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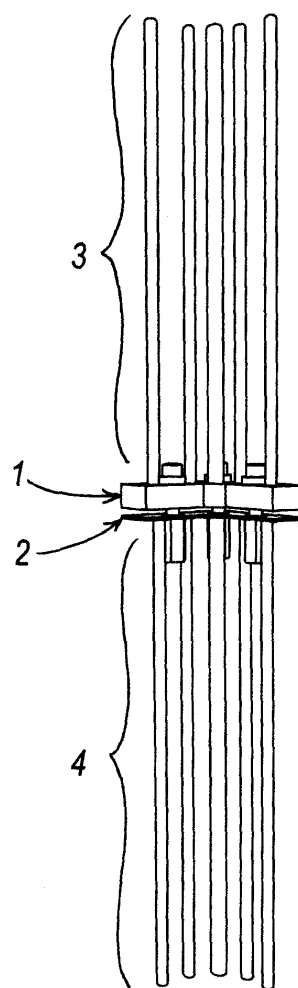
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(54) **Mechanical connection for concrete elements**

(57) A mechanical connection for concrete elements, comprising:

- a first plate (1) with a first anchoring system (3) for a first concrete element;
- a second plate (2) with a second anchoring system (4) for a second concrete element;
- a fixing means for fixing the first plate (1) to the second plate (2), said fixing means comprising at least one female element (10, 11, 12) disposed on the second plate (2) to cooperate with at least one corresponding male element (13, 14, 15) removable coupled to said first plate (1) and arranged to cooperate with a corresponding anchoring hole (16, 17, 18) provided therein.



**Fig. 1**

## Description

**[0001]** The present invention relates to a mechanical connection for concrete elements, and to concrete elements comprising a connection element in accordance with the introduction to the independent claims.

**[0002]** In the current state of the art, prefabricated reinforced concrete elements are connected together by providing in a first of them a male connection element projecting from the concrete element and non-removably fixed to it, and a female connection element provided in a second concrete element to be connected to the first.

**[0003]** The male connection element which projects in this manner from the prefabricated concrete element gives rise to considerable difficulties when the two concrete elements to be connected together are in the process of being superposed.

**[0004]** In the case of columns to be butt-connected, the upper column has to be suitably lifted above the male element and precisely positioned, to be then lowered onto the lower column by inserting the male connection element into the female connection element.

**[0005]** In the case of a beam to be joined to the lateral surface of a column the male connection element prevents the two elements from being brought into contact by an edgewise sliding movement, so making other more complicated types of connection necessary.

**[0006]** Moreover, as this male connection element is a single element, it does not embrace the plurality of longitudinal reinforcement rods of the concrete element, so creating considerable discontinuities in the transmission of tensions from one concrete element to the other, so weakening the combined two concrete elements once connected together.

**[0007]** An object of the present invention is therefore to provide a mechanical connection for prefabricated concrete elements which enables the stated drawbacks to be overcome, a particular object being to provide a connection which does not present projections and which hence enables simple and precise superposing of the two concrete to be joined together.

**[0008]** Another object is to provide a mechanical connection which enables two prefabricated concrete elements to be easily and quickly joined together.

**[0009]** A further object is to obtain concrete elements comprising connection elements which create continuity with the reinforcement rods present in them, to improve force transmission.

**[0010]** Said objects are attained by a mechanical connection and by reinforced concrete elements the inventive characteristics of which are defined by the claims.

**[0011]** The invention will be more apparent from the ensuing detailed description of one embodiment thereof provided by way of non-limiting example and illustrated in the accompanying drawings, in which:

Figure 1 is a perspective view of the mechanical connection according to the invention;

Figure 2 is an enlargement of said mechanical connection in that region joined by the connection elements;

Figure 3 is a front view on that side comprising the female connection elements of the mechanical connection ;

Figure 4 is a front view on that side comprising the male connection elements of the mechanical connection ;

Figure 5 is a first perspective view of the mechanical connection showing the two connection elements separated and the first anchoring system separated from the first plate;

Figure 6 is a second perspective view of the mechanical connection showing the two connection elements separated and the first anchoring system separated from the first plate;

Figure 7 is a transparency showing two reinforced concrete elements of the invention with the reinforcement rods visible, and joined together by the mechanical connection;

Figure 8 represents an enlargement of the preceding figure in the region in which the two concrete elements are mechanically connected;

Figure 9 shows two reinforced concrete elements of the invention joined together by the mechanical connection;

Figure 10 represents an enlargement of the preceding figure in the region in which the two concrete elements are mechanically connected.

