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 [21] Appl. No. **759,424**
 [22] Filed **Sept. 12, 1968**
 [45] Patented **Mar. 16, 1971**
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 [32] Priority **Sept. 20, 1967**
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 [31] **I-1323**

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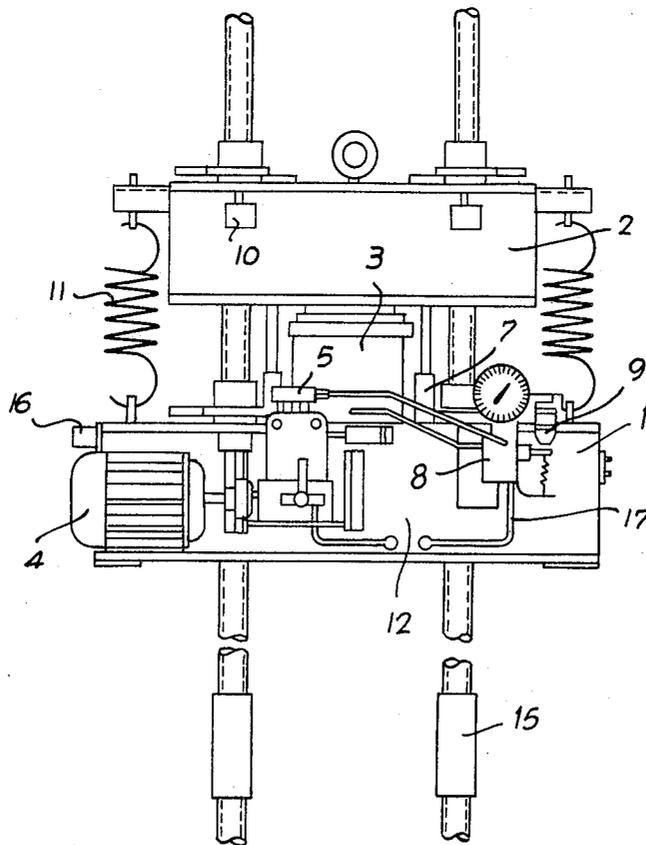
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[54] **LIFTING EQUIPMENT FOR THE ASSEMBLAGE IN VERTICAL DIRECTION OF BUILDING CONSTRUCTIONS MACHINES AND PLANTS**
6 Claims, 6 Drawing Figs.

[52] U.S. Cl..... **254/106**
 [51] Int. Cl..... **B66f 1/00,**
E02d 21/00
 [50] Field of Search..... **254/(Cur-**
sory), 105, 106, 107

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ABSTRACT: A system for lifting objects, e.g. parts of a building to be erected, wherein a plurality of lifting devices are spaced along the object and are connected thereto by threaded rods. The device comprises an upper and a lower member interconnected by a hydraulic jack and nuts on each of the members rotatable by mechanical means. The synchronization of the devices is carried out by a relay arrangement such that each device is associated with a respective switch having a plurality of contacts and coupled with the means for advancing one of the members with respect to the other. Movement is done in stages with each contact signaling the completion of its associated stage for all of the devices before any of them is energized to begin the second movement stage.



