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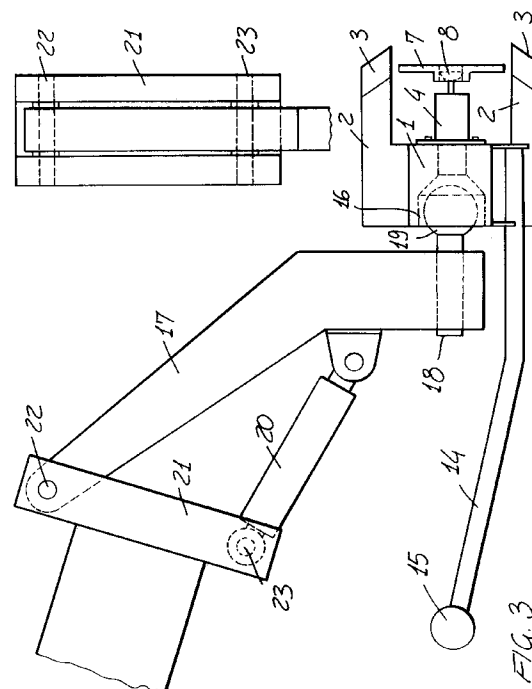
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(54) **Apparatus for assembling reinforcement or supporting ribs in a tunnel being built.**

(57) A fork apparatus (1) for assembling reinforcing or supporting ribs in a tunnel consists of a box-like supporting construction with two short abutment teeth (2) on the sides and four abutment teeth (3) in the central part. On the sides, two pistons (4) are arranged for clamping the ribs to the apparatus. In the central part, a base member (12), driven by a small piston (13), operates as an abutment for the rib crown. The apparatus is connected to the arm of a vehicle by means of an adjustable hinge (17,20,21,22) and a ball joint (16,19).



BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for assembling reinforcement or supporting ribs in a tunnel being built.

As is known, tunnel supporting ribs conventionally comprise curved element, made of a metal material, which are used for lining the walls of the tunnel being made.

As seen in cross-section, the mentioned reinforcement ribs comprise either one or two iron or section members.

The latter are connected to one another by means of metal cross elements.

The reinforcement ribs made of a single piece are called simple reinforcement ribs, whereas the ribs comprising two iron or section members are conventionally called double reinforcement ribs.

The reinforcement ribs are conventionally installed by means of raising arms which engage the ribs at a middle portion thereof and raise them so as to be properly located by the operators.

Prior reinforced ribs, however, because of their curved configuration, have a comparatively high resiliency, which makes very difficult their gripping and, moreover, can cause the ribs to be easily deformed.

Their installation, accordingly, is very difficult and dangerous.

SUMMARY OF THE INVENTION

Accordingly, the aim of the present invention is that of allowing the reinforcement ribs, pre-assembled on the ground, to be installed in a tunnel being built in a very quick and safe manner, and this by specifically designing a rib handling apparatus allowing the reinforcement rib to self-balance, as it is raised and further allowing the raised reinforcement rib to be automatically arranged in its proper position in which it can also be turned rightwardly and leftwardly.

The two reinforcement rib locking pistons operate to:

1° lock the reinforcement rib to the handling fork during the raising operation: in this case the supporting base is arranged under the crown of the reinforcement rib;

2° as the reinforcement rib has been brought to a proper vertical position, to release the gripping, thereby the reinforced rib will tend to close, whereas, by removing the supporting base and increasing the gripping force, the reinforced rib will tend to be opened.

The spherical or ball articulation allows, moreover, the gripping fork to properly grip or engage the reinforcement rib, pre-assembled on the ground, independently from the position of the operating apparatus and the slant of the reinforcement rib, with respect to the ground surface.

According to one aspect of the present invention, the above mentioned aim, as well as yet other objects, which will become more apparent hereinafter, are achieved by a reinforcement rib laying apparatus, for tunnels and the like, characterized in that said apparatus essentially comprises a support member thereon there are pivoted an operating arm and a raising piston.

The arm is specifically designed for raising a reinforcement rib gripping fork member, through a male ball support provided on the arm, and a female ball support provided on the reinforcement rib laying fork.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention will become more apparent hereinafter from the following detailed disclosure of a preferred, but not exclusive embodiment, of a reinforcement rib laying fork apparatus, as well as of its operating arm and support, which are illustrated, by way of an indicative, but not limitative, example, in the accompanying drawings, where:

Figure 1 illustrates the reinforcement rib laying fork apparatus with its raising arm and support, in a condition in which the reinforcement rib is assembled on the ground and is mounted or assembled in its end configuration;

Figure 2 illustrates the reinforcement rib laying fork apparatus of Figure 1, with its raising arm and support, the apparatus being mounted on an operating machine specifically designed for receiving it;

Figure 3 illustrates the reinforcement rib laying fork apparatus shown in Figure 1, with its raising arm and support, the apparatus being shown in the condition thereof for gripping or engaging a reinforcement rib arranged on the ground;

