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(54) Switch machine for railroad switches or the like, having a trailing resistant device for opposing trailing of the switch points

(57) A switch machine for railroad switches or the like, having a device for opposing trailing of the switch points, which switch machine comprises: a drive unit (12, 18, 120, 21, 24) for transmitting linear throw motion to the switch points (A1, A2, A1', A2'), by a movable switch point carrier member (12, 18), which is dynamically connected to a motor (M); switch point displacing drive means (120, 21, 220), which are connected to said carrier member by connections (220, 518) which are releasable when a predetermined force is exceeded to allow free motion of the drive means, hence of the switch points relative to the carrier member; trailing resistant means (50, 50'), for opposing displacement of the switch points, i.e. of the drive means (21, 120) from each of the two proper operating positions of the switch points due to the direct exertion of a force on the switch points. According to the invention, the trailing resistant means (50, 50') for opposing displacement of the switch points, which are integral with a stationary portion of the switch machine are made in such a manner as to have a predetermined rupture behavior when the force exerted thereon exceeds a predetermined value, so that they break and release the drive means under the action of a predetermined switch point displacement force directly exerted on the switch points, particularly by the wheels of a rail car.

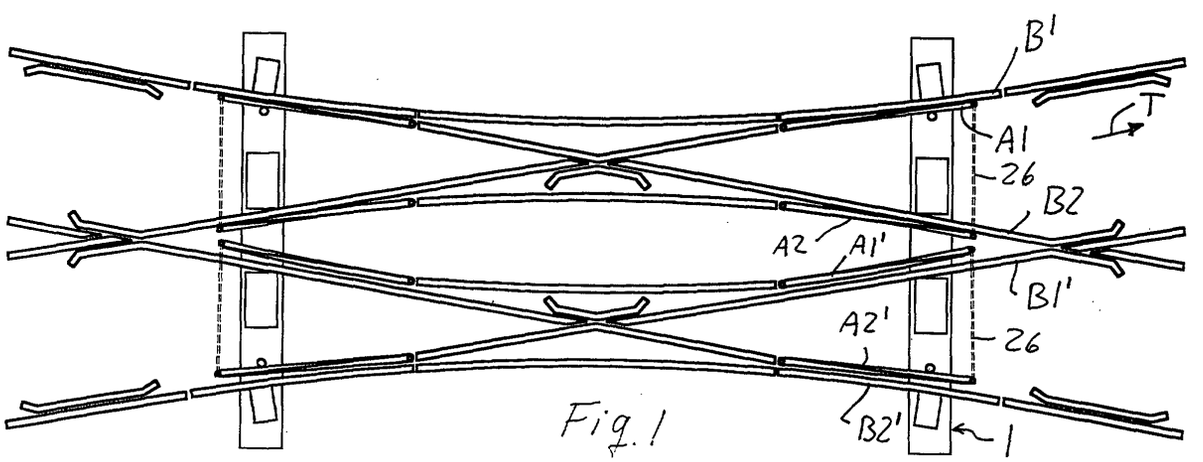


Fig. 1

EP 1 219 521 A1

Description

[0001] The invention relates to a switch machine for railroad switches or the like, having a trailing resistant device for opposing trailing of the switch points, which switch machine comprises:

a drive unit for transmitting linear throw motion to the switch points, including a movable switch point carrier member, which is dynamically connected to a drive motor;
displacing drive means which transmit motion from the carrier member to the switch points, and are connected to said carrier member by connections which are releasable when a predetermined and resettable force is exceeded, to allow free motion of the drive means, hence of the switch points relative to the carrier member;
mechanical trailing resistant means, for opposing the displacement of the switch points, i.e. of the drive means from either proper operating position of the switch points due to the direct exertion of a force on the switch points, which means may be actuated when the switch points reach their proper operating position, and disabled when the carrier member is operated to displace the switch points from one to the other operating position.

[0002] Prior art railroad switches are basically provided in two designs, known as trailable and non-trailable switches. The so-called trailable switches allow the switch points to be displaced from the predefined operating position, when a train coming in the direction opposite the deviation caused by the switch finds the turnout with the switch points in the improper position. In this case, the wheels of the train act on the switch points and force them from the predefined - improper - position to the proper position they should have. In this case, the carrier means which are dynamically connected to the drive motor are dynamically coupled to the switch point displacing drive means - typically rods or ties - by means of elastic coupling elements which, when a displacement force is exerted on the switch points that exceeds a predetermined value, releases the drive means from the carrier means, typically a carriage which is slid by a motor thanks to the action of irreversible drives, such as feed screw drives or the like. Hence, in this case, the switch points are released from the irreversible displacing mechanism acting thereon and may be displaced by the train wheels to a position differing from their former improper position.

[0003] In the so-called non-trailable switches, the switch point displacing drive means are locked in the different operating positions by substantially rigid means, which are operated when the switch points reach their respective operating positions. As a rule, the locking means consist of removable stops, such as pins, studs or bosses which are associated to stationary parts of the switch machine, e.g. to its enclosure, and cooperate with appropriately positioned stops, associated to mechanical parts of the switch point displacement drive, particularly to the switch point displacing drive means. In the above conditions, when a train passes in the direction opposite the diverting direction and the switch points are in the wrong position, the switch points do not fail under the action of the train wheels unless a stress causes the failure of some mechanical elements of the displacing drive chain from the motor to the switch points.

[0004] In order to provide a single switch machine to be applied with both "trailability" and "non-trailability" functions, the provision of mechanical latches to be removably inserted between the drive means connected to the switch points and the stationary elements of the switch machine is known. In this case, when a trailing condition occurs, there is no way to determine which elements of the kinematic chain for displacing the switch points is damaged. This is a drawback, as the personnel charged of restoring the functionality of the switch machine cannot presume which type of maintenance intervention will have to be effected. Moreover, the damaged means are typically more complex, hence more expensive and difficult to replace. This obviously is a cause for higher costs and longer repair times.

[0005] Moreover, in order to prevent the rocking movements of rolling stock running across the railroad switch in the right direction as well as the partial trailing displacement due to trailing attempts from causing switch machine damage conditions, at present, the means for locking the switch point driving means are made in such a manner as to allow the switch points a certain displacement caused by forces acting thereon, within predetermined tolerances. This may be achieved, for instance, by providing that the removable locking means, associated to stationary members of the switch machine and the cooperating stops, associated to the switch point displacement drive means in such positions that, in the operating condition of said locking means and with the switch points in the thrown position, said locking means and the stops cooperating therewith are at a certain distance from each other with reference to the direction of mutual caused by the displacement of the switch points due to trailing. In these conditions, the switch points may be slightly displaced to a predetermined extent before the locking means come to cooperate with the stops associated to the drive means. This displacement is not problematic when the train runs through the switch in the right direction. Conversely, when the partial displacement of the switch points is caused by partial or attempted trailing, prior art switch machines do not allow detection of this condition, nothing visible remaining of this abnormal use of the switch. However, for safety purposes, such a switch which has been used in improper conditions should be checked by the operating personnel.

[0006] Therefore, the invention has the object to pro-

vide a switch machine as described hereinbefore which, by relatively simple and inexpensive arrangements, provides a switch machine for a railroad switch or the like with non-trailability characteristics up to a certain load, thereby obviating all drawbacks caused by damages to unforeseeable parts of the switch machine if the latter is set to be non trailable and provides at the same time improved features for controlling the conditions of the switch when it is trailed.

[0007] Another object of the invention consists in providing a switch machine as described above, which has the same or substantially the same outer size as those of a tie and may take the place of a tie.

[0008] The invention achieves the above purposes by providing a switch machine as described hereinbefore, in which the trailing resistant means for opposing the displacement of the switch points, which are integral with a stationary portion of the switch machine are made in such a manner as to have a predetermined rupture behavior when the force exerted thereon exceeds a predetermined value, i.e. as to break and release the drive means under the action of a predetermined force of switch point displacement directly exerted on the switch points, particularly by the wheels of a rail car.

[0009] This condition or rupture behavior may be obtained thanks to coupling keys cooperating with engagement grooves or stops associated to the drive means and to a stationary part of the switch machine respectively, which are weakened or conformed in such a manner as to oppose a certain maximum resistance before breaking when the ends of the grooves or abutments act against the trailing resistant keys or studs.

[0010] In this invention, there are no longer provided means for preventing any displacement of the switch points, but means for only preventing such displacement until the force acting on the switch points remains below a predetermined threshold.

[0011] According to an additional characteristic, the trailing resistant means and the stops cooperating therewith are associated to means for signaling the broken condition of the locking means and/or the stops. These signaling means may be of any type, e.g. signals for indicating the position of the stops or the trailing resistant means, which are operated when the drive means - typically rods - take or exceed a predetermined position relative to the carrier member.

[0012] In order to control actuation and disabling of the trailing resistant means when the switch points are displaced in a normal manner by the displacement of the carrier means, the invention provides that the trailing resistant means are mounted so as to be movable between a position of interference and a position of non-interference thereof with the stops associated to the switch point displacing drive means, whereas said displacement is controlled by actuating cams, which are integral with the carrier means and cooperate with control rollers borne by the trailing resistant means.

[0013] Advantageously, the trailing resistant means may be provided in combination with elastic means which stress said trailing resistant means to a stable interference position, whereas the displacement of said trailing resistant means to a position of non-interference with the stops associated to the switch point displacing drive means occurs against the action of said elastic means.

[0014] Thanks to this arrangement, when the motor of the switch machine is operated to displace the carrier means, the trailing resistant means are automatically carried to the position of non interference with the stops associated to the drive means which are rigidly connected to the switch points. When the switch points reach their end-of-stroke position, in either direction, the trailing resistant means are taken again to a position of non interference with the stops associated to the switch point displacing drive means. Conversely, when the turnout is trailed, i.e. the displacement force is exerted directly on the switch points, the drive means are displaced separately from the carrier means, there being provided a compliant connection therebetween once a predetermined force is exceeded. Therefore, in this case, the carrier means keep still and the cams for controlling the position of the trailing resistant means do not interact with the latter, which remain in the operating position of interference with the drive means.

[0015] Since switch point displacement may sometimes be relatively limited - for instance due to side slip or oscillatory motions of rolling stock running through the turnout in the right direction, with respect to the operating position of the switch points - the invention provides a certain freedom of mutual movement between the stops associated to the switch point drive means and the trailing resistant means cooperating with said stops and associated to a stationary part of the switch machine, in such a manner as to prevent any rupture, as well as the consequent trailing signal, when no actual trailing condition occurred.

[0016] Also, in order to be able to account for incomplete trailing impacts, caused by direct displacement of the switch points which, while exceeding a displacement stroke of the drive means relative to the oscillating tolerances of the switch points due to the proper passage of the train, is not sufficient to break the trailing resistant means, the switch machine of the invention has means for signaling the occurrence of a limited or partial trailing impact.

[0017] According to an improvement, the switch machine of the invention includes, in combination with signaling means or even separately therefrom, means for mechanically signaling the partial trailing condition.

[0018] Said mechanical means may advantageously be such as to also cause a functional loss of the switch machine.

[0019] Said functional loss may be set in such a manner that the normal operation of the switch machine may be restored by a specific action, which may be a remote controlled actuation of automatic restoring actuators or

a direct manual intervention, such as when the trailing resistant means, having a predetermined rupture behavior, are broken.

[0020] In accordance with a preferred embodiment of the invention, the means for stably signaling a partial trailing impact consist of sliders situated nearer the stops associated to the drive means which cooperate with the trailing resistant means, as compared to the position of the trailing resistant means relative to said stops, and which signaling means are moved by said stops associated to the means for driving the switch points to the position in which the signaling switches are actuated.

[0021] Advantageously, the signaling means, i.e. the sliders and the signaling switches are also mounted in such a manner as to allow displacement thereof alternately to positions of interference and non interference with the stops associated to the means for driving the switch points under the action of the carrier means, in the same manner as described for trailing resistant means.

[0022] Both the trailing resistant means and the means for signaling partial trailing may be advantageously mounted on a single saddle which is controlled by cams associated to the carrier means by control tailpieces.

[0023] In order to stably keep the signaling sliders in the signaling switch actuating position, said sliders are associated to signaling position locks, which are in turn caused to cooperate with the signaling means in the event of a partial trailing impact.

[0024] To this end, the invention advantageously provides that the signaling means, particularly the sliders are associated to a cam which may be moved along with the signaling sliders and cooperates with a lock, which is elastically loaded against said cam, the latter having a cam track with at least one boss, bulge, projection or recess behind which the lock is positioned when displacement occurs due to a partial trailing impact on the slider, so that said slider can no longer snap backwards when the direct thrust force on the switch points stops.

[0025] According to an additional characteristic, the signaling means are associated to additional means for holding them in the starting position, which only release the signaling means, i.e. the sliders, when a predetermined force on the switch points, hence on the drive means, is exceeded.

[0026] These holding means advantageously consist of a roller elastically stressed against a cam, which may be moved along with the slider and has a recess with inclined end walls, in which the roller is held until a predetermined force is exceeded.

[0027] Advantageously, the holding cam is made of one piece with the cam for locking the slider in the signaling switch actuating position.

[0028] All cam tracks may be integrated on a single cam associated to a single slider for both displacement directions of the drive means. In this case, the holding recess may be provided in the central position and the two locking tracks of the slider may be provided in the partial trailing position on both sides of the recess for holding the slider in its starting position. Moreover, the slider may be displaced in both directions, hence it has opposite surfaces abutting against the stops associated to the drive means.

[0029] Obviously, the holding cam and the roller cooperating therewith may be also moved, like the trailing resistant means, the sliders and the cam for locking them in the partial trailing position, alternately to positions of interference and non-interference with the stops of the switch point displacing drive means.

[0030] A preferred embodiment of the invention provides that the sliders have a substantially circular shape, with a flattened abutment face on the side facing toward the corresponding stop associated to the drive means, the latter being able to rotate about their axis. In this case, advantages may be obtained from providing both start position holding cam track and partial trailing position locking cam track along the peripheral edge of the circular slider. Moreover, the holding roller, and the partial trailing position locking roller may be integrated in a single roller borne on a transverse tailpiece of a member which is slidable in a radial direction with respect to the circular slider and loaded against the peripheral surface of said slider by elastic means, as well as provided with stops for operating and/or controlling the signaling switches.

[0031] In this embodiment, there is provided a circular slider for each sliding direction of the drive means, hence a pair of symmetrical opposite circular sliders, which are rotatably mounted on the same axle, the retaining recesses along the peripheral edge being coincident, whereas the cam tracks for locking the sliders in the partial trailing condition are provided on respectively opposite sides of the retaining recesses, and the stops associated to the switch point drive means are asymmetric, i.e. extend in such a manner as to cooperate each with one of the sliders.

[0032] Advantageously, the trailing resistant means consist of a weakened pin which is formed by an end coaxial extension of a saddle, which slides radially with respect to the circular sliders and carries the axles about whose axes the circular sliders rotate, whereas the roller for displacing the circular sliders for signaling the partial trailing impact and the weakened trailing resistant pin is mounted coaxially to the circular sliders on a terminal extension outside said circular sliders.

[0033] The rollers cooperating with the peripheral cam tracks of the circular sliders are also mounted on a saddle sliding radially with respect to the circular sliders, which is independent from the saddle which carries the sliders and the weakened trailing resistant pin, the two saddles being loaded by a single elastic member which stresses them into the position in which the trailing resistant pin and the sliders are engaged with the stops and the roller for locking and/or retaining said sliders are

held pressed against the peripheral track thereof, the two saddles being further mounted in such a manner as to allow separate control and movement thereof.

