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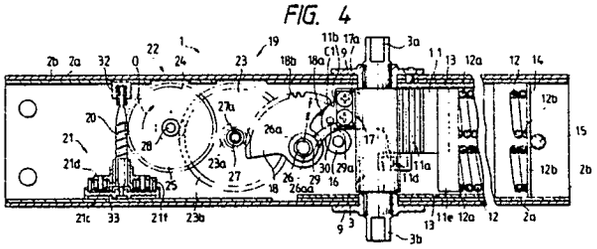
(54) Mechanical door check.

(57) Herein disclosed is a continuous speed change type door check (1) for closing a door, which comprises: a pivot pin (3) made rotatable; a slider (11) adapted to be linearly moved by the rotations of the pivot pin (3) and to rotate the pivot pin (3) when it returns; a coil spring (11) for biasing the slider to return; a gear train (19) for speeding up the rotations of the pivot pin (3); brake means (21) connected to the gear train (19); and a one-way transmission clutch (22) for operating the brake means (21) in a direction to close the door.

FIG. 4



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MECHANICAL DOOR CHECK

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a door check for automatically closing an open door and, more particularly, to a continuous speed change type door check for closing the door at a continuously changing speed.

Description of the Prior Art

Most frequently practised in the prior art is an oil cylinder type door check in which a piston is slidably fitted in a cylinder having a spring and a working fluid or oil confined therein so that the spring may be energized when the door is opened whereas the flow resistance is utilized to provide a damping effect when the door is closed.

Another door check is proposed in Japanese Patent Publication No. 52 - 21810, for example. This is the so-called "mechanical door check", in which a spring is energized when the door is opened whereas its releasing force is speeded up by a speed up gear train composed of multiple spur gears when the door is closed, and in which the damping effect is established by the use of a mechanical (or centrifugal) governor. Also disclosed in Japanese Patent Publication No. 52 - 3227 is a mechanical door check which uses a coil spring. We also have disclosed another mechanical check in United State Patent Application No. 157,665.

The oil cylinder type door closer establishes the damping effect by the use of the flow resistance of the oil confined in the cylinder so that its damping effect will disperse depending upon the change in the temperature. Specifically, at a high temperature, the viscosity of the oil will drop to reduce the flow resistance so that the door closing speed is accelerated. At a low temperature, on the contrary, the flow resistance is increased to decelerate the door closing speed. As a result, the oil cylinder type door check of the prior art must have its door closing speed adjusted. Another defect of the oil cylinder type is that the confined oil will leak to raise a problem in durability. Since, moreover, there has to be prepared a casing which includes a cylinder capable of enduring high spring force and oil pressure, another problem is that the door check itself must have large size and weight. This heavy weight will make it troublesome to mount the door check.

On the other hand, the mechanical door check is freed from the problems of the dispersion in the damping effect accompanying the temperature change and the oil leakage. Despite of this freedom, however, the overall construction is enlarged because a predetermined speed up ratio cannot be attained unless the number of gears to be interposed between the spring and the governor is large. If the speed up gear train is composed of the multiple spur gears, there arise other problems that the gear train has to be elongated and that the noises of the gears are high when the door is opened or closed.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a door checker which is free from both the dispersion in the damping effect due to the changing temperature and the oil leakage and which is simply constructed to reduce the noises accompanying the opening or closing operation of the door.

According to the present invention, there is provided a door check for closing a door, which comprises: a pivot pin made rotatable; a slider adapted to be linearly moved by the rotations of said pivot pin and to rotate said pivot pin when it returns; a coil spring for biasing said slider to return; a gear train for speeding up the rotations of said pivot pin; brake means connected to said gear train; and a one-way transmission clutch for operating said brake means in a direction to close said door.

More specifically, the door check according to the present invention comprises: a pivot pin connected through an arm to a door frame and made rotatable in response to the opening of closing operation of a door; a slider adapted to be linearly moved by the rotations of the pivot pin for rotating the pivot pin when it returns; a gear train for speeding up the rotations of the pivot pin; brake means connected to the gear train; a return coil spring adapted to be energized when the slider is moved in a direction to open the door; and a one-way transmission clutch for operating the brake means in a direction to close the door.

When the door is opened, the pivot pin is rotated to move the slider in the door opening direction thereby to energize the return coil spring. Following the movement of the slider, the transmission gears are rotated. If the door opening operation is released, the slider is moved by the en-

ergized force of the return coil spring so that the pivot pin is rotated to close the door. The slider to be moved by the return coil spring rotates the transmission gears. The rotations of the transmission gears will rotate a worm at a high speed through the speed up gear train and the one-way transmission clutch. If the worm is rotated at a high speed, the brake means applies its braking force to the rotations of the worm and accordingly the braking slider, i.e., the rotations of the pivot pin rotated by the slider so that the closing speed of the door is adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become apparent from the following description to be made in connection with the embodiments thereof with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view showing the profile of a continuous speed change door check according to a first embodiment of the present invention;

Fig. 2 is a top plan view showing a plurality of open positions of the door by way of example;

Fig. 3 is a sectional top plan view showing the first embodiment of the present invention when the continuous speed change door check is in the door opening position;

Fig. 4 is a longitudinal section showing the same;

Fig. 5 is a sectional top plan view showing the brake means;

Fig. 6 is a section taken along line A - A of Fig. 5;

Fig. 7 is a section taken along line B - B of Fig. 5;

Fig. 8 is a side elevation showing the positional relation between a slider and a transmission member just before the door comes to its closed position;

Fig. 9 is a top plan view showing the relative positions of the slider and a pivot pin when the door is in its closed state;

Fig. 10 is a front elevation of Fig. 9;

Fig. 11 is a top plan view showing the state in which the door is stopped at an arbitrary position;

Fig. 12 is a diagram plotting the relations between the door opening position and the door closing speed;

Fig. 13 is a side elevation showing the positional relations of the slider and the transmission member in the door closing position according to a second embodiment of the present invention;

Fig. 14 is a side elevation showing an essential portion in the course of the door closing operation;

Fig. 15 is a diagram showing the relations between the door opening position and the door closing speed according to the second embodiment;

Fig. 16 is a side elevation showing an essential portion in the door closing position according to a third embodiment of the present invention;

Fig. 17 is a top plan view showing an essential portion in the door closing position according to a fourth embodiment of the present invention;

Fig. 18 is a diagram showing the structure of an essential portion in which brake means is exemplified by an electric power generator;

Fig. 19 is a top plan view showing a portion of Fig. 18;

Fig. 20 is an exploded diagram showing the structure of a rotating portion of brake means which can have its speed adjusted; and

Fig. 21 is a top plan view showing an essential portion of the same.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be described in detail in the following in connection with the embodiments thereof with reference to the accompanying drawings.

First of all, a continuous speed change type thin door check will be described with reference to Figs. 1 to 11.

