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(54) Method and apparatus for drilling dewatering holes into a hollow-core slab

(57) Method and apparatus for drilling dewatering holes into the lower surface of a concrete hollow-core slab (5). The apparatus comprises at least two drills (10) connected with a slab lifting crane. The drills (10) are attached to a detachable beam (9), and the apparatus is provided with at least two interchangeable beams with different mutual distances between the drills. The beam (9) is fastened to the apparatus by means of a quick-release fastener.

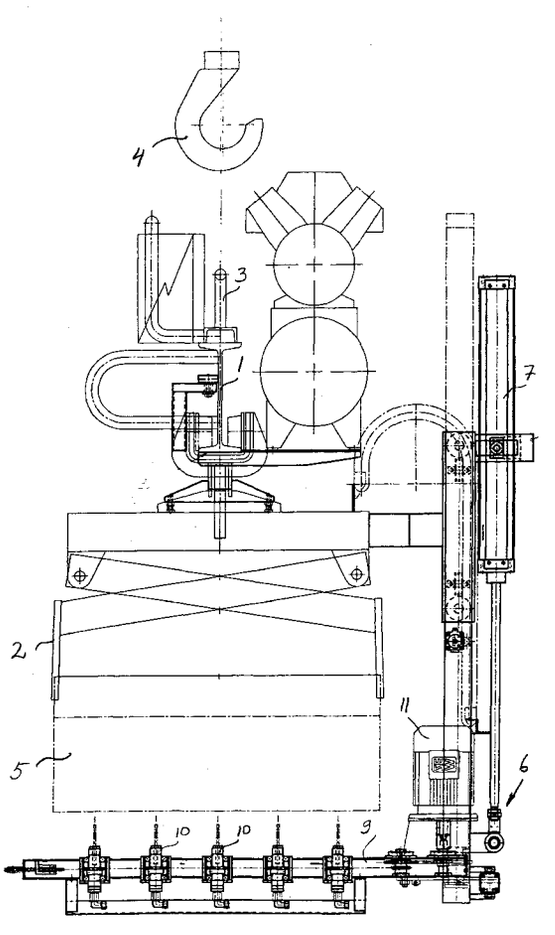

Fig. 2

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Description

[0001] The present invention concerns a method and an apparatus for drilling dewatering holes into the lower surface of a hollow-core concrete slab. Hollow-core slabs, made of concrete by slide casting, are generally used building technology. Into the lower surface of the slabs, close to the end portions thereof, it is necessary already in the factory to drill holes at the position of the hollow-cores in order to remove water running from above through the concrete to the hollow-cores, or condensing as a result of variations in temperature.

[0002] Several different methods are used for drilling dewatering holes at the position of the hollow-cores. Often the holes are drilled not until on the building site by using hand-drilling machines, from below the concrete slabs that are already installed. By more developed methods, the dewatering holes are drilled already in the factory, in connection with the production.

[0003] Patent publication FI 82631 discloses a method for drilling dewatering holes, where the drilling machines are connected with the beam for lifting the hollow-core slabs. There the dewatering holes can be drilled during the hoisting, and no separate transport or waiting is required for drilling, it can be made simultaneously with the transport. According to this known solution, separate drilling units for drilling the holes are attached to both ends of the lifting beam. In the apparatus the drills are placed into a pivoting drill frame, where the drills are standard types of electric hand drills with an adjustable distance from each other. A weakness and disadvantage of the method are the difficulties caused by the changes of numbers and positions of the drills and by the adjustments required when drilling dewatering holes to different types of slabs, in which e.g. the spacing of the hollow-cores and the thickness of the wall to be drilled varies. In case the adjusting of the position of the drills etc. is automated, the apparatus will become relatively expensive.

[0004] The object of the present invention is to eliminate the mentioned disadvantages. The characteristics of the method and apparatus in accordance with the invention are stated in the enclosed claims 1 and 2. The invention provides a solution, where the drills are constructed and installed into complete modules designed according to each element type respectively, whereby no adjustments or changes are required at all, and the drills can be constructed with the correct capacity according to each slab type.

