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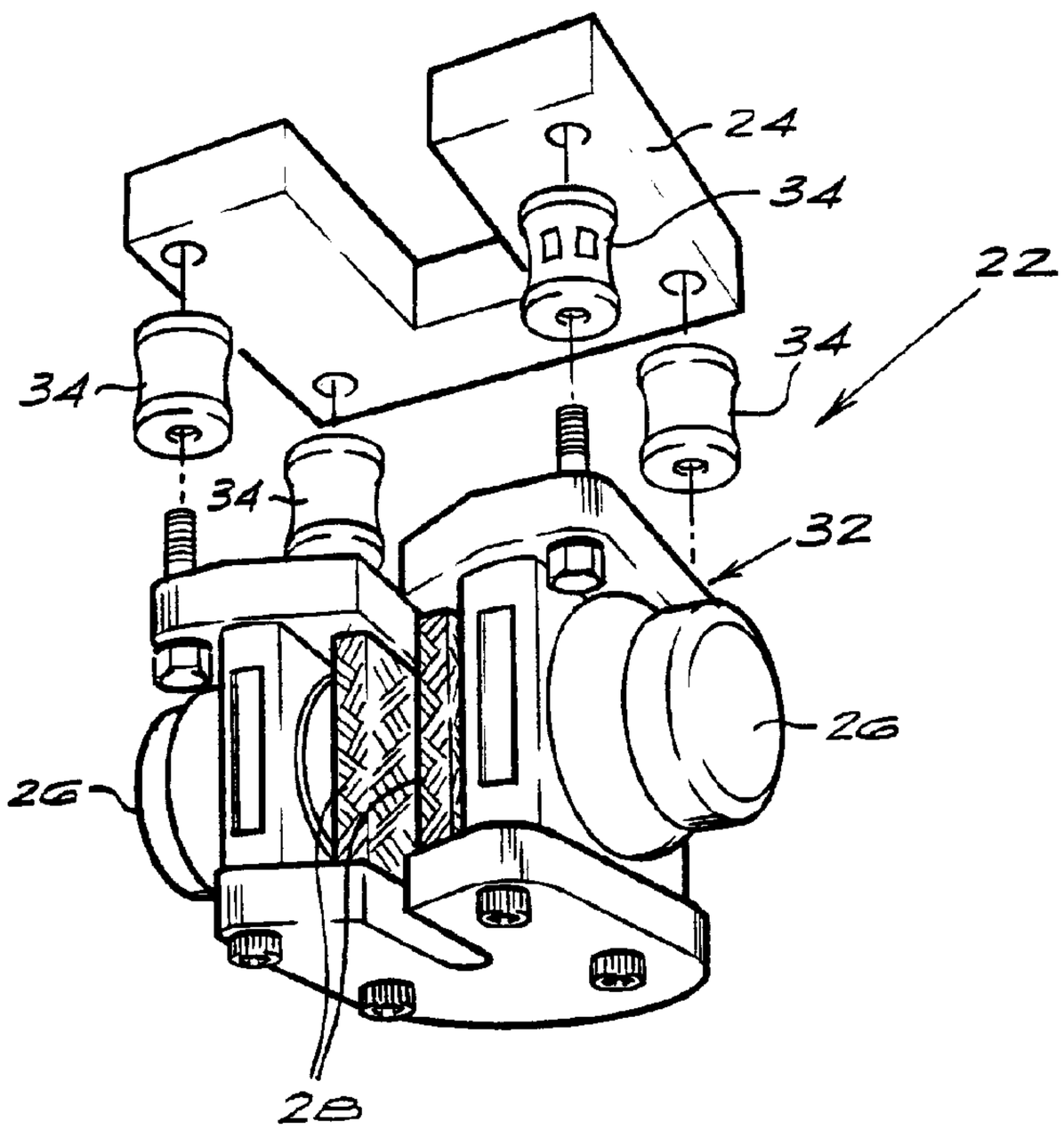
(54) Title: BRAKING APPARATUS



(57) Abrégé/Abstract:
The braking apparatus is provided for a shaft conveyance system in which a conveyance 18 is driven up and down an upright track 20 in the shaft 10. The braking apparatus comprises a brake 22 associated with the conveyance 18 which is operable to engage a counter-member 16 in the shaft 10 to hold the conveyance 18 at a chosen elevation on the track 20. A load cell 34 is provided for sensing the vertical load on the brake when it is engaged with the counter-member. Also provided are means operable in response to the load cell to disengage the brake from the counter-member when the load cell senses a predetermined load on the brake.