Figure 4 illustrates the reinforcement rib laying fork apparatus, with its raising arm and support, in the condition with an assembled reinforcement rib;

Figure 5 is a side view of the preceding Figures; Figure 6 is a top plan view of the preceding Figures and, in particular, showing the the reinforcement rib laying fork apparatus adapted to engage or grip a reinforcement rib made of two section members; and

Figure 7 is a top plan view of the preceding Figures and illustrates, in particular, the reinforcement rib laying fork apparatus provided for gripping a reinforced rib comprising a single section member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the number references of the

above mentioned figures, the reinforcement rib laying fork apparatus, including a rib gripping arm and related support, which can be used for installing tunnel reinforcement ribs assembled on the ground, in a tunnel being built, essentially comprises a box-like construction, of welded sheet metal, the so-called body, generally indicated at the reference number 1, which supports, on its right and left sides, two short teeth 2 and, at its central portion, four long teeth 3.

On the body 1 there are connected, for example by means of bolts, two pistons 4, which are specifically designed to lock the simple reinforcement rib 5 or the double reinforcement rib 6 by means of a stop member 7, to be engaged with the reinforcement ribs by means of a semi-spherical articulation 8.

In the case of a simple reinforcement rib 5 there are used the short teeth 2 and 9, as well as the long teeth 3 and 10 and the support 11 as is shown in Figure 7.

In the case of a double reinforcement rib, there are used the short teeth 2 and the long teeth 3, as shown in Figure 6.

The base member 12, driven by the small piston 13 bolted to the body 1, is mounted, as shown in Figure 7, in the case of a simple reinforcement rib and as shown in Figure 6 in the case of a double rib.

To the body 1 there is welded a rod 14 which supports a balancing or equalizing assembly 15.

The body 1 moreover supports, on its central portion, a female ball 16, comprises two mutually welded portions.

The arm 17 comprises a cylinder 18 ending with a ball 19, nested within the female ball 16.

This arm is raised by a piston 20.

The support 21, anchored to the operating machine arm, is articulated, through a hinge assembly 22, to the arm 17 and, by a further hinge 23, to the piston 20.

A shim or spacing element 24 can be interposed between the teeth 2 and 3 and the body 1, so as to increase the distance or inter-axis between the teeth to raise reinforcement ribs of larger or smaller width.

From the above disclosure and the observation of the Figures of the accompanying drawings, there are self-evident the great functionality and facility of use of the reinforcement rib laying fork apparatus according to the present invention.

While the invention has been disclosed and illustrated with reference to a preferred embodiment thereof, it should be apparent that the disclosed embodiment is susceptible to several modifications and variations all of which will come within the spirit and scope of the appended claims.

Claims

1. An apparatus for laying, in a tunnel being built,

ground pre-assembled reinforcement ribs or the like, characterized in that said apparatus comprises a support member thereon there are pivoted an arm and a raising piston, said arm being provided for raising a reinforcement rib fork member through a male ball supporting member applied on a female arm portion of said reinforcement rib laying fork member.

2. An apparatus according to Claim 1, characterized in that said reinforcement rib laying fork member is provided with a plurality of teeth suitable to engage or grip a simple reinforcement rib comprising a single section member, or a double reinforcement rib comprising two section members mutually welded to one another.

3. An apparatus according to Claims 1 and 2, characterized in that said reinforcement rib is locked by means of two pistons supporting a semi-spheric articulation stop element.

4. An apparatus according to one or more of the preceding claims, characterized in that said apparatus comprises a base driven by a small piston operating as a support for the crown of the reinforcement rib, as the latter is locked to the reinforcement rib laying fork member.

5. An apparatus according to one or more of the preceding claims, characterized in that said movable base is removed from said crown of said reinforcement rib as said reinforcement rib has been arranged in a vertical position and it is desired to open or close it by increasing or decreasing the gripping force of the two pistons on said reinforcement rib.

6. An apparatus according to one or more of the preceding claims, characterized in that said apparatus is adapted to be mounted on an operating machine provided for raising the support, the fork member supporting arm and reinforcement rib laying fork member with the reinforcement rib of said apparatus.

7. An apparatus according to one or more of the preceding claims, characterized in that said operating machine supplies pressurized oil for driving the pistons of said reinforcement rib laying apparatus.

8. An apparatus according to one or more of the preceding claims, characterized in that said welded sheet metal support bearing the hinge of said arm and that of said piston for raising said arm is adapted to be anchored to said operating machine by means of welding or a bolted connection.