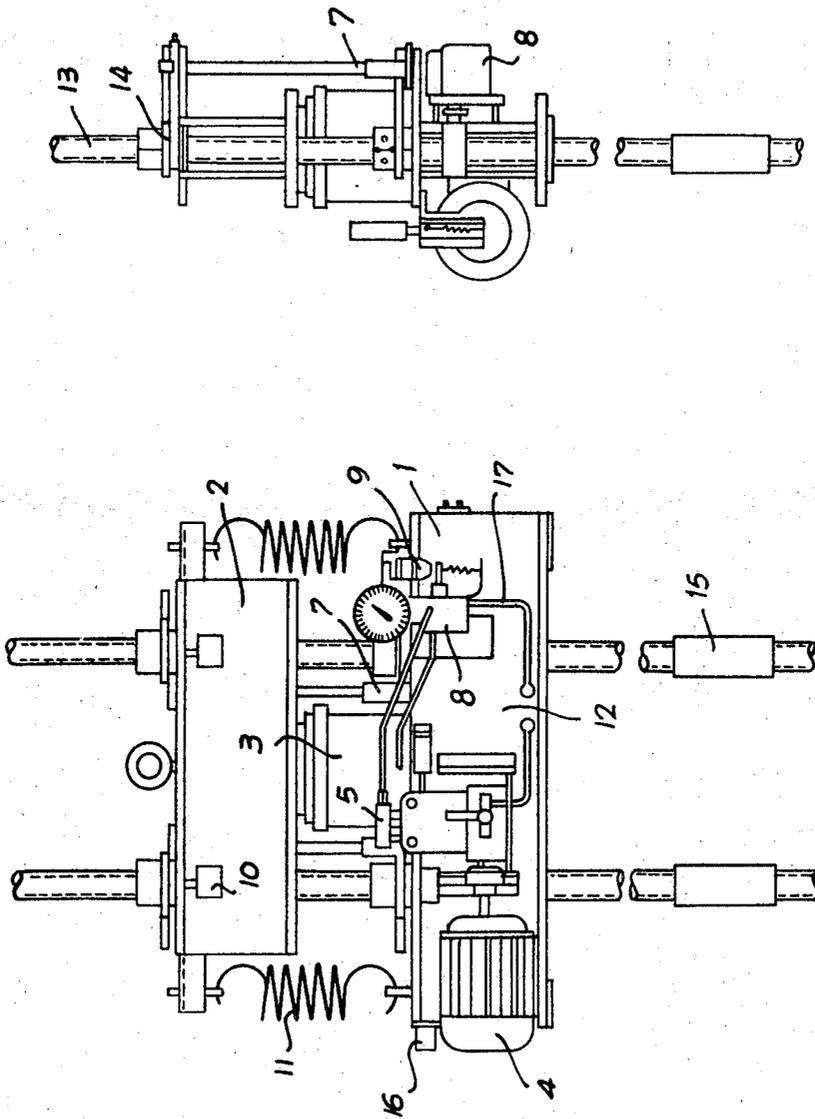


FIG. 2

FIG. 1