[0005] Thus, the actual drilling time is shortened, the apparatus can be made reliable and, additionally, drilling costs will be saved when the durability of the apparatus improves. The drilling unit in accordance with the invention is designed according to each slab type, and due to its quick-release fastener, it can be changed quickly according to the required slab type. The drilling unit is constructed as one complete assembly, where the required rotation, vibration, longitudinal motion and limiting of motions of the drills are combined into one detachable assembly.

[0006] The invention and its details will now be described in more detail in the following, with reference to the enclosed drawings, wherein

Figure 1 is a side view of the apparatus in accordance with the invention, drilling beam being turned in its transverse position,
Figure 2 is an end view of the same apparatus in a larger scale,
Figure 3 shows in a larger scale a section of the drilling beam, viewed from the side of the beam,
Figure 4 is a section from figure 3, viewed from above,
Figure 5 is an enlarged detail of figure 2, and
Figure 6 is a schematic cross section of the connection point of the drilling beam and the frame portion of the drilling device.

[0007] The apparatus in accordance with the invention comprises a beam 1 for lifting hollow-core slabs and, below that, close to both ends thereof, the actual tongs 2 for lifting the hollow-core slab. The grip loops 3 of the beam are caught by means of a lifting hook 4. In figure 2, a slab 5, supported by the lifting tongs, is shown with dashed lines. The lifting device itself and its function are known in the art.

[0008] Apparatus 6 for drilling of dewatering holes is attached to the side of the lifting tongs 2. The drilling apparatus comprises, as the lowest part, a detachable drilling unit according to each slab, which can be lifted and lowered by means of a compressed air cylinder 7. The drilling unit can be turned around its vertical axis between the position longitudinally on the side of the slab, and the position transversally under the slab, shown in the figures, by means of a separate compressed air cylinder 8.

[0009] The drilling unit is provided with drilling machines 10 attached to the drilling beam or arm 9. There are as many drilling machines in the beam as hollow-cores in the slab to be handled, and the distance of the drilling machines from each other corresponds to the spacing of the hollow cores of the slab to be handled. The drilling machines are driven by an electric motor 11.

[0010] The shaft 12 of the electric motor 11 is connected to the driving shaft 13 of the drilling unit by means of a quick-release fastener (figures 5 and 6). The motion of the driving shaft 13 is transmitted to every drilling machine of the drilling beam as rotating motion, by means of a chain 14 (figure 4). Each drilling machine is, in addition, provided with a compressed air impacting device 16, by means of which the drill is moved axially (figure 3).

[0011] In the embodiment of figures 5 and 6, the quick-release fastener is formed of a transversal groove 17 and a flat iron protrusion 18 to be fitted in said groove, respectively at the ends of the shafts 12 and 13. The detachable drill beam 9 is mounted to the drilling device

6 by turning first both the groove 17 and the protrusion 18 into a position parallel with the beam 9, and by pushing the beam then into a slide 19 in the frame part of the drilling device, and by fitting the protrusion 18 into the groove 17. The slide is equipped with longitudinal battens 20 on its sides, with a gap between them, to receive the shaft 13. The beam is fitted below the side battens 20, and the battens secure the beam vertically in its place. In addition, the beam can be locked with bolts going through holes 21, 21' in the beam and the lower wall of the slide.

[0012] The apparatus has, in addition, necessary position sensors and limit switches.

[0013] In practice, the drilling of dewatering holes goes as follows. The lifting beam is moved with an overhead travelling crane above a ready-made hollow-core slab lying on a casting bed. The lifting beam is lowered on the hollow-core slab and the lifting tongs are locked against the sides of the slab. There, the drilling beam has been turned to the side of the slab and lifted to its upper position. After that, the slab is lifted up from its casting bed and transfer to the carry-out wagons is started.