9. An apparatus according to one or more of the preceding claims, characterized in that said welded sheet metal arm, pivoted to the support or raising piston supports a cylinder ending with a ball member forming the support of said reinforcement rib laying fork member. 5
10. An apparatus according to one or more of the preceding claims, characterized in that the piston for raising said arm is pivoted to the support and to said arm. 10
11. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member, made of welded sheet metal, comprises several mutually cooperating parts. 15
12. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member supports, at an intermediate portion thereof, said female ball member in which there is engaged the ball supporting male member of said arm. 20
13. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member supports a rod provided with an equalizer or balancing member, the weight whereof is suitable to allow said fork member to be held in a perfect equilibrium condition on the ball assembly, and to be driven, by manually operating the balancing assembly, in any directions with a minimum effort. 25
14. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member comprises four teeth, having a smaller height on the outside, and four teeth having a larger height at the center, which are suitably shaped and bolted so as to engage reinforcement ribs comprising either a section member or two section members. 30
15. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member also supports spacing or shim members which, as interposed between said body and teeth, allow the spacing of said teeth to be changed so as to fit a broad range of reinforcement rib widths. 35
16. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member supports the two reinforcement rib locking pistons, bearing on their piston rods said semispherical articulation stop member so as to lock a reinforcement rib at 40

any slanted position thereof.

17. An apparatus according to one or more of the preceding claims, characterized in that said reinforcement rib laying fork member supports said base, of a welded sheet metal construction, which is adapted to be displaced, as driven by said small piston, and that said base and small piston are arranged either parallel or orthogonally with respect to the main axis of the fork member depending on the fact whether are mounted single section member reinforcement ribs or double section member reinforcement ribs.