**[0012]** With reference to Figures from 1 to 6, these show that the mechanical connection according to the invention comprises:

- a first plate 1 presenting a first front surface 5 and a first rear surface 7 from which a first anchoring system 3 for a first concrete element projects;
- a second plate 2 presenting a second front surface 6 and a second rear surface 8 from which a second anchoring system 4 for a second concrete element projects;
- a fixing means for fixing the first plate 1 to the second plate 2.

**[0013]** Said fixing means comprises at least two connection elements, namely a male element and a female element. The fixing means is releasable. In the embodiment shown, three fixing means are present with female elements in the form of three threaded sockets 10, 11, 12 disposed on the second plate such that the second front surface 6 is free, the three threaded sockets 10, 11, 12 being accessible from the second front surface 6.

**[0014]** In the illustrated embodiment, three removable male connection elements 13, 14, 15 are also present, comprising three screws to be inserted into the first plate 1 via anchoring holes 16, 17, 18.

**[0015]** The three threaded sockets 10, 11, 12 are fixed

permanently to the second plate 2 on the side comprising the second rear surface 8.

**[0016]** The second anchoring system 4 comprises five bars joined to the threaded sockets 10, 11, 12 by welding.

**[0017]** Specifically, the three threaded sockets 10, 11, 12 are disposed at a right angle, with one element 10 at the corner and two elements 11 and 12 in a lateral position.

**[0018]** Four of the five component bars of the anchoring system 4 are adjacent to and welded in pairs to each of the threaded sockets 11, 12 disposed in the lateral position, while one is adjacent to and welded to the corner threaded socket 10.

**[0019]** The three anchoring holes 16, 17, 18 are provided in the first plate 1 in positions corresponding to those of the three threaded sockets 10, 11, 12 when the first plate 1 is superposed on the second plate 2. They have a diameter greater than the outer diameter of the screws 13, 14, 15 to be inserted through them and engage in the corresponding threaded sockets 10, 11, 12. The slack created by the greater diameter is important during assembly as the screws can then be moved about within the anchoring hole through which they have been inserted, to search for the corresponding socket and engage it. Hence said connection elements can be coupled together even if the anchoring hole is not aligned with the female element. For this reason a washer must be provided with each screw. The purpose of this washer is to enable the screw to be moved within the anchoring hole and to act as an abutment for the screw head.

In the example the second plate 2 to which the threaded sockets 10, 11, 12 are joined acts only as a template, i.e. as an alignment element such that the inlets of the threaded sockets 10, 11, 12 lie in the same plane.

In the example shown in the figures, the first plate 1 has a greater thickness than the second plate 2, as the thickness of the first plate 1 is required to withstand the connection forces transmitted by the screws 13, 14 and 15, this force being transmitted by the direct connection (weld) between the threaded sockets 10, 11, 12 and the constituent bars of the second anchoring system 4.

**[0020]** The three anchoring holes 16, 17, 18 provided in the first plate 1 are disposed at a right angle with one 16 at the corner and two 17, 18 in a lateral position.

**[0021]** The first anchoring system 3 comprises five bars joined to the first plate 1 by welding, of which four are disposed in pairs in proximity to each of the two anchoring holes 17, 18 in a lateral position and one is disposed in proximity to the corner anchoring hole 16 on the bisector of the right angle formed by the three anchoring holes 16, 17, 18.

**[0022]** Said five bars 3 are able to anchor to the three column reinforcement rods by adherence. The bars can also present a transverse enlargement and anchor by interference.

**[0023]** The screws 13, 14, 15 are of socket head type to enable them to be easily tightened.

**[0024]** The threaded sockets 10, 11, 12 are dead-end-

ed at that end facing the concrete element, i.e. in the direction in which the second anchoring system projects. This serves to prevent entry of concrete into the threaded sockets on forming the concrete element.