[0014] The dewatering holes are drilled during the transfer. When the slab has been lifted up from the casting bed, the drilling operation is switched on. Then, the drilling beam is lowered to the lower limit. After the lower limit has been recognized, the drilling beam turns 90° into a transversal position under the slab. When the turning limit has been recognized, the lifting motion of the drilling beam starts. At the same time, the rotation of the drills driven by electric motors and the compressed air impacting start. The drills are spring-relieved in order to balance the pressure of the drills during the drilling. When the drilling beam has reached the lower surface of the slab, and the drilling is completed, the limit switch recognizes the completed drilling motion and stops the lifting motion, starting to lower the drilling beam. In the lower position, the motor and the impactor are stopped. The same recognition limit senses if the drill is broken. After that, the drilling beam turns to the side, into the longitudinal direction of the slab, and rises up to its original position, whereby the springloaded locking cylinder is on. This procedure is continued for drilling the waterholes, one slab after another.

[0015] When the slab type is changed, a drilling beam according to the slab type is changed to the drilling unit. Because the drilling beam is attached to the drilling unit by means of a quick-release fastener, the beam is easily changed.

[0016] The present invention is not restricted to the above described embodiment only, it can vary in different ways within the scope of the claims. The construction of the quick-release fastener can be different from what has been described above. However, preferably the counter surfaces 17 and 18 of the shafts 12 and 13 to be connected with each other, are designed so that they have an axial dimension and their cross-profile is not a circle. Thereby they are able to transmit the driving torque from the first shaft to the other, and there is no need of any special tools or other equipment for connecting the shafts.

Claims

1. Method for drilling dewatering holes into the lower surface of a concrete hollow-core slab (5) so that the holes are drilled into the slab by means of at least two drills (10) attached to a beam (9), simultaneously at the position of at least two hollow-cores of the slab, at the same time while the slab is supported by a crane, **characterized** in that

   - an apparatus is used, which is provided with at least two interchangeable drilling beams (9) with different mutual distances between the drills (10),
   - a beam (9) is chosen, in which the mutual distance between the drills (10) corresponds to the spacing of the hollow cores of the slab, and
   - the beam (9) is attached to the apparatus by means of a quick-release fastener (12, 13).

2. Apparatus for drilling dewatering holes into the lower surface of a concrete hollow-core slab (5) which apparatus comprises at least two drills (10) attached to a beam (9), connected with a crane for lifting concrete slabs, **characterized** in that

   - the apparatus is provided with at least two interchangeable beams (9) with different mutual distances between the drills (10), and that
   - the beam (9) is fastened to the apparatus with a quick-release fastener (12, 13).

3. Apparatus in accordance with claim 2, **characterized** in that the quick-release fastener is formed between a shaft (12) driven by a motor (11) and a shaft (13) driving the drills (10) in such a way that the shafts have counter-surfaces (17, 18), connected with each other, said counter-surfaces having an axial dimension and the cross profile thereof being different from a circle.

4. Apparatus in accordance with claim 2, **characterized** in that the rotational motion of the drills (10) is transmitted to the drills (10) by means of a chain drive (14) from their common driving shaft (13).