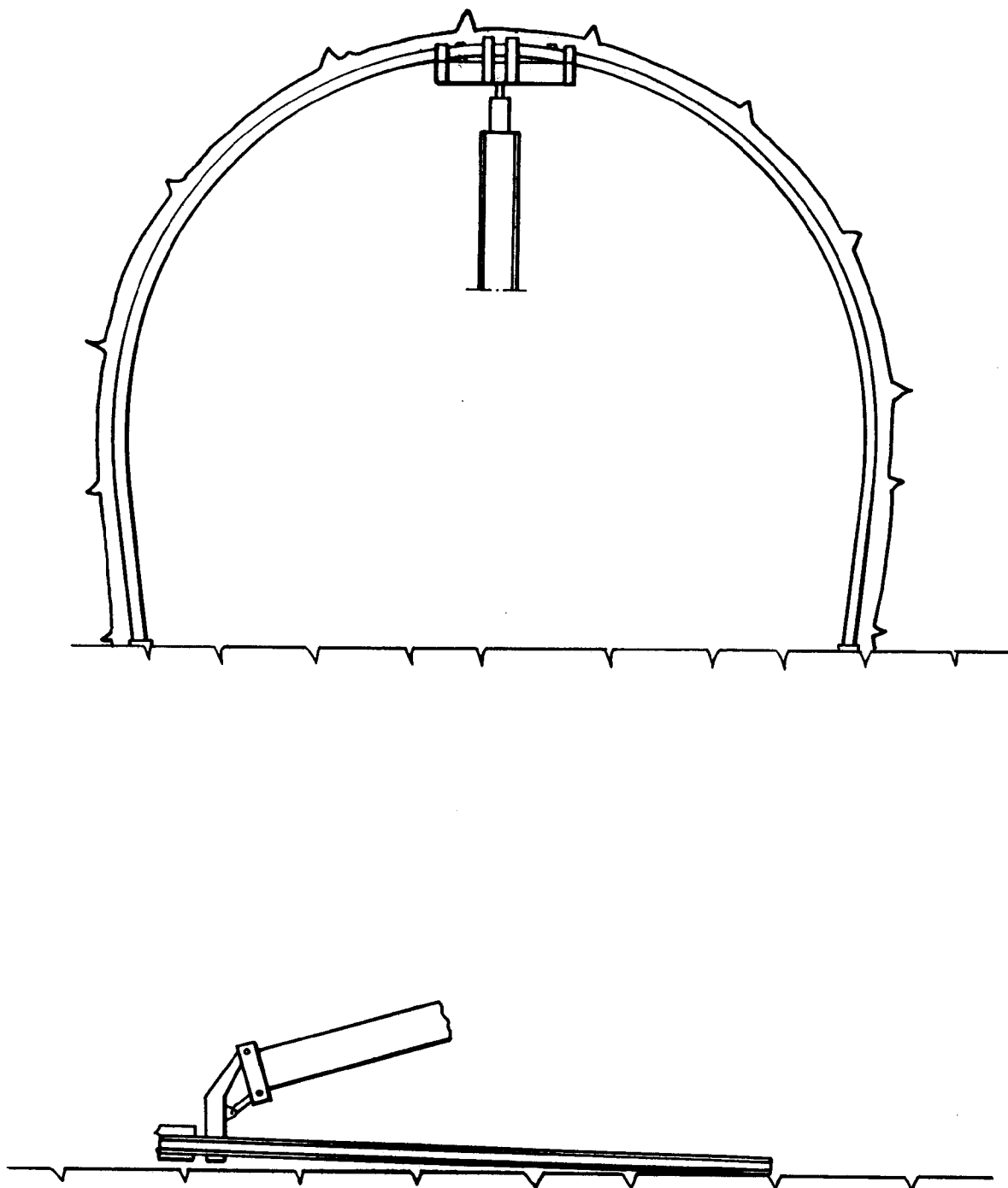