[0034] Advantageously, the saddle which carries the rollers for retaining and locking the circular sliders in the partial trailing position is interposed between the elastic member and the saddle which carries the roller for displacing the trailing resistant means and the partial trailing signaling means into the positions of interference and non-interference with the stops of the switch point drive means, the two saddles being mounted in such a manner as to allow displacement of the saddle which carries the partial trailing position holding and locking rollers, cooperating with the sliders for signaling the partial trailing condition and for controlling the signaling switches without causing the trailing resistant means and the trailing condition signaling means to be displaced between the positions of interference and non-interference with the stops on the drive means.

[0035] In a particularly advantageous embodiment, thanks to the high construction integration of the trailing resistant means and the partial trailing signaling means, instead of separating the trailing resistant means from the partial trailing signaling means, the trailing resistant means are arranged to cooperate directly with the partial trailing signaling means. To this end, said sliders have surfaces designed to contact with stationary abutment elements, e.g. pins, teeth, etc. These stationary abutment elements are mounted in such a manner as to be displaceable with the sliders into the positions of interference and non-interference with the stops associated to the switch point displacing drive rods. Preferably these contact elements are axial teeth or pins engaging in slots of the sliders. In the case of circular sliders, the slots are obviously in the form of coaxial circular sectors, and have such a width as to prevent any interference of the ends of said slots with the axial pins or teeth until the predetermined partial trailing stroke is overcome. When the switch point stroke overcomes said predetermined axial stroke, the pin or tooth will come to cooperate with the end of the slot formed in the sliders, thereby being broken.

[0036] This construction advantageously allows to dispose a single circular sector with the axis of rotation perpendicular to the upper surface of the switch machine. The surface of the circular sector for abutment with the stops associated to the switch point drive rods consists in this case of an axial tooth on the face of said slider facing toward the drive rods.

[0037] The latter embodiment allows to considerably limit construction costs and dimensions of the trailing signaling device. Said device is also more easily mounted and replaced.

[0038] The advantages of the present invention are self-evident from the above description. Unlike prior art arrangements, the invention does not include means for actually locking the switch points against trailing, but has means which provide locking functions against trailing up to a certain trailing force exerted on the switch points, and signal in any case the occurred partial trailing condition. While a trailing condition with the switch points being forced above the threshold requires the switch machine to be restored by only replacing the trailing resistant means, when a partial trailing impact occurs, a stable switch point slight or partial forcing signaling condition, require a local intervention by the personnel to reset the signaling means and to inspect in any case the switch machine. All this is achieved by relatively simple mechanical means which do not require substantial changes to the construction of existing switch machines, and which are easy to mount and to replace. Also, as specified above, the invention prevents any unforeseeable parts from being broken before trailing, thereby avoiding all associated heavy maintenance and replacement interventions on the parts of a switch machine. This is a critical feature when considering that the replacement of a whole switch machine is not a fast and easy operation. These conditions are obviously even more difficult in the case of switch machines wholly integrated in housings having the same size and arrangement as a rail tie.

[0039] Further improvements of the invention will form the subject of the subclaims.

[0040] The characteristics of the invention will appear more clearly from the following description of a few embodiments, illustrated without limitation in the annexed drawings, in which:

Fig. 1 is a plan view of a so-called English type turnout.

Fig. 2 is an sectional view of the switch machine as seen through a vertical plane transverse to the track.

Fig. 3 is an vertical cross sectional view of the switch machine.

Fig. 4 is an enlarged sectional view of the portion of the switch machine corresponding to the rod carrier, as seen through a horizontal plane.

Figs. 5 to 7 are respectively a sectional view as seen through a horizontal plane and two views of a detail of the trailing resistant means and of the partial trailing signaling means, as seen through two sectional orthogonal vertical planes of a switch machine according to the first embodiment which is in the rest condition.

Figs. 8 and 9 are two views of the detail of the trailing resistant means and of the partial trailing signaling means as seen through two sectional orthogonal vertical planes of the switch machine according to the first embodiment, as shown in Figs. 6 and 7, in a condition of a first limited displacement of the switch points, caused for instance by lateral oscillations of a train or by an initial trailing attempt.

Figs. 10 to 12 are views like Figs. 5 to 7, in which the switch points have been displaced to an extent corresponding to a minimum partial trailing stroke,

which has brought the stops of the drive means to contact with the trailing resistant means and with the partial trailing signaling means, thereby only causing the rotation of the corresponding signaling slider.

Figs. 13 to 15 are views like Figs. 10 to 12, in which the railroad switch has been completely trailed, with the switch points being forced with a thrust force exceeding the rupture strength of the trailing resistant means.

Fig. 16 is a cross sectional view of a construction variant of the switch machine and of the trailing resistant and partial trailing signaling means.

Fig. 17 is a top plan view of a portion of the switch machine in which there are provided trailing resistant and partial trailing signaling means as seen in Fig. 16, said means being shown in the position of non-interference with the stops associated to the switch point drive means.

Figs. 18 to 21 are views like Fig. 17, with the trailing resistant and partial trailing signaling means in the different positions corresponding to Figs. 8 to 15 of the previous embodiment.

Figs. 22 to 25 are a plan view of the position of the switch points and of the drive means relative to the rod carrier through the different positions of the trailing resistant and partial trailing signaling means as shown in Figs. 18 to 21.

[0041] The switch machine of the invention is shown without limitation in combination with a so-called English-type switch. This combination is to be intended without limitation, but shows one of the most complex implementations of the invention. The provision of a switch machine in the form of a tie is also to be intended without limitation and here again said provision is a preferred embodiment as compared with traditional switch machines which may have the inventive characteristics as claimed, obviously mechanically adapted to the different construction conditions.

[0042] The so-called English-type turnout is provided at crossings and has four switch points. In the English-type turnout two tracks are provided with the rails B1, B1' and B2, B2' cooperating with the switch points A1, A1' and A2, A2' respectively. A switch machine 1 having a shape and a size substantially corresponding to those of a rail tie houses the means for displacing the switch points A1, A1' and A2, A2'.

[0043] Referring to Figs. 1 to 15, the tie-shaped switch machine 1 extends for a certain length even outside the trucks to an extent substantially corresponding to the ties and a drive motor, typically an electric motor, denoted as M, is housed in one of these outer end extensions. The motor M rotatably drives, by means of a bevel gear drive 5, 5', a threaded rod 3 which is coupled to the output shaft 5" of the drive by means of a joint of any type, which may be even disengageable in a stress condition above a predetermined torque or friction. A non-rotatable nut screw, sliding integrally with a first carriage 12 is fitted onto the threaded rod 3. The carriage 12 may roll on wheels 13 in both directions longitudinally to the threaded rod 3 on the bottom of the switch machine 1. The carriage 12 may be moved between two stop end-of-stroke walls which delimit the actuating stroke. The end-of-stroke positions of the carriage 12 are defined by a stationary stop 80, which is integral with the bottom of the switch machine and through which an axial extension 412 of the carriage 12 passes, which carries an abutment widened part 512 at its free end.

[0044] The actuating carriage 12 is integral with a superposed guide 19 for a rod carrier 18 which is integral in its translation with the actuating carriage 12, thanks to a vertical stud or any other interlocking arrangement 618 and rolls on rollers 218 along the lateral longitudinal walls of the guide 19 in the switch machine 1 . The rod carrier 18 is tubular, and its side walls, which have the shape of isosceles trapezoids, and form symmetrically opposite inclined planes 518 at the opposite ends of each side wall 318 of the rod carrier 18, which planes converge toward the center of the carriage 18. At said center, the rod carrier 18 has, at the bottom and top sides, a sliding guide which may be double, i.e. provided on both sides or simple 418, for instance a median longitudinal groove, or a half thereof, for housing the ends of a central rod 120. The central rod 120 is connected to the rod carrier 18 by means of two leaf springs 220. Each of the two leaf springs is fastened by its extrados side and in a symmetric position with respect to the other leaf spring of the central rod 120, whereby a substantial "X" shape, vertically cut into halves by the rod 120 results in a plan view. Each of the free ends of the leaf springs 220 carries a roller 320. The leaf springs 220 are dimensioned in such a manner that each roller 320 cooperates with an inclined plane 518 of the rod carrier. Particularly, the rollers 320 at the ends of each leaf spring 220 cooperate with the inclined planes 518 respectively at the end sides of the same side of the rod carrier 18 toward which the leaf spring 220 faces.

[0045] The central rod 120 is fastened to the leaf springs 220 substantially at one point, particularly at the point or more precisely the tangent strip between the leaf springs 220 and said rod 120, by means of a clamp 420.

[0046] The central rod 120 is connected at both ends by means of joints to drive rods 21 extending up to the portion under the corresponding rail B1, B1', B2, B2'. The end 121 of the drive rods is made in the form of a plate, which is horizontal in the example, and is slidably engaged between two guiding side walls 23. At the ends 121 of the pulling rods 21, on the upper face thereof, there are provided a first elongated groove 221 having a certain predetermined length and a second angled groove 321 in the end portion, closer to the joint 22 for connecting the rod carrier 18 of the rod carrier 18 and at a predetermined distance from said first groove 221. The first groove 221 is rectilinear and the longitudinal

axis thereof is parallel and coincident with the central longitudinal axis of the corresponding drive rod 21. The second groove 321 forms an obtuse angle and has a branch parallel to the central axis, longitudinal to the corresponding drive rod 21, but laterally staggered with respect to the latter, substantially to an extent corresponding to the length of the tooth 124 of an oscillating lever 24 and a transverse inclined branch which ends substantially at the center of the drive rod 21. The length of the projection of the second groove 321 on the longitudinal axis of the corresponding drive rod 21 is substantially identical to the total length of the first groove 221.

[0047] An oscillating lever 24 is provided at the end 121 of each drive rod 21, which lever is angled at the end corresponding to the free end of the drive rod 21 to form a hook-like tooth 124. Two transverse pins 224 and 324 extend from the lower side supporting the oscillating lever 24, and are engaged in the corresponding grooves 221 and 321 at the ends 121 of the drive rods 21. One of the pins 224 is provided at the end of each oscillating lever 24 facing toward the rod carrier 18, whereas the other pin 324 is provided in line with the former 224, with reference to the longitudinal axis of the longer branch of the oscillating lever 24 and in the corner area thereof. The distance between the two pins 224 and 324 substantially corresponds to the distance between the projections of the ends, on the same side, of the grooves 221 and 321 on the longitudinal axis of the drive rods 21, in such a manner that, when the pin 224 abuts against one of the ends of the groove 221, the pin 324 abuts against the end on the same side of the angled groove 321, in this case having the function of a guide track for the pin 324, and causes an angular displacement in the horizontal plane of the oscillating lever 24, whose stroke is sufficient to bring the lever alternately into the position in which the tooth 124 is engaged behind the end edge of the opposite guiding side wall 23 and into the position in which it is disengaged therefrom due to a relative displacement between the drive rod and the oscillating lever 24.

[0048] A transverse extension connected to the switch point, extends coaxial to the pin 224 engaged in the rectilinear groove 221 of the drive rod 21, on the upper side of each rocking lever, which extension consists of a pin 424 having a head 524 in the form of a spherical interlock seat for a spherical tailpiece which is integral with the switch point A1, A1', A2, A2' in such a manner that the rocking lever 24 is connected to the corresponding switch point A1, A1', A2, A2', to rotate at least about the axis shared with the pin 224 of the lever 24. The spherical tailpiece extends from an arm 125 fastened to the switch point A1, A1', A2, A2', particularly to a longitudinal side wall thereof.

[0049] The above construction provides the following operation:

[0050] By actuating the threaded rod 3 to cause the switch points to be displaced from a starting position in which one of said switch points abuts against the corresponding rail into the position in which the opposite switch point abuts against the associated rail, the carriage 12 is displaced and drives along the superposed rod carrier 18 together with the rod 120, hence with the drive rods 21. In the starting condition, the pins 224 and 324 of the rocking lever 24, connected to the initially thrown switch point abut against the end of the associated grooves 221, 321 on the front side thereof with reference to the direction of translation of the drive rods 21. Therefore, at the beginning of the translation stroke of the drive rods 21, the drive rod 21 associated to the thrown switch point in the start position performs a movement relative to the switch point and to the connecting oscillating lever 24. The relative movement is such as to bring the lever 24 associated to the thrown switch point/s in the starting condition, into a position of disengagement from the end edge of the guiding side wall 23 whereas, on the opposite side, the guide rod has performed such a relative motion that the connecting oscillating lever 24 associated to the switch point/s which are to be brought into the thrown position, takes a slightly inclined position, substantially abutting against the inner surface of the guiding side wall 23 associated thereto. When this condition is reached, the pins 324 of all the oscillating levers 24 which are connected to the corresponding switch points A1, A2 have reached a substantially intermediate position between the end of the inclined branch and the end thereof in the corner area of their respective grooves 321. The oscillating levers 24 are held in this position thanks to the side guides 23 against which they slide in the further stroke during which, the levers 24 and the switch points are pulled together with the drive rods 21. The switch point reaches the thrown position and at the same time the tooth 124 of the connecting oscillating lever 24 passes beyond the rear edge of the facing guide side wall 23, with reference to the translation direction of the drive rods 21, whereby any further translation of the drive rods 21 causes a further oscillation, especially of the connecting lever 24 associated to the switch point which has been brought into the thrown position into the position in which it is engaged behind the end edge of the facing guide side wall. The oscillating lever for connecting the switch point which has moved away from the associated rail is further brought into the central position with respect to the side guides 23.

[0051] Referring to the English-type turnout as shown in the figures, providing two pairs of switch points A1, A1' and A2, A2', since the switch points of the two pairs must take constrained thrown positions in pairs, a single actuating carriage 12, and a single rod carrier 20 are sufficient for all four switch points. Besides having four switch points, the English-type turnout differs from the normal one in that no specific position locking means may be provided at the center of turnout for the switch points A2 and A1'. Therefore, in this condition, since the switch point A1 must take the thrown condition with the switch point A2 of the other pair, both are rigidly linked

together by means of a rod 26, whereby the lock device, i.e. the connecting oscillating lever 24 is only provided outside the track and at the switch point A1. An identical construction is also provided for the switch points A1' and A2' which take together the thrown position against their respective rail.

[0052] The above clearly shows that the construction of the switch machine for a traditional two-point turnout is perfectly identical to the one of the English-type turnout and may be obtained therefrom by simply removing the rods 26 and the inner switch points A2, A1'.

[0053] The particular construction of the rod carrier 18 allows the turnout to be trailable. This means that the turnout may be actuated by a train which runs in the direction opposite the arrow T of Fig. 1 and in the wrong track, thereby acting with its wheel on the non-thrown switch point.

[0054] In these conditions, the train wheel exerts a displacement force against the associated rail to throw the non-thrown switch point and if the switch point did not fail, it would break or anyway cause derailment.

[0055] Thanks to the connecting leaf springs 20 and to the rod carrier 18, when a force is exerted on the non thrown switch point to displace it towards the corresponding rail, and when this force exceeds the elastic force of the leaf springs 220, the rollers of the rear branches of the two opposite leaf springs 220 roll on the inclined planes 518, running past the latter and compressing together the two associated branches of the leaf springs 220, whereby the central rod 120 and the associated drive rods 21 are free from the carriage 12 and may be translated in the direction of the force acting on the switch point. The mechanism of the connecting oscillating levers is wholly independent from that of the actuating carriage and operates in the same manner as described above. The inclined planes 518 have such a length that the rolling distance run by the rollers from an end to the other thereof substantially corresponds to the length of the angled grooves 321 of each drive rod, which are rectilinear and parallel to the longitudinal axis of the drive rods whereby, as long as the rollers remain on the inclined planes 518 without reaching the intermediate portion of the side walls of the rod carrier 18, the oscillating levers 24 to be connected to the thrown switch points do not take the disengagement position. This allows the drive mechanism to absorb slight mechanical stresses exerted on the switch points, without causing the turnout to change its position. The rod carrier 18, which is integral with the actuating carriage 12 allows to prevent any stress on the drive motor when mechanical obstacles interpose between the switch point and its respective rail when the former is thrown against the latter. In fact, if, for instance a stone or else prevents the switch point from taking its final thrown position, the actuating carriage may be nevertheless be brought to its end-of-stroke position, by a disengagement of the central rod 120 from the rod carrier 18 like the one described for the trailing condition.

