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(54) Store crane.

(57) A stores crane for internal materials handling comprising a load carrier (16) so arranged as to run along guides (22) on a vertical crane mast (12) and a lifting device (18) for the load carrier arranged for displacement of the load carrier along the mast. A fall brake (26) is attached to the load carrier for the purpose, in the event of a fault in the lifting device, of preventing the load carrier from falling downwards through engagement with the guides. A detector device (27) is so arranged as to sense the movement of the load carrier and, in the event of deviation from set values, to actuate the fall brake. This exhibits a brake housing (30) with a moving wedge-shaped brake body (33), which is capable of moving against one of the guides (22) and along a support surface (45) angled against the guide in the brake housing. The movement is controlled so as to take place between a first, non-braking position and a second, braking position in which the brake body is in contact under the effect of the wedge with both the guide (22) and the support surface (45).

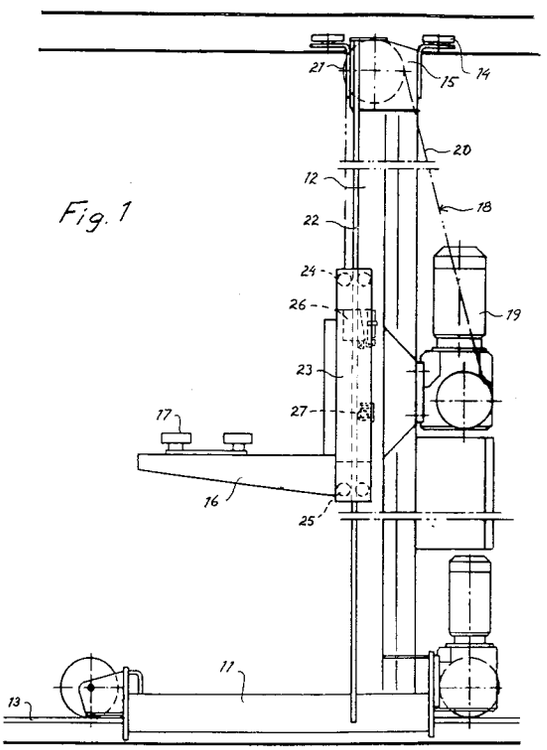

Fig. 1

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The present invention relates to a stores crane for internal materials handling comprising a load carrier so arranged as to run along guides on a vertical crane mast, a lifting device arranged for displacement of the load carrier along the mast, a fall brake attached to the load carrier for the purpose, in the event of a fault in the lifting device, of preventing the load carrier from falling downwards through engagement with the guides, and a detector device so arranged as to sense the movement of the load carrier and, in the event of deviation from set values, as to actuate the fall brake.

Stores cranes of the aforementioned kind are used for the transport of loads in various storage buildings. The cranes are normally fully automatic in operation, but can also be equipped for manual operation, usually from a cab on the load carrier. Servicing and maintenance are also carried out manually on the mast and load carrier. Lifting heights of 30-40 m can be encountered, for which reason special safety systems must be provided to arrest the load carrier in the event of a fault occurring in the vertical lifting devices, for example overspeeding of the lift motor, slipping power transmission or cable fracture. The safety systems comprise, on the one hand, a detection arrangement for sensing the rate of descent and, on the other hand, a fall brake for arresting the load carrier. All the components must be capable of operating independently of the normal energy supply to the crane, which means that an entirely separate sensing and braking system must be arranged on the crane.

Previously disclosed stores cranes normally have a detector device in the form of an endless chain or cable, which is attached to the load carrier and runs around guide pulleys at the top and at the foot of the mast. The chain is so arranged as to drive some form of speed-dependent locking wheel, for example of the kind which incorporates balanced weights which are thrown outwards and lock a rotating unit once a certain speed of rotation has been reached. The rotating unit then causes a mechanical brake to engage via rods, cables or the like. One example of such a stores crane can be found in EP-A-433922. The mechanical brake is provided for this purpose with a toothed dog, which can be rotated into contact with the respective control guide of the load carrier, so that the load carrier is arrested essentially instantaneously through the clamping of the toothed stop against the control guide, which is deformed at the same time. In order to avoid triggering the brake in the presence of normal occasional free play and vibrations, the locking wheel is connected to a delay arrangement, which permits a fall of a few centimetres before actuation occurs.

