United States Patent [19]

Chin

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[45] **Nov. 26, 1974**

[54] **APPARATUS FOR FIRE ESCAPING FROM HIGH BUILDING**

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[52] **U.S. Cl.** **182/73,** 182/5, 254/158

[51] **Int. Cl.** **A62b 1/12**

[58] **Field of Search** 182/75, 74, 73; 254/158, 254/154

[56] **References Cited**

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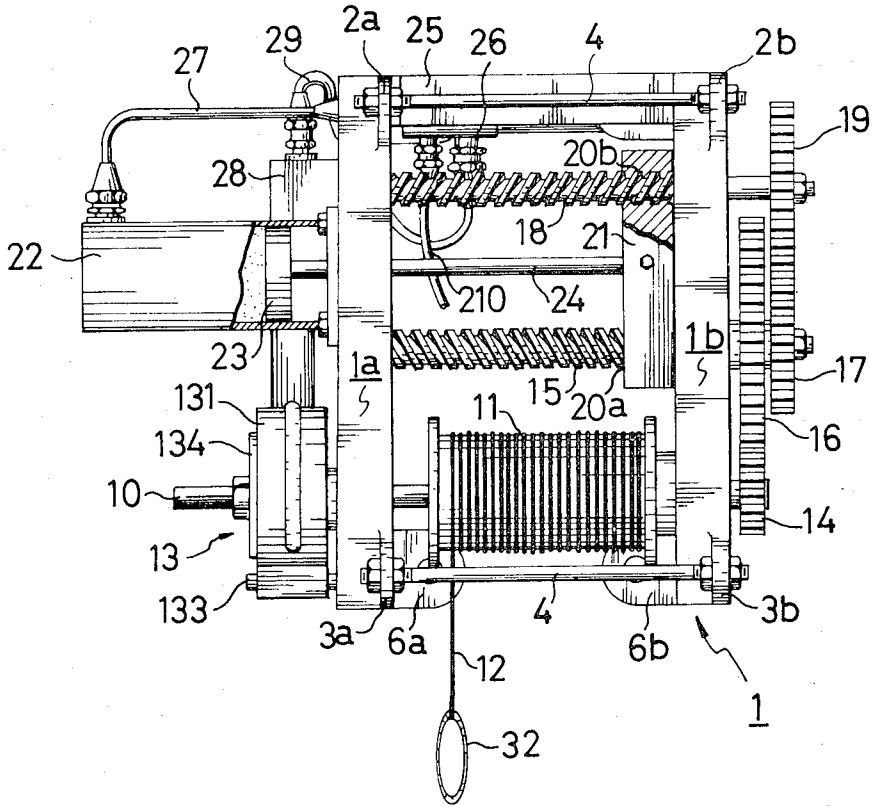
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Primary Examiner—Reinaldo P. Machado

[57] **ABSTRACT**

Apparatus for fire escaping from a high building comprising a frame, a winch rotatably mounted on said frame, a gear train driven by the winch shaft, a pair of parallelly disposed screw rods having threads in reverse direction to each other and being driven by said gear train, a plate with a pair of nuts matching said pair of reversely threaded screw rods and slidably mounted thereon, a hydraulic cylinder having a piston driven by the slide motion of the plate, a hydraulic selecting pump actuated by said hydraulic cylinder, a brake control cylinder actuated by said selecting pump, and a brake assembly controlling the rotation of said winch, whereby upon the rotation of the winch caused by the unwinding of the winch cable due to the falling of an escaper hanging on the cable end, pressure is built up in the hydraulic cylinder and passes through the selecting pump to actuate the brake assembly to stop the motion of the winch and the falling of the escaper. Upon release of the brake assembly the winch resumes rotation to start the whole cycle all over again, so that the escaper reaches the ground in intermittent stop-and-go intervals without undergoing gravitational acceleration.