ABSTRACT

The braking apparatus is provided for a shaft conveyance system in which a conveyance 18 is driven up and down an upright track 20 in the shaft 10. The braking apparatus comprises a brake 22 associated with the conveyance 18 which is operable to engage a counter-member 16 in the shaft 10 to hold the conveyance 18 at a chosen elevation on the track 20. A load cell 34 is provided for sensing the vertical load on the brake when it is engaged with the counter-member. Also provided are means operable in response to the load cell to disengage the brake from the counter-member when the load cell senses a predetermined load on the brake.

BRAKING APPARATUS

This invention relates to a braking apparatus to be used in a shaft conveyance system.

It has already been proposed in PCT/GB90/00335 to provide a mine shaft conveyance system in which linear motors are used to transport men, ore and materials to and from the surface in a mine shaft. This contrasts with the conventional mine shaft conveyance system in which mine conveyances, such as personnel cages and ore and material skips are suspended at the ends of ropes which are paid out and wound in by surface, or in some cases, underground, winding apparatus.

A first aspect of the present invention provides a braking apparatus for a shaft conveyance system in which a conveyance is driven up and down an upright track in the shaft, the braking apparatus comprising a brake associated with the conveyance which is operable to engage a counter-member in the shaft to hold the conveyance at a chosen elevation on the track, a load cell for sensing the vertical load on the brake when it is engaged with counter-member and means operable in response to the load cell to disengage the brake from the counter-member when the load cell senses a predetermined load on the brake which is present when an upward thrust applied to the conveyance is sufficient to take at least a major part of the dead weight of the conveyance.

The shaft is typically a mine shaft.

The conveyance system may be of the linear motor type disclosed in PCT/GB90/00335. Accordingly, a second aspect of the invention provides a braking apparatus for a shaft conveyance system in which a conveyance carried by a reaction

member is driven up and down the shaft, by electromagnetic forces, relative to a winding support member extending vertically in the shaft, the braking apparatus comprising a brake on the conveyance or reaction member which is operable to engage a counter-member extending vertically in the shaft to hold the conveyance and reaction member at a chosen elevation in the shaft, a load cell for sensing the vertical load on the brake when it is engaged with the counter-member and means operable in response to the load cell to disengage the brake when the load cell senses a predetermined vertical load on the brake.

In the interests of safety, the brake is preferably of the spring-applied, hydraulically released type. In a preferred brake construction, the brake includes a caliper carrying brake pads which are adapted to engage the counter-member between them under spring force and wherein the means for disengaging the brake from the counter-member includes hydraulic actuators operable to separate the brake pads against the spring force.

There may be a housing accommodating the caliper and a mounting plate for mounting the brake on the conveyance, the load cell being arranged between the housing and the mounting plate and being sensitive to tension or compression applied to it.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which :

Figure 1 shows a diagrammatic horizontal cross-section through a mine shaft;

Figure 2 shows an exploded view of a braking apparatus of the invention; and

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Figure 3 shows a side view of the assembled braking apparatus.

In Figure 1, the numeral 10 designates a vertical, circular cross-section mine shaft. Fixed in the shaft is steelwork which includes structural members 12 and 14. The members 14, which are located at vertically spaced intervals in the shaft, have T-section brake reaction rails 16 fixed to them as illustrated, the members 16 extending in the shaft from the top to the bottom thereof.

Figure 1 also shows two mine conveyances 18, such as ore, personnel or equipment conveyances which are driven vertically up and down the shaft as required by electromagnetic forces generated by linear motors indicated generally with the numeral 20. Each linear motor is constituted by a vertically extending winding support member and a reaction member, typically incorporating permanent magnets, as described in the specification of PCT/GB 90/00335. The conveyances 18 are carried by the reaction members of the linear motors.

Caliper brakes 22 are mounted on the conveyances 18, although it is also within the scope of the invention for the brakes to be mounted directly on the reaction members. Referring to Figures 2 and 3, each caliper brake has a mounting plate 24 which is secured to the underside of the conveyance and a pair of hydraulic brake actuators 26 which act on a caliper carrying brake pads 28 of friction material.

The brakes 22 are mounted on the conveyances 18 in such positions that the webs 30 of the counter-members 16 are located between the brake pads 28. The brakes are of the spring-applied, hydraulically released type. Thus the normal operation of the springs in the actuators is to apply the brakes, i.e. to force the brake pads 28 together to clamp the webs 30 between them. When the brakes are to be released, hydraulic fluid is supplied to release cylinders in the actuators which pull the brake

pads apart and off the webs 30.