These previously disclosed arrester devices possess a satisfactory safety function, although at the expense of very considerable stresses on materials and operators due to the extremely short braking distance. The disadvantages increase, of course, as the loads, speeds and lifting heights increase, although even moderate values can give rise to considerable damage and require extensive measures in conjunction with restarting. Another major disadvantage is the endless sensor chain, which requires maintenance and space to be provided, and the same is true of the mechanical overspeeding indication. One particular problem associated with these arrangements is the fact that they are subject to wear and produce varying free play in the systems, for which reason the latter must be provided with relatively broad tolerance ranges, which in turn means that falling is able in many cases to continue for an excessive distance before braking takes place.

One object of the present invention is thus to make available a stores crane which overcomes the aforementioned disadvantages without in any way impairing safety. Further objects and advantages of the invention can be appreciated from the following description. They are achieved via the characteristics set out in the Patent Claims below.

The invention is based on the view that all mechanical deformation of the guides must be avoided in order for the system to be capable of operating more gently and enabling restarts without the need for repairs. This problem is resolved in accordance with the invention in that the fall brake is so executed that the frictional force is increased very rapidly after application of the brake and, more specifically, in that a wedge-shaped body is forced against the respective guide with a spring force and wedge effect. The shape of the wedge and other parameters must be selected so that the braking effect is sufficient, even if the guides were to become covered with oil or contaminated in some other way. At the same time, the brake must be capable of being released easily once the fault that caused its actuation has been remedied. For these reasons, the wedge angle of the brake body should lie within the range 5-20°, and preferably 8-15°, in order to ensure that sufficient normal force can be applied to the guide, but, at the same time, to prevent the fall brake from assuming excessive dimensions and becoming difficult to operate. In addition, the brake body should be provided with a separate scraper device, which not only cleans the guide, but also provides an initial frictional force sufficient to initiate the wedging movement of the brake body against the guide.

In accordance with a further development of the invention, previously disclosed mechanical detector devices have been replaced by a generator, which is driven by a drive wheel running along the mast. The generated voltage controls the operation

of the fall brake via an appropriate switching device. The constituent parts are significantly fewer than previously and consist essentially of very reliable electrical components.

The invention is now described in greater detail with reference to the illustrative embodiment shown in the following drawings, in which:

Fig. 1 is a side view of a stores crane in accordance with the invention;

Fig. 2 is a detailed view of part of a load carrier on the stores crane and a fall brake mounted thereon;

Fig. 3 is a side view of the fall brake viewed in the sense of the arrow A in Fig. 2;

Fig. 4 is a view from above of the fall brake viewed in the sense of the arrow B in Fig. 2;

Fig. 5 is a block diagram of an appropriate detector device and an appropriate control system for the fall brake.

The stores crane in accordance with Fig. 1 consists of, in the accepted manner, a wheel-mounted chassis 11 and a vertical lifting mast 12 arranged on the chassis. The crane is designed to run on rails 13 in bearing tracks and is retained in a vertical position by means of a guide arrangement 14 at the top 15 of the mast. A load carrier 16 with a telescopic unit 17 for palletized loads is capable of displacement along the entire length of the mast by means of a lifting arrangement 18 comprising a lift motor 19, a supporting cable 20 and an upper guide wheel 21. The load carrier 16 is guided along the mast by means of two guides or guide fins 22 on either side of the mast. Each of two vertical lateral beams 23 on the load carrier is fitted with two pairs of guide rollers 24, 25 to make contact and provide location to either side of the respective guide fin 22. The normal raising and lowering movement of the lifting carriage is provided by the supporting cable 20 and is controlled by means of conventional control devices for the electric lift motor 19. In order to avoid excessive damage in the event of a fault in the lifting arrangement 18, the load carrier 16 is equipped with a fall brake 26. This is intended purely as a safety component and need only be actuated in the event of cable rupture, motor brake failure or some other extreme defect. The fall brake is thus controlled by a detector device 27, which senses the vertical displacement of the load carrier and, at a certain predetermined variation, ensures that the brake is actuated.