6 Claims, 6 Drawing Figures



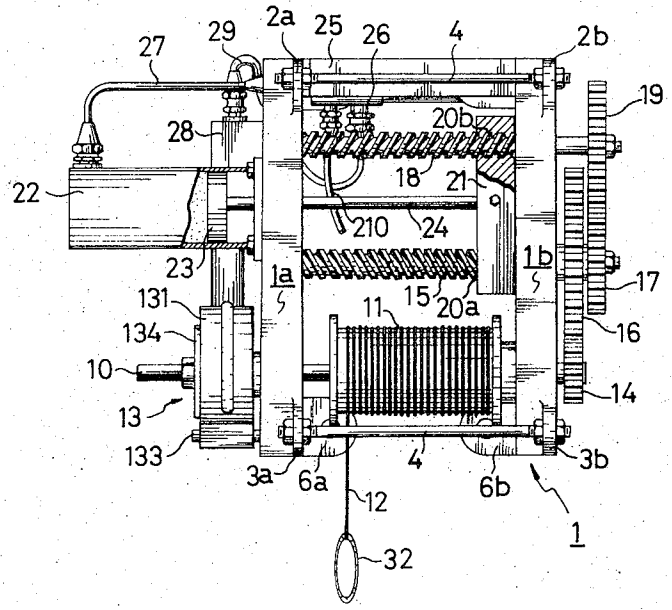

27
29
2a
25
26
4
2b
19
28
20b
18
21
22
210
24
23
1a
1b
17
131
11
15
20a
134
16
10
14
13
133
3a
6a
12
4
6b
3b
1
32

FIG. 1

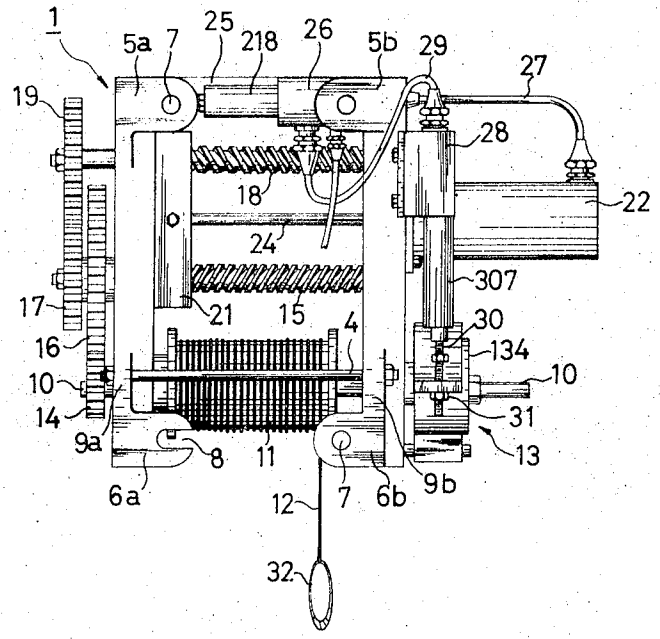

1
5a
7
25
218
26
5b
29
27
19
28
18
22
24
307
17
21
15
4
30
16
134
10
10
14
31
9a
8
11
13
6a
12
7
6b
9b
32