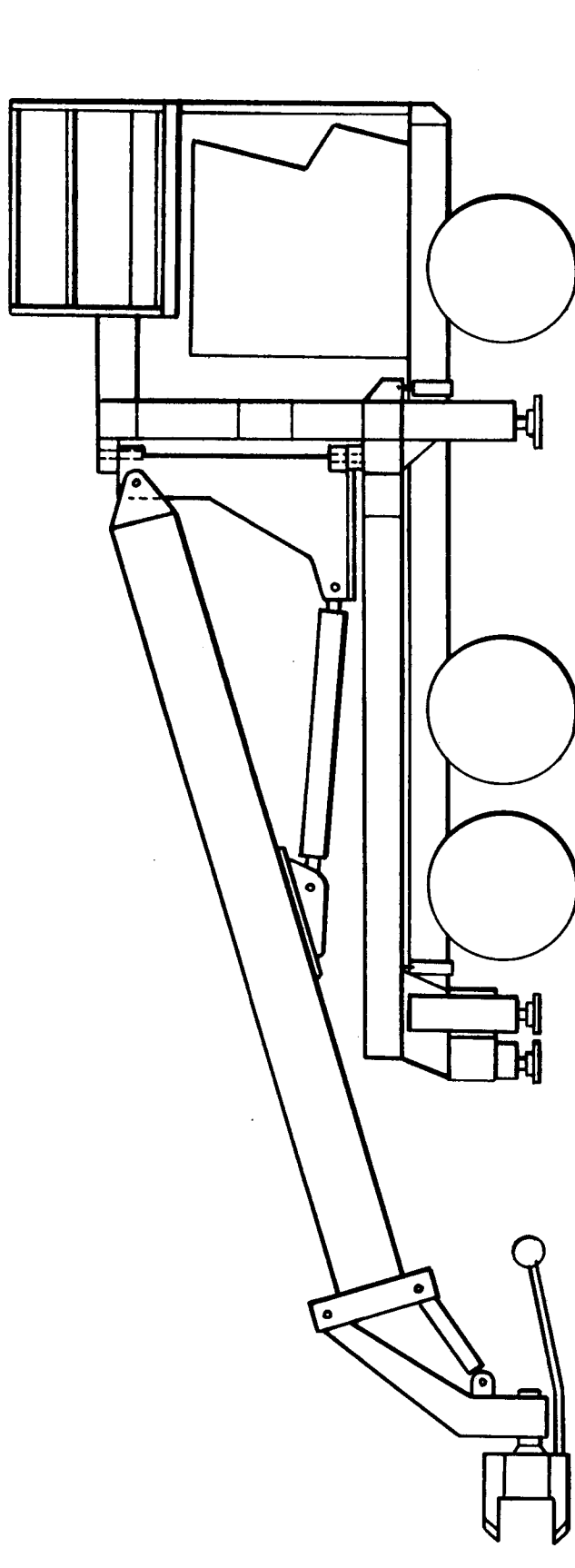
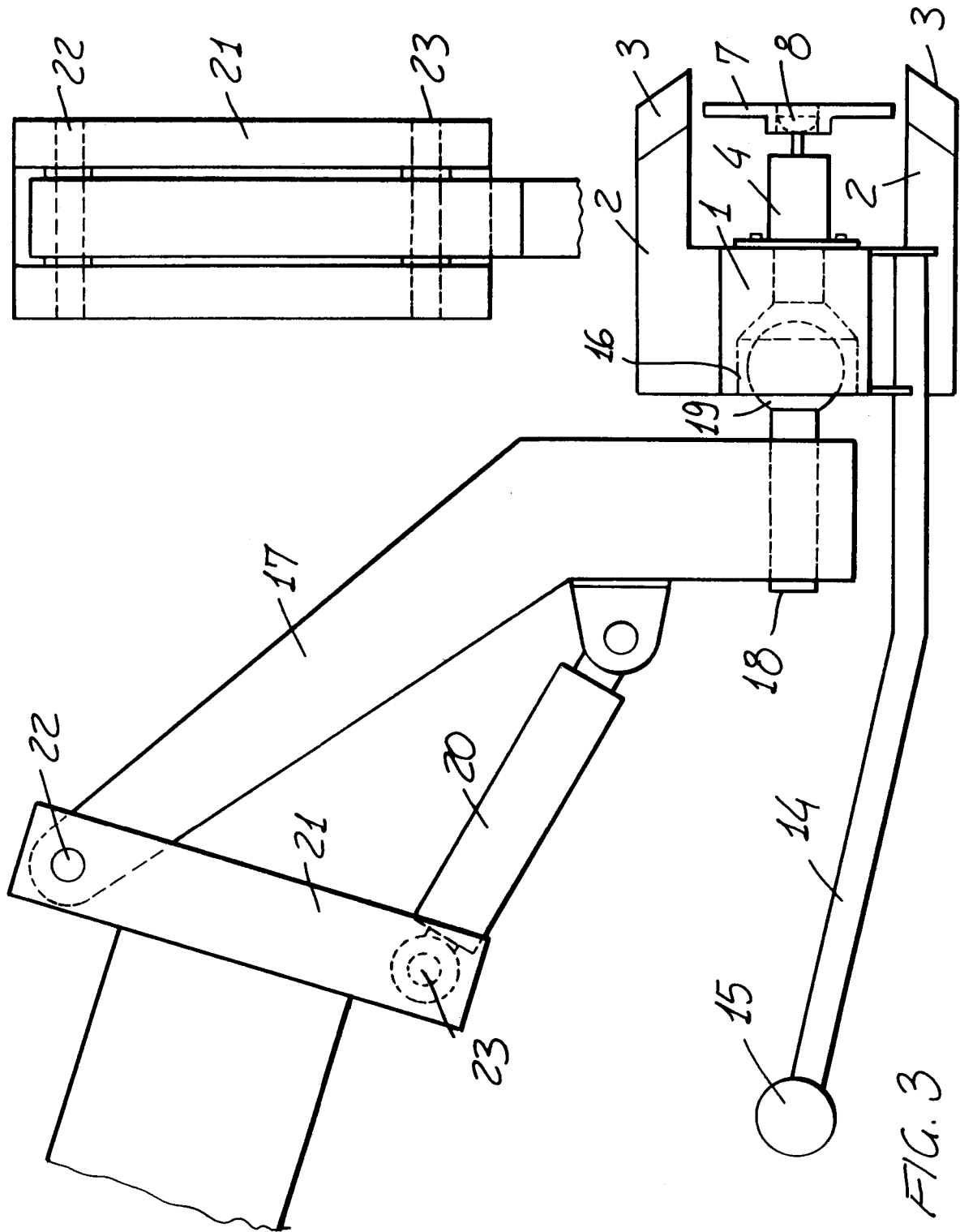