In accordance with the illustrated example, a fall brake is arranged on each lateral beam 23 in order to apply a braking effect by engaging around the respective guide fin 22. Each fall brake exhibits a brake housing 30 with a U-shaped brake yoke 31, which is mounted on the lateral beam 23 by means of a number of bolts 32. The brake housing also comprises a brake body or brake wedge 33, which is supported on the first shank 34 of the brake yoke 31 in order to make contact during braking with one side 35 of the guide fin. The second shank 36 of the brake yoke extends along the other side 37 of the guide fin to provide an abutment for the contact with the brake body 33. The brake yoke 31 can be adjusted to an appropriate position in relation to the guide fin 22 by means of adjuster screws 38, 39 in a transverse beam 40 between the two side beams 23. Two of the screws 39 are screwed into the second shank 36 and are provided with spring washers 41 so as to permit a certain amount of floating movement for the brake yoke as a whole. The movement is limited, however, by the free play of the bolts 32 in the respective hole 42.

The brake body 33 is wedge-shaped with a top angle α between a flat brake surface 43 facing towards the guide fin 22 and a similarly flat sliding surface 44 so arranged as to slide along and to make contact with a support surface 45 on the first shank 34. The support surface 45 is arranged at an angle to the guide fin 22 with the same inclination as the top angle α of the brake wedge, so that a wedge-shaped space 46 after the brake wedge is formed between the first shank and the guide fin. The sliding surface 44 of the brake wedge is guided along the support surface 45 by means of a suitable guide device 47. The brake wedge is able to move between the first position shown in Fig. 3, in which the brake surface 43 and the opposing surface 48 on the second shank 36 are provided with a certain clearance 49, 50 with the guide fin 22, and a second braking position, in which the brake wedge is displaced upwards in the Figure relative to the brake housing and the brake surface 43 is in contact with the guide fin. This brake surface 43 is preferably arranged completely parallel with the guide fin and is provided with an appropriate brake lining 51. Provided on the lower part or base of the brake wedge is a scraper device 52 so arranged, when the brake is applied, as to scrape with two metal teeth 53 against the guide fin and to clean it of any larger impurities, so that the lining 51 can work more efficiently. The scraper device 52 also contributes to the rapid build-up of friction between the guide fin and the brake wedge, and in order to avoid damage to the former, the scraper device is not rigidly attached to the brake body, but is able to move under the influence of a pressure spring (not shown here). The scraper device will thus make contact with the guide fin with a force determined solely by the spring's characteristic, which is selected so that all scraping and clamping damage can be avoided.

The brake wedge 33 shall be situated at all times during normal operation in the first, non-

braking position, but shall be displaced immediately to the second, braking position upon actuation of the brake. This displacement is achieved with the help of a spring device 54, which is constantly in engagement with a moving pressure rod 55 supported on the brake housing 30 with a spring pressure F acting downwards in Fig. 3, which pressure is transformed via a lever arm 56 into a pressure acting upwards on the brake wedge 33. In order to retain the latter in its non-locking position in the normal position, the pressure rod 55 is also connected to a hydraulic cylinder 57, which, via an upper transverse rod 58, is capable of forcing the pressure rod 55 upwards and of compressing the spring device 54. The operating chamber 59 of the hydraulic cylinder is kept pressurized by means of an electrically operated solenoid valve 60 connected to the hydraulic system 28 of the crane as shown in Fig. 5. The opening and closing of the valve are controlled by a device for detecting movement of the load carrier.