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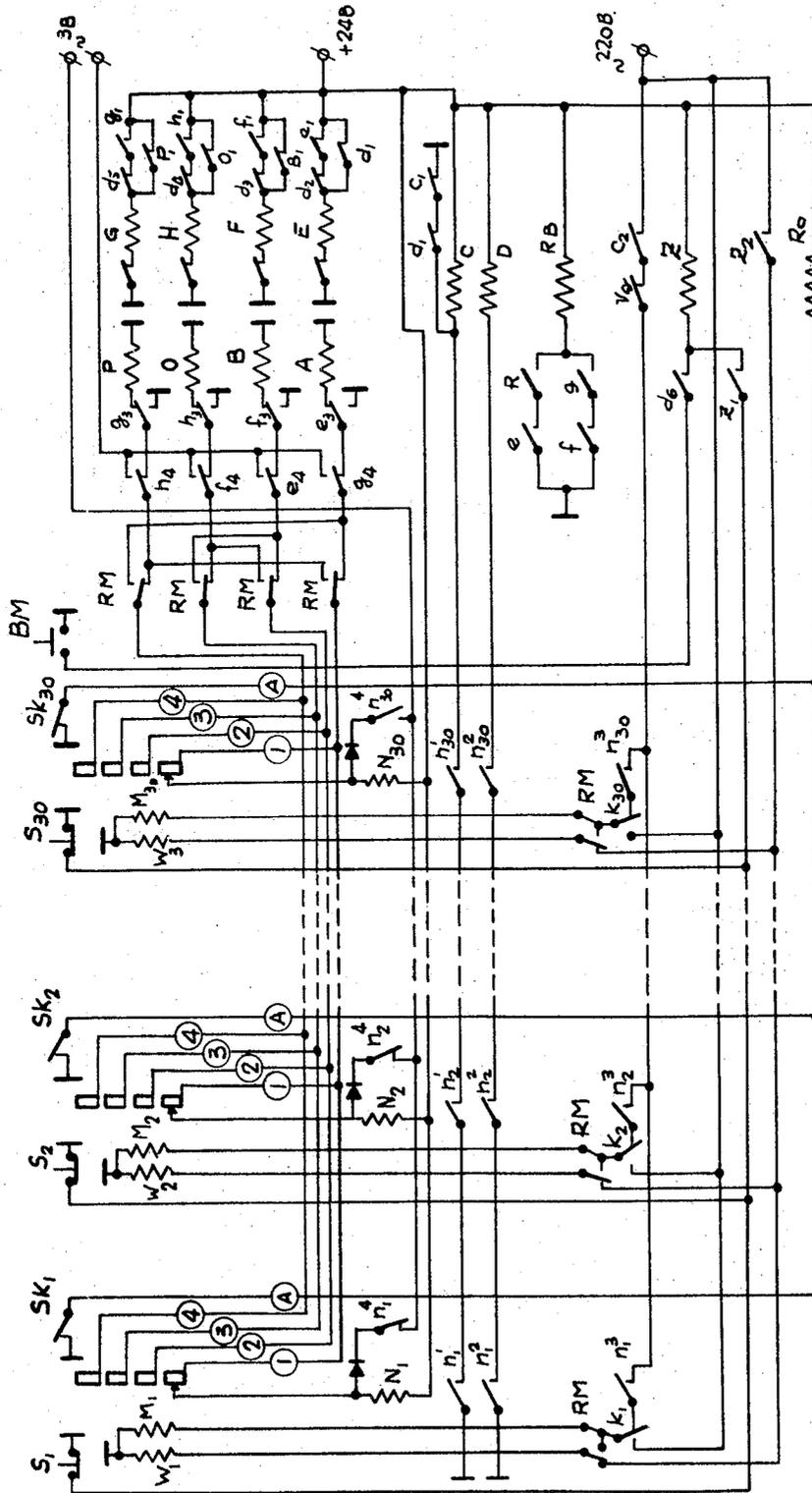