FIG. 2

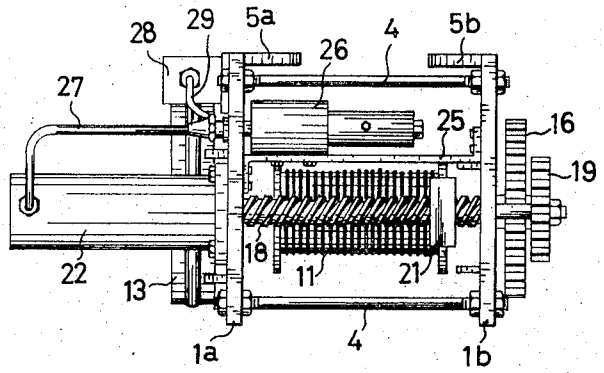

28
29
5a
4
5b
26
27
25
16
19
18
11
21
22
13
1a
4
1b

FIG. 3

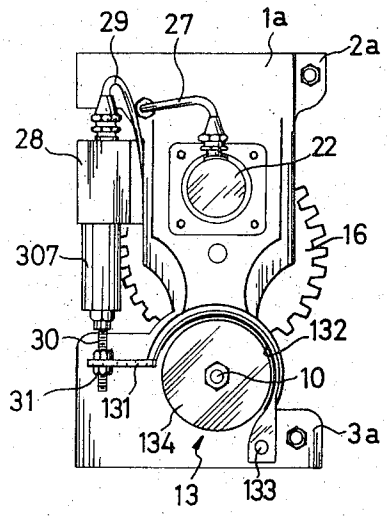

29
27
1a
2a
28
22
16
307
132
30
10
31
131
134
3a
13
133

FIG. 4

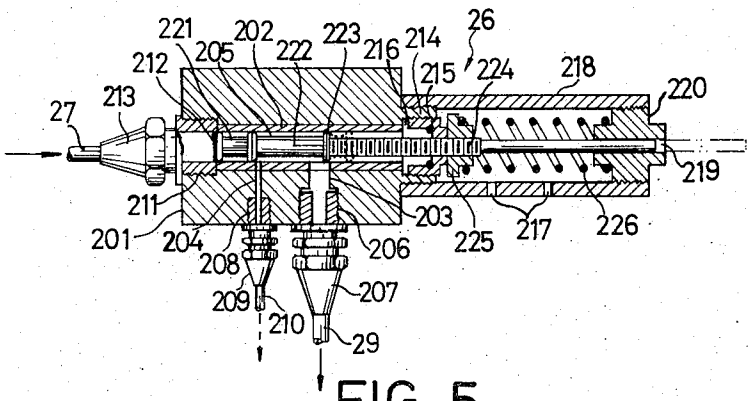

221
202
223
214
26
212
205
222
216
215
224
218
220
27
213
219
211
203
225
217
226
201
204
208
206
207
209
210
29

FIG. 5

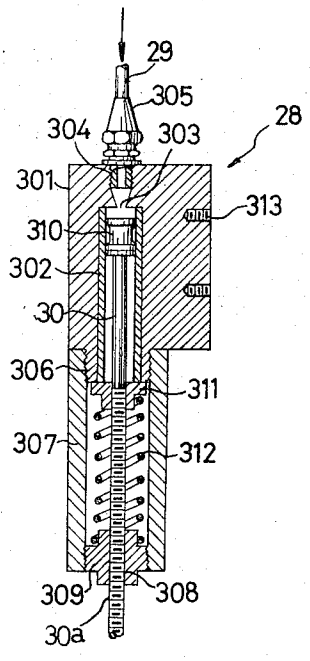

29
305
304
303
28
301
313
310
302
30
306
311
307
312
309
308
30a

FIG. 6

APPARATUS FOR FIRE ESCAPING FROM HIGH BUILDING

FIELD OF INVENTION

The present invention relates generally to apparatus for fire escaping, and more particularly to an apparatus that can be installed at window openings of high buildings which, when fire or other emergency strikes, would enable an escaper to descend to the ground safely utilizing the balancing of gravitational force and hydraulic force.

BACKGROUND OF INVENTION

During fire hazard or other emergencies in a high building, elevators and fire extinguishing facilities often are paralyzed due to power failure. Stairways become the best channel for the up-drafting flame and smoke. The only aid for escaping the fire has to come from outside. However, due to the unreachable height of the building, the rescuing work is very difficult, and many casualties usually result.

Many types of escaping apparatus have heretofore been disclosed. Generally speaking, they fall within two main categories. One utilizes centrifugal force developed by the falling body of an escaper to govern the speed of descent and the other employs a series of rope connected pulleys to the unwinding mechanism to increase friction which in turn results in retardation of the falling speed. Both categories are purely mechanical, have a bulky volume and are troublesome.

In view of the aforesaid drawbacks, the present inventor has gone through many experiments to overcome the difficulties incurred by prior conventional apparatuses.

SUMMARY OF INVENTION

Accordingly, the main object of the present invention is to provide a novel apparatus for fire escaping from a high building, which is light in weight, compactly constructed, and whose operation is very simple and reliable.

Another object of the present invention is to provide an apparatus for fire escaping by providing a balance between the gravitational force on a falling escaper and the hydraulic power produced due to the falling in order to control the falling speed of the escaper.

A further object of the present invention is to provide an apparatus for fire escaping the function of which is accomplished by the balancing between the gravitational force on the escaper and the hydraulic power of a winch from which a falling escaper is hung and unwound in an intermittent work and stop fashion.

Still another object of the present invention is to provide an apparatus for fire escaping comprising a winch, a gear train driven by said winch, a pair of parallelly disposed screw rods being threaded in reverse direction to each other and being driven by said gear train, a plate with a pair of nuts matching said pair of reversely threaded screw rods and slidably mounted thereon, a hydraulic cylinder having a piston driven by the slide motion of the nuts-plate, a hydraulic selecting pump actuated by said hydraulic cylinder, a brake control cylinder actuated by said selecting pump, and a brake assembly controlling the rotation of said winch.

Still a further object of the present invention is to provide an apparatus for fire escaping that utilizes the gravity of the falling escaper himself without the aid of outside control or power to effect a safe falling speed control to escape from a high building fire or other emergencies.