In Fig. 1 showing an embodiment of the present invention, a built-in type door check 1 is constructed of a frame 2, a pivot pin 3 borne rotatably in the frame 1 and having a journal projecting therefrom, and various components to be described hereinafter. The frame 2 is fixedly mounted in a recess which is formed in the upper end portion of a door D (as shown in Fig. 2). On the not-shown door frame, on the other hand, there is fixed a guide rail 4 which has a section of inverted "U". In this guide rail 4, there is slidably fitted a slider 5a which is pivotally mounted on one end of an arm 5. The other end 5b of this arm 5 is formed with a square hole 5c, through which it is connected to the projecting end of the pivot pin 3.

Turning to Figs. 3 and 4, the frame 2 is composed of walls 2a and 2b overlapping each other. These frame walls 2a and 2b are fixed to each other by means of non-shown screws.

Generally at the center of the frame 2, there is arranged the pivot pin 3 which has its rotating center axis extending vertically. This pivot pin 3 is made of a metal, considering the load to be ap-

plied thereto, and is rotatably borne in bearings 9 and 9 which are fixed on the frame 2. The journals 3a and 3b of the pivot pin 3 projecting from the frame 2 are formed into a square shape, and and their former one 3a is fitted in the spare hole 5c of the arm 5 (as shown in Fig. 1). The pivot pin 3 is formed with a tooth portion 3c and a column portion 3d which has a diameter substantially equal to the addendum circle of the tooth portion 3c.

In the frame 2, there is slidably fitted a metallic slider 11. As better seen from Fig. 9, this slider 11 is formed with: a rack portion 11a meshing with the tooth portion 3c of the pivot pin 3; a cam portion 11b formed at one end portion thereof for abutting against a later-described transmission member; a non-rack portion 11c for engaging with the column portion 3d of the pivot pin 3 at its position where a spring 12 has been biased; and an engagement portion 11d capable of engaging with a guide 16. To the other end portion of the slider 11 located at the end formed with the cam portion 11b, there is fixed a spring seat 11e for receiving one end 12a of the spring 12. Between the inner side of the plate-shaped frame 2 and the slider 11, there is sandwiched a spacer 13 which is made of a synthetic rein to lighten the frictional resistance between the metallic components.

The spring 12 is composed of two spring elements which are vertically juxtaposed to each other such that their other ends 12b and 12b are received by a receiving plate 14. This receiving plate 14 in turn is supported by a stay 15 which is fixed on the frame 2. The springs 12 and 12 are so precompressed as to bring the latch of the door into engagement.

To the slider 11, as also shown in Fig. 11, there is fixed by two screws 17a and 17a a brake member 17 which is to be brought into abutment against the column portion 3d of the pivot pin 3 when the door is opened a predetermined angle.

In the frame 2, there are mounted: a transmission member 18 which is formed with a cam portion 18a abutting against the cam portion 11b of the slider 11 and a larger-diameter tooth portion 18b; a speed up gear train 19 for speeding up the movement of the slider 11; a worm shaft 20 meshing with the final gear of the speed up gear train 19; brake means 21 mounted on the worm shaft 20; and clutch means for allowing the brake means 21 the movement of the slider 11 only in the door opening direction. The speed up gear train 19 is composed of the tooth portion 18b of the transmission member 18, a double gear 23, a smaller-diameter gear 24 and a worm wheel 25. And, these gears are arranged in a horizontal direction and borne rotatably by pivot pins 26, 27 and 28 which have their respective two ends caulked to the frame 2. On the pivot pins 26 and 27, there are rotatably fitted sleeves 26a and 27a which are made of a synthetic resin.

The transmission member 18 is made substantially integral with the sleeve 26a. On this sleeve 26a, there is integrally fitted a return lever 29. This lever 29 engages at its leading end 29a with a pin 30, which is anchored at the slider 11, to turn the transmission member 18 clockwise (as viewed in Fig. 10) following the movement of the slider 11 when in the door opening operation, as will be described hereinafter. Incidentally, the return lever 29 may be replaced by a spring for biasing the transmission member 18 (as modified in Fig. 17). Moreover, the transmission member 18 of the shown embodiment is prepared by laying two pressed plates one on the other and by bringing the notches formed in the inner edges of the center holes of those plates into engagement with the projections 26aa of the sleeve 26a so that the two plates are integrated in the rotating direction. The cam portion 18b abuts against the cam portion 11b of the linearly moving slider 11 and has its abutting point shifted in accordance with the rotational position of the transmission member 18. As shown in Fig. 4 the abutting point between the cam portion 18a of the transmission member 18 and the cam portion 11b of the slider 11 is located at a distance ℓ from the pivot pin 26 providing the center of rotations of the transmission member 18. When the door is opened to a position of about 20 degrees (as indicated at DB in Fig. 2) from its closed position (as indicated at D in Fig. 2), the abutting point of the two cam portions 18a and 11b is positioned at a distance $\ell 1$ ($< \ell$), as seen from Fig. 8. When the door is in its closed position D, the abutting position of the two cam portions 18a and 11b is positioned at a distance $\ell 2$ ($< \ell 1$), as shown in Fig. 10. That is to say, the abutting point of the cam portions 18a and 11b comes the closer to the pivot pin 26 as the opening angle of the door becomes the smaller. In other words, the rotating speed of the transmission member 18 to be pushed by the slider 11 is gradually accelerated the more as the abutting point of the two cam portions comes the closer to the pivot pin 26.

The double gear 23 is a speed up gear which is formed with a smaller-diameter tooth portion 23a meshing with the tooth portion 18b of the transmission member 18 and a larger-diameter tooth portion 23b. This tooth portion 23b meshes with a tooth portion 24a of the small gear 24.

This small gear 24 and the worm wheel 25 constitute together the clutch means 22. The small gear 24 is formed with a sleeve 24b retaining one end 31a of a coil spring 31 which is wound thereon. The worm wheel 25 has a sleeve 25a enclosing the sleeve 24b and formed with a tooth portion 25b on its outer circumference. The coil spring 31 is

biased to expand to contact with the inner circumference of the sleeve 25a while leaving its free and 31b free from the sleeve 25a. When the small diameter 24 rotates in the direction of arrow a, the coil spring 31 is wound up to transmit none of the rotations of the sleeve 24b to the sleeve 25a. When the small gear 24 rotates in the direction opposite to the arrow a, the coil spring 31 is loosened to allow the rotations of the sleeve 24b to be transmitted to the sleeve 25a, i.e., the worm wheel 25. As a result, the rotations of the transmission member 18 are speeded up and transmitted to the worm wheel 25. Incidentally, the clutch means should not be limited to the shown example but may adopt another type if the aforementioned operations are retained.

The worm shaft 20 is rotatably borne at its two ends by means of bearings 32 and 33 which are fixed on the frame 2 through shock absorbing members of rubber of the like to reduce the noises.