Between the mounting plate 24 and the caliper housing 32 of each brake 22 is a series of load cells 34 which may be of a conventional type designed to sense vertical loads tending to force the plate 24 towards the housing 32 or tending to force the plate and housing apart.

When a conveyance 18 is travelling vertically in the shaft 10 under electromagnetic forces and it is desired to brake the conveyance at a desired elevation, an electromagnetic control is used to decelerate the conveyance to zero speed and then hold the conveyance in a "hover" mode at the desired elevation. Hydraulic feed to the actuators is terminated and the springs apply the brakes to clamp the conveyance relative to the counter-members 16. The electrical supply to the winding support members of the linear motors can now be terminated and the conveyance remains in a stationary position, held only by the mechanical braking forces.

If it is now desired to cause the conveyance to rise or descend, the electrical supply to the winding support members is re-established. It will be appreciated that it will take a short time for the linear motors to build up sufficient thrust to support the weight of the conveyance and its contents, and in the case of upward movement, to lift it. It would clearly be extremely dangerous for the brakes to be released too early, since this could have the result that the conveyance falls down the shaft under gravity.

Assuming that the conveyance is to be lifted up the shaft by the linear motors, the load cells 34 will come under tension as the linear motors build up thrust. It is only when a predetermined thrust has been attained that the load cells relay a signal to a hydraulic control circuit (not shown) which operates, in response to that signal,

to feed hydraulic fluid to the actuators to pull the brake pads 28 apart.

Normally the load cells will not permit the brakes to be released until at least about 90% of the thrust required to take the dead weight of the conveyance and its contents is attained. This will permit the conveyance to drop a small distance before the full thrust is attained to take the weight of the conveyance and contents, whereafter further thrust which is generated will serve to lift the conveyance and contents.

If it is intended that the conveyance will descend in the shaft from its braked position, the load cells will again sense when sufficient thrust has been built up to take at least the major part of the dead weight of the conveyance and contents, and only then will a signal be transmitted to the hydraulic control circuit to cause the brakes to be released.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1.

A braking apparatus for a shaft conveyance system in which a conveyance is driven up and down an upright track in the shaft, the braking apparatus comprising a brake associated with the conveyance which is operable to engage a counter-member in the shaft to hold the conveyance at a chosen elevation on the track, a load cell for sensing the vertical load on the brake when it is engaged with counter-member and means operable in response to the load cell to disengage the brake from the counter-member when the load cell senses a predetermined load on the brake which is present when an upward thrust applied to the conveyance is sufficient to take at least a major part of the dead weight of the conveyance.

2.

A braking apparatus according to claim 1 wherein the brake is of the spring-applied type.

3.

A braking apparatus according to claim 2 wherein the brake is of the spring-applied, hydraulically released type.

4.

A braking apparatus according to claim 3 wherein the brake includes a caliper carrying brake pads which are adapted to engage the counter-member between them under spring force and wherein the means for disengaging the brake from the counter-member includes hydraulic actuators operable to separate the brake pads against the spring force.

5.

A braking apparatus according to claim 4 wherein the brake includes a housing accommodating the caliper and a mounting plate for mounting the brake on the conveyance and wherein the load cell is arranged between the housing and the mounting plate and is sensitive to tension or compression applied to it.

6.

A braking apparatus according to claim 5 and including a plurality of load cells between the housing and the mounting plate.