**[0025]** In a different embodiment (not shown for simplicity), the second anchoring system 4 can lack bars which project from the rear second surface 8 of the second plate 2. The bars of the second anchoring system 4 can present a transverse enlargement allowing anchoring by interference. The second anchoring system can be in the form of the said threaded sockets 10, 11, 12 terminating with a transverse enlargement able to anchor them to the concrete element. In this case the threaded sockets are known as self-gripping. This is particularly useful when the mechanical connection has to be made on the lateral surface of a column, it hence being impossible to insert into the column a second anchoring system comprising very long bars, which would emerge from the column. The enlargement used to render the threaded socket self-gripping can be surrounded by bracing irons inside the column, which withstand the external traction to which the self-gripping socket is subjected.

**[0026]** Instead of the threaded sockets 10, 11, 12, the female elements 10, 11, 12 of the second plate 2 can comprise threaded holes provided in the second plate 2. In this case the second plate 2 must have a considerable thickness, at least similar to that of the first plate 1.

**[0027]** With reference to Figures from 7 to 10, it can be seen that the invention also comprises two mutually connectable reinforced concrete elements 30 and 31 of elongated shape, with reinforcement rods of longitudinal axis.

**[0028]** A first concrete element 30 reinforced with reinforcement rods 32, 33, 34 of longitudinal axis comprises a first plate 1 presenting a free first front surface 5 and, facing the concrete element 30, a first rear surface 7 from which there projects an anchoring system 3 which enters the concrete element 30 to adhere to it. In the represented embodiment, the first plate 1 comprises three anchoring holes 16, 17, 18 disposed on the prolongation of the longitudinal axis of the reinforcement rods 32, 33, 34. The concrete element 30 is shaped to make the anchoring holes 16, 17, 18 accessible from the side comprising the first rear surface 7 for the screws 13, 14, 15 used for the connection. This shape is achieved by means of inserts, which are either recoverable (of steel) or disposable (of polystyrene).

**[0029]** In the example the concrete element 30 is of quadrangular cross-section with four corners, in proximity to each corner it presenting three reinforcement rods 32, 33, 34 of longitudinal axis and three anchoring holes 16, 17, 18 disposed in the first plate 1 on the prolongation of the longitudinal axis of each of said reinforcement rods 32, 33, 34.

**[0030]** The three anchoring holes 16, 17, 18 are disposed at a right angle with one element 16 at the corner and two elements 17, 18 in a lateral position.

**[0031]** The first anchoring system 3 comprises five

bars, of which four are disposed in pairs in proximity to each of the two anchoring holes 17, 18 in a lateral position and one is disposed in proximity to the corner anchoring hole 16 on the bisector of the right angle formed by the three anchoring holes 16, 17, 18.

**[0032]** The invention also comprises a second elongated reinforced concrete element 31 with reinforcement rods 38, 39, 40 of longitudinal axis comprising a second plate 2 presenting a free second front surface 6 and, facing the concrete element 31, a second rear surface 8 from which there projects a second anchoring system 4 which enters the concrete element 31 to adhere to it, said second plate 2 presenting female connection elements 10, 11, 12 accessible from the second front surface 6 and disposed on the prolongation of the longitudinal axis of the reinforcement rods 38, 39, 40.

**[0033]** In the example the female connection elements are threaded sockets 10, 11, 12, joined permanently to the second plate 2. Said threaded sockets 10, 11, 12 project from the second rear surface 8 to penetrate into the concrete element 31.

**[0034]** The concrete element 31 is of quadrangular cross-section with four corners, in proximity to each corner it presenting three reinforcement rods 38, 39, 40 of longitudinal axis and three threaded sockets 10, 11, 12 disposed on the prolongation of the longitudinal axis of each of said reinforcement rods 38, 39, 40. The three threaded sockets 10, 11, 12 are disposed at a right angle with one 10 at the corner and two 11, 12 in a lateral position.

**[0035]** The second anchoring system 4 comprises five bars, of which four are adjacent to and welded in pairs to each of the two threaded sockets 11, 12 disposed in the lateral position, while one is adjacent to and welded to the corner threaded socket 10.

**[0036]** Said second anchoring system can comprise a transverse enlargement of the threaded sockets 10, 11, 12 (self-gripping sockets).

**[0037]** To make the connection between two concrete elements, the two concrete elements are abutted so that the first plate 1 is superposed on the second plate 2. The first and second front surfaces of the first and second plate are free and without elements projecting therefrom. The washers 19, 20, 21 are superposed on the anchoring holes 16, 17, 18; the screws 13, 14, 15 are inserted through the anchoring holes via the washers and are moved about until they find the entry of the threaded sockets 10, 11, 12. At this point the screws are tightened to join the two concrete elements together. The first and second anchoring system 3 and 4 ensure that the first and second plate 1, 2 are anchored to the respective concrete elements.