Turning to Figs. 4 to 7, the brake means 21 is composed of: a pair of arms 21d and 21d borne in a rocking manner through pins 21c and 21c by holders 21a and 21b press-fitted on the worm 20; high-friction members 21e and 21e press-fitted on the outer edges of the arms 21d and 21d near the free ends thereof; and a braking ring 21f surrounding the arms 21d and 21d. The ring 21f is fixed in the bearing member 33. When the worm 20 is rotated at a high speed, the arms 21d and 21d are expanded by the centrifugal force established to bring the high-friction members 21e and 21e into sliding contact with the inner circumference of the ring 21f thereby to brake the rotations of the worm 20. In order to establish the centrifugal force sufficiently, the arms 21d are made of a metal or a material having a mass near that of the metal. Moreover, the high-friction member 21e is made of rubber or the like, which has a high friction resistance and an excellent wear resistance. Incidentally, the brake means 21 should not be limited to the shown example but may use friction arms made of feathers or friction arms made of elastically deformable rubber, or a variety of governor mechanisms of eddy current electromagnetic or brake shoe types.

The door check according to the present embodiment can be made thin, as shown, so that it can be built in a sash door.

The operations of the embodiment thus constructed will be described in the following.

The door check shown in Figs. 3 and 4 are in the state where the door is opened about 90 degrees, as indicated at DA in Fig. 2. In this state, the slider 11 is pushed by the tooth portion 3c of the pivot pin 3 against the elastic force of the springs 12 to have its non-rack portion 11c facing the column portion 3d. At this time, the springs 12 are energized to bias the slider 11 in a door closing direction (i.e., leftwardly of Figs. 3 and 4). At this time, moreover, the cam portion 11b of the slider 11 and the cam portion 18a of the transmission member 18 are in abutment against each other in a position C1 which is at the radius ℓ from the pivot pin 26.

Now, if the door DA opened about 90 degrees is released from its opening operation, as shown in Fig. 2, the pivot pin 3 has its tooth portion 3c meshing with the rack portion 11a of the slider 11, which is biased by the springs 12 to move in the direction of arrow b (as shown in Fig. 3), so that it is rotated counter-clockwise. The rotations of the pivot pin 3 turn the door through the arm 5 (as shown in Fig. 1) to the door closing position, as indicated at D in Fig. 2.

When the slider 11 is moved in the door closing direction, the transmission member 18 having its cam portion 18a abutting against the cam portion 11b of the slider 11 is rotated in the direction of the arrow, as shown in Fig. 8. The rotations of the transmission member 18 are transmitted, as shown in Figs. 3 and 4, through the double gear 23 to the small gear 24 to rotate the small gear 24 in the direction opposite to the arrow a, as shown in Fig. 4. When the small gear 24 rotates, its sleeve 24b expands the coil spring 31 to rotate the sleeve 25a together with the worm wheel 25 at a high speed. In other words, the clutch means is applied, when the door is to be closed, so that the worm wheel 25 rotates the worm shaft 20 at a high speed. Then,, the arms 21d are expanded by the centrifugal force so that the high friction members 21e frictionally slides on the inner circumference of the ring 21f to brake the rotations of the worm shaft 20. This braking force in turn brakes the driving speed up gear train 19. The braking force thus applied to the speed up gear train 19 in turn brakes the rotations of the pivot pin 3 meshing with the slider 11. This braking force in turn brakes the rotations of the door being closed.

Now, the braking force of the brake means 21 is released when the arm portions 21 are released from their frictional sliding contact with the ring 21b as the rotations of the worm shaft 20 drop. When the r.p.m. of the worm shaft 20 exceeds a predetermined number, the braking operation is started. This braking operation is released when the r.p.m. of the worm shaft 20 drops.

Now, according to the door checker of the present invention, the door closing speed is continuously changed, as plotted by a solid curve in Fig. 12. This door closing speed. i.e,. the rotating speed of the pivot pin 3 is determined by the moving speed of the slider 11. With the door being opened about 90 degrees, as shown in Fig. 4, the am portion 11b of the slider 11 and the cam

portion 18a of the transmission member 18 are in abutment against each other at the position C1 spaced the distance ℓ from the pivot pin 26. As shown in Fig. 8, on the other hand, the abutting point of those two cam portions are positioned at a point C2 of the distance ℓ1 when the door is closed to the opening angle of 20 degrees. The slider 11 is braked when it is moved in the door closing direction, as has been described hereinbefore. However, the closing speed of the door from the angle of 90 degrees to an angle of about 20 degrees drop relatively steeply, as seen from Fig. 12. The abutting point between the cam portion 11b of the slider 11 and the cam portion 18a of the transmission member 18 comes the checker to the center of rotations of the transmission member 18 as the door opening angle becomes the smaller. As a result, the rotating angle of the transmission member 18 pushed by the slider 11 grows gradually the larger as the door comes the checker to its closed position. When the door is completely closed (as indicated at D in Fig. 2), as shown in Fig. 10, the two cam portions 11b and 18a are in abutment against each other at the closest distance ℓ2 from the center of rotations of the transmission member 18. The abutting point of those two cam portions change most abrutply from the position C2 just before the closed position of Fig. 8, in which the opening angle is about 20 degrees, to the closed positions C3 of Fig. 10, to speed up the rotations of the transmission member 18. As a result, the rotations of the transmission member 18 thus speeded up are further speeded up through the speed up gear train 19 and transmitted to the worm shaft 20. As the r.p.m. of this worm shaft 20 rises, the braking force of the brake means 21 is increased to apply a high braking force to the rotations of the speed up gear train 19 and the transmission member 18, i.e., the movement of the slider 11 thereby to drop the moving speed of the same 11. As a result, an increased braking force is applied to the pivot pin 3 meshing with the rack portion 11a to slow down the door closing speed. As shown in Fig. 2, more specifically, the door rotating from the open position DB of the open angle of 20 degrees to the closed position D is slowly closed as the movement of the slider 11 is slowed down. The door closing speed, as plotted by the solid curve in Fig. 12, drops relatively steeply from the opening angle of 90 degrees to the opening angle of 20 degrees. However, what is plotted in Fig. 12 is only one model, and the door can be closed relatively promptly up to the opening angle of 20 degrees by suitably devising the shape of the cam portion 18a of the transmission member 18.

Figs. 9 and 10 shown the relative positions of the transmission member 18 and the slider 11 when the door is in its completely closed state (as indicated at D in Fig. 2). If the door is opened in this state, the pivot pin 3 is rotated in the direction of arrow to bring the slider meshing with its tooth portion 3c in the rightward or door opening direction, as shown, thereby to energize the springs 12. When the slider 11 is moved, it is followed by the return lever 29 engaging with the pin 30 to rotate the transmission member 18 clockwise. These rotations of the transmission member 18 rotate the speed up gear train 19, but are not transmitted to the worm wheel 25 because the coil spring 31 (as shown in Fig. 3) of the clutch means 22 is wound up. This means that the brake means 21 is inoperative when the door is opened.