FIG. 3

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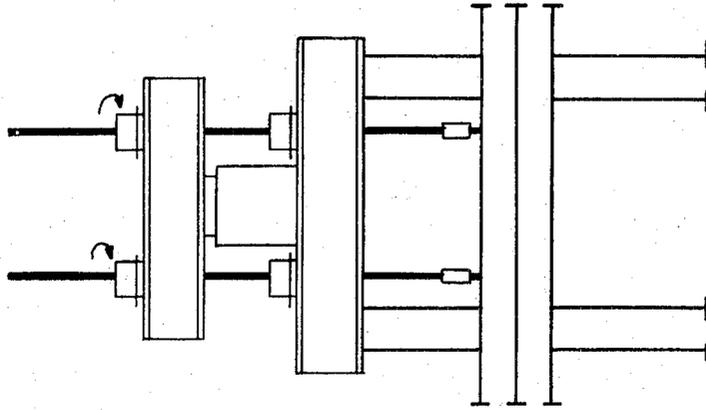


FIG. 6

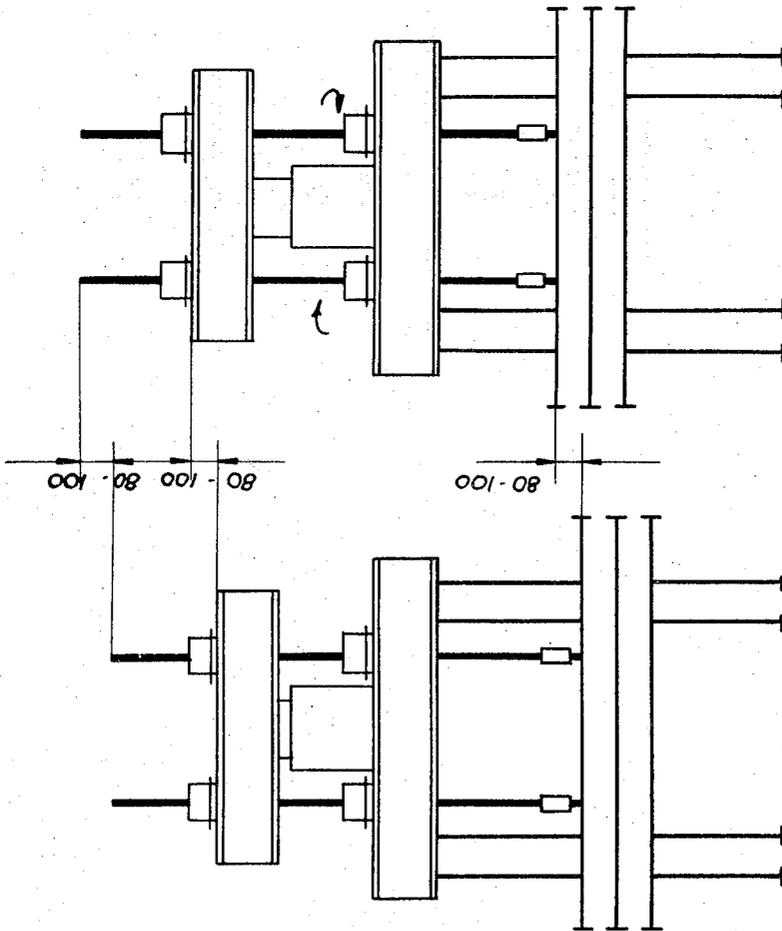


FIG. 5

FIG. 4

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**LIFTING EQUIPMENT FOR THE ASSEMBLY IN
VERTICAL DIRECTION OF BUILDING
CONSTRUCTIONS MACHINES AND PLANTS**

The present invention relates to lifting equipment for the assembly in vertical direction of buildings, machines, plants and the like wherein the hoisting is achieved by the reciprocating movement of a plurality of electrohydro mechanically actuated hoisting devices.

Lifting equipment is known, wherein the hoisting devices are actuated by hydraulic or electrohydraulic means, and the synchronizing system securing the hoisting conveyance is operated on hydraulic principles. The feeding of the lifting apparatus is achieved by means of separate armored rubber tubes through a high-delivery pumping set with an average pressure of 50—150 atm. The synchronization of the hoisting velocity of all of the hoisting devices is accomplished via a hand-operated central control panel by regulation of the feeding hydraulic fluid of each hoisting device. The utilization of a plurality of armored rubber tubes for each hoisting device requires a considerable number of rubber tubes, having a limited durability. Furthermore the synchronization of the hoisting velocity is subject to supervision by an operator, thus not insuring the cases of an unequal hoisting velocity, a lowering of the individual suspension points and an overloading of some of the hoisting devices. The hydraulic system securing the hoisting conveyance requires a central pump with a high delivery and respectively an increased electrical power. The net weight of the single hoisting device is very high (at a carrying capacity of 60 tons it is 320 to 400 kg.).

There is lifting equipment known, which are only mechanically actuated, wherein the hoisting conveyance is secured by means of supporting nuts, screwed through a ratchet mechanism. The latter is actuated by means of a central hoist through a continuous cable. Such lifting equipment is notable for its restricted carrying capacity (up to 20—25 tons) of the individual hoisting device and for the rapid wear of the supporting spindles, the nuts and the axial bearings.

It is therefore an object of the invention to provide lifting apparatus, in which the shortcomings of known lifting apparatus is avoided.

The hoisting devices of the lifting apparatus in accordance with the present invention, are operated in accordance with electrohydro mechanical principles: with their own high pressure charging pump up to 500 atm. individually driven by an electric motor and a mechanically or otherwise actuated synchronizing system securing the hoisting conveyance. The automatic synchronization of the hoisting velocity of the hoisting devices included in this lifting equipment is ensured through a central control panel, supplied with information units, information processing elements, controls and other elements monitoring the hoisting process, all the elements of the panel being completely electrically operated.

A preferred embodiment of the lifting equipment complete with the hoisting devices and the control panel in accordance with the invention is hereinafter particularly described with reference to the accompanying drawing in which:

FIG. 1 is a front elevation of a hoisting device in schematical representation;

FIG. 2 is a side elevation of a hoisting device in schematical representation;

FIG. 3 is a circuit diagram of the control panel;

FIG. 4 is a diagram of the hoisting device operating mode;

FIG. 5 is a diagram of the hoisting device during the working stroke of the hydraulic jack; and

FIG. 6 is a diagram of the hoisting device showing the return movement of the hydraulic jack.