The second shank 36 of the brake yoke 31 is also provided with a brake lining 61 and a scraper device 62 of the same shape as the corresponding components 51, 52 on the brake wedge 33. This second shank 36 thus serves not only as a passive abutment for the brake wedge, but also contributes actively to improving the effect of the brake. The floating suspension of the brake yoke in this way plays a part in the uniform distribution of the pressure and the braking force between the two brake shoes. Loading of the guide rollers 24, 25 by the normal force against the guide fin produced by the brake wedge is also prevented in this way.

As previously described, a detector device is so arranged as to sense the vertical movement of the load carrier 16 along the mast and, on reaching a certain speed, to actuate the fall brake by opening the solenoid valve 60. The vertical movement in this case is sensed by means of a wheel 63 attached to the load carrier in such a way as to roll along a solid track on the mast, preferably one of the guides or guide fins 22. The wheel 63 is connected to a generator or tachometer 64 on the lifting carriage. Generated in a conventional manner in the generator is an electrical voltage, which is directly proportional to the speed of rotation of the drive wheel 63 and thus to the speed of the load carrier. The generator is connected to a variable voltage relay 65, the tripping voltage of which is set at a level corresponding to the maximum permissible speed. When this is exceeded, the tripping relay 66 of the valve is caused to interrupt the voltage to the associated magnetic coil 67, so that the valve is opened by spring pressure and by hydraulic pressure inside the operating chamber 59. Once the operating chamber is empty, the hydraulic cylinder 57 is no longer able to counteract the spring device 54, which is now capable via the link mechanism 56 of forcing the brake wedge 33 upwards along the support surface 45. The brake surface 43 is displaced simultaneously in a parallel sense towards the guide fin 22, and the spring-assisted scraper block 52 begins to scrape against the fin and to accelerate the movement of the brake body inwards into the space 46. As the brake lining 51 reaches the guide fin, the frictional force, as well as the normal force, are further reinforced by the continued wedging. As this process continues, the whole of the brake yoke is forced over against the side of the wedge during compression of the spring washers 41. The lining 61 and the scraper 62 on the second shank of the yoke thus come into contact with the guide fin and contribute to the braking effect.

As already mentioned, the wedge angle α is selected to provide a certain balance between the requirement for high normal force and small vertical movement of the brake wedge. A suitable angle would lie in the range from 8 to 15°, at which the brake will also be easy to release following an arrest. This is easily done by raising the load carrier vertically by means of the lifting arrangement 18. Dimensions and angles should thus be selected so as to prevent any residual deformation or locking in a brake wedge, brake yoke or guide fin. The constituent parts of the fall brake and the detector device must always be maintained in working order, in spite of the fact that they will never actually need to be used. Notwithstanding the fact that the safety system as a whole is arranged to operate irrespective of the normal electrical power supply to the crane, the generator 64 and the valve 60 are also connected to the central control unit 68 of the crane for monitoring signal output. Control is effected by causing the output signals from the generator to pass to a monitoring unit 69, in which the level is measured and then compared with the normally recorded values in the control unit 68. Further control is possible by monitoring the actual position of the pressure rod 55 using appropriate position indicators.

Claims

1. Stores crane for internal materials handling comprising a load carrier (16) so arranged as to run along guides (22) on a vertical crane mast (12), a lifting device (18) arranged for displacement of the load carrier along the mast, a fall brake (26) attached to the load carrier for the purpose, in the event of a fault in the lifting device, of preventing the load carrier from falling downwards through engagement with the guides, and a detector device (27) so arranged as to sense the movement of the

load carrier and, in the event of deviation from set values, as to actuate the fall brake, ***characterized*** in that the fall brake (26) exhibits a brake housing (30) with a moving wedge-shaped brake body (33) capable of moving against one of the guides (22) and along a support surface (45) angled against the guide in the brake housing (30) between a first, non-braking position and a second, braking position in which the brake body is in contact with the guide and the aforementioned support surface.

2. Stores crane in accordance with Patent Claim 1, ***characterized*** in that the brake body (33) exhibits a sliding surface (44) and a braking surface (43), in conjunction with which the sliding surface is so arranged as to make contact with the support surface (45) inside the brake housing during movement of the brake body, whereas the braking surface is arranged parallel with the guide (22), so that this surface is displaced in a parallel sense towards or away from the guide in conjunction with movement of the brake body.