In Fig. 3 showing the state in which the door is opened about 90 degrees, the slider 11 is in its position having the springs 12 energized and has its non-rack portion 11c facing the column portion 3d of the pivot pin 3. In this case, the slider 11 biased by the springs 12 have their movement blocked by having its rack portion 11a engaging with the column portion 3d. As a result, the slider 11 is disabled to rotate the pivot pin 3 so that it is blocked from its door closing operation. As a result, even if the pivot pin 3 is rotated more, that is, even if the door 90 degrees is opened more than 90 degrees, the slider 11 is not moved any more so that it does not close the door. If the door is opened 90 degrees or more, as indicated at DC in Fig. 2, the pivot pin 3 rotates independently at the non-rack portion 11c of the slider 11, as shown in Fig. 11, so that the door can be stopped at an arbitrary open position. In this state, moreover, the brake member 17 is in abutment against the circumference of the column portion 3d of the pivot pin 3. As a result, this pivot pin, i.e., the door is braked so that it can be stopped in an arbitrary position without fail. Since the brake member 17 is made of a material such as rubber having high friction and elasticity, it can be pressed and deformed to have its press-fit increased on the pivot pin 3 as the screws 17a and 17a are fastened into the slider 11. In other words, the degree of the stopping action upon the door at the arbitrary position can be adjusted by turning the screws 17a. Incidentally, the frame 2 is formed with non-shown inspection holes which are positioned to face the screws 17a.

The door DC is rotated from an arbitrary position of an opening angle of 90 degrees or more, as shown in Fig. 2, to the position indicated at DA if it is to be closed. Then, the rack portion 11c of the slider 11 and the tooth portion 3c of the pivot pin 3 come into engagement, as shown in Fig. 3, the slider 11 being biased by the springs 12 then rotates the pivot pin 3 in the direction to close the door. Incidentally, in case an inclining force is

applied to the slider 11, the strengths of the two spring 12 can be made different to insure a balance.

Next, another embodiment directed to a door check of double brake type will be described with reference to Figs. 13 to 15. What is different from the foregoing embodiment is the push portion 11f formed on the slider 11 and the engagement portion 18c formed on the transmission member 18, but the remaining portions are kept identical so that they are not shown.

The operational differences will be described in the following. Fig. 14 shows the state in which the open door is in the course of its closure with the opening angle of 20 degrees. In this state, the cam portion 11b of the slider 11 pushes the cam portion 18a of the transmission member 18, and the push portion 11f begins to push the engagement portion 18c. As a result, the rotational angle of the transmission member 18 relative to the displacement of the slider 11 increases with the rotating speed of the worm 20 so that a strong braking force is applied to stop the door in the closed state of Fig. 13. In other words, the door is closed more slowly within the opening angle angle of 20 to 0 degrees. These relations are plotted in the diagram of Fig. 15, from which it is seen that the change-over is more gentle than that of the hydraulic type. Incidentally, this angle should not be limited to 20 degrees but may be set at a suitable value.

Fig. 16 shows still another embodiment in which the transmission member is rotated by the rack of the slider. The pivot pin 3 is borne by a bearing 90, which is held by a bearing holder 91 fixed on the frame. The slider 110 is guided through a spacer 130 by the frame and is in meshing engagement like the foregoing embodiments by the pinion and the rack (although not shown). The slider 110 is formed with a downward rack portion 110B which meshes with a partial tooth portion 180A of a transmission member 180 within an open angle range of 0 to 90 degrees (as can be suitably set). The other partial tooth portion 180B meshes with a double gear 23a of the speed up gear train. The construction thus made can do without the return member (e.g., the lever 29, the pin 30 and so on) of the transmission member.

Fig. 17 shows a further embodiment in which the slider is guided by a guide groove. The slider 111 is formed with a rack portion 111a, an end 111b, a rotatable roller 111c and a spring seat 111d. Reference numerals 150 and 151 designates seat receivers; numeral 152 a guide groove fitting the roller 111c therein; and numeral 16 a guide roller. A transmission member 181 is formed with a cam portion 181a and is biased to rotate clockwise by the action of a spring 181b.

The operations are similar to those of the aforementioned first embodiment such that the end 111b of the slider 111 abuts against the cam portion 181a to transmit the motions.

Figs. 18 and 19 show a further embodiment in which the brake means generates an electric power. The worm 20 fixes a magnet 41, which is enclosed by a yoke 42 fixed to the non-shown frame. In the yoke 41, there is fitted a generated oil 43 which constitutes a generator 40.

In operation the worm 30 rotates at a high speed when the door is being closed, so that an electromotive force is generated in the coil 43 to brake the door. Thus, the door is slowly closed. The electromotive force thus generated can operate a voice generating circuit, an electronic orgel or a spot illuminator. Incidentally, in case the braking force is short, the brake means of the foregoing embodiments and the electric generator may be connected to the worm.

Figs. 20 and 21 show a further embodiment in which a speed adjusting function is added to the brake means. The worm 20 is formed with D-shaped cut portions 20a and 20c, a slender portion 20b and a groove 20d. In the D-shaped cut portion 20a, there are fitted a D-shaped hole 210a of a stopper 210, a friction ring 211 and an adjusting support member 212. A cylindrical portion 213b of a support member 213 is fitted in the slender portion 20b. A D-shaped hole 213c at the upper end is fitted in the D-shaped cut portion 20c so that it is prevented from rotation. A not-shown stop ring is fitted in the groove 20d such that the cylindrical portion 213b has its leading end pushing the adjusting support member 212. With this assembly, two opposed pins 213a and 212a are attached to the support member 213 and the adjusting support member 212 and are fitted in the support groove 214a and adjusting groove 214b of a metallic weight 214. As a result, this weight 214 is made rotatable on the pin 212a. Like the foregoing embodiments, the high friction members 21e are press-fitted in the weight 214. The support groove 214a regulates the position (taken in the worm rotating direction) of the weight 214 through the pin 213a and has a length to allow the rotations of the weight 214 on the pin 212a.

In operation, the weight 214 is rotated to expand around the pin 212a by the action of the centrifugal force, as the worm 20 is rotated, so that the high frictional member 21 comes into sliding contact with the non-shown ring (as indicated at 21f) to establish the braking force. This force is determined by the centrifugal force of the weight 214, which in turn is determined by the position of the fulcrum 212a. In case this braking force is to be adjusted, the outer circumference 210b of the stopper 210 holds the support member 213 while rotating the outer circumference 212b of the adjusting

support member 212. Since this member 212 is held on the friction ring 211 by the support member 213, it is allowed to rotate on the worm, if it is rotated by a force stronger than that holding force. Then, the position of the pin 212a in the adjusting groove 214b and accordingly the fulcrum position of the weight 214 are changed. As a result, the centrifugal force is changed to vary the door closing speed.

Fig. 21 shows the state of an intermediate speed, which is dropped (with the centrifugal force being increased), if the pin 212a is rotated clockwise, but is increased if counter-clockwise. Moreover, an inspection hole may be formed in the frame to adjust the speed of the completed product of the door checker.

Incidentally, in the embodiments shown, the description has been made assuming that the angle for closing the door automatically is 90 degrees. It should naturally be understood that the present invention be not limited to such angular value. Moreover, the shown embodiments have been exemplified by the door check of door built-in type, but the present invention may be extended to a door check of external type, which is to be fixed on the surface of a door. Still moreover, the door can be slowly opened by a spring force and can be closed by human hands, if a one-way clutch is operated in the reverse direction or if the pivot pin moves the slider in the door closing direc tion toward the coil spring. Furthermore, the slider and the transmission member may be interconnected through a link. In case, on the other hand, the door is broken if a strong external force is applied in the door closing direction, overload preventing means such as a torque limitter may be added to the speed up gear train.