The lifting equipment in accordance with the present invention comprises a plurality of hoisting devices, a control panel and a plurality of connecting cables.

The hoisting devices represent a hauling up appliance (machine) with a carrying capacity in accordance with the requirements of the assembly procedure, e.g. 40 to 100 tons. (At a carrying capacity of 60 tons the net weight of a single

hoisting device is 240 kg.). The hoisting devices (FIGS. 1 and 2) secure the hoisting conveyance by the reciprocating movement (FIG. 4, 5 and 6) of a built-in hydraulic jack 3, operated by means of a separate variable-stroke high pressure pump 5, driven by an electric motor. The hoisting conveyance is achieved by means of supporting nuts 14 and 18, screwed through an automatically operated mechanism or an electrically driven system with a hydraulic clutch being synchronized with the movement of the jack 3. Each hoisting device comprises the supporting spindles 13, with the upper supporting nuts 14 and the lower supporting nuts 18, an upper and a lower transverse bridge 1 and 2, a hydraulic jack 3, a synchronizing system including gears and a multilead spindle with a nut 7, a hydraulic unit including a distribution valve, a safety valve, a throttle and a manometer, an electric motor 4, a multipiston adjustable high pressure petroleum pump 5, a level indicator 8, interlocking contacts 10, electromagnets 9 for the control of the pump and a distribution valve.

The control panel for the automatic synchronization, is an electrically operated relay system, ensuring the synchronization of the hoisting velocity of a limitless number of hoisting devices, i.g. 24, 30, 36 and more, through the geometrical (in accordance the reference level) and the power (in accordance with the fluid pressure) levelling of the single hoisting devices and by the control of the supporting nuts. The control panel for the automatic synchronization comprises a relay unit for the processing of the information supplied from each individual hoisting device, an illuminated indicator panel with a fixed number of reference levels for the visual monitoring of the hoisting operations and the synchronization, a panel for the manual control of each individual hoisting device, a terminal panel, a current distribution panel and a plurality of connecting cables with couplings.

The lifting equipment operates in the following manner.

A determined number of hoisting devices are mounted on service supports (columns) 20 (FIG. 4) erected on the spots defined in the assembly project. By means of the supporting spindles and a connecting clutch with a ball-headed bolt, each individual hoisting device is fastened to the structure to be lifted. Through a multicore cable provided with couplings, every hoisting device is connected with the central control panel, whereof it is supplied with electric power and through information signals about the position of the single hoisting devices the control panel performs the control operations, securing the synchronization of the complete hoisting equipment.

In the initial position (FIG. 4) all hoisting devices are on the baseline. The level indicators 8 (FIG. 1) are adjusted on the first reference level spacing, thus closing the circuit of the individual relay N (FIG. 3) and illuminating the respective indicator lamps of the first reference level spacing 1 (FIG. 3). In this position the circuit of the relay C (FIG. 3), the contacts thereof supplying with 220 v. the electromagnets, which control the pump 5 (FIG. 1) is closed. The electromagnets 9 (FIG. 1) actuate the pumps for their maximum delivery and put the distribution valve of the hydraulic unit 6 (FIG. 1) in such a position, that a communication way between the pump 5 and the hydraulic jack 3 (FIG. 1) is established. The hoisting operation begins at all suspension points simultaneously. In each individual hoisting device performing the first reference level spacing, respective the level indicator 8 (on one of the supporting spindles of each hoisting device) switches over on the next in turn second reference level spacing, whereby its individual relay N releases the armature and closes the circuit of the luminous signal with diminished luminosity, an indication that the respective hoisting device is in an awaiting position. Through a contact positioned in the manometer of every hoisting device (adjustable for different pressures) the circuit of the electromagnet 9, controlling the pump of the respective hoisting device, is opened when the allowable pressure is exceeded, thus securing the control of the lifting equipment in accordance with the geometrical level as well as with the fluid pressure. When all hoisting devices are in the awaiting posi-