**[0038]** By virtue of the fact that the connection elements (screws and threaded sockets) lie on the same axis as the reinforcement rods, the forces are transmitted axially.

**[0039]** As the component bars of the anchoring systems are disposed in proximity to the anchoring holes

and to the threaded sockets, said bars extend into the concrete element to lie alongside the longitudinal reinforcement rods, so improving force transmission.

**[0040]** A further advantage is the fact that the front surfaces 5, 6 of the plates 1, 2 are free, allowing considerable freedom of movement when superposing the first front surface 5 of the first plate 1 on the second front surface 6 of the second plate 2.

## Claims

1. A mechanical connection for concrete elements, comprising:

- a first plate (1) presenting a first front surface (5) and a first rear surface (7) from which a first anchoring system (3) for a first concrete element projects;
- a second plate (2) presenting a second front surface (6) and a second rear surface (8) from which a second anchoring system (4) for a second concrete element projects;
- a fixing means for fixing the first plate (1) to the second plate (2),

said fixing means comprising at least one female element (10, 11, 12) disposed on the second plate (2) such that the second front surface (6) is free, said female element (10, 11, 12) being accessible from the second front surface (6) and being arranged to cooperate with at least one corresponding male element (13, 14, 15) associated with the first plate (1), **characterised in that** the male element (13, 14, 15) is removable coupled to said first plate (1) and is arranged to cooperate with a corresponding anchoring hole (16, 17, 18) provided therein.

2. A mechanical connection as claimed in claim 1, **characterised in that** said first plate (1) has a greater thickness than said second plate (2).

3. A mechanical connection as claimed in claim 1, **characterised in that** said fixing means is releasable.

4. A mechanical connection as claimed in claim 3, **characterised in that** said female element comprises at least one threaded socket (10, 11, 12) joined to the second plate (2) on the same side as the second rear surface (8), said male element comprising at least one screw (13, 14, 15).

5. A mechanical connection as claimed in the preceding claim, **characterised in that** said screw (13, 14, 15) is of socket head type.