Other objects and features of the present invention will become clear from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** shows a front view of a preferred embodiment of the apparatus of the present invention in elevation with partial cut away;

FIG. **2** shows a back view of the apparatus;

FIG. **3** shows a top view of the apparatus;

FIG. **4** shows an end view taken from the right end of the apparatus;

FIG. **5** shows a longitudinal section of the hydraulic selecting pump; and

FIG. **6** shows an elevational section of the brake control cylinder.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2**, there is shown the front and back view of a preferred embodiment of the present invention. The Frame **1** of the apparatus is comprised of left frame member **1***a* and right frame member **1***b*. The two members **1***a* and **1***b* are connected by three tie rods **4** passing through three pairs of ears **2***a*–**2***b*, **3***a*–**3***b* in the front (FIG. **1**) and **9***a*–**9***b* at the rear (FIG. **2**). All the rod ends are locked with nuts. Other pairs of ears **5***a*–**5***b* and **6***a*–**6***b* are disposed at the backside of the frame and have holes **7** to enable the frame to be anchored against the wall or window sill outside of a building. Instead of a hole **7**, a slot **8** is provided on ear **6***a* to facilitate easier adjustment upon installation.

Between the frame members **1***a*–**1***b*, at a lower position, a winch **11** is rotatably mounted on shaft **10.** A cable **12** is wound on the winch **11**, and a sling **32** for connecting a safety belt or other aids is provided on the free end of the cable **12.** Shaft **10** extends at both ends beyond the frame members **1***a* and **1***b*. A brake drum **134** is mounted on the shaft end outside the member **1***a*, while on the shaft end outside member **1***b*, a gear **14** is fixed thereon. When cable **12** is unwound, winch **11** rotates and the brake drum **134** and gear **14** rotate together.

At about middle position of the frame **1** disposed in parallel with the winch shaft **10**, a screw rod **15** is mounted freely rotatable between members **1***a*–**1***b*. Screw rod **15** has left-hand square threads thereon. At the end of the screw rod **15** projecting outside frame member **1***b* are fixed two gears **16** and **17.** The gear **16** is of larger diameter and meshes with gear **14** on winch shaft **10.**

At upper position of the frame **1**, a screw rod **18** is mounted in a similar manner and in the same dimension as screw rod **15**, except that the threads thereof are right-handed. At the shaft end of rod **18** extending outside frame member **1***b*, a gear **19** of the same diameter as the gear **17** is fixed thereon and meshes with gear **17.** Therefore, the screw rod pair **15**–**18** rotates synchronously in reversed direction.

A nut plate **21** having two nuts **20***a* and **20***b*, each with reversed threads are screwed on rods **15** and **18**, so that when rods **15** and **18** rotate, the nut plate **21**

tends to move in a linear direction towards the frame member 1*a*.

Outside frame member 1*a*, in a position corresponding to the middle point of the nut plate **21**, there is mounted a horizontally disposed hydraulic cylinder **22**. A piston **23** is slidably mounted in cylinder **22**. A piston rod **24** has one end connected to piston **23** and the other end passing through frame member 1*a* to connect at the middle point of nut plate **21**.

Referring to FIG. **3**, a hydraulic selecting pump **26** is mounted on a bracket **25** at the uppermost position of the frame **1**. The hydraulic field inlet of said pump **26** is connected with the outlet of hydraulic cylinder **22** by a tube **27** so that the hydraulic pressure from cylinder **22** actuates the pump **26**.

A brake control cylinder **28** is vertically attached to frame member 1*a* on the side thereof facing outside the member **1**. The inlet of cylinder **28** is connected with the outlet of pump **26** by a tube **29**. Hydraulic pressure from pump **26** actuates the brake control cylinder **28**.

Now refer to FIG. **4** for a more detailed description of the brake assembly **13**. As aforementioned, a brake drum **134** is mounted on the winch shaft **10**. A brake band **131** is pivotally mounted at point **133**. The horizontal portion of the band **131** is adjustably connected to a piston rod **30** which extends downwardly from the brake control cylinder **28** and has adjusting nuts **31** thereon. When the piston rod **30** moves downwardly, the band **131** having brake lining **132** thereon presses tightly against the brake drum **134** to achieve a braking effect.