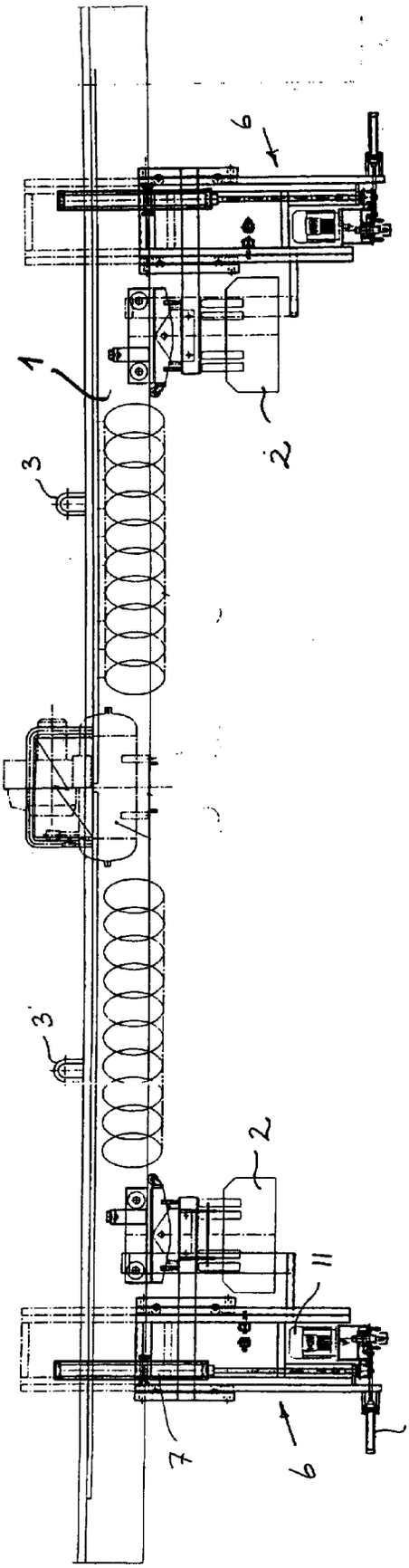

Fig. 1

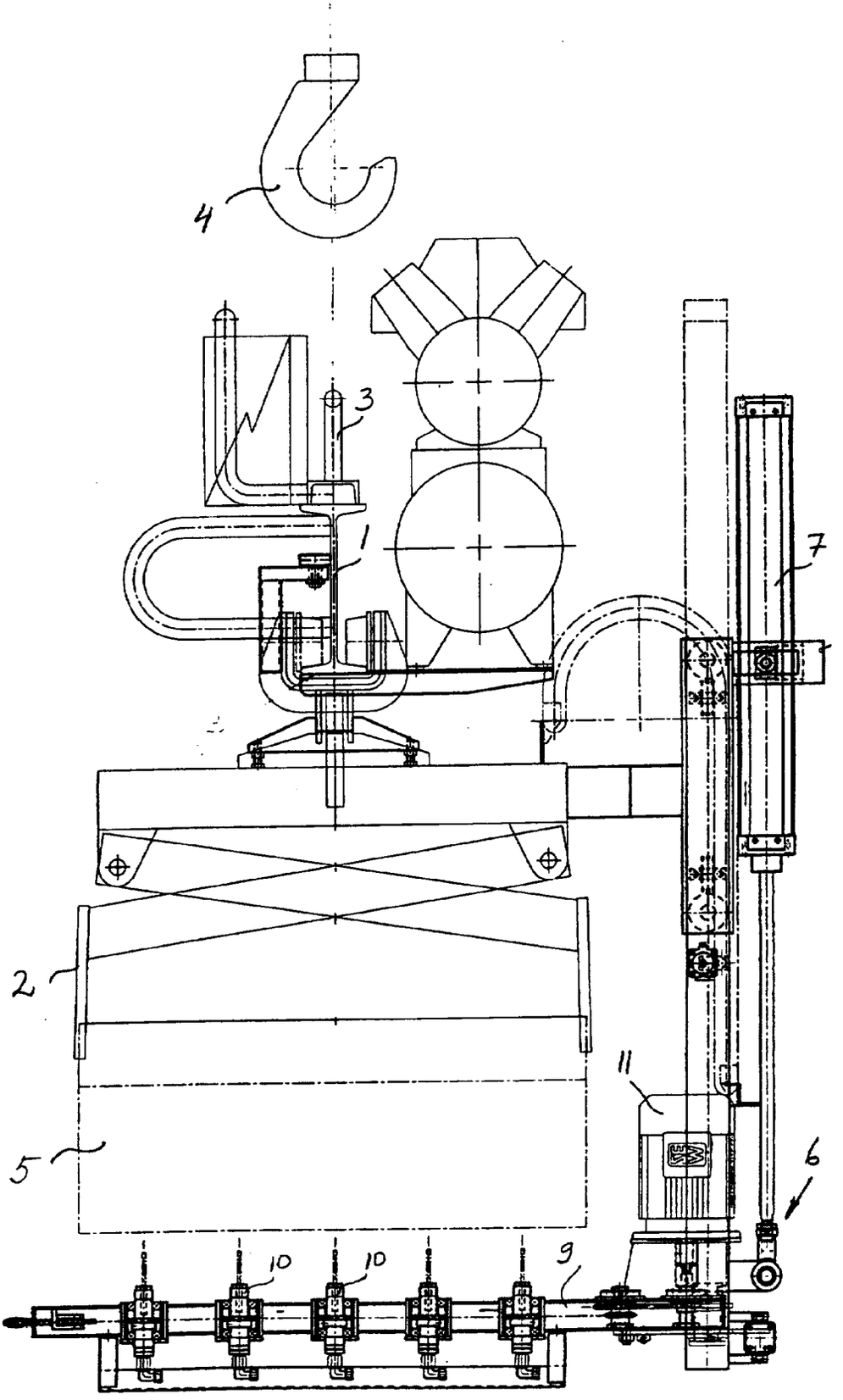

Fig. 2