[0056] According to a further characteristic, means may be provided for limiting the displacement of the central rod 120 or of the drive rods 21 or anyway for opposing, at least to a predetermined extent with reference to a predetermined opposition resistance, the displacement of said rods thereby disabling the trailability feature of the turnout. Particularly, this may be obtained by means of a transverse, vertical stud 50 engaged in coincident slots 52 of the central rod 120 or of the rods 21 rigidly connected thereto. The stud 50 may be either arranged to be only inserted manually, thereby preventing the turnout to be trailable unless a manual change is made, or may be controlled in its two positions in an automatic manner, e.g. by means of electromagnets which, by being actuated or disabled, take the stud 50 into positions of engagement or disengagement of the central rod 120. The whole may be also achieved in other manners and by other actuator means. This feature may be also provided indiscriminately and with no considerable variants or modifications both in the English-type turnout as shown by way of example and in the conventional two-point turnout.

[0057] The stud 50 cooperates with slots 52 formed in the central rod 120, whose length is such that a certain relative movement is allowed, within preset limits, between the central rod 120 and the vertical trailing resistant stud 50. This is particularly aimed at allowing the rod carrier 18 and the activating carriage 12 to always reach the end-of-stroke position in which the motor M is stopped, even when obstacles are interposed between the switch point and the rail against which it is thrown, and prevent the switch point from being thrown against said rail in the end-of-stroke position, or when the switch points are only partially displaced either in the case of incomplete trailing or due to the action of transverse oscillations of rail cars running in the right direction through the switch but nonetheless exerting such translation forces on the switch points, as to simulate the trailing condition.

[0058] The slots 52 have such a length that, the relative stroke between the central rod and the carriage which, in the above case is run against the action of the leaf springs 220, always keeps the rollers of the leaf springs within the inclined plane 518 of the rod carrier 18. Hence, the central rod may perform small movements relative to the rod carrier 18 and to the actuating carriage 12, but may be never completely released therefrom like in the case of complete trailing when the turnout is trailable.

[0059] In order to allow the turnout to be actuated, even in the case of a stud which cannot be controlled automatically in its operating and idle position, there are provided means for automatically carrying the stud 50 into its idle position upon actuation of the turnout. In this example, lifting means are provided for the purpose, which are associated to the rod carrier 18 and consist of inclined planes 154 of a cam track 54 cooperating with a roller 53 which is supported in such a manner as to

rotate about an axis transverse to the sliding direction of the central rod 120 and to overhang laterally in line with said inclined planes 154 at the free end of the stud 50.

[0060] Upon actuation of the rod carrier 18, before the stud 50 reaches the corresponding end of the associated slot 52 in the central rod 120, the roller 53 on the stud 50 comes to cooperate with the inclined plane 154 of the cam 54 carried by the rod carrier 18 and is lifted into a position in which it is released from the corresponding slot 52 of the central rod 120, thereby allowing the latter to be freely displaced with the rod carrier 18. When the end-of-stroke switching position is reached, an opposite inclined plane or an interruption of the cam track pushes the stud 50 back to the position in which it engages the other slot 51 in the central rod 120 thereby restoring the non-trailability condition.

[0061] With reference to Figures 5 to 15, the invention includes particular means to make the switch non trailable and to signal partial trailing conditions. The stud 50 is mounted at the end of a saddle 60 which is accommodated in an enclosure 61, in such a manner as to be able to slide in the axial direction of the stud itself and perpendicular to the rod. The saddle 60 is stressed by a spring 62 into a stable condition in which it engages the slots 52 of the central rod. A transverse tailpiece of the stud 50 which is provided in the form of a spindle or axle 63 bears a control roller 53, cooperating with the cam 54, 154 of the rod carrier 18, in a slightly staggered position, coinciding with the cam 54, 154. The latter displaces the roller alternately upwards to a position in which the stud 50 does not interfere with the corresponding end of the two slots 52 of the central rod 120, when the switch points are displaced properly, thanks to the carriage and to the associated rod carrier 18, and to a position in which the stud 50 interferes or engages in the corresponding slot 52 of the central rod when the switch points are in one of the two end-of-stroke positions. In this condition, if the switch points are displaced by a force exerted directly thereon, e.g. by rolling stock, thanks to the elastic connection between the leaf springs 220 and the rod carrier 18, the rods 21 and the central rod 120 may be displaced relative to the enclosure and to the stud 50 as well as relative to the rod carrier 18. Nevertheless, the displacement of the switch points under a direct force acting thereon does not allow the stud 50 to be displaced to a position of non-interference with the end sides 152 of the respective groove 52, since the carriage for driving the rods 120, 21, i.e. the rod carrier 18 which controls displacement while the stud 50 is in the idle position stands still.

[0062] As is apparent from Figs. 5 to 7, in the proper end-of-stroke position of the switch points, the stud 50 is at a certain distance from the end wall 152 of the slot 52 against which it abuts when the switch points are displaced due to a direct action thereon. In this case, the initial displacement through a certain distance corresponding to an incomplete disengagement of the leaf springs 220 from the rod carrier 18, i.e. from the inclined planes of the end sides thereof and to a condition in which the switch points are slightly displaced, may be caused for instance by a partial trailing impact or by a side slip of the wheels of a train even though it runs in the proper direction of traffic. Thanks to this arrangement, in these conditions no stress is exerted upon the stud 50, and the switch machine must not necessarily be disabled.

[0063] The stud 50 further has a weakening peripheral groove 250 which has such a depth as to allow the stud to be broken when a predetermined transverse force is applied thereon. When a limited and partial displacement of the switch points occurs, due to a force exerted thereon, the stud 50 does not interfere with the end sides 152 of its respective groove 52 and hence is not broken thereby (Figs. 8 to 12). However, when the switch points are displaced through a distance that exceeds a certain minimum predetermined stroke (Figs. 13 to 15), substantially corresponding to the stroke of the end rollers 320 of the leaf springs 220 associated to the central rod 120, which is run by these rollers to finally pass over the inclined planes 518 of the rod carrier 18, the corresponding end side 152 of the corresponding groove 52 of the central rod 120 comes to cooperate with the stud 50. If the force acting on the switch points reaches the predetermined rupture strength of the stud 50, the latter breaks, thereby leaving the rods 21, 120, hence the switch points the possibility to further move in the direction of the opposite operating position without damaging the other parts of the switch machine.

[0064] The saddle 60 is composed of a first saddle 160 carrying the stud 50 at its end and whereto the roller 53 for controlling the positions of interference and non-interference of the stud 50 is associated, and of a second saddle 260 interposed between the end saddle and the spring 62, which bears the means for controlling the signaling switches 65, 66, two of which are provided for safety purposes. The two saddles 160 and 260 may be displaced in the same direction and are free from each other, hence displaceable either together or separately. Hence, the signaling means may be operated regardless of the displacement of the stud 50 and such feature will be more apparent from the following description. Moreover, the first saddle 160 for carrying the stud 50 cooperates with end-of-stroke stops of stud engagement in the grooves 52 of the central rod 120, which stops face away from the elastic member 62 and delimit the deepest penetration position of the stud 50 in said grooves 52 of the central rod 120.

[0065] According to an additional characteristic of the invention, the stud 50 is associated to means designed to control signaling of the trailing condition, both in case of complete trailing with the stud 50 being broken, and in the case of partial trailing, within a range of displacement of the switch points from a position of simple contact between the end side 152 of the corresponding groove 52 and the stud 50 to the position in which the

stud 50 is broken and passed over, i.e. from an initial trailing position when a minimum stroke is run by the switch points within a range in which such displacement is considered irrelevant for the purposes of detection, to the opposite end-of-stroke position of the switch points after the stud 50 has broken.

[0066] In the illustrated embodiment, these means consist of a rotating slider 70, consisting of two circular coaxial plates 170 which are particularly fitted onto the same axle 63 which bears the roller 53 for controlling the movement of the stud 50 into the positions of interference and non-interference with the grooves 51, said roller also moving the plates 170 into positions of interference and non interference with actuating stops again consisting of the end sides 152 of the grooves 52 of the central rod 120. The two circular plates 170 have a flattened portion 270 on the side facing toward the end side 152 of the corresponding groove 52, which is relevant for the corresponding displacement direction of the switch points upon trailing. Said flattened portion is ahead toward the relevant end side 152 of the corresponding groove 52 with respect to the stud 50. Moreover, the circular plates 170 which obviously have their flattened portions in diametrically opposite positions, have a first peripheral cam track with a particularly V-shaped recess 370, for engagement of a roller 71 fitted onto the second saddle 260 for controlling the signaling switches 65, 66. The roller 71 and the groove 370 have the joined function to hold the circular plates in the defined starting position and the faces of the groove 270 are inclined to such an extent as to set a predetermined force for holding the two circular plates 170 in position, below which said two circular plates 170 are not rotated. Hence, as long as the switch points are displaced within a certain stroke and the force exerted thereon is lower than the force whereby the circular plates 170 could be released from the retaining roller 71, the two plates are not set into rotation and the second saddle 260 for controlling the signaling switches 65, 66 is not displaced against the action of the spring to the state in which said switches are operated.

[0067] It shall be noted that the grooves 52 or the single groove 51, since only the two opposite end sides 152 nearest the switch points are relevant, have such an extension that each end side 152 always coincides with the central stud 50, whereas the two opposite and facing end sides 152 extend sidewise to such an extent as to be coincident or interfere with one of the two rotating circular sliders 170 respectively, i.e. with the circular slider whose flattened portion 370 faces toward the corresponding end side 152 respectively.

[0068] According to an additional characteristic, in order to allow the saddle 260 for controlling the signaling switches 65, 66 to be maintained in the signaling position when such a partial trailing action has been exerted on the switch points as to displace the sliders 60 for detecting and signaling such partial trailing, but not as to cause the stud 50 to break (Figs. 10 to 12), a peripheral profile 470 which forms another depression-like cam track having a predetermined angular width is provided at the periphery of the circular plates 170 immediately past the groove 370 with reference to the corresponding direction of rotation of the corresponding circular plate 170. The depression 470 has end faces 570 whose shape is such as to form stops for stably holding the circular plate in its angular position and for preventing it from taking its former angular position. Therefore, in the partial trailing position, the signaling switches 65, 66 are stably operated and functionality may be only restored by a manual intervention whereby the circular plates 170 are brought back to their starting position after checking the functionality of the switch machine. Such functionality is independent from the behavior of the stud 50, which is not under stress here. The peripheral cam track 470, 570 has such an angular width as to allow that the conditions in which trailing is signaled may be maintained even when complete trailing occurs, and the stud 50 breaks, as shown in Figs. 13 to 15.

[0069] Trailing conditions are detected when the signaling switches 65, 66 are operated, as well as when signals are received from the position sensors associated to the carriage and/or to the rod carrier 18. In fact, the switches for signaling the trailing condition are operated anytime the stud 50 and/or the means 70 for detecting and/or signaling partial trailing are moved outwards either due to trailing or to the displacement caused by the cams 54, 154 of the rod carrier when the switch machine is in normal operating conditions. Nevertheless, while in the latter conditions, the rod carrier 18 and/or the carriage cause their own position signals to be switched, in case of trailing said position signals of the rod carrier 18 and/or the carriage are not switched, the switches for signaling the displacement of the stud 50 and/or of the sliders 170 for detecting and signaling partial trailing conditions are only switched.

[0070] With reference to Figures 16 to 25, a variant embodiment of the switch machine of the previous Figures 1 to 15 is shown. The features are substantially the same, except that there is not provided a real trailing resistant stud 50, but a mechanical member which breaks upon trailing but is of no essential hindrance to the translation of the switch points. Essentially, in this embodiment the stud 50 is replaced by a mechanical member of an irreversible fuse, which is denoted as 50'.

[0071] The variant embodiment as shown in Figures 16 to 25 is further improved as regards construction rationalization and in terms of position of the axis along which the saddles slide parallel to the upper wall of the switch machine. This allows to limit dimensions in the vertical direction, which is particularly advantageous for a switch machine which is integrated in a box replacing a rail tie or positioned like a rail tie.

[0072] In this case, the saddle 60 consists of a plate 160 which may be moved transverse to the direction in which the rods 21, 120 slide and parallel to the upper wall of the switch machine. The saddle 160 is subjected

to the action of a spring 62 which pushes it to a stable end-of-stroke position in which a first displacing roller 53 interferes with a cam 54, 154 of the rod carrier 18. The roller 53 projects downwards from the plate 160 toward the inside of the switch machine and in a position coinciding with the cam 54, 154, which is obviously staggered through 90° with respect to the cam 54, 154 of the previous embodiment. Like in the previous embodiment, a second saddle 260 is interposed between the plate 160 and the spring 62 and bears, like in the previous embodiment, a roller 71 which cooperates with the recess 370 of the slider for detecting and signaling the partial trailing condition. The second saddle 260 controls, like in the previous embodiment, two signaling switches 65, 66. Here, the slider for detecting and signaling the partial trailing condition 70 consists of a single circular plate 170' which is fitted in such a manner as to rotate about its axis onto the first saddle or plate 160, parallel thereto. On the lower side of the circular plate 170', in a diametrically opposite position with respect to the peripheral retaining recess 370 cooperating with the roller 71, said plate 170' has an axial tooth 670 which projects inside the switch machine through an arched aperture having the shape of a sector of a circle 360 and being formed in the sliding plate 160, said tooth being coincident, in a position of interference with the rods 21, 120, with stops 152', associated to said rods 21, 120, designed to rotatably actuate said plate. The first plate-like saddle 160 bears a stationary pin 50' which is engaged in an aperture 770 shaped like a coaxial sector of a circle and formed in the circular plate 170. This pin 50' has, as described above, the same function as the stud 50 with the predetermined rupture strength of the previous embodiment.

[0073] On both sides of the V-shaped recess 370 the circular plate 170 has a recess 470 which is identical to the one described with reference to the previous embodiment. However, this functionality is achieved here by a single circular plate 170 which has the function to detect and signal the partial or total trailing condition for both switch point displacement directions. The rods, or the central rod 120, does not have several grooves 52, but one or more projections whose end sides 152' form abutments cooperating with the tooth 670 of the circular plate 170' in the two end-of-stroke positions. The cam 54, 154 associated to the carriage and/or to the rod carrier 18 causes, like in the previous embodiment, the lateral displacement of the plate 160 which forms the first sliding saddle, and hence of the slider 70 for detecting and signaling the even partial trailing condition, i.e. of the rotatable plate 170 together with the driving tooth 670 and of the pin 50' engaged in the aperture having the shape of a sector of a circle 770, as well as of the second saddle 260 with the holding roller 71, when the switch points are displaced due to the actuation of the switch machine. Here, the tooth 670 for actuating the slider 70, i.e. the rotatable circular plate 170, is displaced sideways to a position of non-interference with the stops 152' associated to the rods 21, 120.

[0074] The functionality of this second embodiment is substantially the same as the previous one. In Figure 18 and in the corresponding Figure 22, the switch points are in one of the two thrown positions and the plate 170 is disposed with the tooth 670 in a position of interference with the facing stop 152' which is positioned at a certain distance from the tooth 670. In the condition as shown in Figure 19 and in the corresponding Figure 23, the switch points have been slightly displaced to an extent substantially corresponding to a slight trailing attempt or to a side slip of a rail car. The stop 152' has not abutted against the tooth 670 of the circular plate 270'.