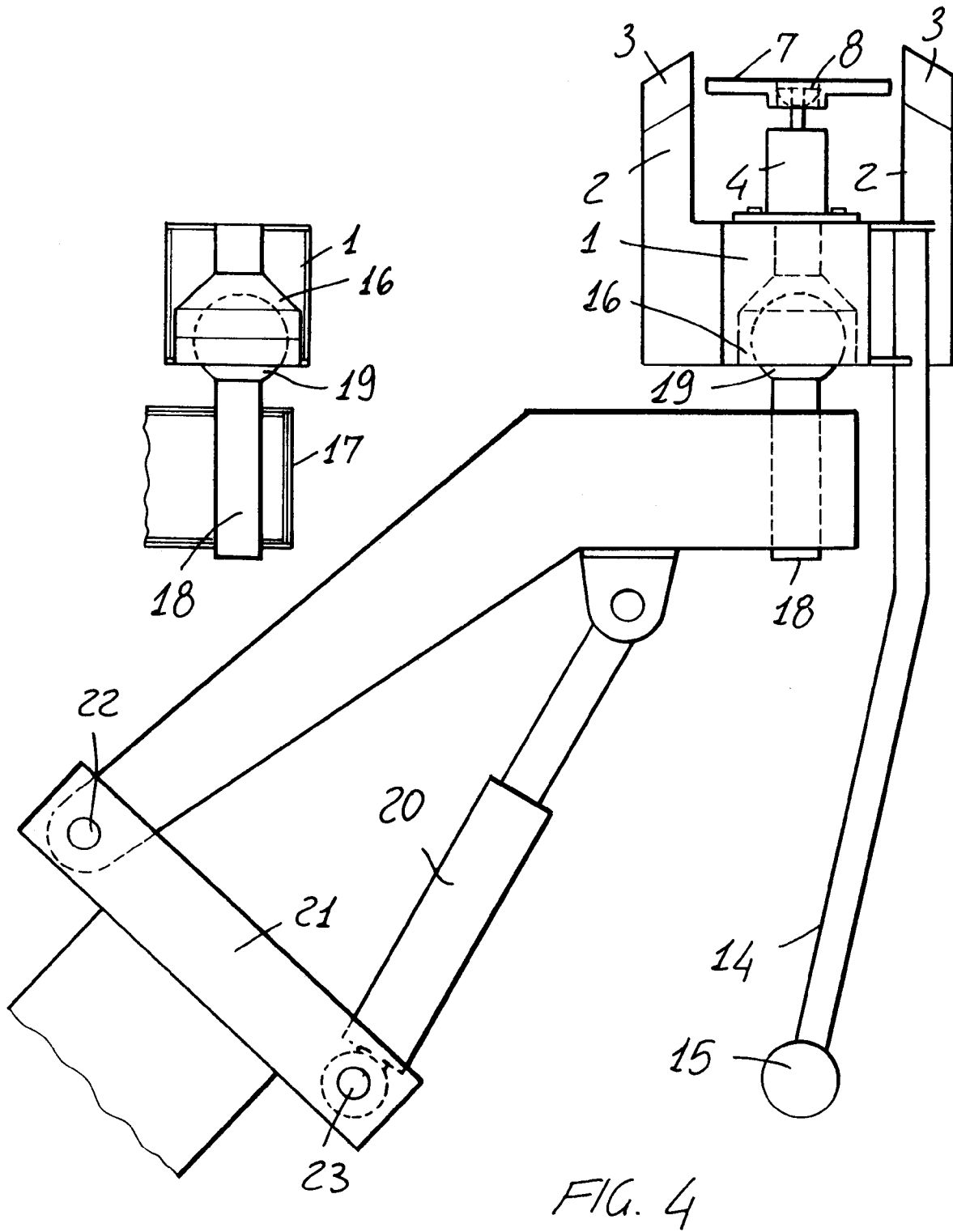