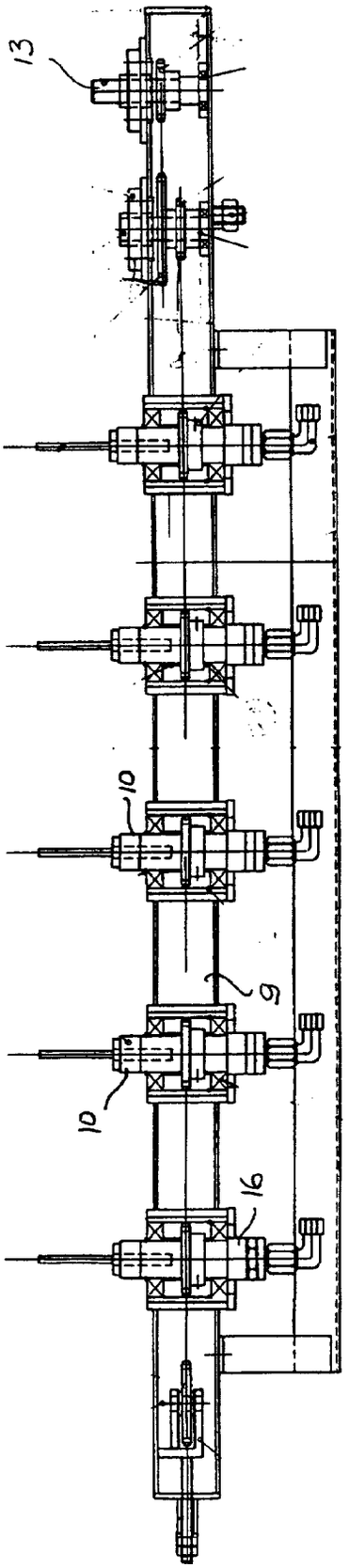

Fig. 3

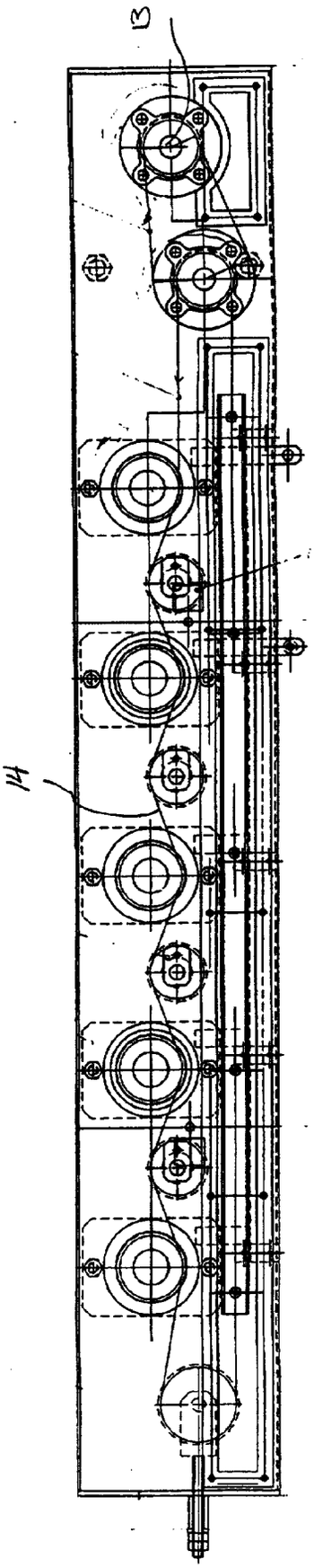

Fig. 4