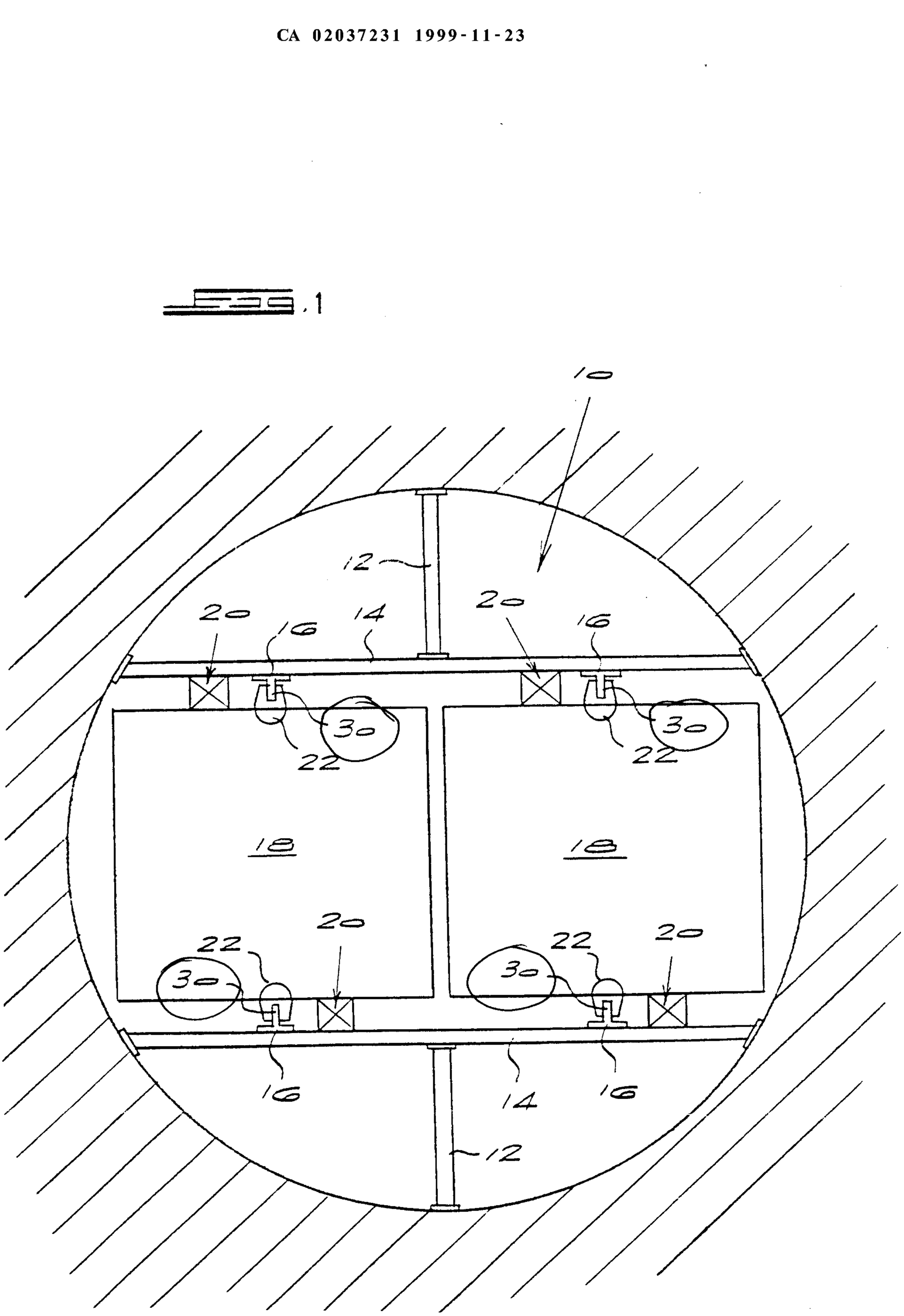
7.

A braking apparatus according to claim 1 wherein the predetermined load is approximately 90% of the upward thrust required to support the dead weight of the conveyance.

8.

A braking apparatus according to claim 1 when used in a mine shaft conveyance system.