[0075] Fig. 20 and the corresponding Figure 24 show the situation of a partial trailing attempt. Here, the switch points are displaced to such an extent as to disengage the circular plate 170' from the holding roller 71 and to cause it to rotate by letting the roller 71 pass in the recess 470 beyond the non-return projection 570. Nevertheless, the displacement stroke of the switch points is not sufficient to cause the pin 50' to break, and the latter only reaches the end-of-stroke position in the aperture 770 having the shape of a sector of a circle.

[0076] Figs. 21 to 25 show a trailing condition which caused the switch points to be displaced to a greater extent than allowed by the aperture shaped like a sector of a circle 770 and in which the force exerted by the switch points exceeded the rupture strength of the pin 50' which was broken by the end side of the aperture 770 shaped like a sector of a circle , thereby allowing the switch points to be displaced freely in the direction imposed by the trailing action.

[0077] In both conditions of Figures 20, 21, 24, 25 the signaling switches 65, 66 are kept operating.

[0078] Construction advantages are self-evident from the previous description of this second embodiment, i. e. smaller dimensions, a smaller number of parts and a simplification of the conformation of the parts to obtain a pin having a predetermined rupture strength and the means for signaling the partial trailing condition.

[0079] Obviously, as shown in the different embodiments illustrated herein, the invention may be greatly varied, especially as regards construction, without departure from the inventive principle disclosed above and claimed below, which consists in providing means for opposing the displacement of the switch points in the trailing condition by a predetermined rupture strength and in combination with a stable signaling condition which is irreversible without a manual intervention by the personnel.

Claims

1. A switch machine for railroad switches or the like, having a trailing resistant device for opposing trailing of the switch points, which switch machine comprises:

a drive unit (12, 18, 120, 21, 24) for transmitting linear throw motion to the switch points (A1, A2, A1', A2'), including a movable switch point carrier member (12, 18), which is dynamically connected to a drive motor (M) ;
displacing drive means (120, 21, 220) which transmit motion from the carrier member (12, 18) to the switch points, and are connected to said carrier member by connections (220, 518) which are releasable when a predetermined and resettable force is exceeded, to allow free motion of the drive means, hence of the switch points relative to the carrier member;
mechanical trailing resistant means (50, 50'), for opposing the displacement of the switch points, i.e. of the drive means (21, 120) from either proper operating position of the switch points due to the direct exertion of a force on the switch points, which means (50, 50') may be actuated when the switch points reach their proper operating position, and disabled when the carrier member (12, 18) is operated to displace the switch points from one to the other operating position.

characterized in that

the trailing resistant means (50, 50') for opposing displacement of the switch points, which are integral with a stationary portion of the switch machine, are made in such a manner as to have a predetermined rupture behavior when the force exerted thereon exceeds a predetermined value, so that they break and release the drive means under the action of a predetermined switch point displacement force directly exerted on the switch points, particularly by the wheels of a rail car.

2. A switch machine as claimed in claim 1, **characterized in that** the trailing resistant means consist of connecting keys, studs or pins (50, 50') which cooperate directly or indirectly through mechanisms (70, 170', 670, 770, 50') controlled by said stops (152), with engagement grooves or stops (52, 152, 152') respectively associated to the drive means (21, 120), whereas the pins, studs or keys (50, 50') are associated to a stationary part of the switch machine and are weakened (250) or conformed in such a manner as to oppose a certain maximum rupture strength when the ends of the grooves or stops (52, 152, 152') act directly or indirectly against said trailing resistant means.

3. A switch machine as claimed in claim 1 or 2, **characterized in that** the trailing resistant means consist of means (50') having a predetermined rupture behavior, designed to have the only function of a mechanical fuse.

4. A switch stand as claimed in one or more of the preceding claims, **characterized in that** the trailing resistant means (50, 50') and the stops (52, 152, 152') directly or indirectly cooperating therewith are associated to means (65, 66, 70, 170, 170') for signaling the broken condition of the trailing resistant means (50, 50') and/or of the stops which signaling means (65, 66, 70, 170, 170') are operated when the drive means (21, 120) - typically the rods - take or pass a predetermined relative position with respect to the carrier member (12, 18) and to the stationary parts of the switch machine.

5. A switch machine as claimed in one or more of the preceding claims, **characterized in that**, in order to control actuation and disabling of the trailing resistant means (50, 50') when the switch points are displaced in a normal manner by the displacement of the carrier means (12, 28), said trailing resistant means are mounted (60, 64, 54, 154) so as to be movable between a position of interference and a position of non-interference thereof with the stops (52, 152, 152') associated to the switch point displacing drive means (120, 21), whereas said displacement is controlled by actuating cams (54, 154), which are integral with the carrier means (12, 18) and cooperate with control rollers (53) whose displacement is integral (63) with the one of the trailing resistant means.

6. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the trailing resistant means (50, 50') are provided in combination with elastic means (62) which stress said locking means (50, 50') to a stable interference position, there being provided end-of-stroke stops (90) in said interference position, whereas the displacement of said trailing resistant means (50, 50') into the position of non-interference with the stops (52, 152, 152') associated to the switch point displacing drive means (120, 21) is effected against the action of said elastic means (62).

7. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the trailing resistant means (50, 50') are disposed at a certain distance from the cooperating stops (52, 152, 152', 770) associated to the switch point displacing drive means (52, 152) or to a mechanism (70, 170, 770) controlled by the drive means, when the switch points are in one of the two displacement end-of-stroke positions, in such a manner as to allow a minimum limited displacement of the switch points without cooperation of the stops (52, 152, 152', 770) with the trailing resistant means (50, 50') and consequential rupture thereof.

8. A switch machine as claimed in one or more of

the preceding claims, **characterized in that**, in order to be able to account for incomplete trailing impacts, caused by direct displacement of the switch points which, while exceeding a displacement stroke of the drive means relative to the oscillating tolerances of the switch points due to the proper passage of the train, is not sufficient to break the locking means, means (70, 170, 71, 370, 470, 570) are provided for signaling the occurrence of a limited or partial trailing impact.

9. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the mechanical trailing resistant means (50, 50') and the means (70, 170, 71, 370, 470, 570) for signaling the occurrence of a limited or partial trailing impact are such that they also cause a loss of functionality of the machine, which may be restored by an intentional intervention.

10. A switch machine for railroad switches or the like, having a trailing resistant device, which switch machine comprises:

a drive unit (12, 18, 120, 21, 24) for transmitting linear throw motion to the switch points (A1, A2, A1', A2'), including a movable switch point carrier member (12, 18), which is dynamically connected to a drive motor (M);
displacing drive means (120, 21, 220) which transmit motion from the carrier member (12, 18) to the switch points, and are connected to said carrier member by connections (220, 518) which are releasable when a predetermined and resettable force is exceeded, to allow free motion of the drive means, hence of the switch points relative to the carrier member;

characterized in that it comprises
means (70, 170, 71, 370, 470, 570) for signaling the occurrence of a limited or partial trailing impact, designed to account for incomplete trailing conditions, due to a direct displacement of the switch points exceeding a predetermined minimum displacement stroke of the drive means relative to the rolling stock oscillation tolerances of the switch points.

11. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the means (65, 66, 70) for stably signaling a partial trailing impact consist of sliders (170) which directly or indirectly cooperate with the stops (52, 152, 152') and have surfaces (270, 670) for abutment against said stops which are closer to the facing stop (52, 152, 152') relevant for the intended switch point displacement direction as compared with the distance of the trailing resistant means from said stops (52, 152, 152') and which means (70, 170, 170') for signaling partial trailing are displaced by said stops (52, 152, 152') associated to the switch point drive means (120, 21) to a position in which the signaling switches (65, 66) are actuated, upon displacement of the drive means (120, 21) due to a direct action of the switch points.

12. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the signaling means (70), i.e. the sliders (170, 170') are also mounted in such a manner as to allow displacement thereof alternately to positions of interference and non interference with the stops associated to the means for driving the switch points under the action of the carrier means (12, 18), like the trailing resistant means (50, 50').

13. A switch machine as claimed in one or more of the preceding claims, **characterized in that** both the trailing resistant means and the means for signaling partial trailing are mounted on a single displacing saddle (60, 160, 260) which is controlled by cams (54, 154) associated to the carrier means (12, 18) by means of control tailpieces (53).

14. A switch machine as claimed in one or more of the preceding claims, **characterized in that** it has means for holding the signaling sliders (170, 170'), in a stable and not automatically reversible manner, in a signaling switch (65, 66) actuating position, said signaling sliders (170, 170') being associated to signaling position locking means (470, 570, 71) which are in turn brought to cooperation with the signaling means when a partial trailing impact occurs.

15. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the partial trailing signaling means (70), particularly the sliders (170, 170') are associated to a cam (470, 570) which may be moved along with the partial trailing signaling means (70), i.e. with the signaling sliders (170, 170') and cooperates with a lock (71), which is elastically loaded against said cam (470, 570), the latter having a cam track with at least one boss, bulge, projection, even formed as an end of a recess, behind which projection the lock (71) is positioned when displacement occurs due to a partial trailing impact on the slider (170, 170'), so that said slider (170, 170') can no longer snap backwards when the direct thrust force on the switch points stops.

16. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the signaling means (70, 170, 170') are associated to additional means (71, 370) for holding them in the starting position, which only release the signaling

means (70), i.e. the sliders (170, 170'), when a predetermined force on the switch points, hence on the drive means (120, 21), is exceeded.

17. A switch machine as claimed in claim 16, **characterized in that** the holding means consist of a roller (71) elastically stressed (62, 260) against a cam, which may be moved along with the slider (170, 170') and which cam has a recess (370) with inclined end walls, in which the roller (71) is held until a predetermined force is exceeded, the roller (71) being carried by a saddle (260) which cooperates with the signaling switches (65, 66).

18. A switch machine as claimed in claim 17, **characterized in that** the holding cam (370) is made of one piece with the cam (470, 570) for locking the slider (170, 170') in the signaling switch (65, 66) actuating position.

19. A switch machine as claimed in claim 18, **characterized in that** all cam tracks (370, 470, 570) are provided on a single cam associated to a single slider (170') for both displacement directions of the drive means (120, 21).

20. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the holding recess (370) is situated in a central position, and the two tracks (470, 570) for locking the slider (170') in the partial trailing position are disposed on both sides of the recess (370) for holding the slider in the starting position, whereas the slider (170') is free to slide in both directions and has opposite surfaces (670) for abutment against the stops (152') associated to the drive means (120, 21).

21. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the holding cam (370) and the roller (71) cooperating therewith may be also moved, like the trailing resistant means (50, 50'), the sliders (170, 170') and the cam (470, 570) for locking them in the partial trailing position, alternately to positions of interference and non-interference with the stops (52, 152, 152') of the switch point displacing drive means (120, 21).

21. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the sliders (170) have a substantially circular shape, with a flattened abutment face (270, 670) on the side facing toward the corresponding stop (52, 152, 152') associated to the drive means (120, 21), the latter being able to rotate about their axis.

22. A switch machine as claimed in one or more of the preceding claims, **characterized in that** both start position holding cam track (370) and partial trailing position locking cam track (470, 570) are provided along the peripheral edge of the circular slider (170).

23. A switch machine as claimed in claim 22, **characterized in that** the holding roller, and the partial trailing position locking roller may be integrated in a single roller (71) borne on a transverse tailpiece of a member (260) which is slidable in a radial direction with respect to the circular slider (170, 170') and loaded against the peripheral surface of said slider (170, 170') by elastic means (62), as well as provided with stops for operating and/or controlling the signaling switches (65, 66).

24. A switch machine as claimed in one or more of the preceding claims, **characterized in that** it has a circular slider (170) for each sliding direction of the drive means (120, 21), i.e. two symmetrically opposite circular sliders (170) with reference to peripheral flattened portions (270) and to the cam tracks for locking said sliders (170) in the signaling means (65, 66) actuating position, which signaling sliders (170) are rotatably mounted on the same axle (63), the holding recesses (370) along the peripheral edge being coincident, while the cam tracks (470, 570) for locking the sliders (170) in the partial trailing positions are provided on respectively opposite sides of the holding recesses (370).

25. A switch machine as claimed in claim 24, **characterized in that** the stops (52, 152) cooperating with one of the two circular sliders (170) are disposed in an eccentric, adjacent and coaxial position with respect to the two circular sliders (170), and have such an extension as to always cooperate with the trailing resistant pin (50) and only with the flattened portion (270) of the corresponding circular slider (170), without interfering with the second adjacent slider, which is operating for the opposite switch point displacement direction.

26. A switch machine as claimed in one or more of the preceding claims 1 to 23, **characterized in that** the trailing resistant means (50') cooperate directly with the partial trailing signaling sliders (170', 770).

27. A switch machine as claimed in claim 26, **characterized in that** it has a single slider (170') having stop surfaces (770) designed to contact a stationary abutment member (50'), e.g. a pin, tooth, or the like, which is mounted in such a manner as to be able to move with the slider (170') into positions of interference and non-interference with the stops (152') associated to the switch point displacing drive rods (120, 21), the circular slider having elements (670) cooperating with said stops (152') associated to the switch point drive means (120, 21).

28. A switch machine as claimed in claim 26 or 27, **characterized in that** the trailing resistant tooth or pin extends axially, with reference to the axis of rotation of the circular slider (170') and engages in a slot (770) shaped like a sector of a circle, which is coaxial to the circular slider (170').

29. A switch machine as claimed in claim 28, **characterized in that** the slot (770) shaped like a coaxial sector of a circle has such an angular width as to prevent any interference between the ends thereof and the trailing resistant pin (50') until the predetermined partial trailing stroke is exceeded whereas, when the switch point stroke exceeds said predetermined axial stroke, the trailing resistant pin (50') comes to cooperate with one of the two ends of the slot (770), thereby being broken when the predetermined rupture strength is exceeded.

30. A switch machine as claimed in one or more of claims 26 to 29, **characterized in that** the single circular slider (170') is disposed with its axis of rotation perpendicular to the upper surface of the switch machine.

31. A switch machine as claimed in one or more of claims 26 to 30, **characterized in that** the circular slider (170') has an axial tooth (670) on the face turned toward the switch point drive means (120, 21) and cooperates with the stops (152') associated to said switch point drive means.

32. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the trailing resistant means (50, 50') are mounted on a first saddle (160) which is able to slide in a radial direction with respect to the circular slider/s (170, 170'), and bears the common axle (63), about whose axis both circular sliders (170, 170') rotate, whereas the roller (53) for displacing the partial trailing signaling circular sliders (170, 170') and the weakened trailing resistant pin (50, 50') into the two positions of interference and non interference with the stops (52, 152) of the switch point drive means (120, 21), is also mounted on the same saddle (160).

33. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the roller (71) which cooperates with the peripheral cam tracks (370, 470, 570) of the circular sliders (170, 170') is also mounted on a second saddle (260), radial with respect to the circular sliders (170, 170') and independent from the saddle (160) which carries the sliders (170, 170') and the weakened trailing resistant pin (50, 50'), the two saddles (160, 260) being loaded by a single elastic member (62), and disposed in such a manner as to be able to slide together or separately.

34. A switch machine as claimed in one or more of the preceding claims, **characterized in that** the saddle (260) which carries the roller/s (71) for holding and locking in the partial trailing position the circular slider/s (170, 170') is interposed between the saddle (160) which carries the roller (53) for moving the trailing resistant means (50, 50') and the elastic means (62) for pushing them in a stable position of interference with the stops (51, 152, 152') associated to the switch point displacing drive means (120, 21).