6. A mechanical connection as claimed in claim 4,

**characterised in that** said threaded socket (10, 11, 12) is dead-ended.

7. A mechanical connection as claimed in claim 1, **characterised in that** said female element comprises at least one threaded hole provided in the second plate (2), said male element comprising at least one screw (13, 14, 15).
8. A mechanical connection as claimed in claim 4, **characterised by** presenting three threaded sockets (10, 11, 12) connected permanently to the second plate (2), and three anchoring holes (16, 17, 18) provided in the first plate (1) in positions which correspond to those of the three threaded sockets (10, 11, 12) when the first plate (1) is superposed on the second plate (2).
9. A mechanical connection as claimed in the preceding claim, **characterised in that** the three threaded sockets (10, 11, 12) and the three corresponding anchoring holes (16, 17, 18) are disposed at a right angle with one (10, 16) at the corner and two (11, 12; 17, 18) in a lateral position.
10. A mechanical connection as claimed in claims 1 and 9, **characterised in that** said first anchoring system (3) comprises five bars, of which four are disposed in pairs in proximity to each of the two anchoring holes (17, 18) in a lateral position and one is disposed in proximity to the corner anchoring hole (16) on the bisector of the right angle formed by the three anchoring holes (16, 17, 18).
11. A mechanical connection as claimed in claim 9, **characterised in that** said second anchoring system (4) comprises five bars, of which four are adjacent to and welded in pairs to each of the two threaded sockets (11, 12) disposed in the lateral position, while one is adjacent to and welded to the corner threaded socket (10).
12. A mechanical connection as claimed in claim 1, **characterised in that** said at least one anchoring hole (16, 17, 18) has a diameter greater than the outer diameter of the male element (13, 14, 15) to be inserted through it and engage in the female element (10, 11, 12), such as to enable said connection elements to be coupled together even if the anchoring hole (16, 17, 18) is out of alignment with the female element (10, 11, 12).
13. A mechanical connection as claimed in claim 4, **characterised in that** said at least one threaded socket (10, 11, 12) terminates with a transverse enlargement able to act as a second anchoring system.
14. An elongated reinforced concrete element (30) with at least one reinforcement rod (32, 33, 34) of longitudinal axis comprising a first plate (1) presenting a free first front surface (5) and, facing the concrete element (30), a first rear surface (7) from which there projects an anchoring system (3) which enters the concrete element (30) to adhere to it, **characterised in that** said first plate (1) comprises at least one anchoring hole (16, 17, 18), said concrete element (30) being shaped to make the anchoring hole (16, 17, 18) accessible from the side comprising the first rear surface (7) for a male element (13, 14, 15) of a fixing means, said anchoring hole being disposed on the prolongation of the longitudinal axis of the reinforcement rod (32, 33, 34).
15. A concrete element (30) as claimed in the preceding claim, **characterised in that** said male element is a screw (13, 14, 15).
16. A concrete element (30) as claimed in claim 14, **characterised in that** said concrete element (30) has a quadrangular cross-section with four corners, in proximity to each corner it presenting three reinforcement rods (32, 33, 34) of longitudinal axis and three anchoring holes (16, 17, 18) disposed in the first plate (1) on the prolongation of the longitudinal axis of each of said reinforcement rods (32, 33, 34).
17. A concrete element (30) as claimed in the preceding claim, **characterised in that** the three anchoring holes (16, 17, 18) are disposed at a right angle with one (16) at the corner and two (17, 18) in a lateral position.
18. A concrete element (30) as claimed in the preceding claim, **characterised in that** said first anchoring system (3) comprises five bars, of which four are disposed in pairs in proximity to each of the two anchoring holes (17, 18) in a lateral position and one is disposed in proximity to the corner anchoring hole (16) on the bisector of the right angle formed by the three anchoring holes (16, 17, 18).
19. An elongated reinforced concrete element (31) with at least one reinforcement rod (38, 39, 40) of longitudinal axis comprising a second plate (2) presenting a free second front surface (6) and, facing the concrete element (31), a second rear surface (8) from which there projects a second anchoring system (4) which enters the concrete element (31) to adhere to it, **characterised in that** said second plate (2) presents at least one female connection element (10, 11, 12) accessible from the second front surface (6) and disposed on the prolongation of the longitudinal axis of the reinforcement rod (38, 39, 40).
20. An reinforced concrete element (31) as claimed in the preceding claim, **characterised in that** said fe-

male connection element comprises a threaded socket (10, 11, 12) joined permanently to the second plate and projecting from the second rear surface (8) to penetrate into the concrete element (31).

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21. A concrete element (31) as claimed in claim 19, **characterised in that** said concrete element (31) has a quadrangular cross-section with four corners, in proximity to each corner it presenting three reinforcement rods (38, 39, 40) of longitudinal axis and three threaded sockets (10, 11, 12) disposed on the prolongation of the longitudinal axis of each of said reinforcement rods (38, 39, 40). 10
22. A concrete element (31) as claimed in the preceding claim, **characterised in that** the three threaded sockets (10, 11, 12) are disposed at a right angle with one (10) at the corner and two (11, 12) in a lateral position. 15
23. A concrete element (31) as claimed in claims 19 and 22, **characterised in that** said second anchoring system (4) comprises five bars, of which four are adjacent to and welded in pairs to each of the two threaded sockets (11, 12) disposed in the lateral position, while one is adjacent to and welded to the corner threaded socket (10). 20 25
24. A concrete element (31) as claimed in claim 20, **characterised in that** said at least one threaded socket (10, 11, 12) terminates with a transverse enlargement able to act as a second anchoring system. 30