The details of the hydraulic selecting pump **26** are further illustrated in FIG. **5**. In fact, the said pump is substantially a hydraulic control valve having a cylinder body **201** with a sleeve **202** tightly fitted inside it. Holes **203** and **204** are drilled through the cylinder wall and sleeve **202**, and are in communication with the inner bore **205** of the cylinder **201**. The bigger hole **203** has a threaded bore **206** within which a fitting **207** is provided for the connection of tube **29** as discharge outlet. The smaller hole **204** has a threaded bore **208** in it within which a fitting **209** is provided for connection of tube **210** for leakage purposes. Tube **210** may return to a reservoir for recovery (not shown). A further threaded bore **211** is provided at the front end of the sleeve **202** to connect a fitting **213** connected to inlet tube **27**. A strainer filter **212** is provided between the fitting **213** and bore **202** to prevent dirt entering into the cylinder **201**.

At the rear end of cylinder body **201** a projection **214** is provided having inside and outside screw threads on it. Threaded inside the projection **214** is an adjusting screw **216** with a sealing ring **215** retained therein. Threaded outside the projection **214** is a sleeve **218** having a plurality of holes **217** around it. Threaded at the rear end of sleeve **218** is a fixed spring retainer **220** having a center opening **219**.

Within sleeve **202** a rubber piston **221** is inserted. The end of a piston rod **222** is passed through the adjusting screw **216** and sleeve **218** and rests inside the opening **219** of spring retainer **220**. The front part of the piston rod **222** has screw threads **224**. In front of the threaded portion **224** is a flange **223** which serves as a valve. Under normal conditions the flange **223** is retained inside the cylinder **201**, while the threaded portion **224** is retained half-way between the rear end of cylinder **201** and the front end of sleeve **218**. On the threaded portion **224** a movable spring retainer **225** is threaded and a spiral spring **226** is retained between the fixed retainer **220** and movable retainer **225**. Under normal conditions, piston **221** is located at the front end of cylinder **201** and spring retainer **225** is pressed by spring **226** against the projected surface of the adjustable screw **216**.

FIG. **6** illustrates the details of the brake control cylinder **28**. Cylinder body **301** has a sleeve **302** tightly fitted therein. On top of the cylinder body **301** an inlet hole **303** having a smaller diameter than the inside diameter of the sleeve **302** is provided. A threaded bore **304** on top of the hole **303** is fitted with a fitting to connect with inlet tube **29**. At the lower end of cylinder body **301** a projection **306** having an outside thread is provided for engaging with a sleeve **307**. At the lower end of sleeve **307** a fixed spring retainer **309** is threaded having a center opening **308**. Retained within cylinder **301** is a piston **310**. The lower end of piston rod **30** is threaded at **30***a*. The threaded portion **30***a* of the piston rod **30** passes through opening **308** of spring retainer **309** and extends toward the horizontal portion of brake band **131** of the brake assembly **13** and is connected therewith by adjusting nuts **31**. A movable spring retainer **311** is threaded on the upper end of threaded portion **30***a*. A Spiral spring **312** is retained between retainers **309** and **311**. When not actuated by hydraulic pressure, the movable retainer **311** is pressed against the projection **306** of the cylinder body **301** and piston **310** is positioned at an upper dead point. Holes **313** having threads therein are provided for mounting purposes.

The operation of the apparatus of the present invention will not be described. The apparatus is usually mounted on the wall near the window openings of a high building with anchoring bolts and nuts. A covering hood (not shown) is provided to protect it from weather, etc. Only sling **32** is exposed. An escaper hangs on the sling **32** with the aid of a belt or the like and jumps out of the window. The body weight of the escaper pulls on the cable **12** which in turn unwinds from the winch **11** and causes the winch **11** to revolve. Upon descent of the body, winch **11** rotates the gear train of gears **14, 16, 17, 19** and brake drum **13**. Gears **17** and **19** turn the screw rods **15** and **18** which force the nut plate **21** to move forward the piston **23** via piston rod **24**, causing hydraulic pressure to be built up within the cylinder **22**. This pressure is in turn transmitted to selecting pump **26** through tube **27** and fitting **213**. Piston **221** in the pump **26** moves against the force exerted by spring **226** until the flange **223** touches the inside hole of adjusting screw **216** (as shown by dotted line in FIG. **5**). In this position piston **221** is stopped below the hole **203** so that a part of hole **203** is exposed to communicate with bore **205** in front of the cylinder. Also, the end of piston rod **222** extends out of fixed spring retainer **220**. The extent of exposure of the hole **203** may be adjusted by the adjusting screw **216**.