As has been described hereinbefore, according to the present invention, it is possible to eliminate the problems such as the oil leakage or the inferior temperature characteristics as in the hydraulic type door check of the prior art. The door check of the present invention can take place of the hydraulic type door check. As has been described in connection with the various embodiments, moreover, the door can be lightly opened by the one-way transmission clutch with a variety of additional functions of reduced noises, small thickness, speed change or adjustment or electric power generation.

Claims

1. A door check for closing a door, comprising:
a pivot pin made rotatable;
a slider adapted to be linearly moved by the rotations of said pivot pin and to rotate said pivot pin when it returns;
a coil spring for biasing said slider to return:
a gear train for speeding up the rotations of said pivot pin;
brake means connected to said gear train; and
a one-way transmission clutch for operating said brake means in a direction to close said door.

2. A door check according to Claim 1, wherein said gear train has a worm at its final stage, and wherein said brake means is attached to said worm.

3. A door check according to Claim 1, wherein said brake means includes a speed adjusting structure.

4. A door check according to Claim 1, wherein said brake means includes an electric power generator.

5. A door check according to Claim 1, wherein said coil spring includes two coil spring elements juxtaposed vertically to each other.

6. A door check according to Claim 1, wherein said slider transmits its displacement through said transmission member to said gear grain.

7. A door check according to Claim 6, further comprising return means for causing said transmission member to follow the movement of said slider in the door closing direction.

8. A door check according to Claim 6, further comprising two engagement portions formed in said slider and said transmission member for switching the braking force in the course of the door closing operation.

9. A door check according to Claim 1, wherein said one-way transmission clutch operates in a direction to open said door.