tion, the relay C and the group relay A (FIG. 3) of the first reference level spacing are disconnected, the group relay B (FIG. 3) of the second reference level spacing is switched on, the indicator lamps of the control panel illuminate with full luminosity, the relay C is energized and the hoisting operation goes on in the second reference level spacing. In such a way the working stroke of the hoisting devices is accomplished, i.e. a hoisting conveyance up to a determined height (a reference level spacing of 0.05 mm. and more, usually 2 to 4 mm.). These operations are repeated for the third and the fourth reference level spacings, which are monitored on the illuminated indicator panel in the upward direction. After the fourth reference level spacing is reached, the levels are repeated periodically. With the help of the synchronizing system, during the working stroke of every hoisting device the hoisting conveyance of the supporting spindles is secured through the lower supporting nuts 18 (FIG. 1), the latter being closely screwed on the lower transverse bridge of the hoisting device.

When the working stroke of the hydraulic jacks 3 (FIG. 5) is out, an instruction "return" is supplied to the control panel by means of a master pushbutton, mounted on one of the hoisting devices, which switches on the circuit of the relay Z, thus actuating the electromagnets of the distribution valves. All hoisting devices return, under the action of springs or hydraulically, to the initial position (FIG. 6). Every hoisting device, being in the initial position, actuates its own pushbutton S (FIG. 3), the contacts of the latter being normally closed, and the respective circuit is opened. When the last hoisting device attains the initial position, the relay Z is switched off and a new working stroke of the hydraulic jack begins. With the help of the synchronizing system, during the return stroke of the hydraulic jack, the upper supporting nuts 14 (FIG. 2) are screwed closely on the upper transverse bridge of the hoisting device, thus realizing a catch on the supporting spindle equal to the already performed working stroke. In such a way the hoisting conveyance of the constructional element is elevated up to the determined height, where it is secured in the service position.

During the hoisting step the lifting equipment is secured against overloading, speedup or other breakdowns in each individual hoisting device in such a manner, that the control panel stops all the operation of the equipment automatically and signalizes for the occurred incorrect operation.

In order to realize these securing operations every hoisting device is provided with a hydraulic safety valve, which can be adjusted on a determined pressure, a throttle for the damping of the mechanical stroke during the change over the return path and with electric interlocking contacts, the latter controlling the normal screwing operation of the supporting nuts.

For the processing of the information, supplied by the different safety means, the control panel is provided with the respective safety interlocking circuits.

We claim:

1. A system for elevating a body, e.g. in building construction, comprising a plurality of lifting devices spaced along said body and each including an upper and a lower member, at least one threaded rod anchored to said body and extending through said members, a hydraulic jack coupling said members for separating same, an electromotor-driven pump connected to the respective jack for hydraulically energizing same, and mechanism on each of said members including a nut threadedly engaging the respective rod and operable to clamp said members along the rod; and synchronizing means for controlling said devices, said synchronizing means including first switch means individual to each of said devices for energizing the respective pump, second switch means common to all said devices for energizing said first switch means upon the establishment of a predetermined elevation level at each said device, and third switch means individual to each said device and including a plurality of contacts representing a plurality of such levels and a wiper engaging the successive contacts of each third switch means upon the attainment of the corresponding level of elevation of said body at the respective device, all said third switch means being connected to said second switch means for activating the latter only upon engagement of the corresponding contact at each third switch means by the respective wipers.

2. The system defined in claim 1 wherein each of said devices is provided with a hydraulic network connecting the respective pump and jack and further comprising a reservoir, distribution valve means connecting said jack and said pump selectively with the reservoir, and damping means for restricting the contraction of said jack.

3. The system defined in claim 1 wherein said first switch means includes a first relay connected in circuit with the respective pump on each said device, said second switch means includes a pair of relays associated with each of said levels for at least three such levels, and the contacts of said third switch means are connected in parallel with one relay of each of said pair assigned to the respective level.

4. The system defined in claim 3, further comprising respective lamps in series with each of said contacts.

5. The system defined in claim 1, further comprising a respective manometer monitoring the pressure in each of said jacks for controlling same.

6. The system defined in claim 1, further comprising means for operating each of said mechanism upon the attainment of the corresponding level at each such device.

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