3. Stores crane in accordance with Patent Claims 1 or 2, ***characterized*** in that a spring device (54) is so arranged as to exert a constant influence on the brake body (33) with a spring force for causing the latter to be displaced into the braking position.

4. Stores crane in accordance with Patent Claim 3, ***characterized*** in that a hydraulic cylinder (57) is so arranged as to counteract the spring force of the spring device (54) via a pressurized operating chamber (59), and in that a valve (60) connected to the detector device is so arranged as to lower the pressure in conjunction with actuation of the brake so that the spring force is able to force the brake body (33) into its braking position.

5. Stores crane in accordance with one or other of the preceding Patent Claims, ***characterized*** in that the support surface (45) in the brake housing and the associated guide (22) together form an upwardly decreasing wedge-shaped space (46) for the brake body (33), and in that the support surface (45) is arranged with an angle α in a vertical sense to the guide of the order of 5-20° and preferably 8-15°.

6. Stores crane in accordance with one or other of the preceding Patent Claims, ***characterized*** in that the brake housing (30) comprises a U-shaped brake yoke (31), the first shank (34) of which is executed to support the moving brake body (33), whereas the second shank (36) is executed to serve as an abutment and to make contact with the side (37) of the guide facing away from the brake body when the brake is actuated.

7. Stores crane in accordance with one or other of the preceding Patent Claims, ***characterized*** in that the brake body incorporates a scraper device (52), arranged to be capable of moving relative to it, and so arranged as to make contact with and scrape against the guide (22) when the brake is actuated.

8. Stores crane in accordance with Patent Claims 6 or 7, ***characterized*** in that the spring device (54) and the hydraulic cylinder (57) are so arranged as to transmit the forces generated respectively by them to a movable rod (55) supported on the aforementioned first shank (34), which rod is connected via a linkage mechanism (56) to the brake body (33) for the purpose of causing its brake movement.

9. Stores crane in accordance with one or other of the preceding Patent Claims, ***characterized*** in that the detector device comprises a wheel (63) attached to the load carrier and so arranged as to rotate through contact with a solid track (22) on the mast, and to control actuation of the fall brake via a device (64) for sensing the speed of rotation.

10. Stores crane in accordance with Patent Claim 9, ***characterized*** in that the device for sensing the speed of rotation consists of a generator (64), which is so arranged as to be driven by the aforementioned wheel (63), and in that the generated voltage controls a switching device (65, 66) for the purpose, when a certain level is achieved, of causing opening of the valve (60) leading to the pressurized operating chamber (59) and reducing its pressure so that the fall brake is actuated.