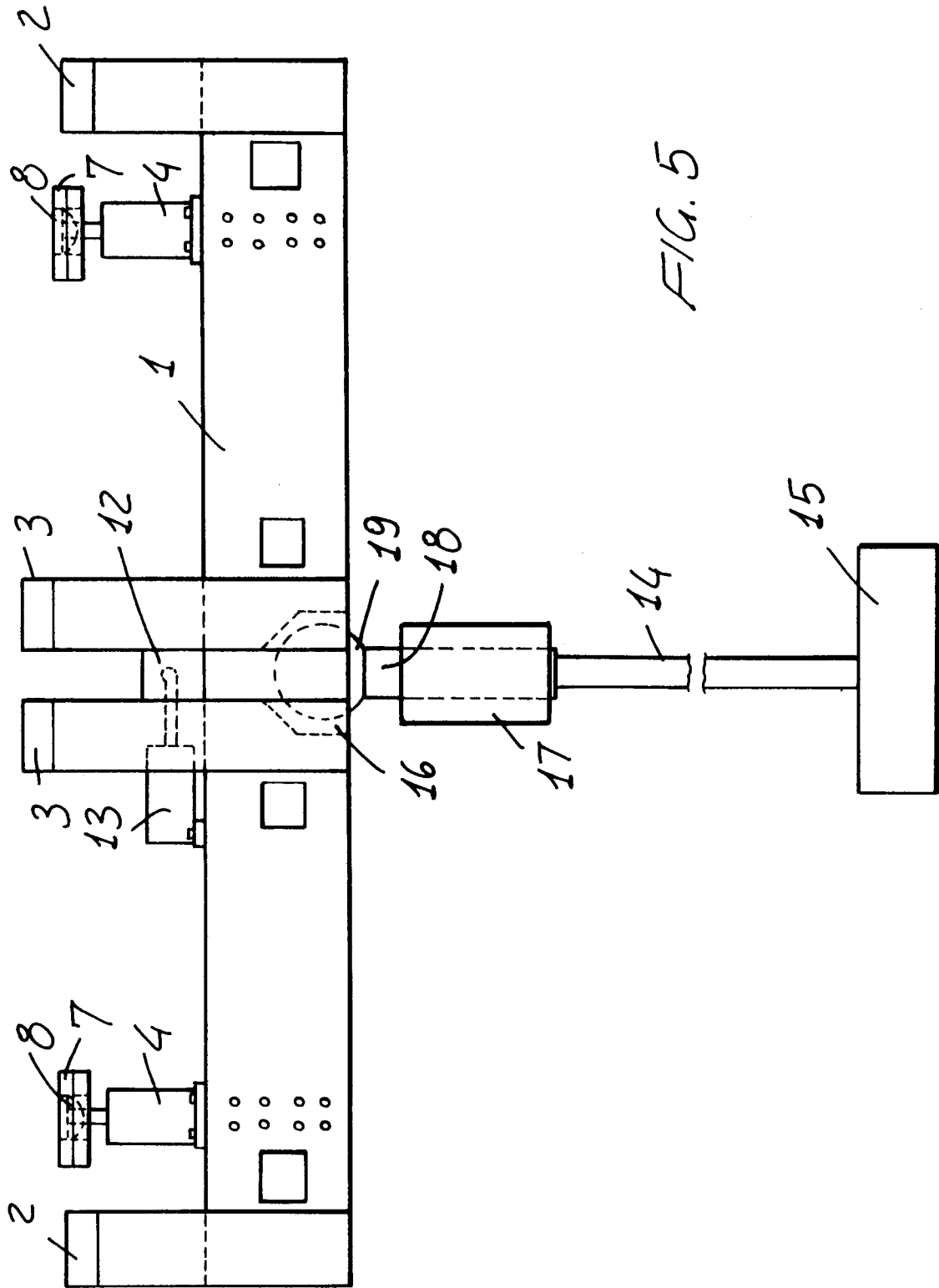
FIG. 1

FIG. 2









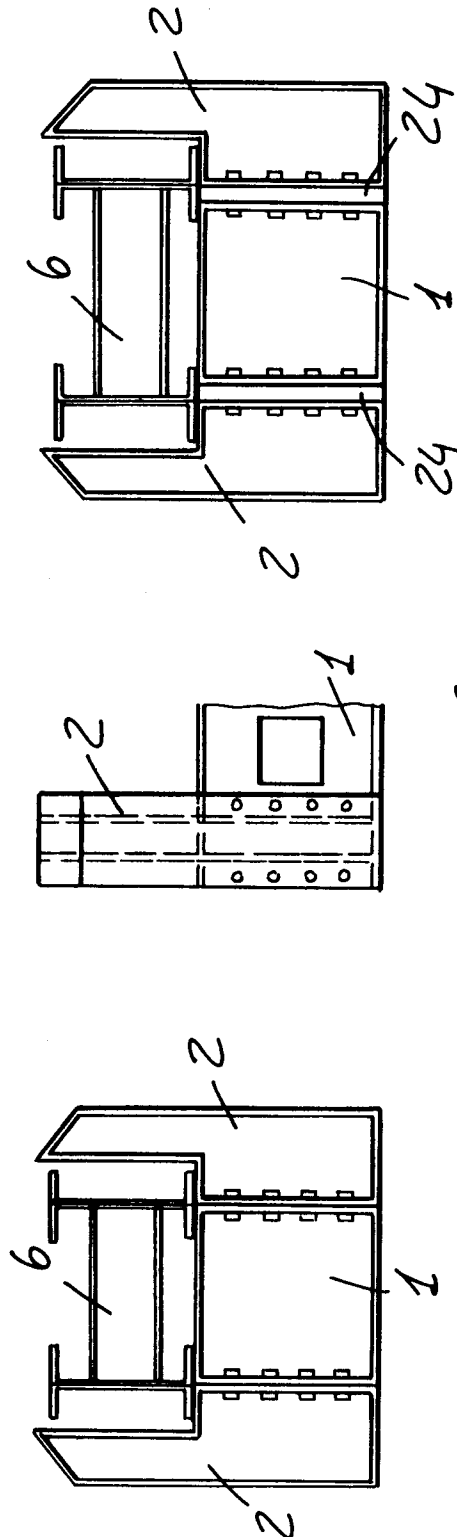
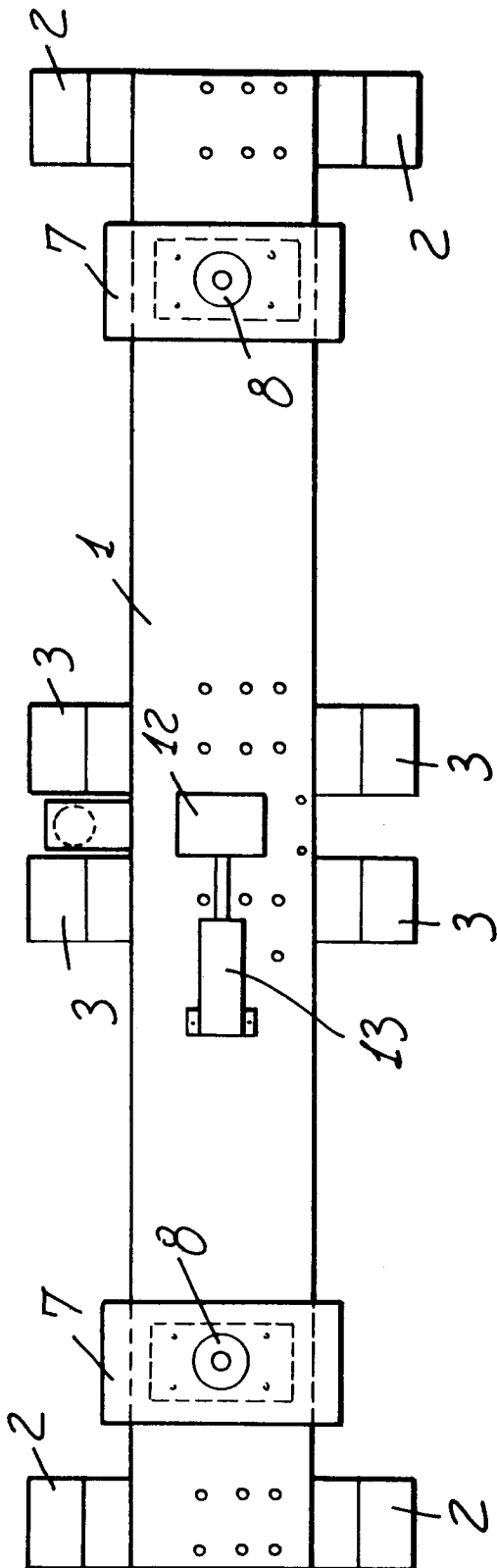
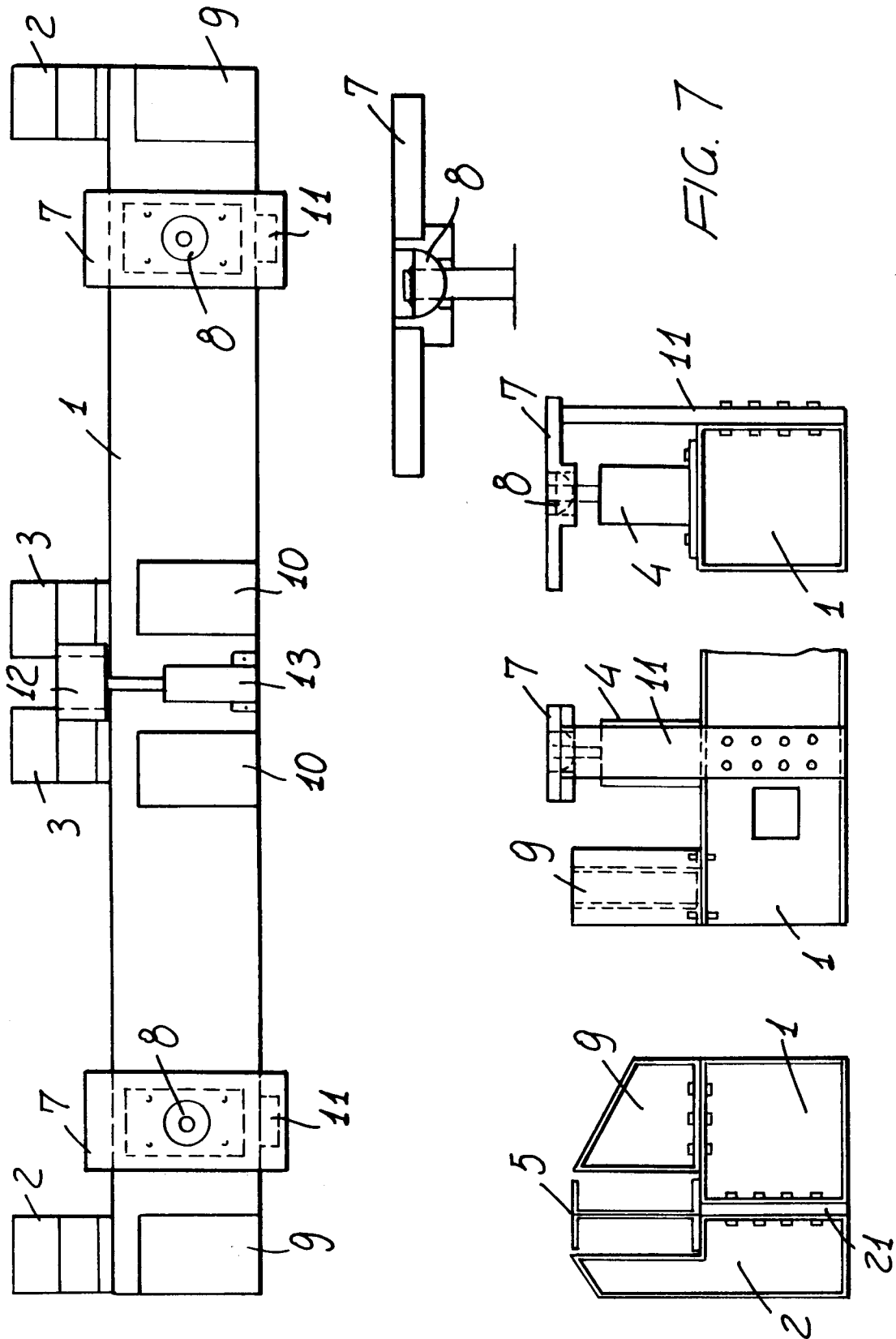


FIG. 6





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 93 83 0332

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)
X	DE-B-21 36 783 (BERGWERKSVERBAND GMBH ET AL.) * column 2, line 59 - column 3, line 33 * * column 3, line 67 - column 4, line 19 * * figures 1-5 *	1,6,7, 11,12	E21D11/40
A	GB-A-2 067 624 (PERARD ENGINEERING LIMITED) * column 2, line 11 - column 2, line 20; figure 1 *	2-4,14, 16,17	
A	GB-A-2 071 180 (HARDING)		
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			E21D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 November 1993	Examiner Rampelmann, J
CATEGORY OF CITED DOCUMENTS 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 T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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