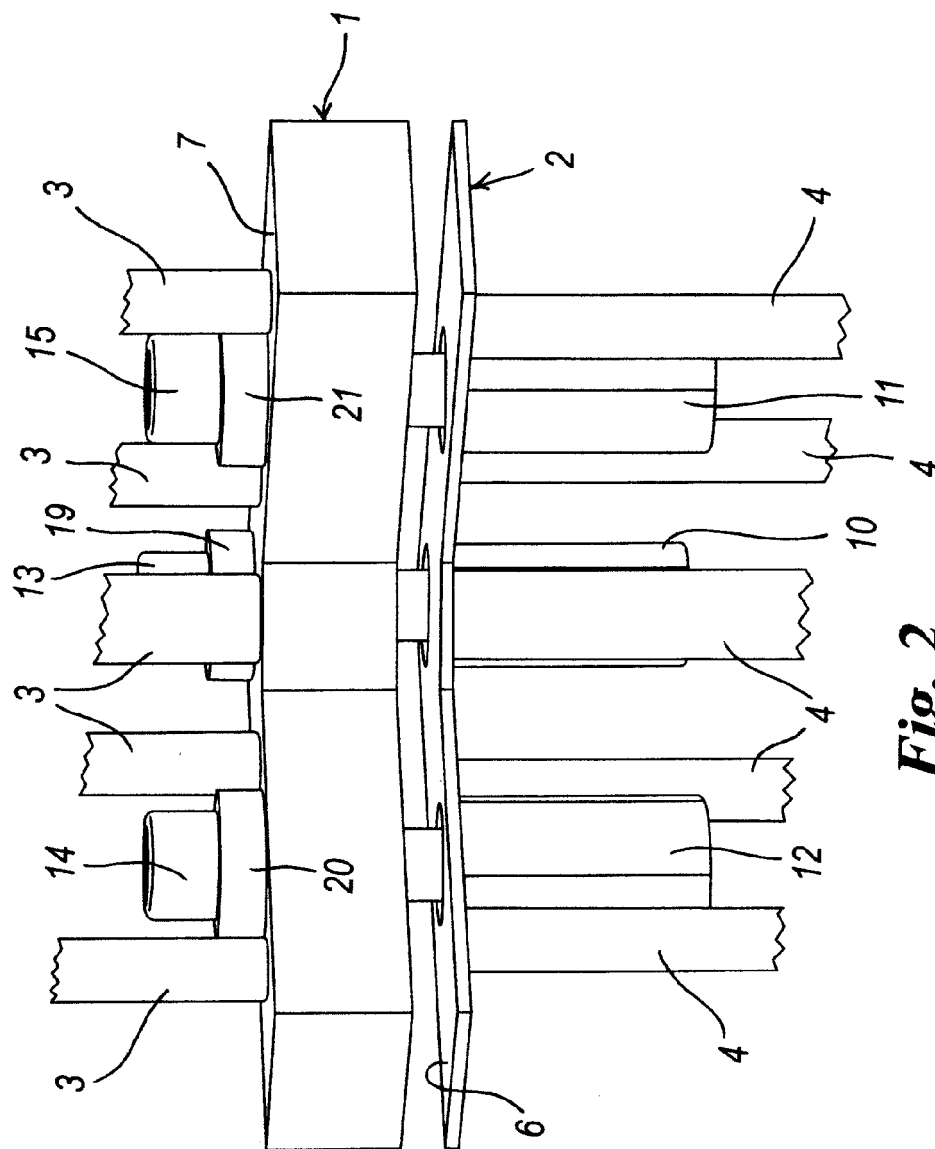
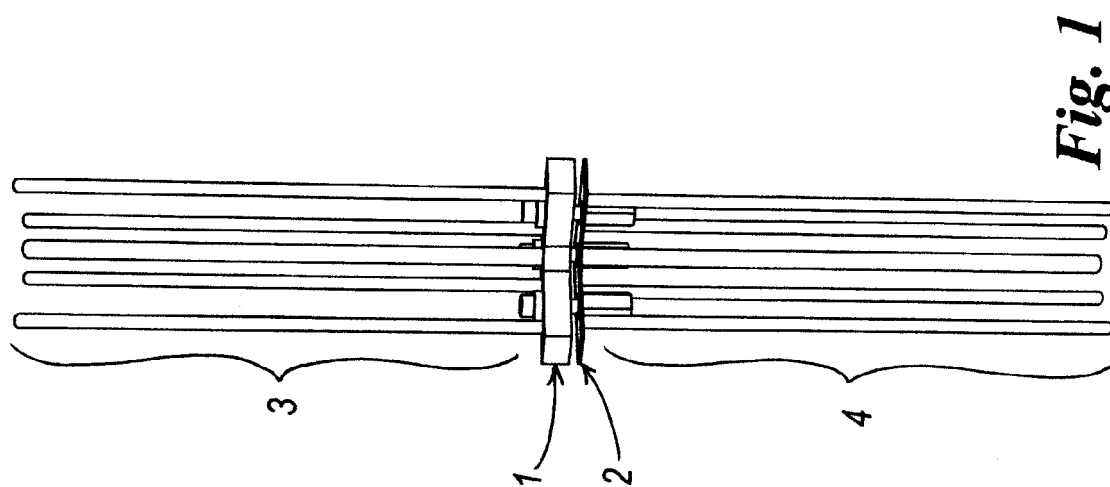
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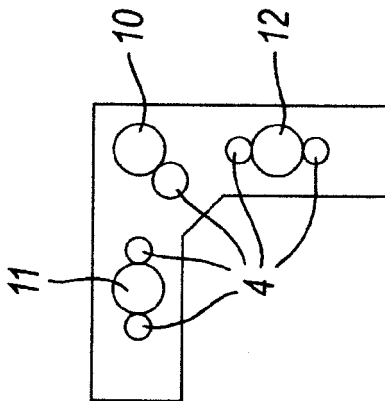