FIG. 1



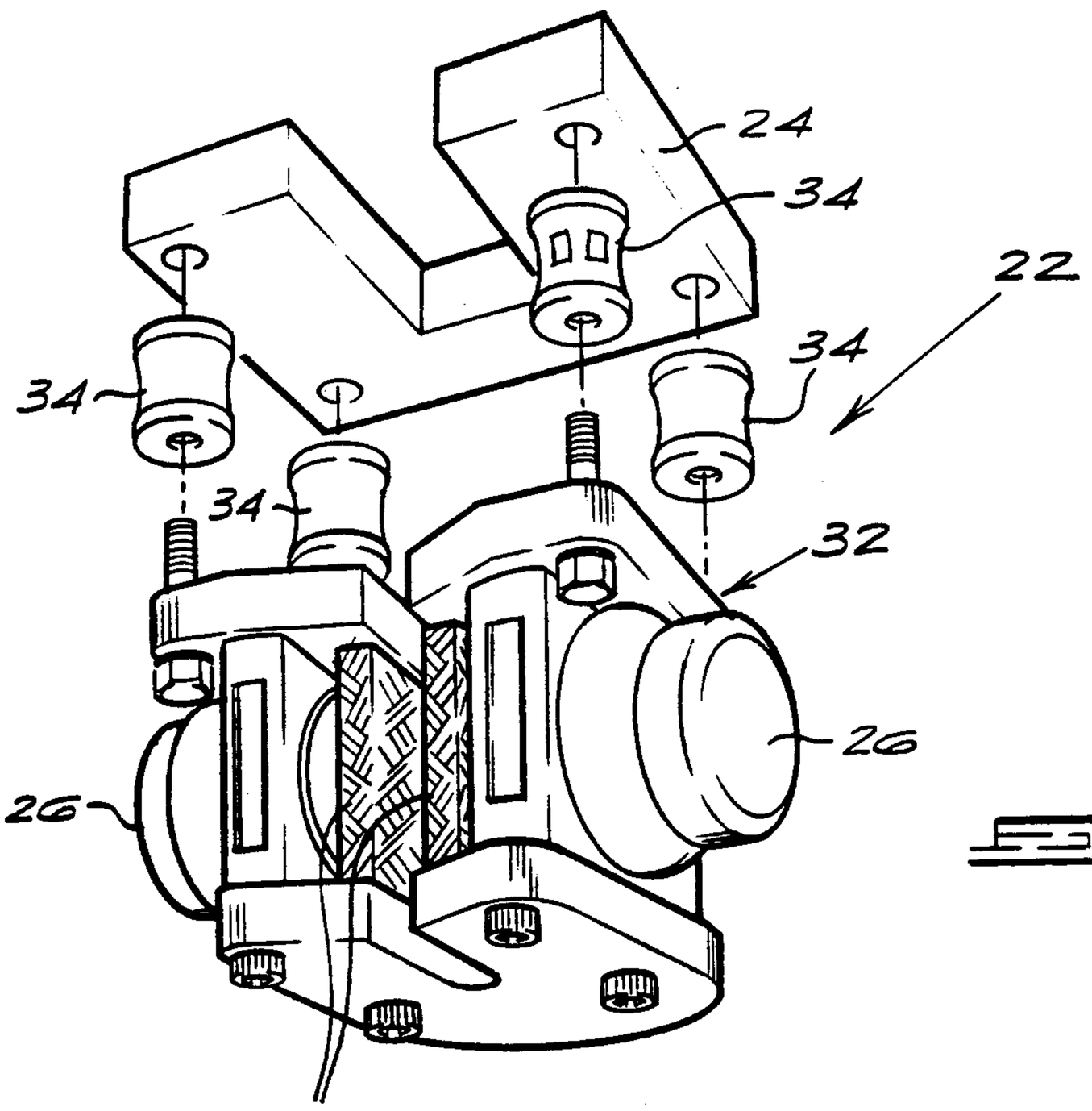


Fig. 2

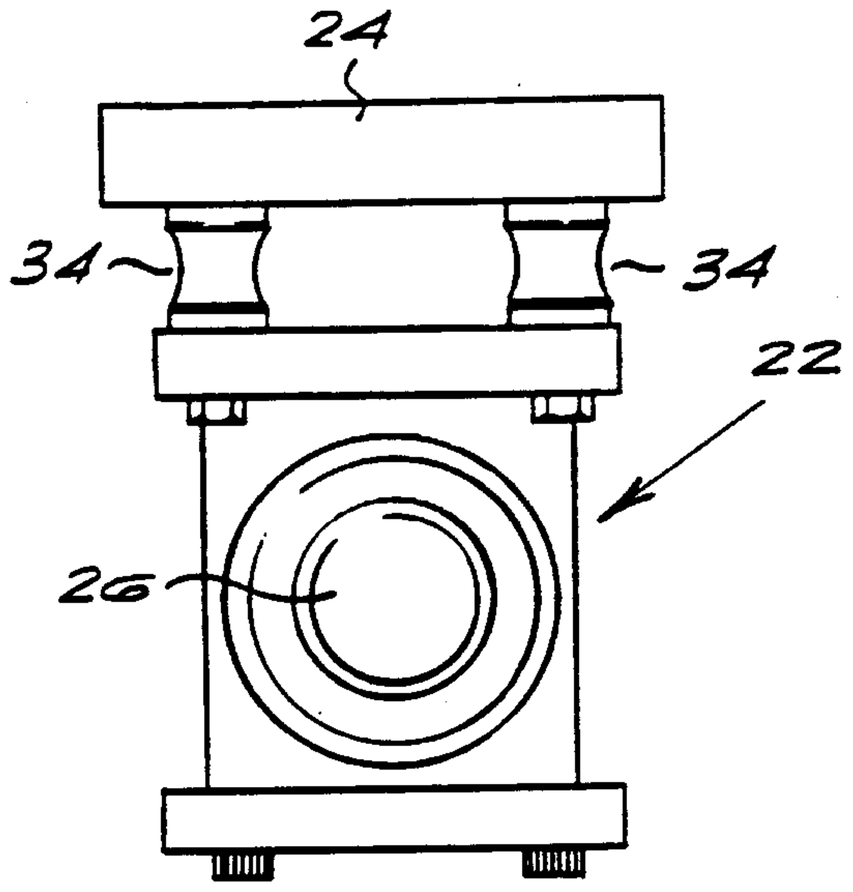