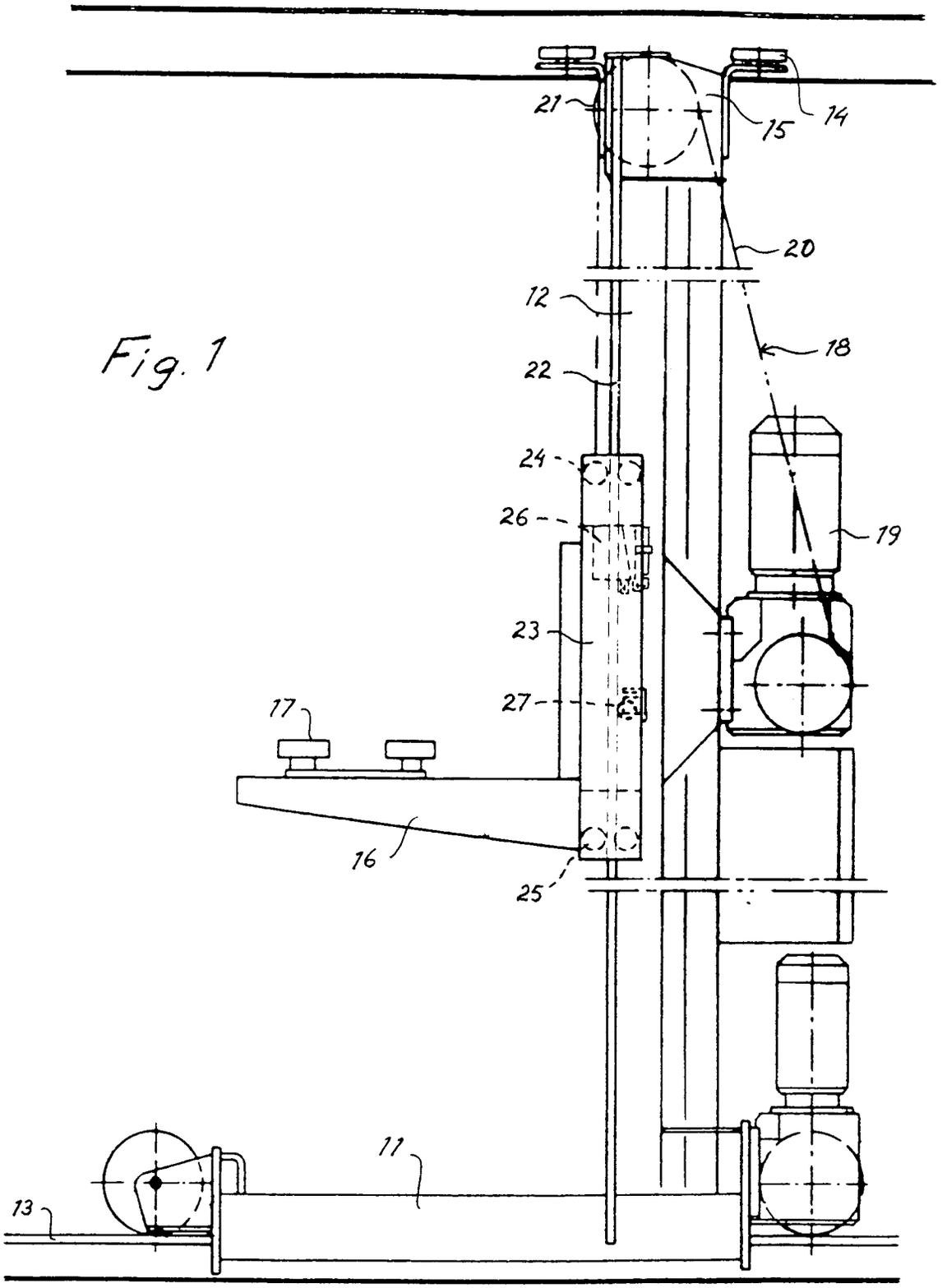

Fig. 1

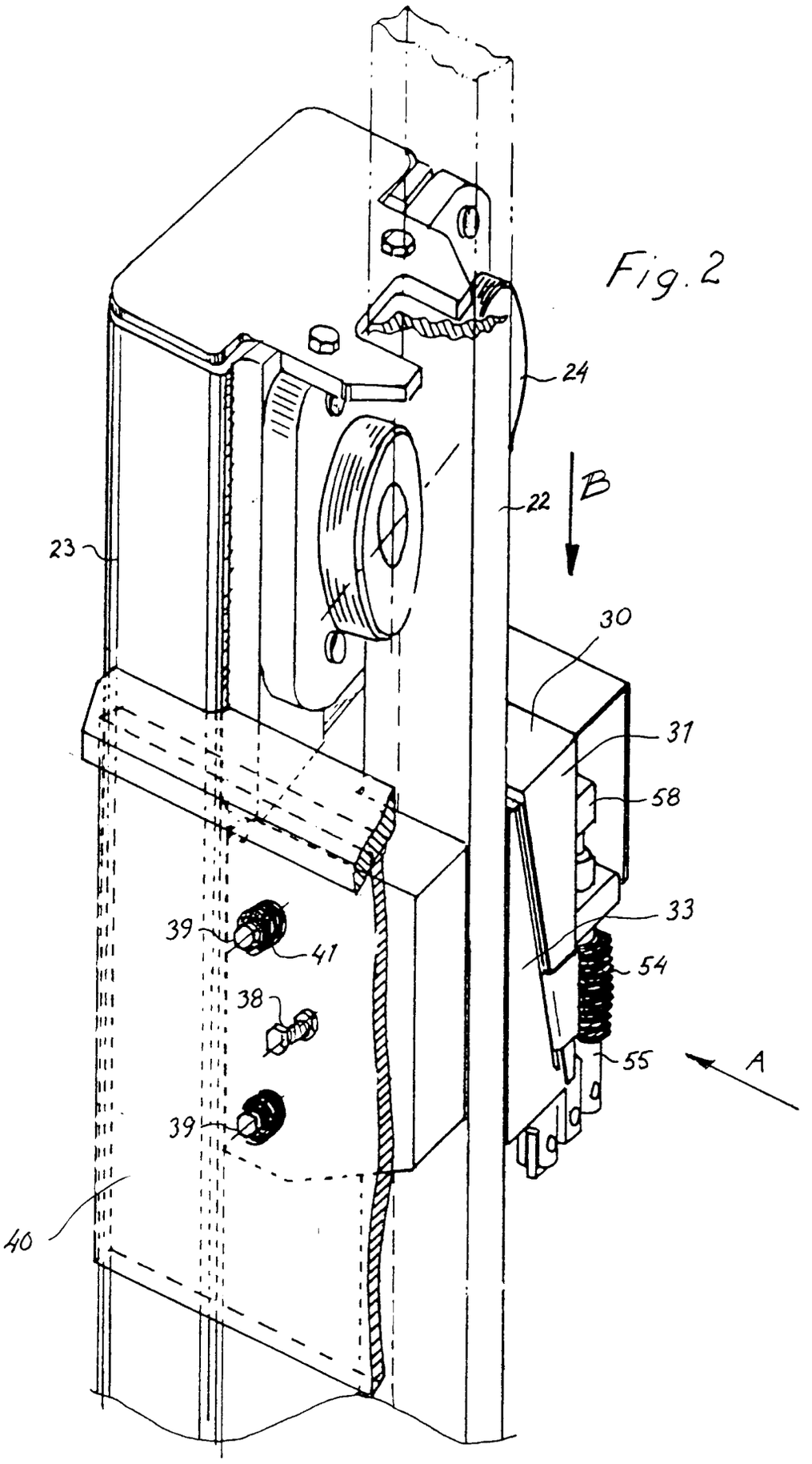

Fig. 2

