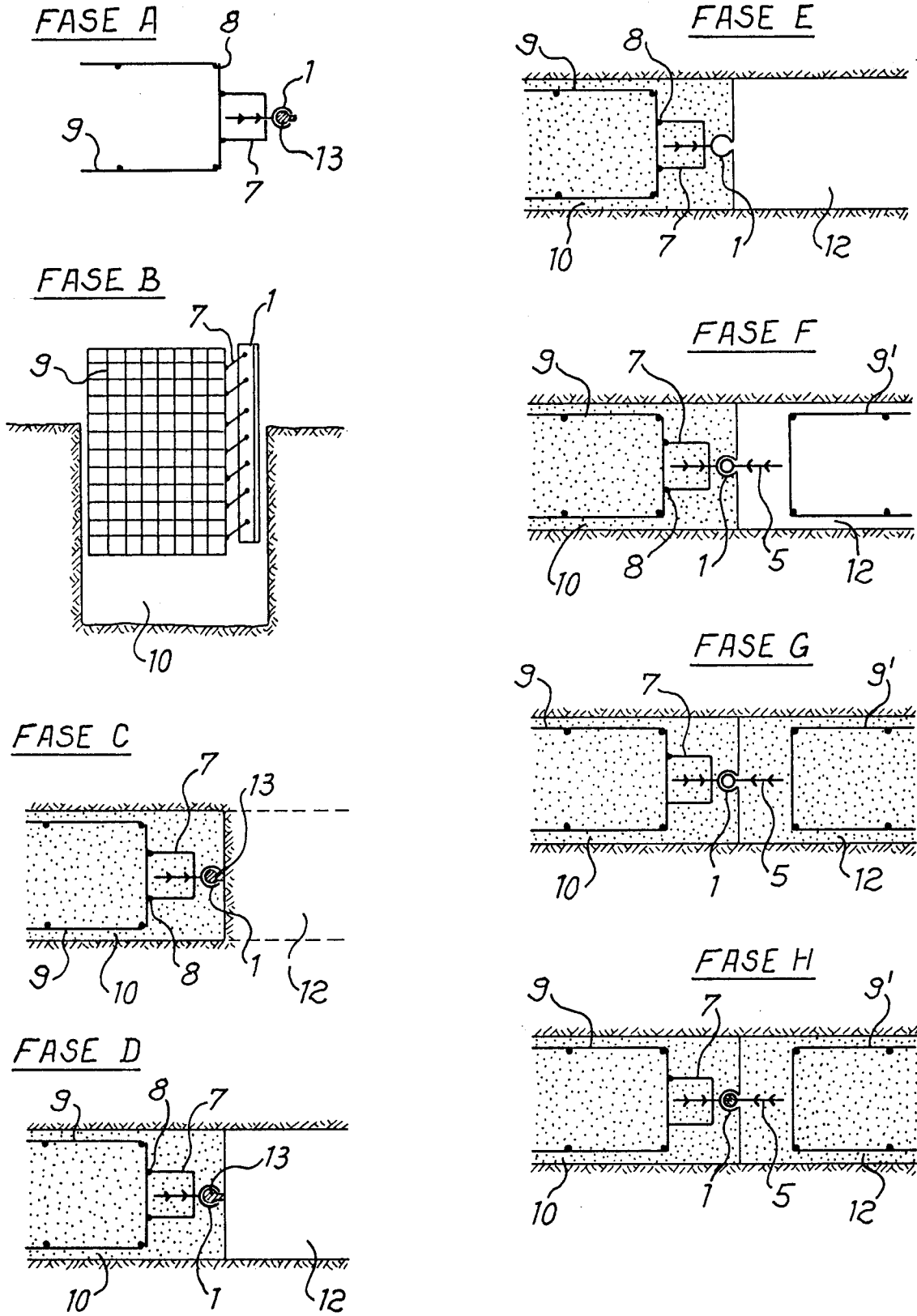
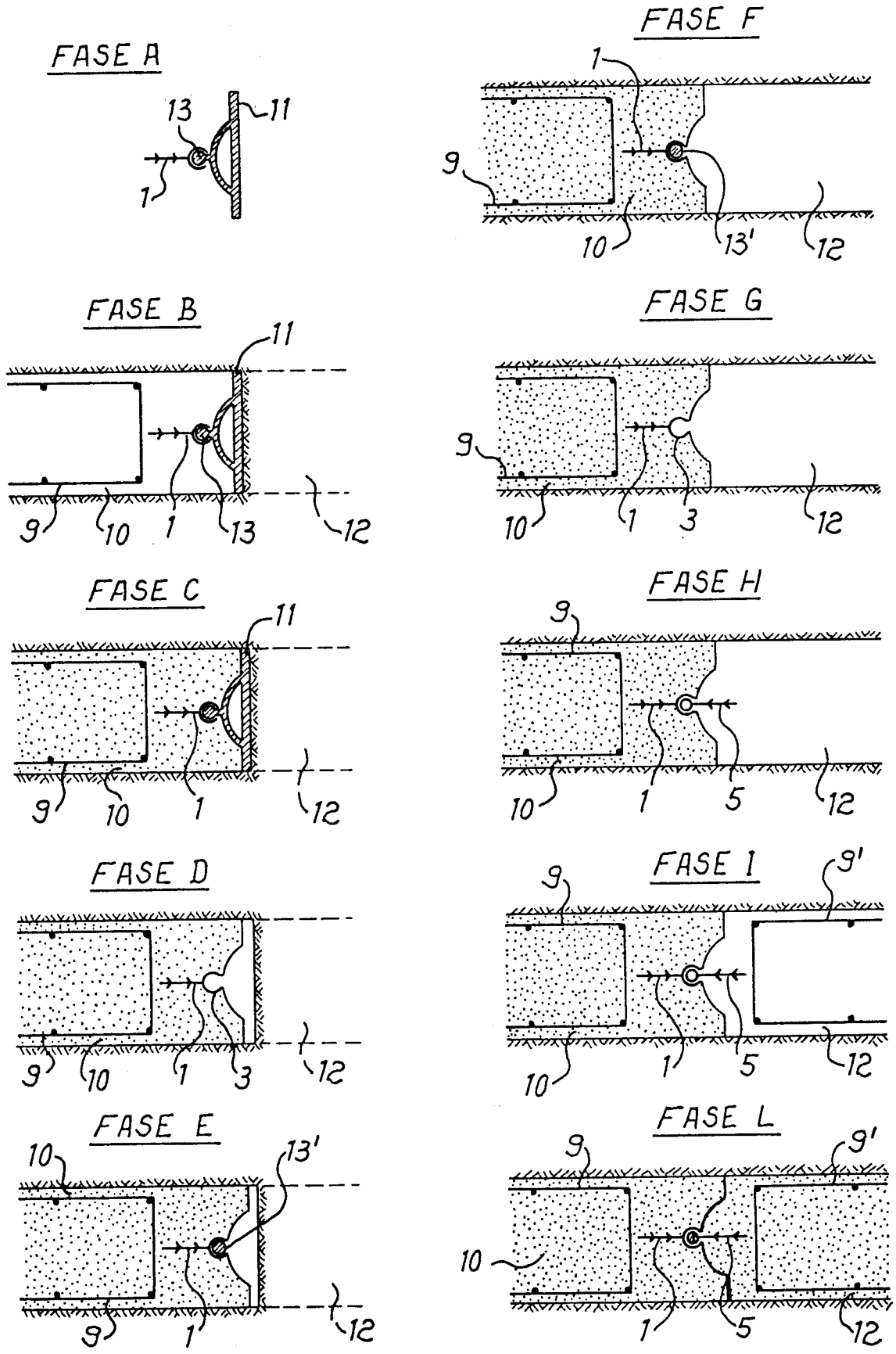


Fig. 7





European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 92 83 0431

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y,D A,D	DE-A-3 430 789 (ZÜBLIN) * the whole document * ---	1-3 4,13	E02D1/00 E02D5/18 E04B1/68
Y A	DE-A-2 349 102 (GOODRICH) * page 4, line 5 - page 5, line 28; figures 1-3 * ---	1-3 4,13	
A	DE-A-3 404 074 (DYCKERHOFF & WIDMANN) * page 7, line 1 - page 9, line 30; figures 1-4 * ---	1-8,10, 12,13	
A	FR-A-2 517 717 (SOLETANCHE) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E02D E04B
Place of search	Date of completion of the search	Examiner	
THE HAGUE	05 MARCH 1993	BELLINGACCI F.	
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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