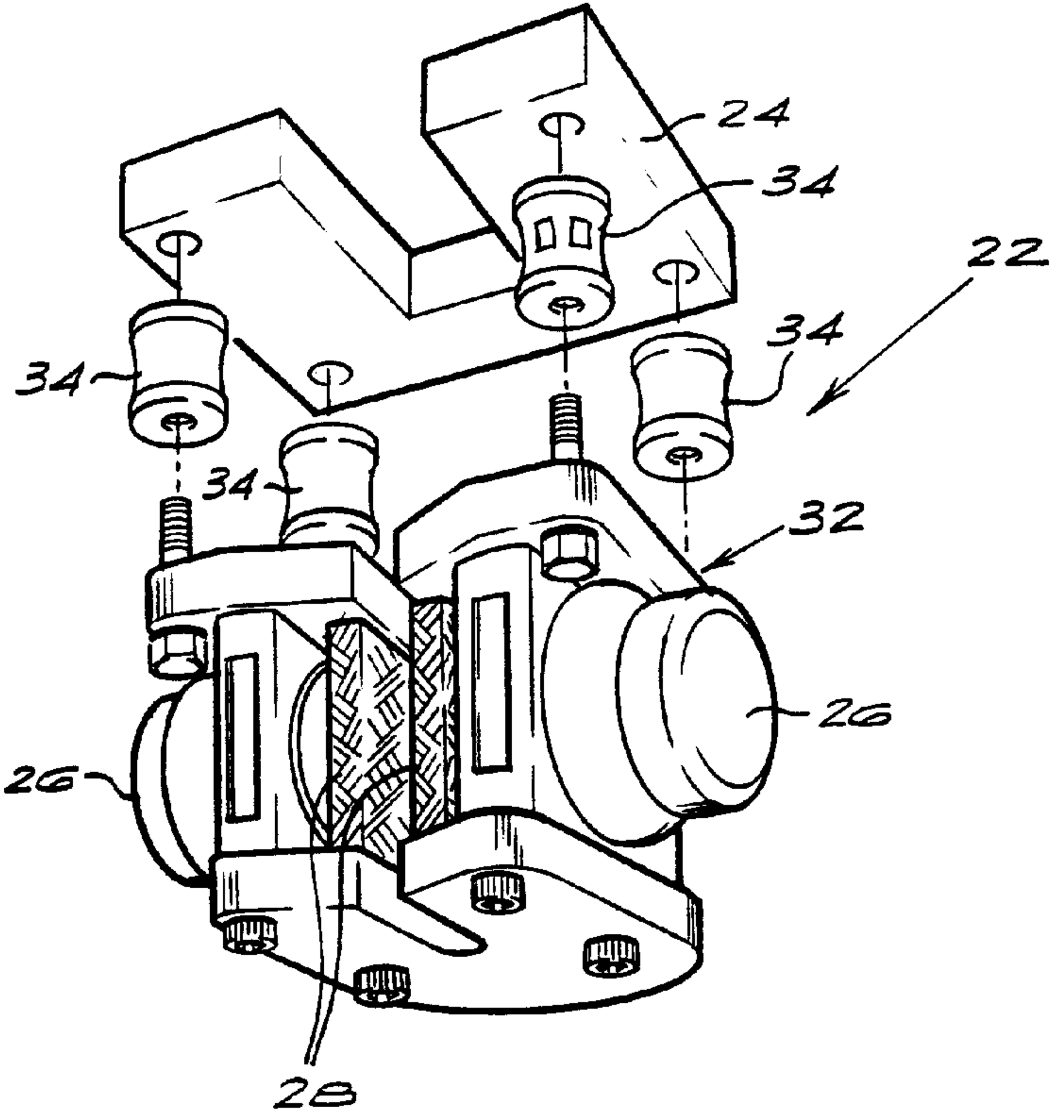


Fig. 3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