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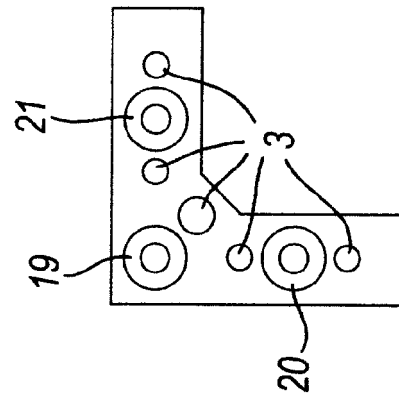
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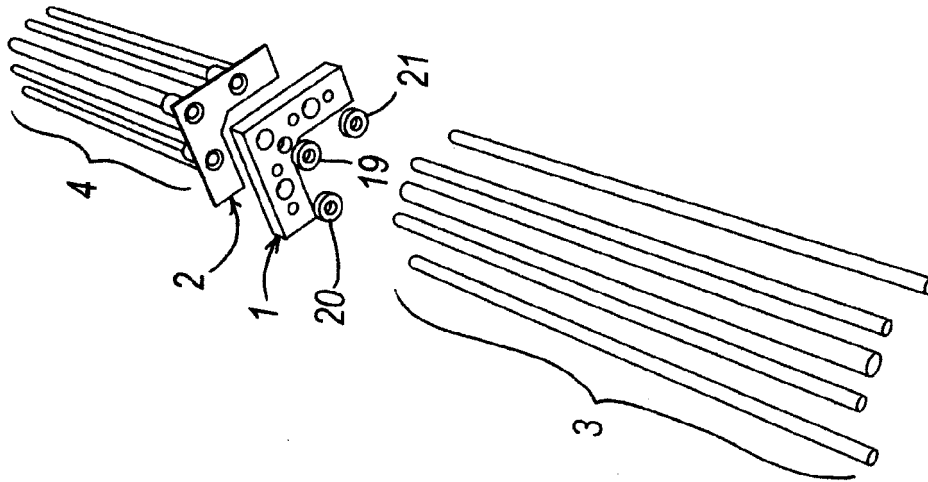