Fig. 3

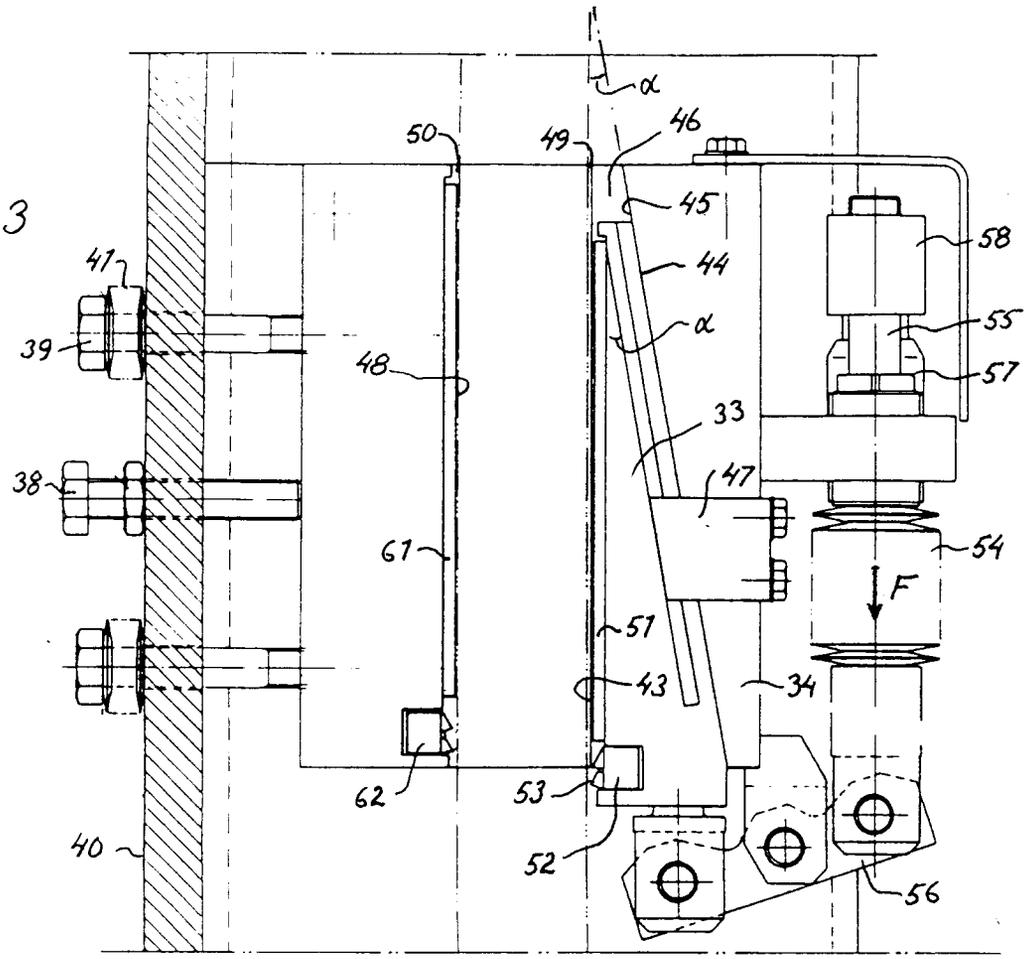
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Fig. 4