FIG. 1

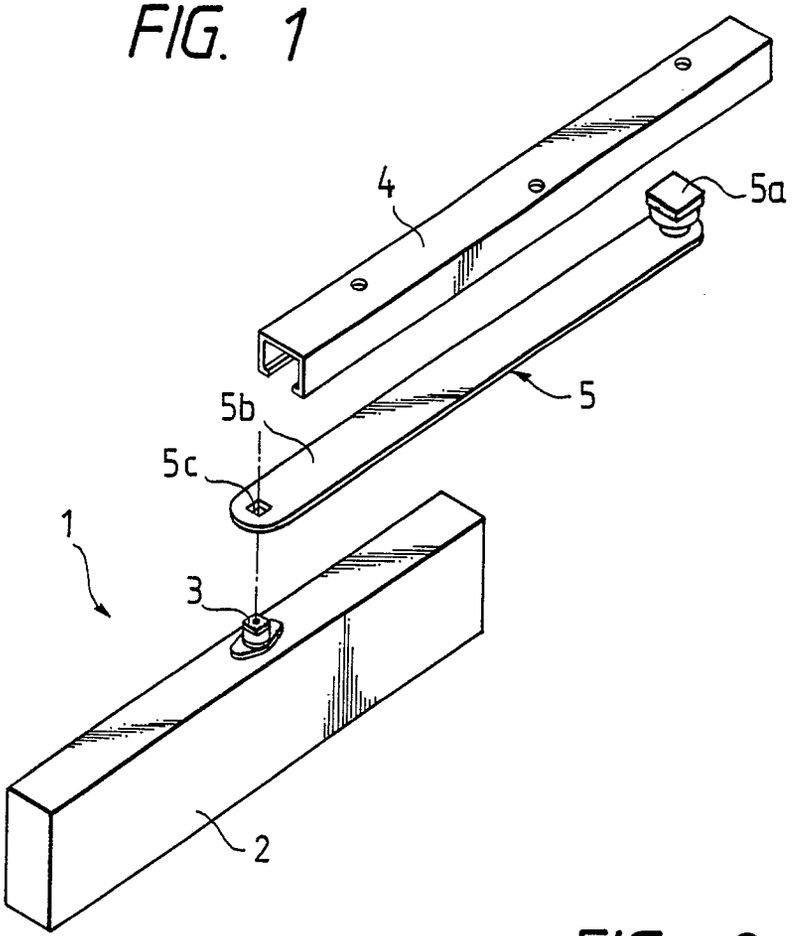

FIG. 2

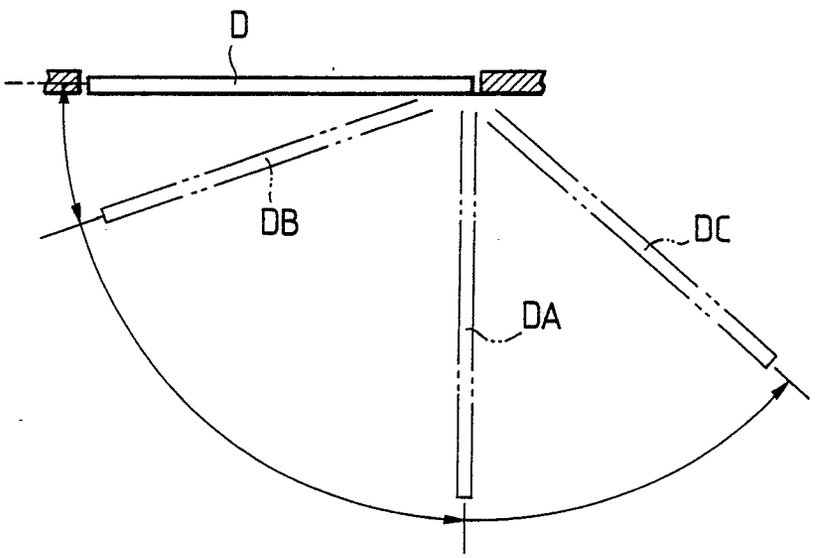

FIG. 3

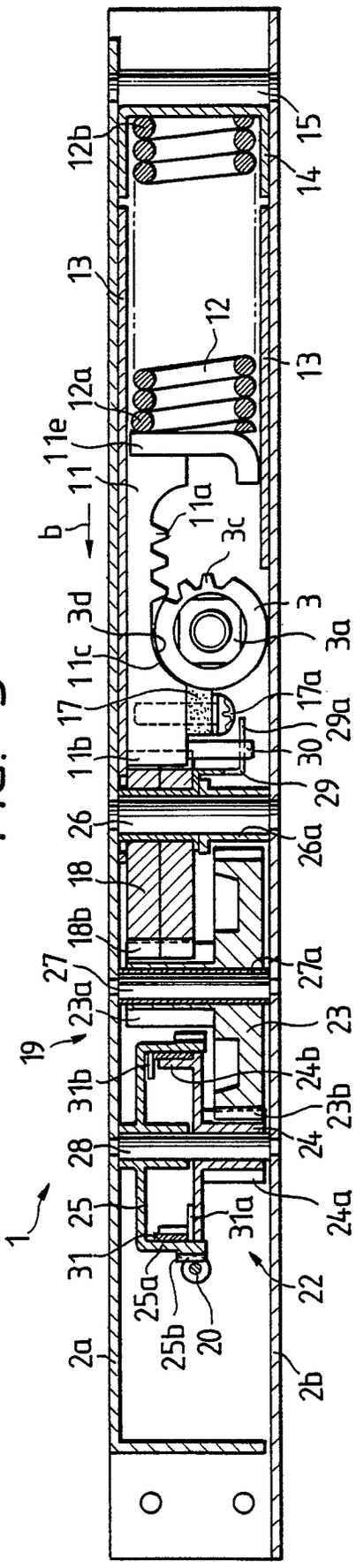

FIG. 4

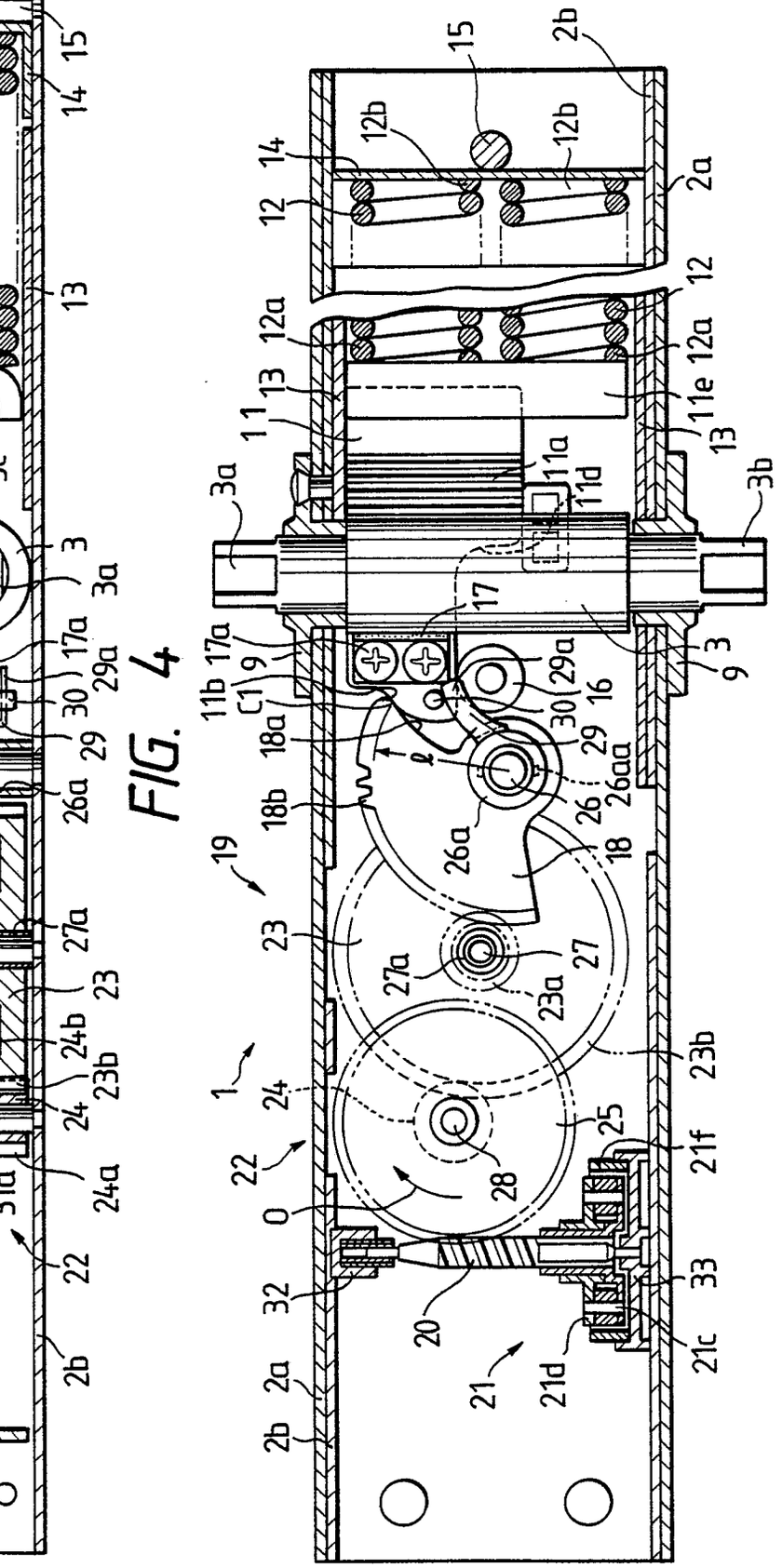

FIG. 5

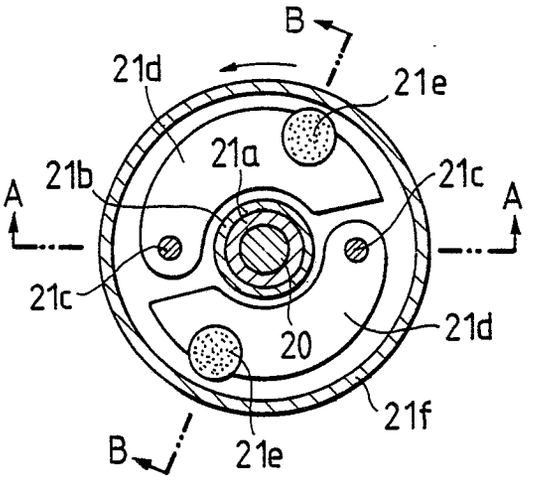

FIG. 6

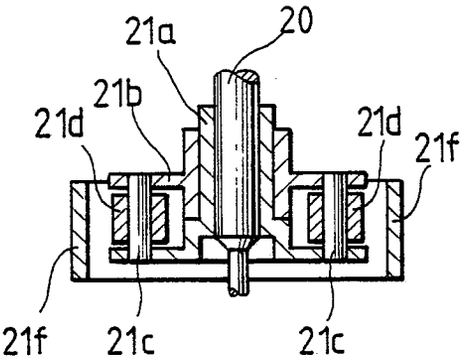

FIG. 7

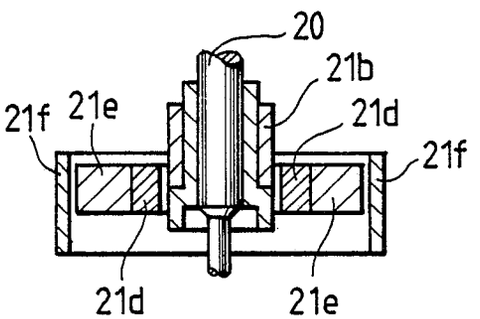

FIG. 8

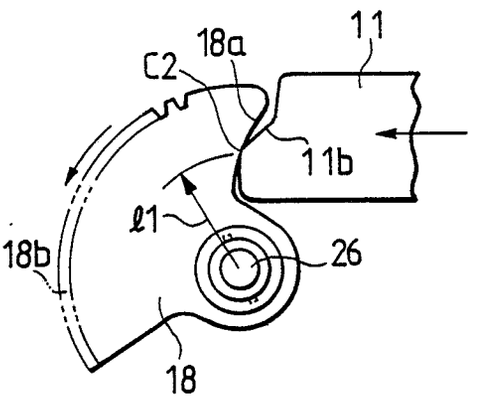

FIG. 9

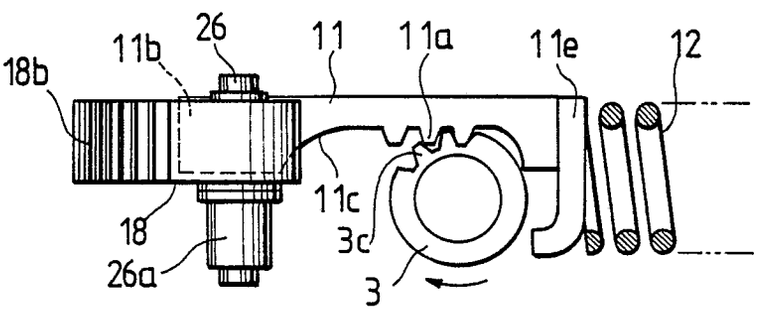

FIG. 10

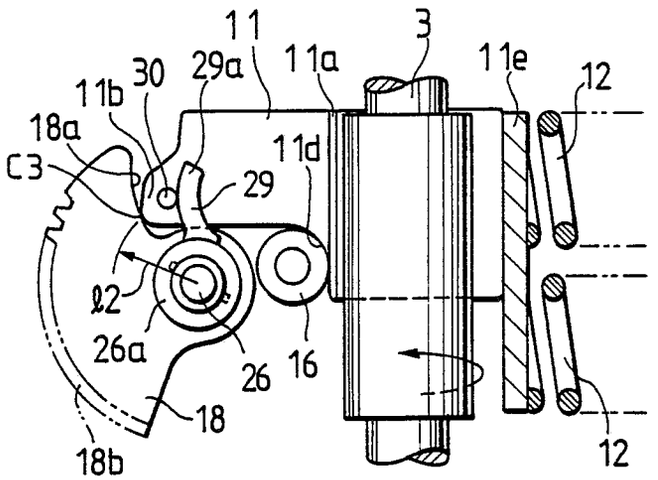

FIG. 11

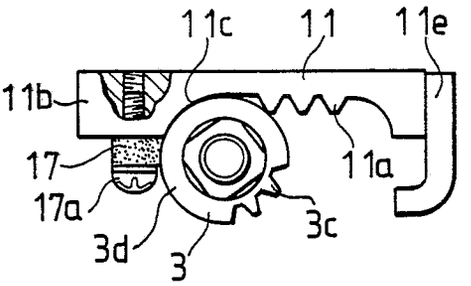

FIG. 12

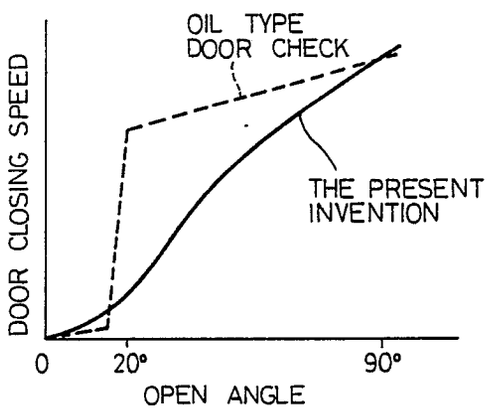