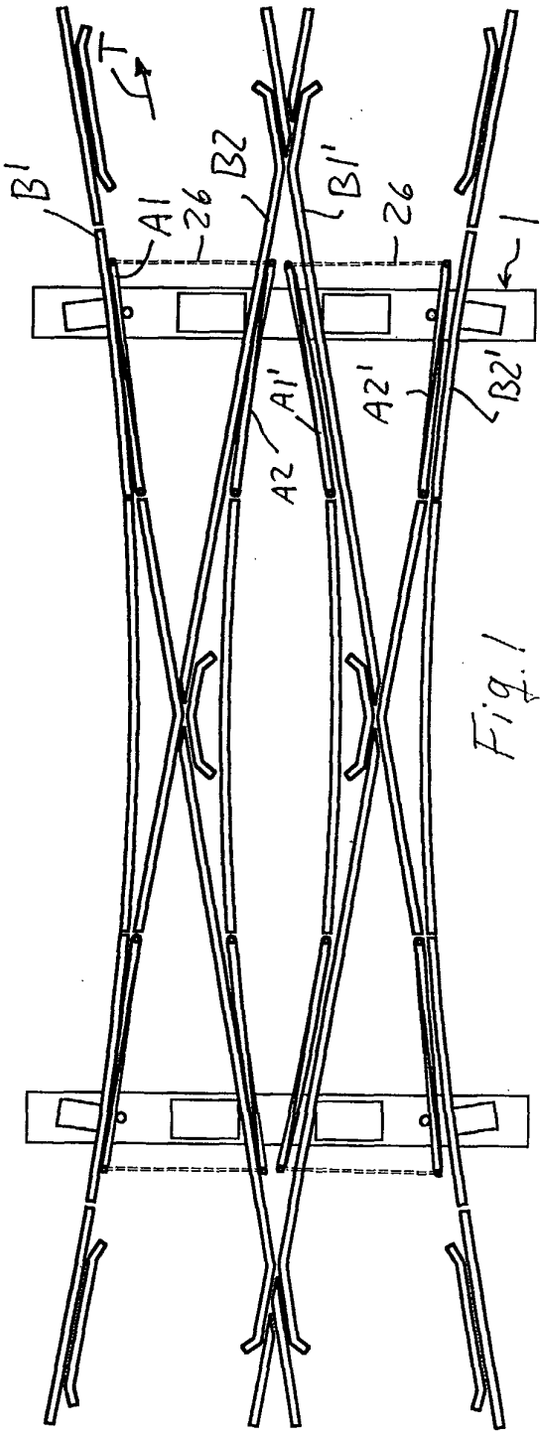
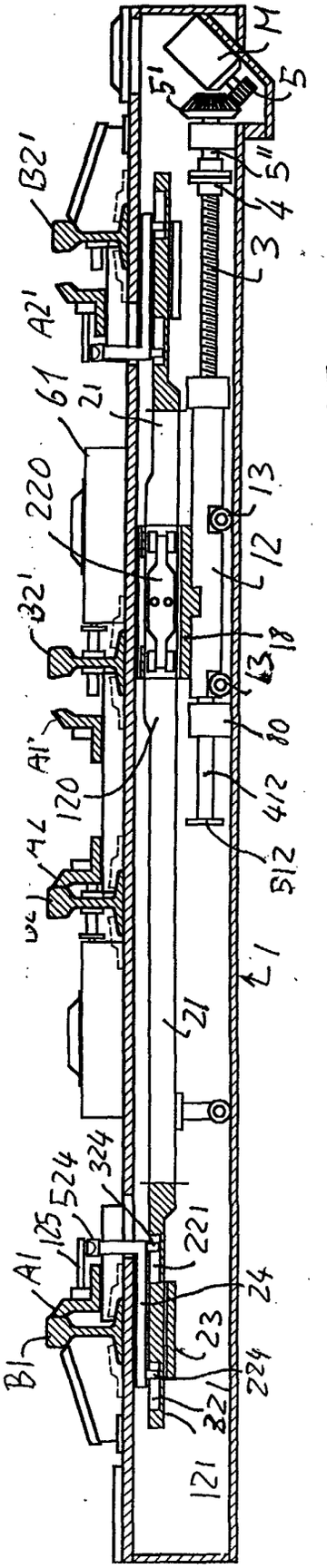

T
B1
A1
26
B2
B1'
26
1
A1'
A2
A2'
B2'

Fig. 1


H
5'
5
5"
4
3
B2'
A2'
61
21
220
13
12
32'
18
31
10
A1'
120
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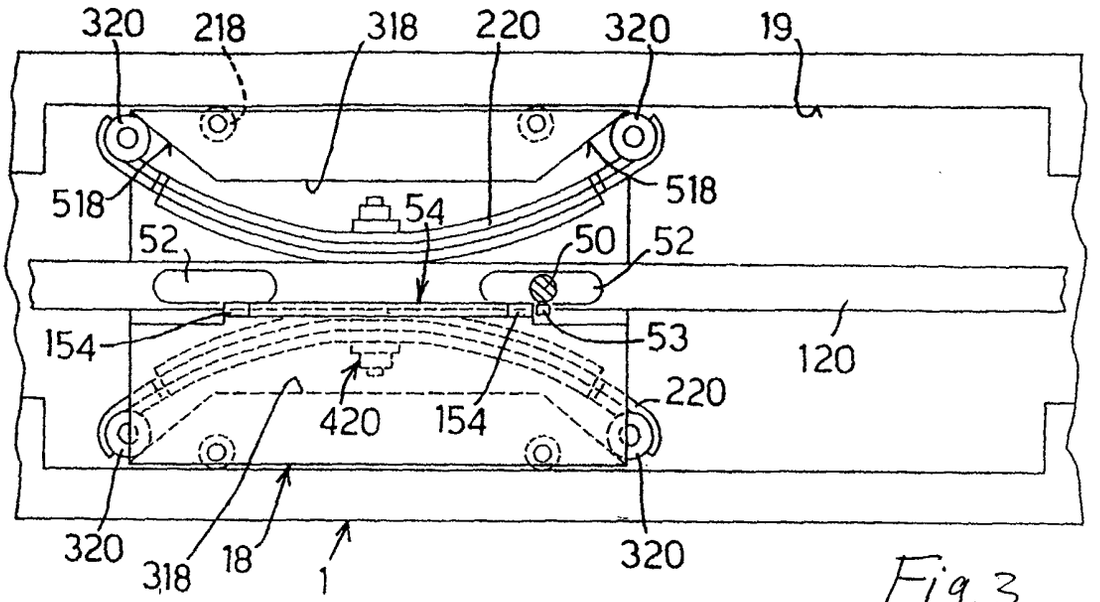
512
41
21
524
324
125
221
A1
24
23
B1
224
321
121

Fig. 2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154
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320
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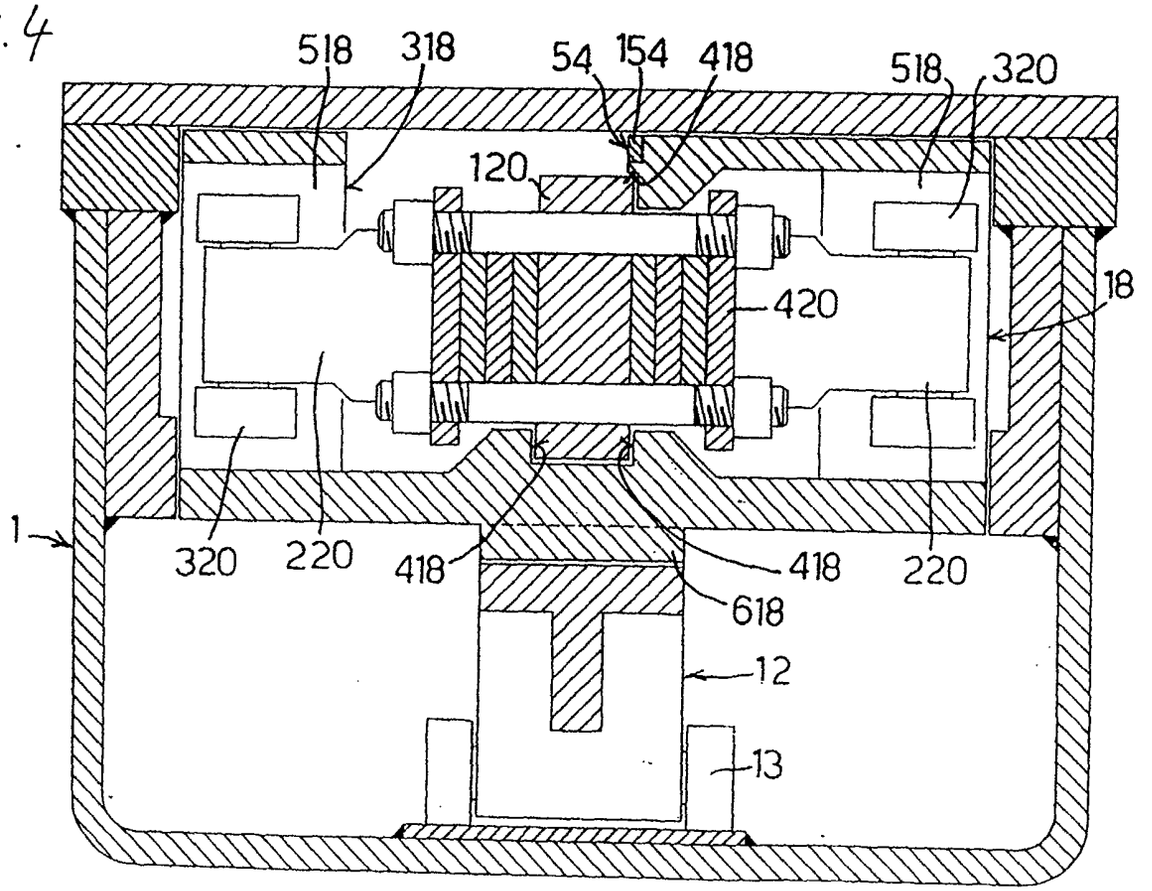
18
1
320

Fig. 3

Fig. 4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618
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13

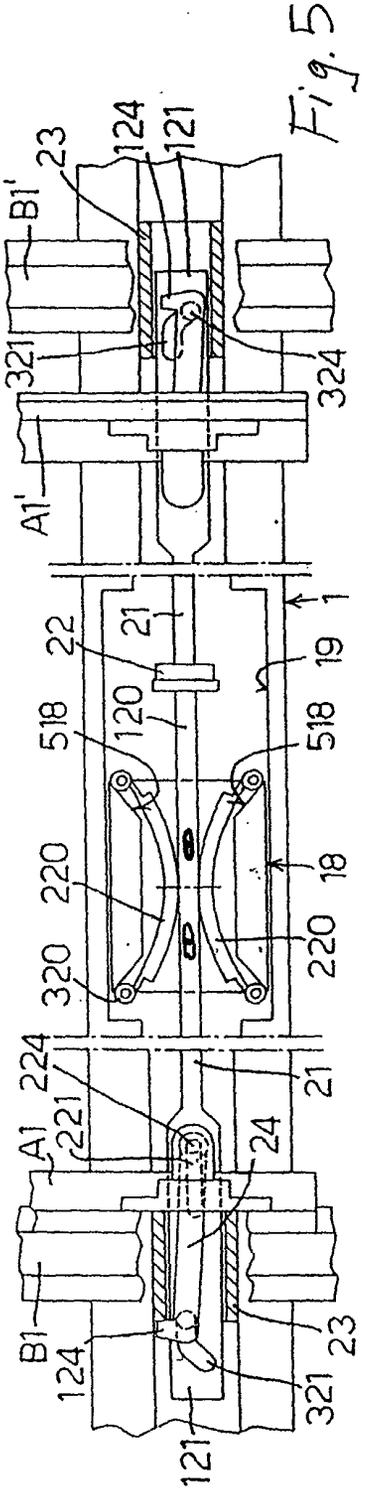
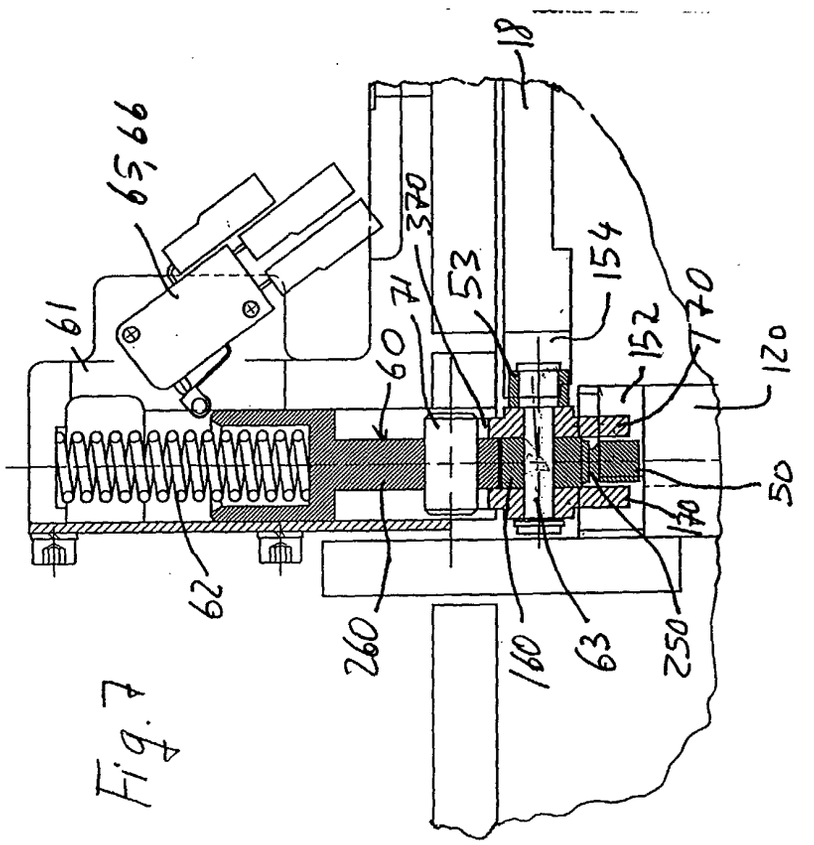


Fig. 5



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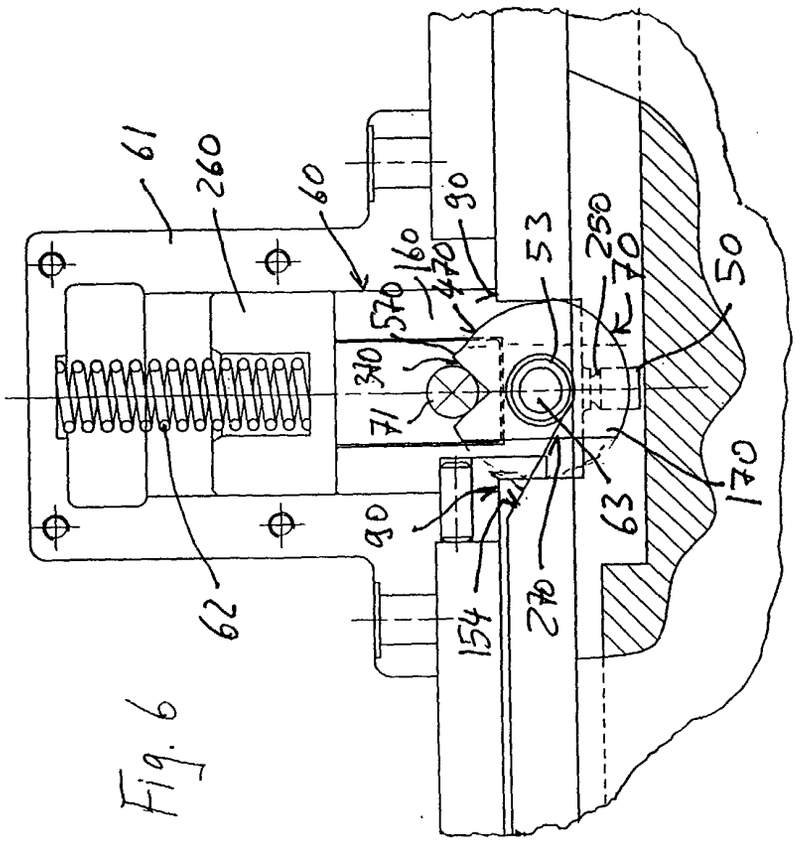