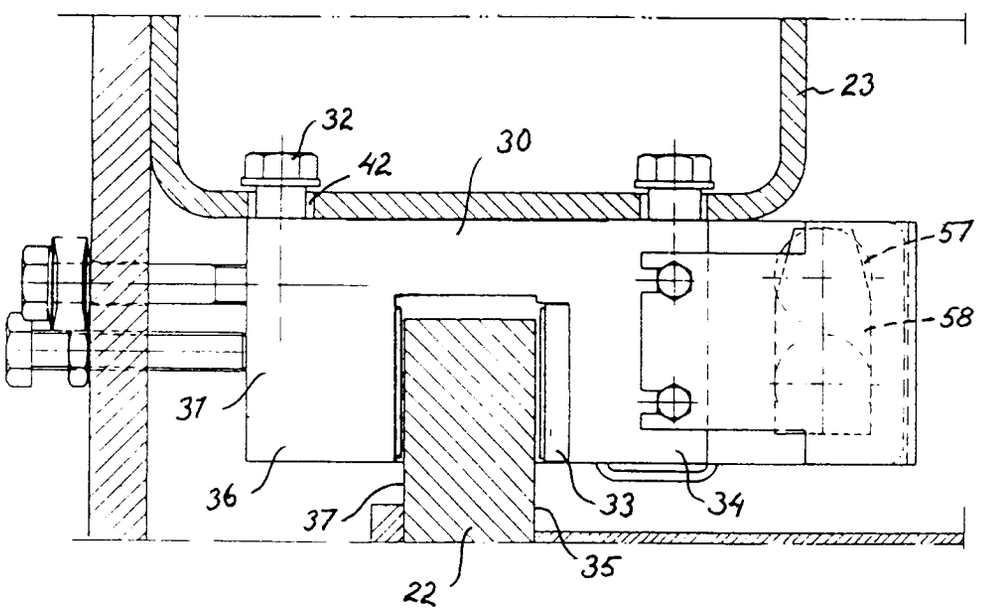
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Fig. 5