FIG. 13

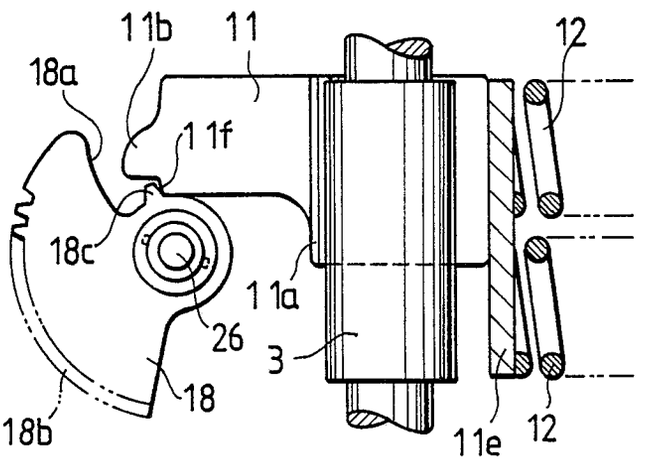

FIG. 14

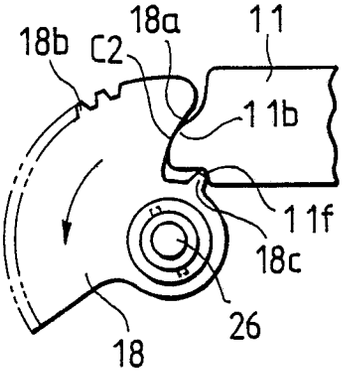

FIG. 15

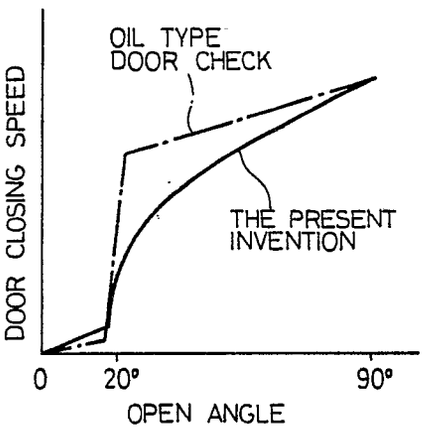

FIG. 16

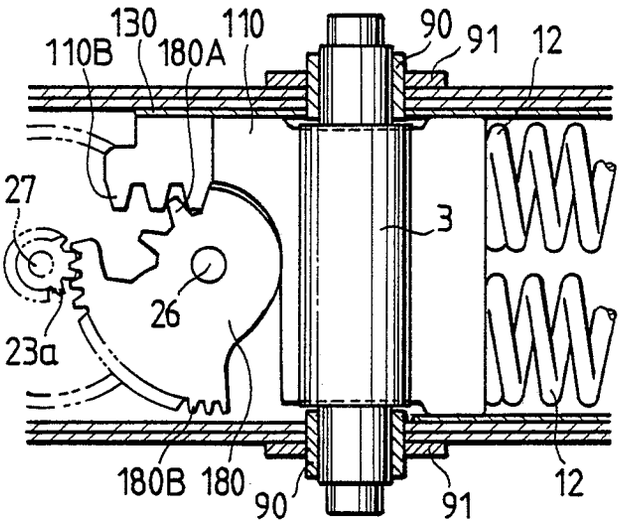

FIG. 17

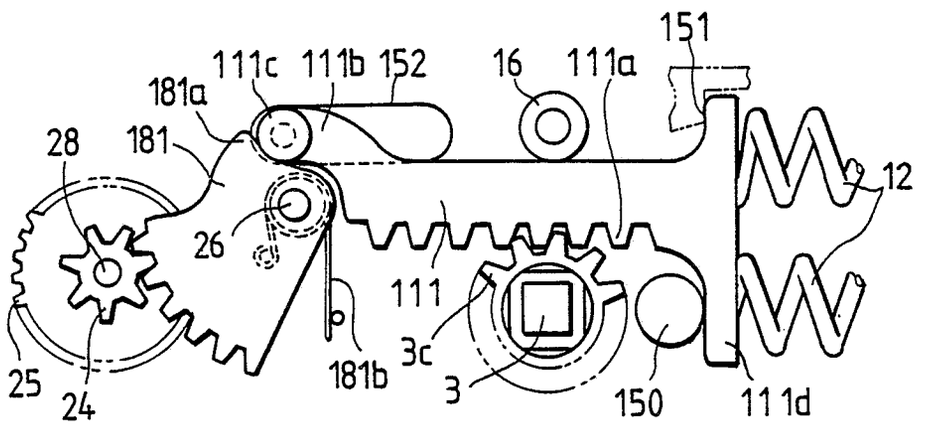

FIG. 18

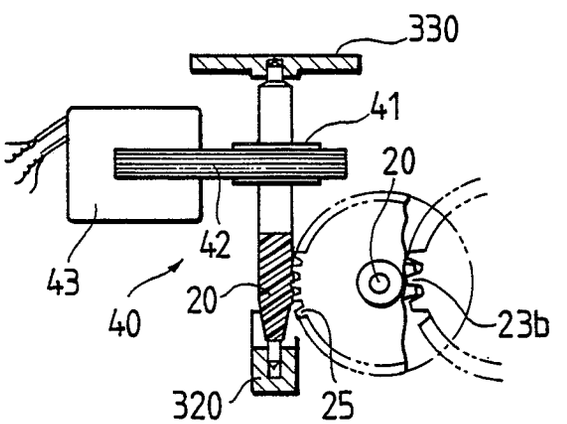

FIG. 19

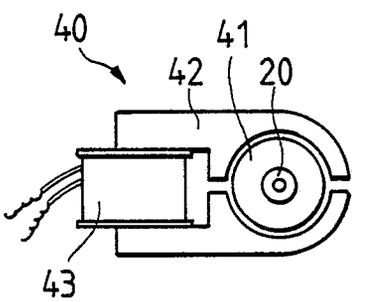

FIG. 20

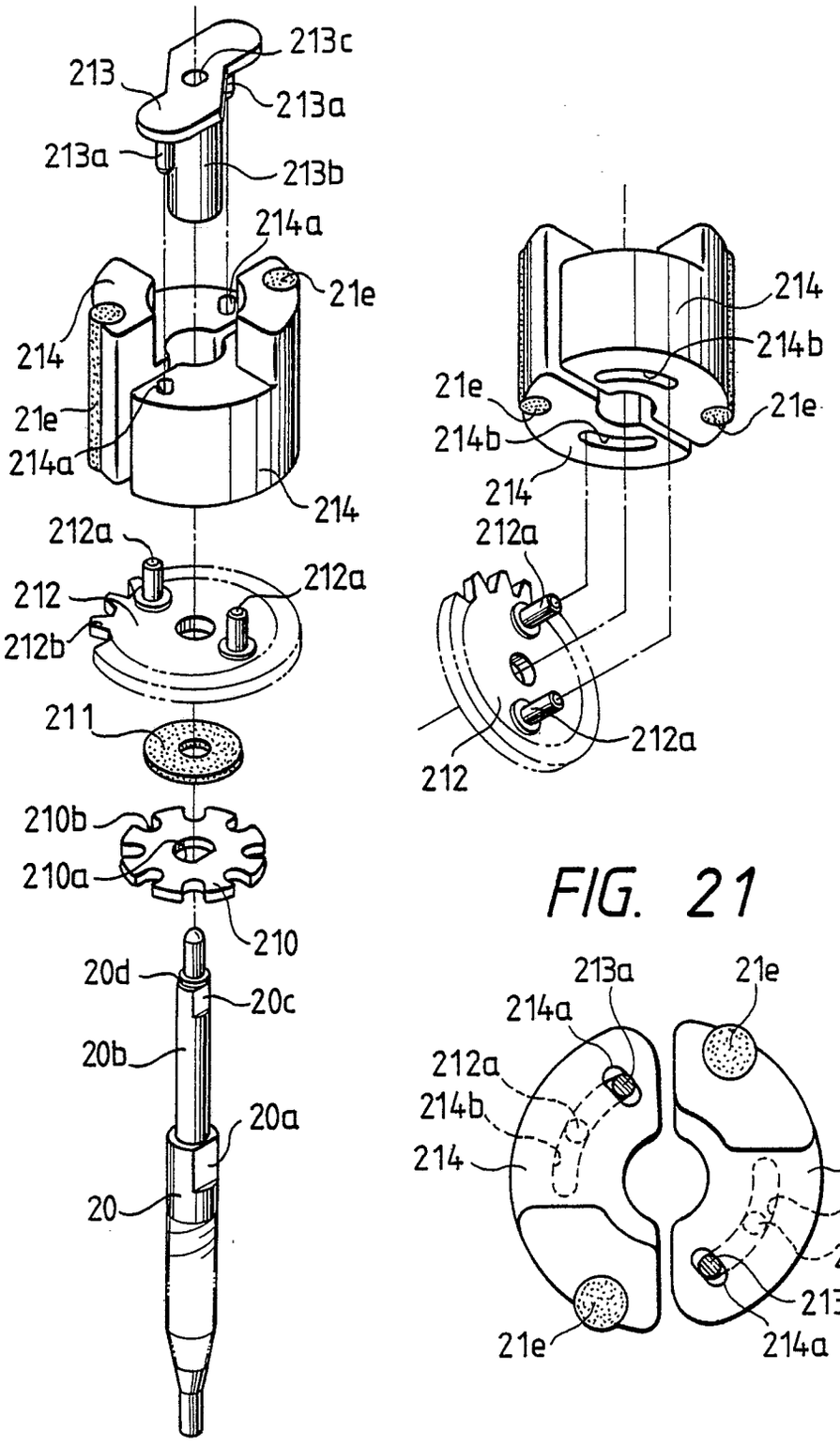

FIG. 21

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 11 0973

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	US-A-2 909 801 (ELLIS) * Whole document *	1-3,6,7	E 05 F 3/16 E 05 F 3/00 E 05 F 5/00
Y	US-A-1 918 879 (WELTON) * Figures 3-5; page 1, line 64 - page 3, line 46 *	1-3,6,7	
A	US-A-1 353 219 (COLLINS) * Figure 3; page 1, line 80 - page 2, line 8 *	1	
A	GB-A- 898 856 (SCHÖNBERGER) * Page 1, lines 34-48 *	4	
A	US-A-3 137 888 (BLOM) * Figure 2 *	5	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 05 F
F 16 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-09-1988	DALL'ANESE D.D.

CATEGORY OF CITED DOCUMENTS

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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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