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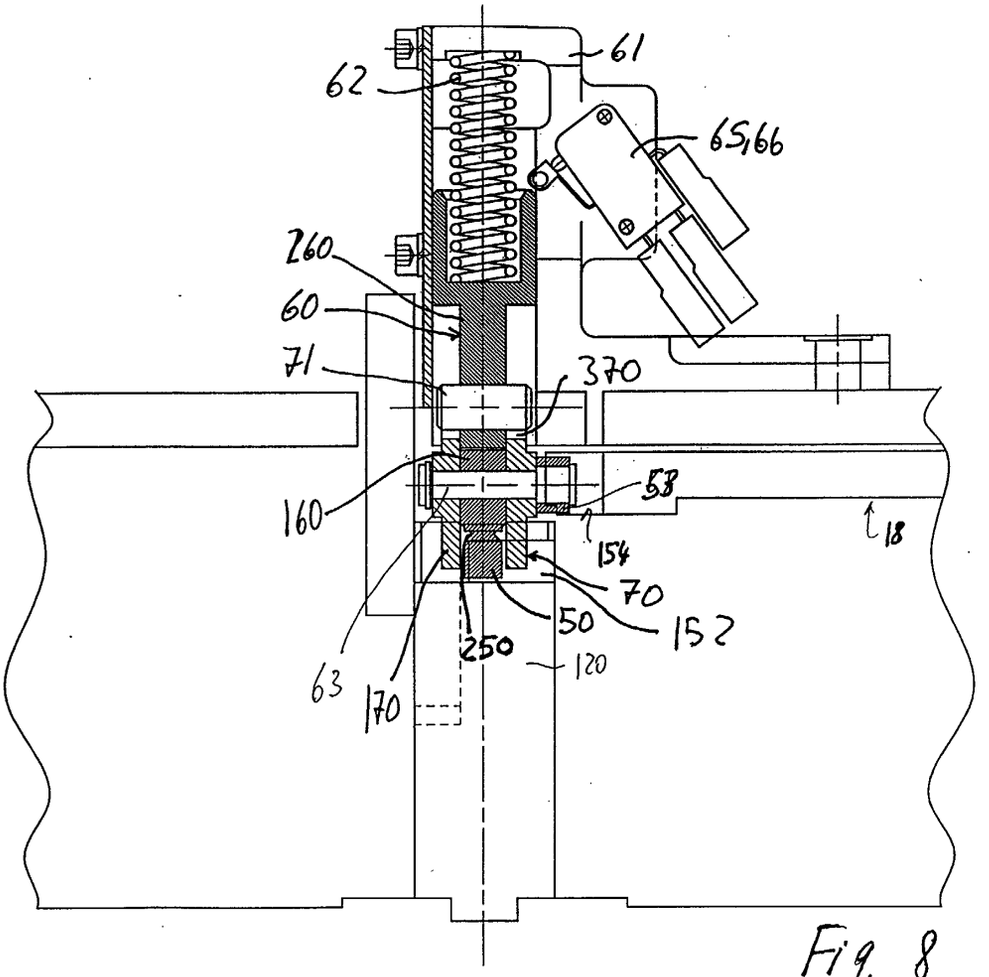
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170

Fig. 8

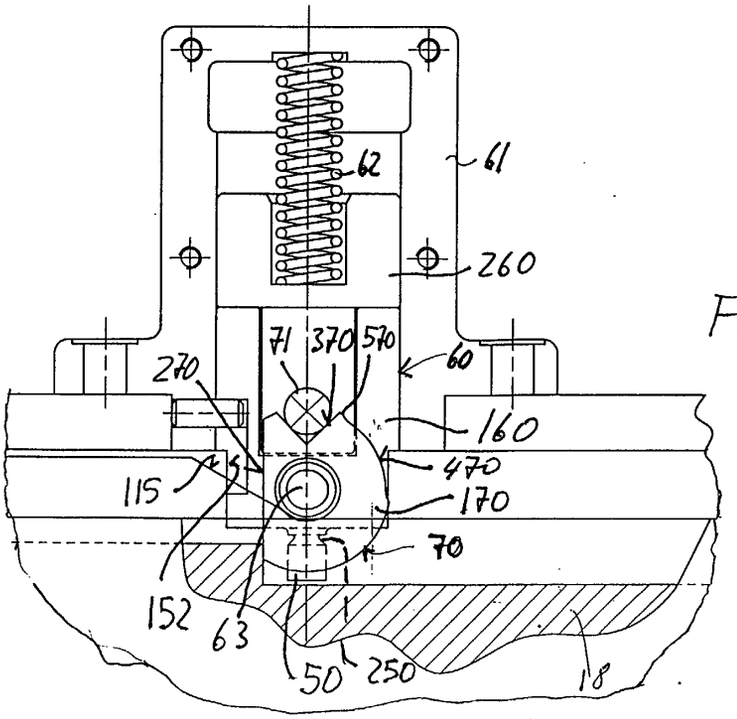
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Fig. 9