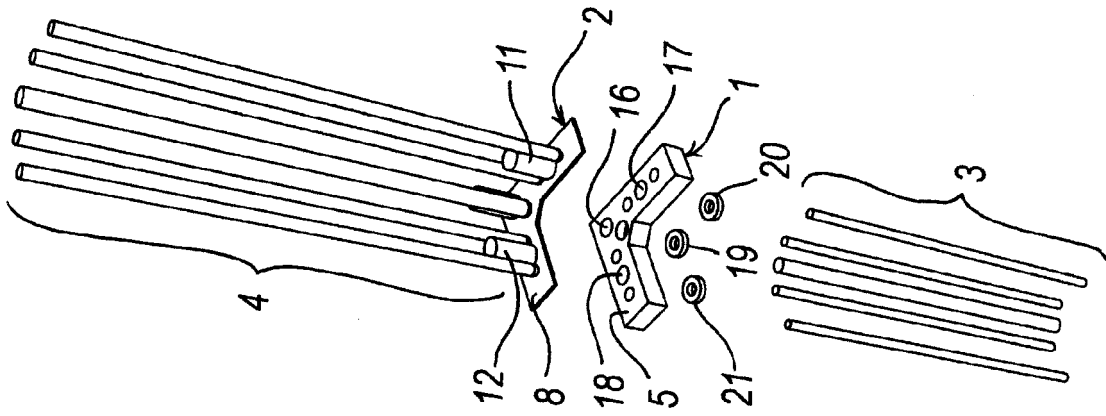
**Fig. 3**



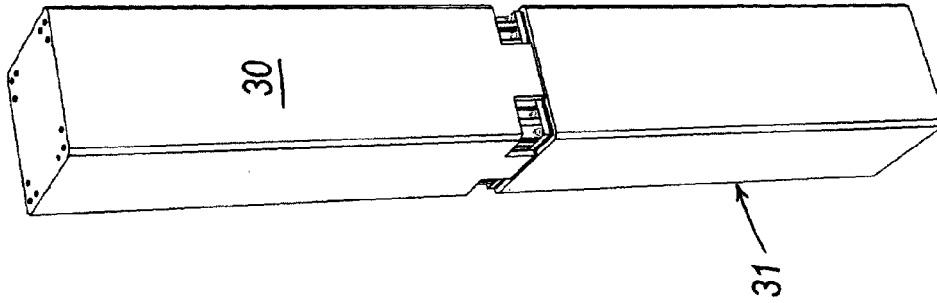
**Fig. 4**



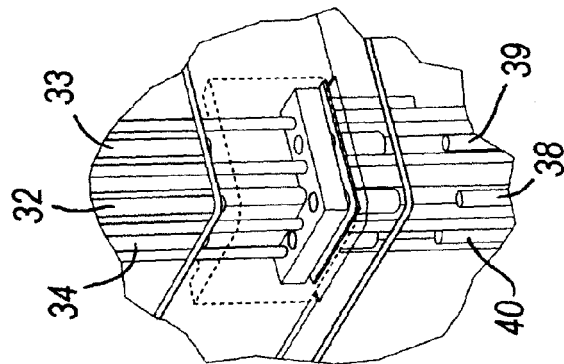
**Fig. 5**



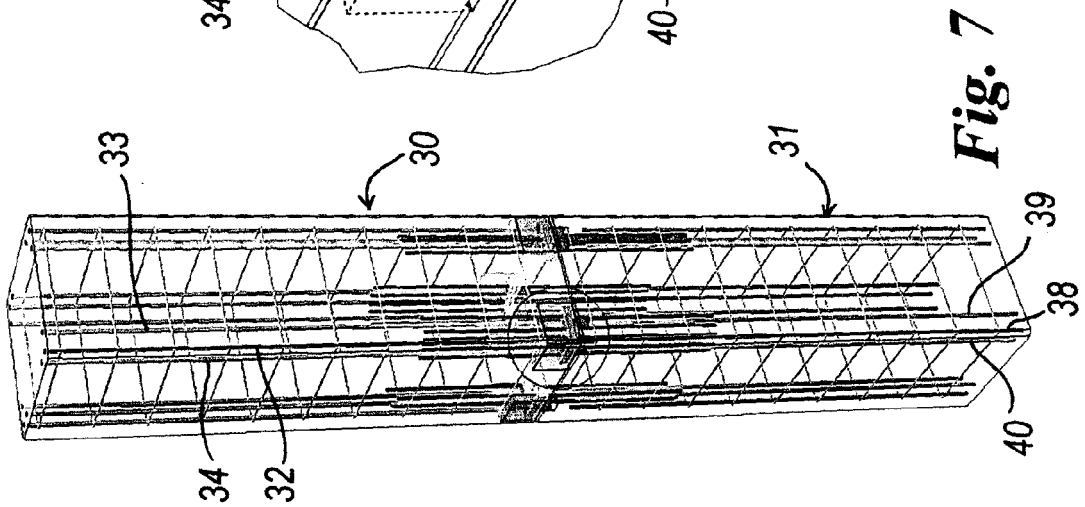
**Fig. 6**



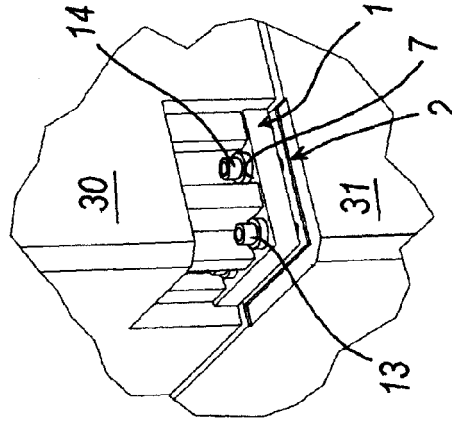
**Fig. 9**



**Fig. 8**



**Fig. 7**



**Fig. 10**