Thus, hydraulic fluid from tube **27** is now transmitted through hole **203** and tube **29** to the brake control cylinder **28**, which in turn forces the piston **310** downward against the force of spring **312**. The lower end of piston rod **30** tightens the brake band **131** to press against the brake drum **134**, thereby stopping the rotation of winch **11**. Once the winch **11** is stopped, cable **12** ceases descending, to stop the falling body of the escaper.

When the winch **11** is stopped, gears **14, 16, 17, 19** and screw rods **15** and **18** are stopped. Nut plate **21** does not move forward any more and pressure inside cylinder **22** does not build up any more. As cylinder **22** ceases to produce pressure, fluid inside it leaks slightly through hole **204.** As a result of pressure decrease, piston **221** is forced back by spring **226** and returns to its original position. The channel between inlet tube **27** and outlet hole **203** is plugged by the piston **221.** Because of the pressure release, cylinder **28** loses pressure and piston **310** is forced upward by spring **312** until it reaches its uppermost position. Piston rod **30** releases brake band **131** from pressing brake drum **134** to diminish the braking effect. Again the escaper starts falling and commences another cycle of operation. When the cycles continue, the escaper can fall to the ground intermittently without undergoing gravitational acceleration. The leakage of fluid through hole **204** is much smaller in comparison with flow through hole **203** so that the time required for brake releasing is longer than that for deceleration of the winch. Thus, even though its an intermittent motion it proceeds smoothly without stumble.

The above embodiment is given only for illustration purposes and not by way of limitation, and modifications will become evident to those skilled in the art which will fall within the scope of the attached claims.

I claim:

1. Apparatus for fire escaping from a high building comprising a frame, a winch having a cable thereon rotatably mounted on said frame, a gear train driven by said winch, a pair of parallelly disposed screw rods having threads in reversed direction to each other and being driven by said gear train, a plate with a pair of nuts matching said pair of reversely threaded screw rods and slidably mounted thereon, a hydraulic cylinder having a piston driven by the slide motion of said plate, a hydraulic selecting pump actuated by said hydraulic cylinder, a brake control cylinder actuated by said selecting pump, and a brake assembly controlling the rotation of said winch, whereby upon rotation of the winch caused by the unwinding of the winch cable due to the falling of an escaper hanging on the cable end, pressure is built up in the hydraulic cyinder and passes through the selecting pump to actuate the brake assembly to stop the motion of the winch, and upon release of said brake assembly, rotation of the winch is resumed to start the whole cycle all over again so that the escaper reaches the ground in intermittent stop-and-go intervals without undergoing gravitational acceleration.

2. The apparatus according to claim **1,** wherein at the free end of the cable a sling is provided for attaching a safety belt or other rescuing aids.

3. The apparatus according to claim **1,** wherein the dimensions and pitches of said pair of screw rods are similar, the rotation of each rod being at the same speed but in opposite direction.

4. The apparatus according to claim **1,** wherein the pair of nuts have threads in reverse direction to each other so as to match with the said pair of screw rods, the plate being normally located at the end of the screw rod pair and having the end of a piston rod of said hydraulic cylinder connected thereto.

5. The apparatus according to claim **1,** wherein the hydraulic selecting pump comprises a cylinder body having a fluid inlet hole at its front end, a leakage hole of smaller diameter and an outlet hole of bigger diameter disposed at the side wall of the cylinder body; a piston slidably inserted inside the front end of the cylinder, a piston rod, a flange and a threaded portion being disposed at the middle portion of the piston rod; a sleeve threaded on the outside of a projecting portion of the cylinder body; an adjusting screw threaded on the inside of said projecting portion, an opening being provided at the center of the said adjusting screw to facilitate the passing through of a free end of said piston rod; a movable spring retainer threaded on the threaded portion of said piston rod; a fixed spring retainer threaded at the end of the said sleeve; and a spiral return spring retained between the said movable and fixed spring retainers.

6. The apparatus according to claim **1,** wherein the brake control cylinder comprises a cylinder body having a fluid inlet hole at its top, and a projecting portion at the lower end of the cylinder body; a piston and a piston rod slidably retained inside the cylinder body, the lower portion of the piston rod being threaded and extending downwardly outside the cylinder body; a sleeve threaded on the outside of the projecting portion; a movable spring retainer threaded on the top of the threaded portion of the piston rod; a fixed spring retainer threaded at the lower part of the sleeve; and a spiral spring retained between said movable and fixed spring retainers; the lower end of said piston rod being connected to a brake band of the brake assembly.

* * * * *