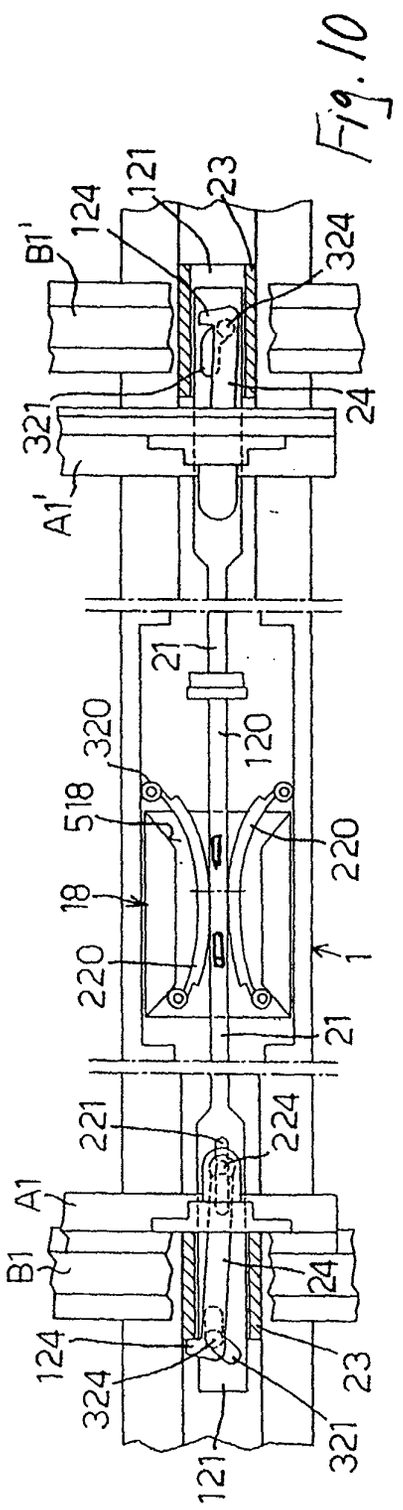


Fig. 10

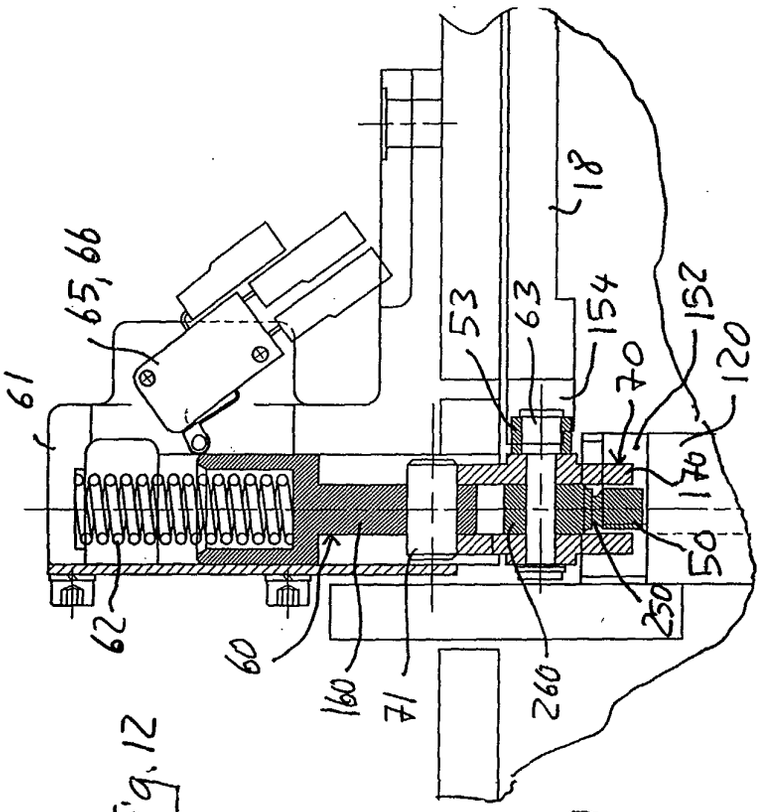


Fig. 12

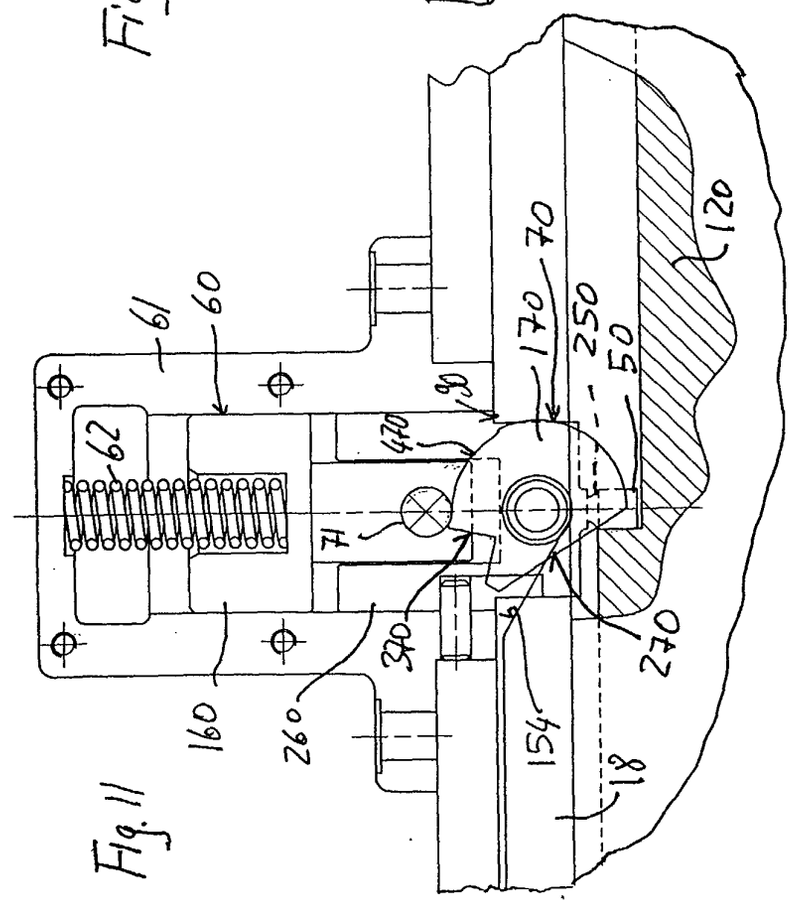


Fig. 11

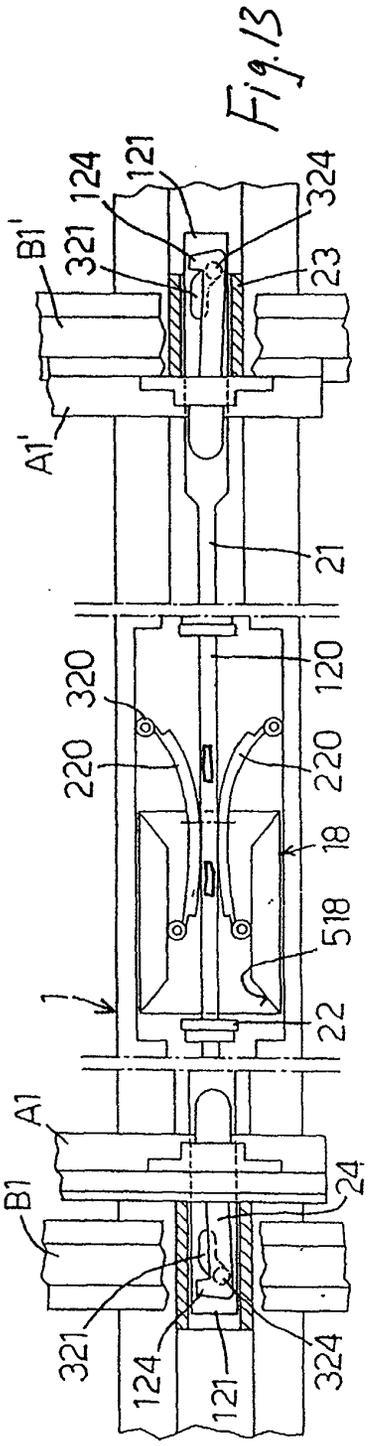


Fig.13

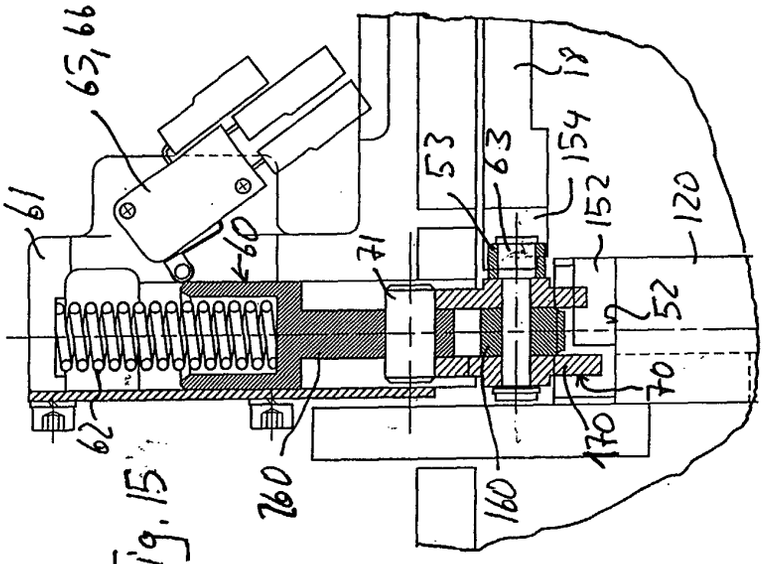


Fig.15

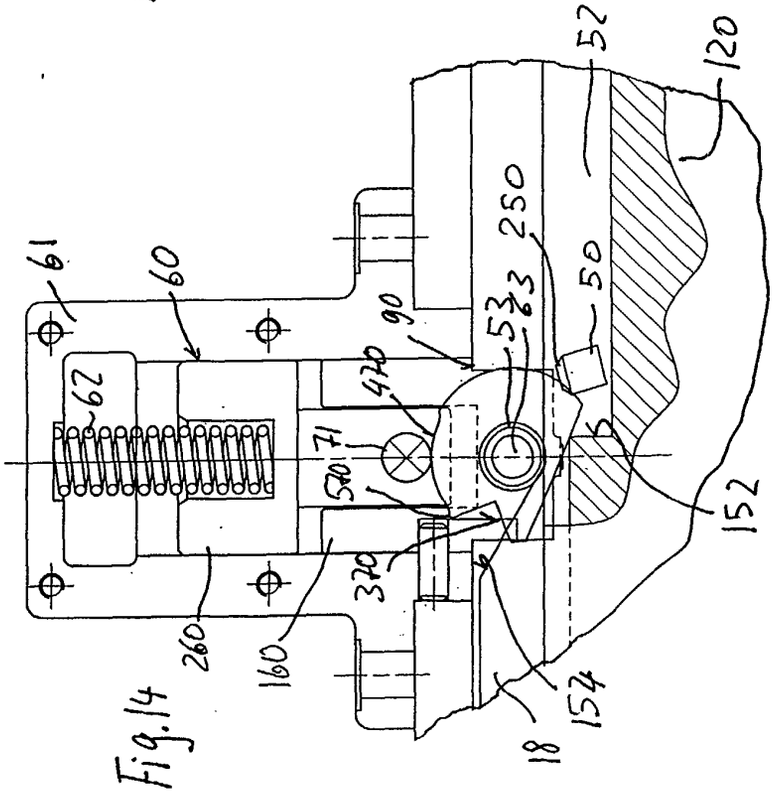


Fig.14

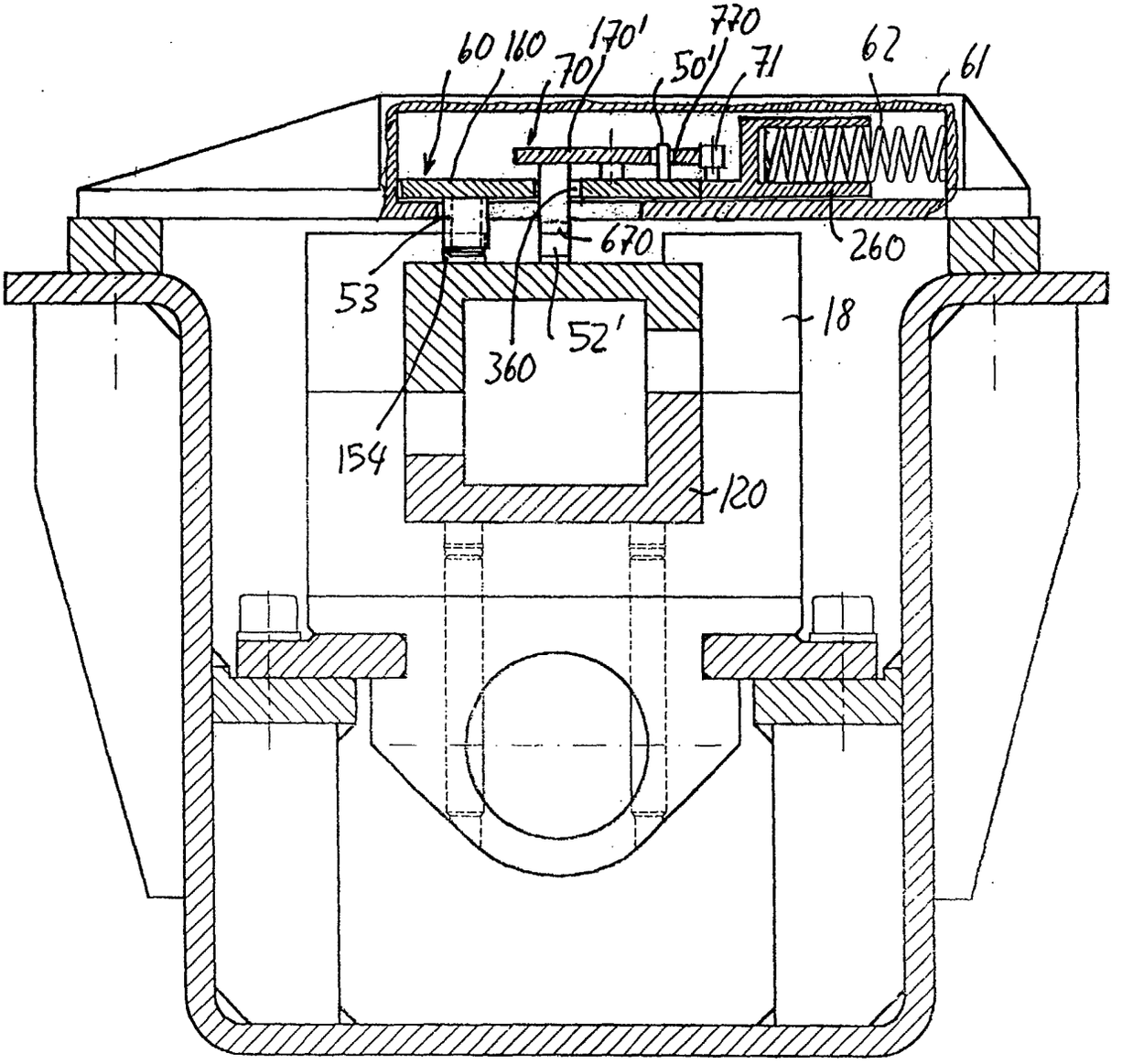
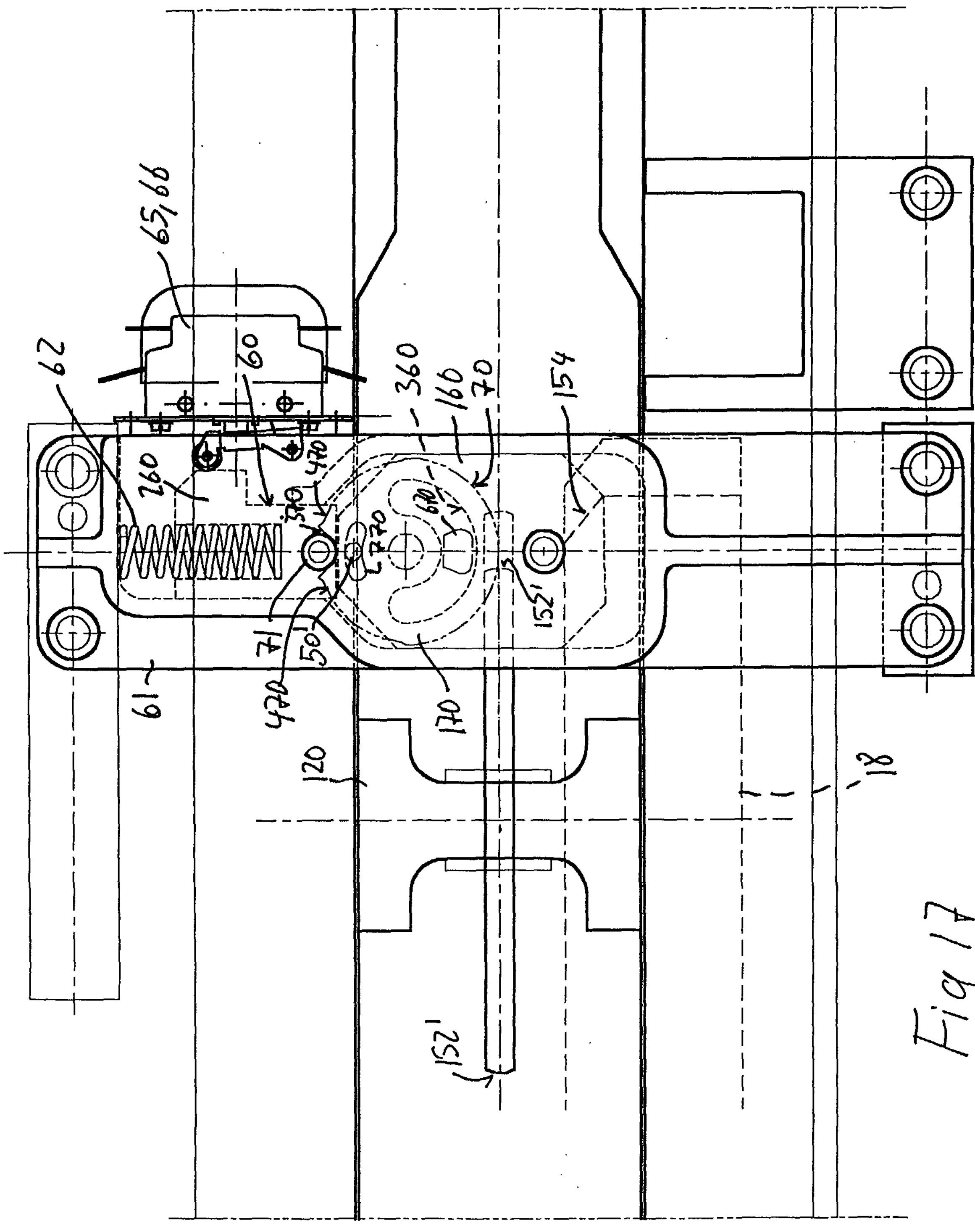


Fig. 16



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65,66
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170
120
152'
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Fig 17

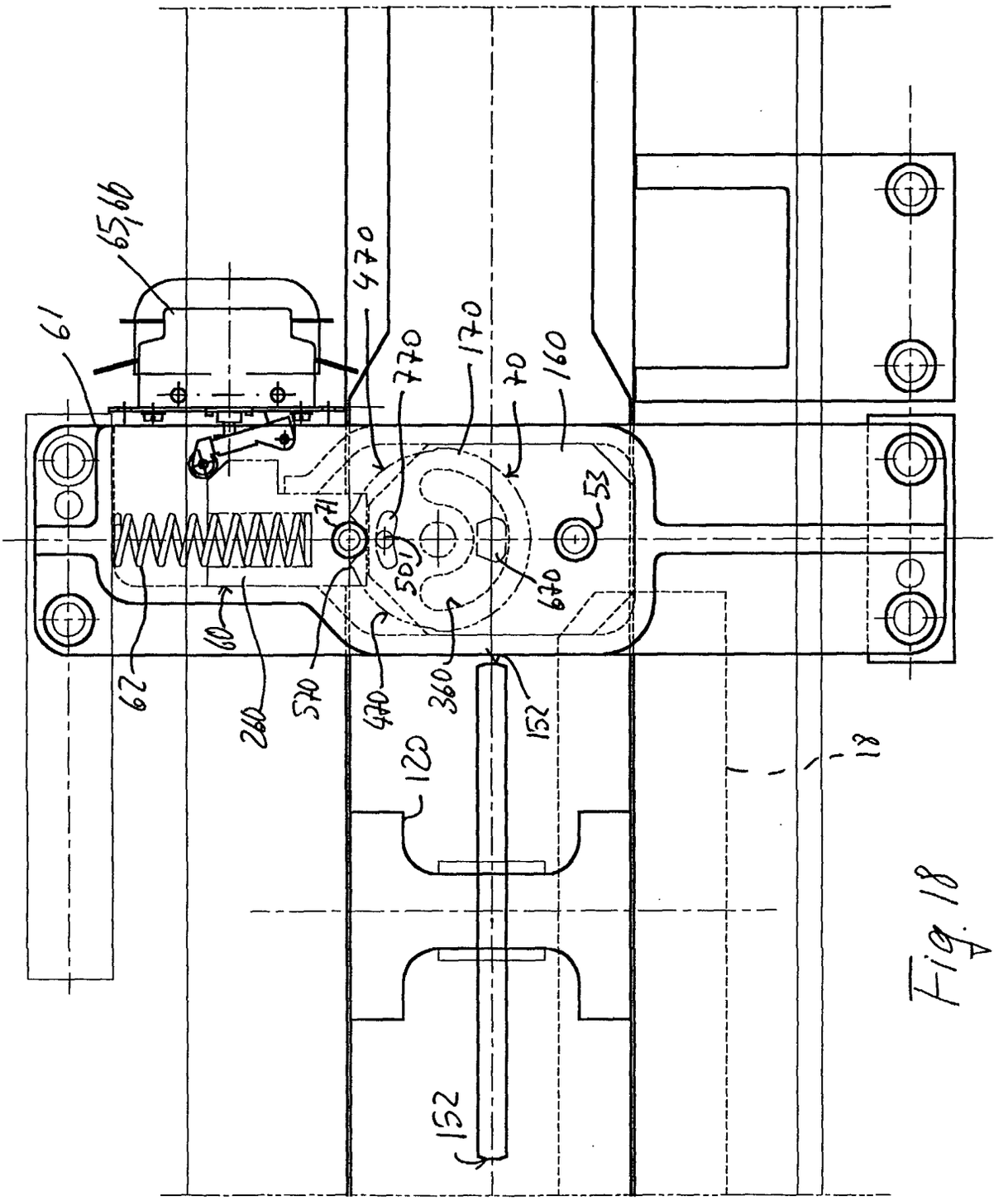
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Fig. 18

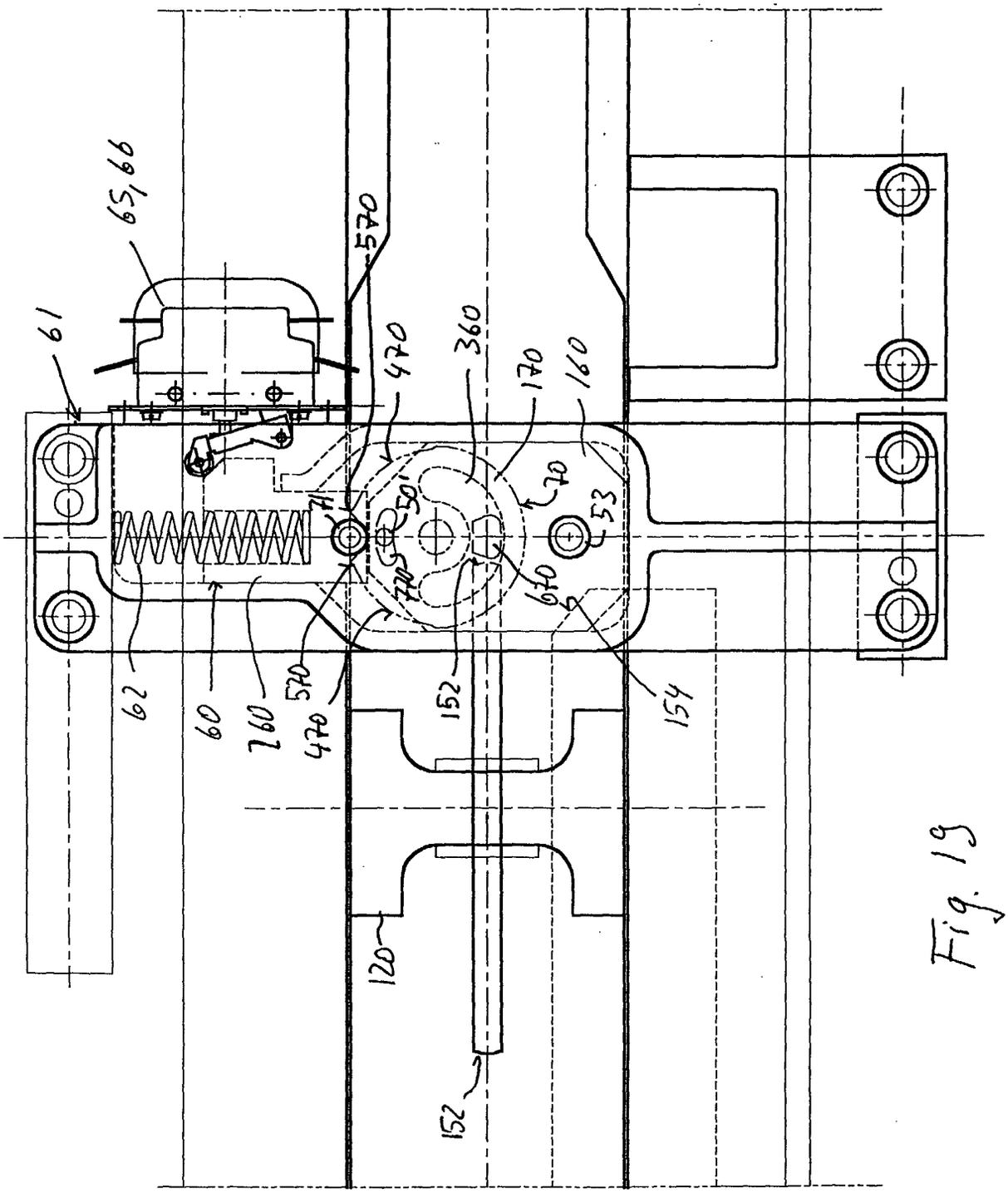
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Fig. 19