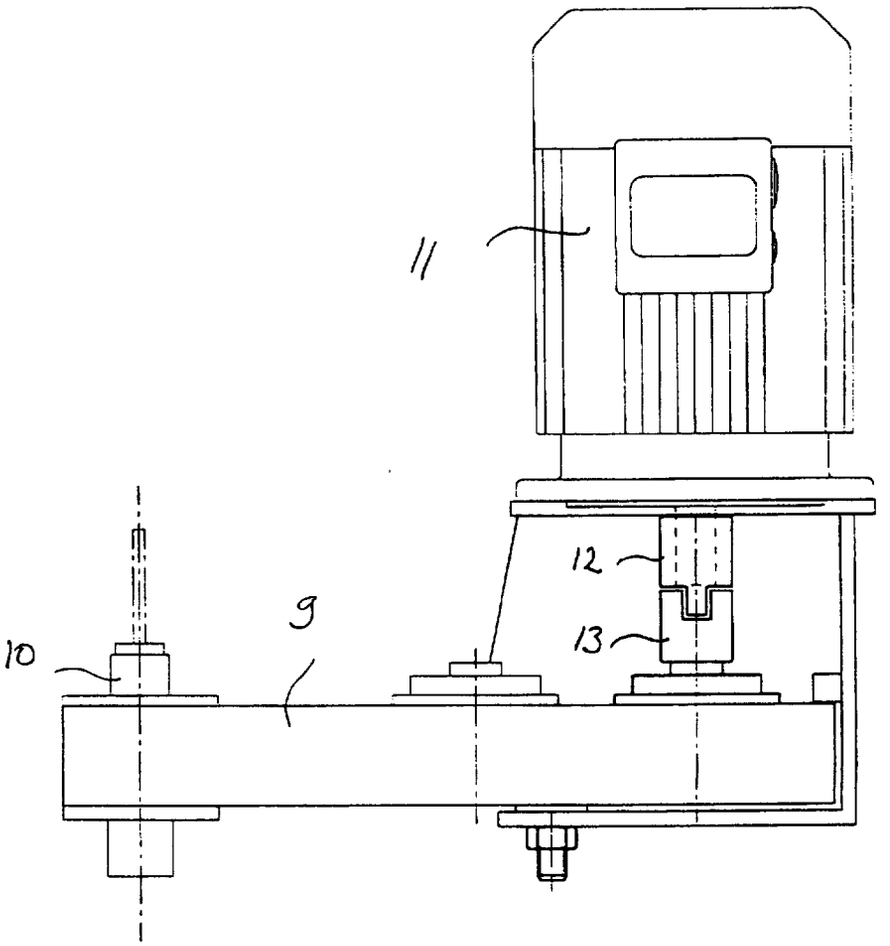

Fig. 5

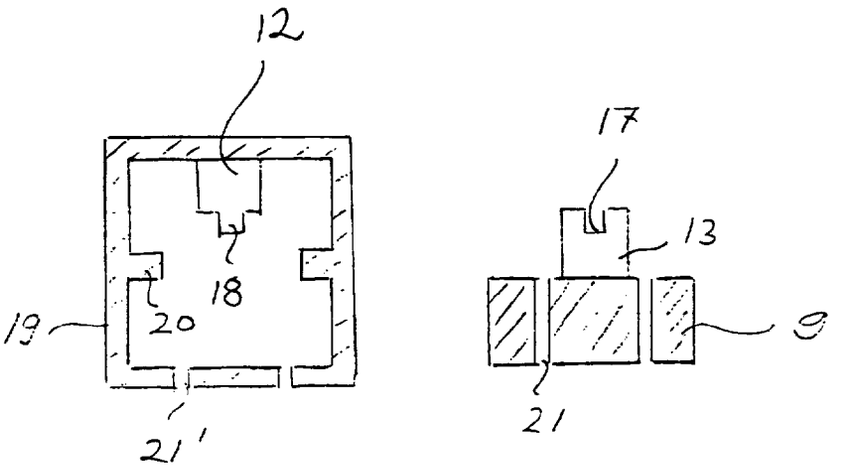

Fig. 6