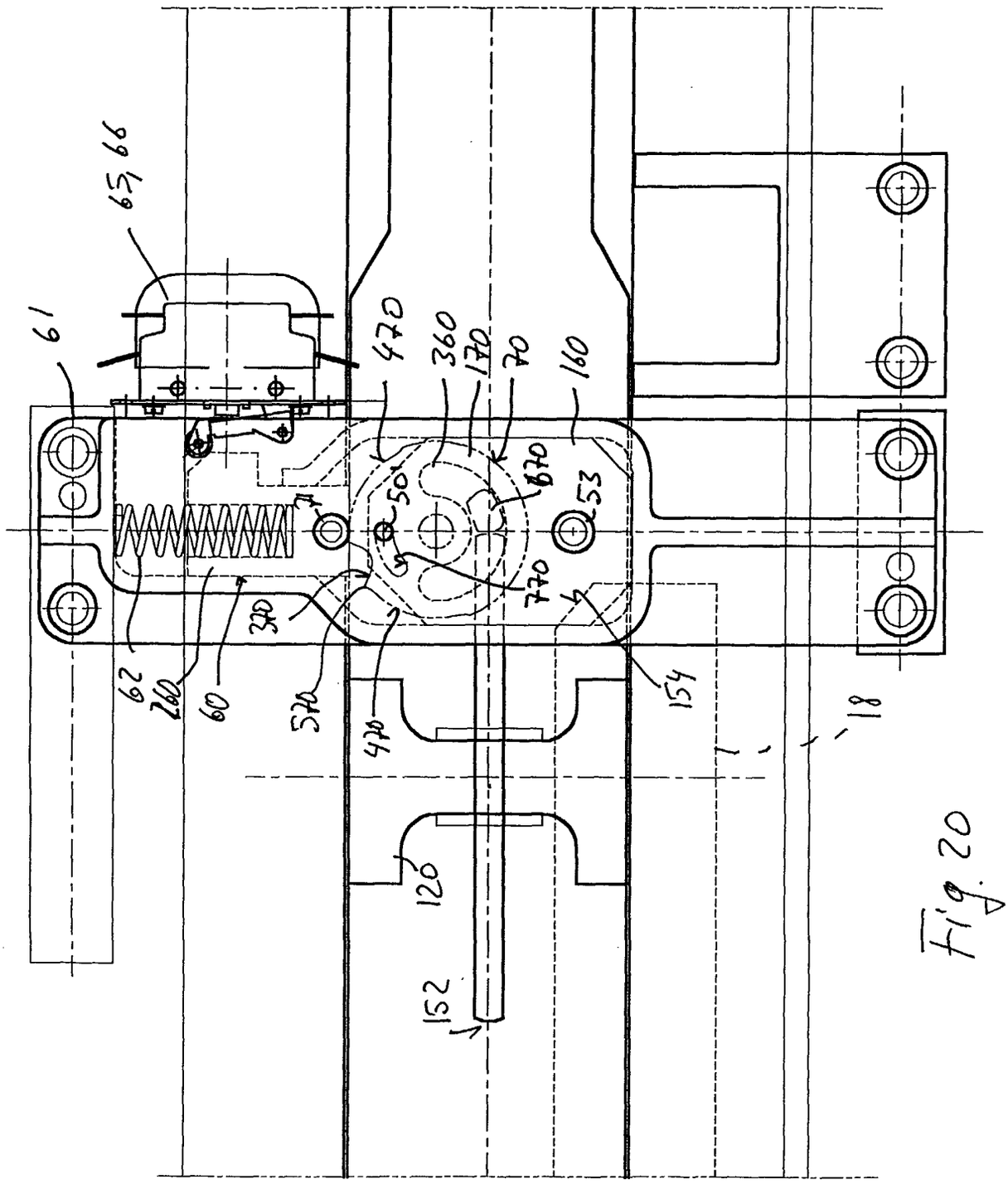
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Fig. 20

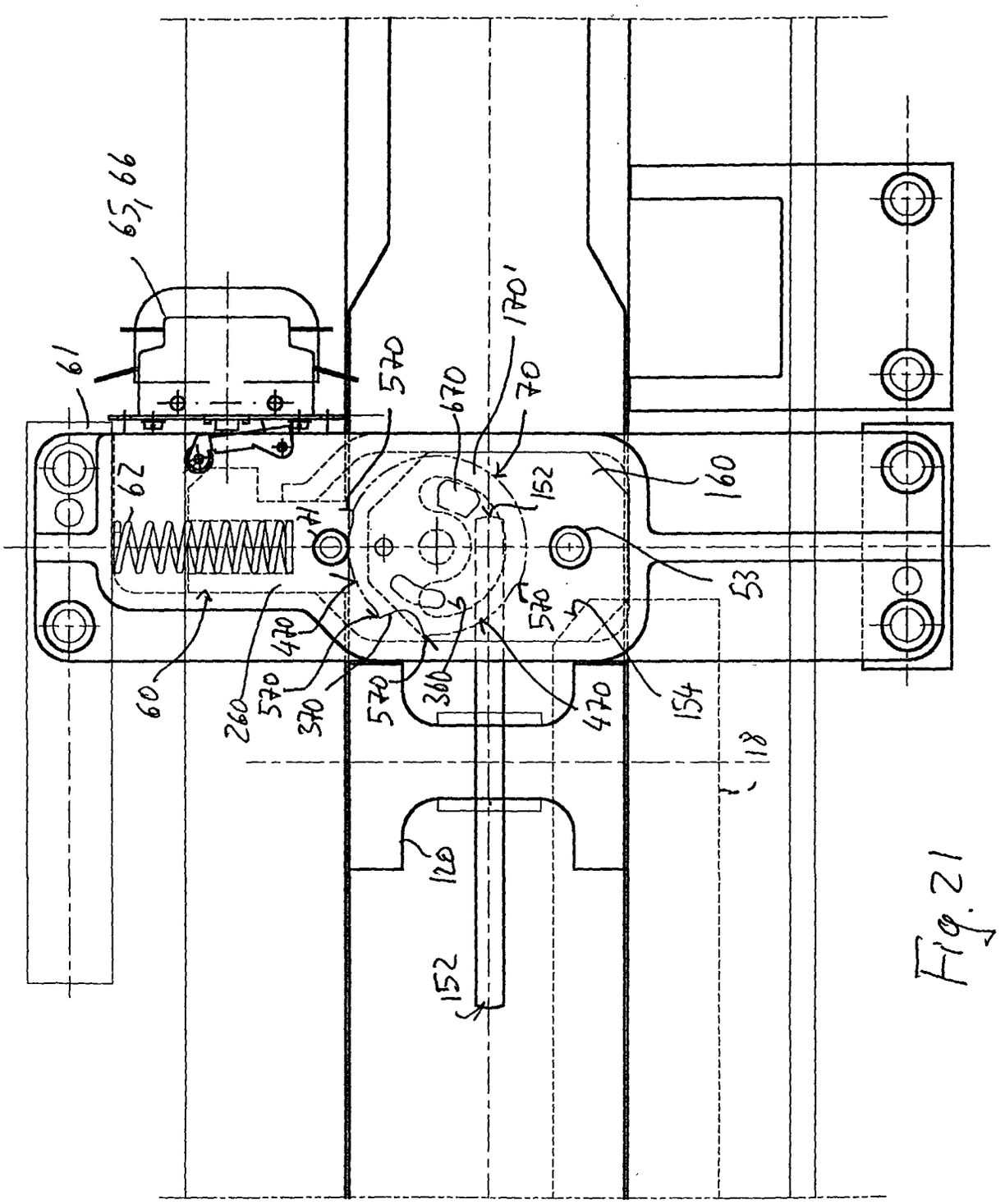
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Fig. 21

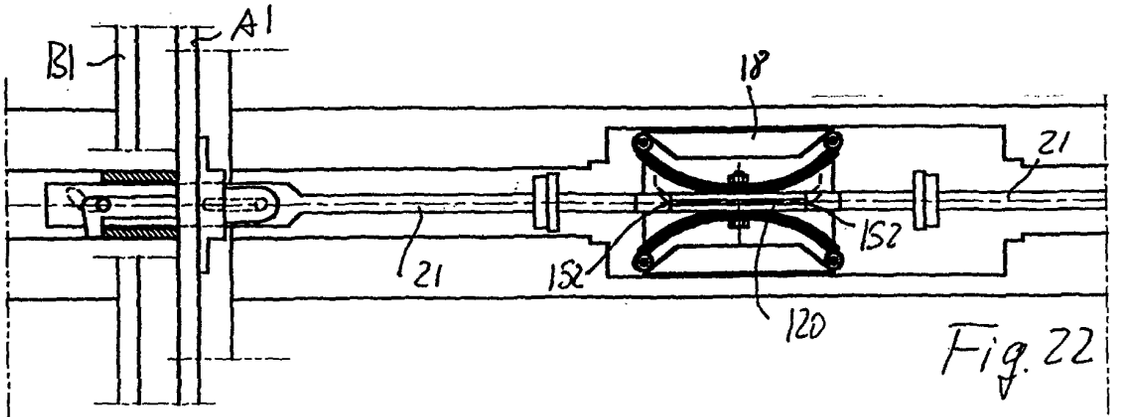

Fig. 22

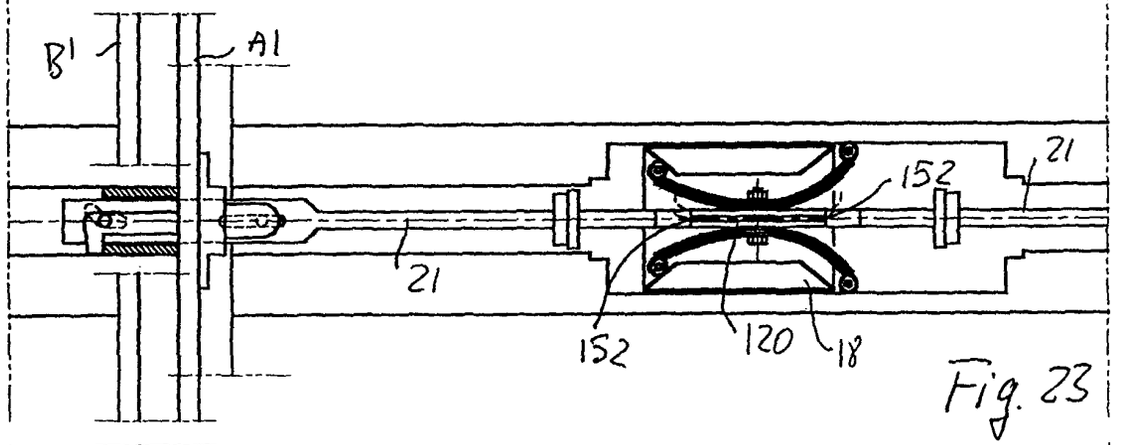

Fig. 23

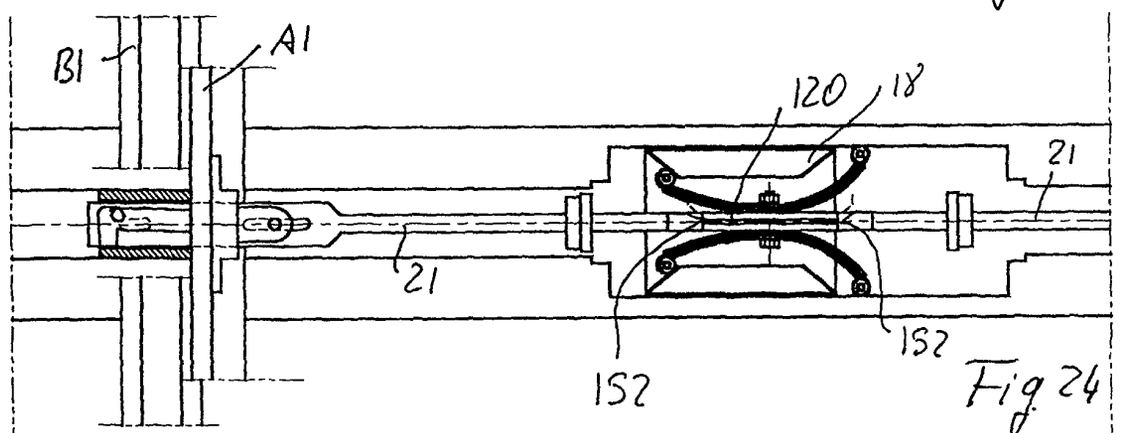

Fig. 24

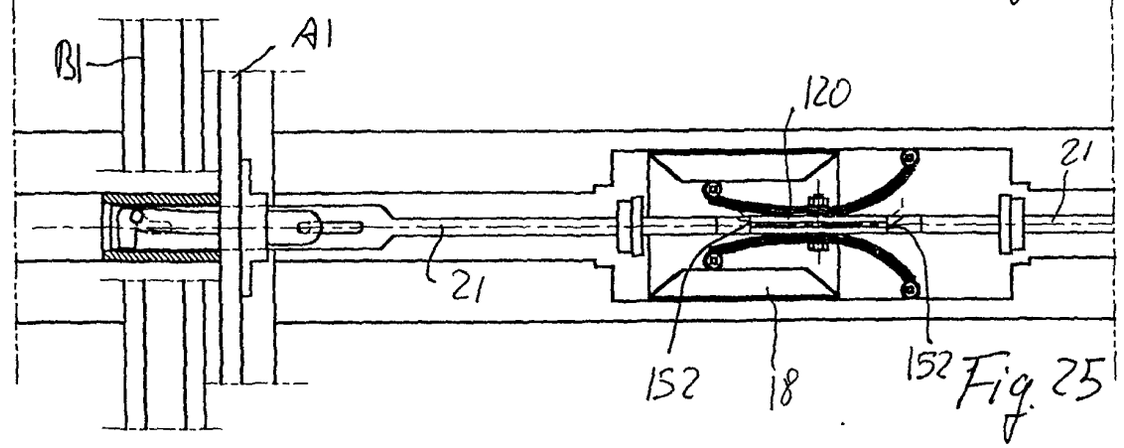

Fig. 25

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 12 9408

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A	PATENT ABSTRACTS OF JAPAN vol. 004, no. 094 (M-019), 8 July 1980 (1980-07-08) & JP 55 051968 A (HITACHI LTD), 16 April 1980 (1980-04-16) * abstract *	1-8	
A	US 5 590 857 A (ALBRECHT HARRY A ET AL) 7 January 1997 (1997-01-07) * the whole document *	1,10	
A	EP 0 320 636 A (SASIB SPA) 21 June 1989 (1989-06-21) * column 2, line 34 - line 52 * * column 7, line 53 - column 8, line 3; figures 6,7,9 *	1,10	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B61L
E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 April 2002	Reekmans, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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