A power transmitting device, especially for lifting heavy loads, in which a chain is connected to the load and leads upwardly therefrom and about a sprocket wheel. A ratchet wheel is coaxial with and nonrotatably connected to the sprocket wheel and pawls are provided adjacent the ratchet wheel for driving the ratchet wheel in load lifting direction or for permitting controlled rotation of the ratchet wheel in load lowering direction. Fluid motors are connected to the pawls for the actuation thereof. A plurality of sprockets and ratchet wheels can be provided and operated in synchronism.

7 Claims, 7 Drawing Figures
LIFTING DEVICE FOR LIFTING AND LOWERING HEAVY LOADS

The present invention relates to a lifting device for lifting and lowering heavy loads. Lifting devices which are able to lift and lower loads in excess of 1,000 tons are needed, for instance, in the building industry for lifting bridges off their bearings or supports or to lower them thereunto. Such lifting devices are also required for lifting prefabricated ceilings to the required height or for lifting and lowering elevating platforms of ships. As a rule a plurality of such lifting devices are employed simultaneously regardless of the individual load acting thereupon. With elevating platforms for ships which have to be able to support loads in excess of 1,000 tons and which may be very long a great number of lifting devices has to be distributed on both sides of the elevating platform. In this connection, on both longitudinal sides of the elevating platform cable winches are used in which, however, the realization of synchronism and a uniform lifting or lowering of the load causes considerable difficulties because the cables lengthen to a different extent and are wound up to a different degree because during the winding operation the cables may slide on or between cable windings therebelow. Therefore, the synchronism requires the provision of synchro-ties or of a continuous mechanical shaft interconnecting all lifting devices on one side. The torsion of the shaft over the entire length thereof causes disuniformities which can be avoided only by considerable and expensive structural means.

It is, therefore, an object of the present invention to provide a lifting device for lifting and lowering of heavy loads which operates with small individual strokes during the lifting and lowering operation and which will assure a complete synchronism when a plurality of such lifting devices is employed simultaneously as is the case, for instance, with elevating platforms of ships or for lifting and lowering of ceilings in buildings.

This object and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 illustrates a side view of a lifting device according to the invention in connection with a ship lifting mechanism while occupying a position prior to the start of a lifting step.

FIG. 2 shows an end view of the upper portion of the lifting device of FIG. 1.

FIG. 3 shows the lifting device of FIG. 1 at the end of a lifting step.

FIG. 4 shows the lifting device according to the invention at the time of initiating a lowering step.

FIG. 5 shows the device according to the invention at the start of a lowering step.

FIG. 6 shows the device according to the invention at the end of a lowering step.

FIG. 7 diagrammatically illustrates the hydraulic control for the device according to the invention.

The lifting device according to the present invention for the lifting and lowering of heavy loads is characterized primarily by a sprocket wheel which is freely rotatably journaled in a bearing support and which has partially looped therearound a load chain while coaxially with the sprocket wheel there is connected a ratchet-following wheel with ratchet teeth directed in the lowering direction. This ratchet-following wheel has on the load side associated therewith one or two pawl pivots for respectively engaging tooth spaces between the ratchet teeth, the pawl pivot respectively interconnecting the two ends of the piston rods of two hydraulic cylinder piston units respectively arranged on both sides of the ratchet-following wheel, the hydraulic cylinder piston units being linked to the pivots in such a manner that one piston rod moves outwardly substantially tangentially with regard to the ratchet-following wheel whereas the second piston rod moves outwardly at an angle with regard to the first piston rod. The lifting device according to the invention is furthermore characterized by a holding pawl which is disengageable from a tooth space of the ratchet-follower wheel against the thrust of a spring.

A lifting device having the above outlined characteristics will be able to carry out in steps a lifting and lowering of the loads suspended on the chain while one step corresponds to the tooth pitch of the ratchet-follower wheel or to a division of the total lifting or lowering stroke.

Starting from the rest position, the two piston rods of the two cylinder piston units of each side will occupy their retracted position in which the pawl pivot interconnecting the ends of the piston rods will be located in a tooth space of the ratchet-follower wheel so that a rotation of the ratchet-follower wheel in lowering direction will be prevented while the load suspended on the chain is held at its starting level. At the same time, the holding pawl is due to the force of a spring moved into a tooth space of the ratchet-follower wheel and likewise prevents a rotation of the sprocket wheel in lowering direction.

For purposes of lifting the load, the two pistons rods are moved out of the cylinders of the cylinder piston units which are directed upwardly approximately tangentially to the ratchet-follower wheel. This outward movement brings about a rotation of the ratchet-follower wheel and results in a corresponding lifting of the load suspended on the chain. With the outward movement of the just mentioned piston rods, also the second pistons engaging the pawl pivots are moved out of the cylinders of their cylinder piston units by a smaller distance in conformity with the angle formed by the second piston rods with the first piston rods. When the ratchet follower wheel rotates, the holding pawl moves over the back flanks of the adjacent ratchet tooth while the spring tensions and permits the holding pawls to slide into the next ratchet tooth space as soon as the holding pawl has moved over the respective tooth head. By the engagement of the respective next tooth space of the ratchet-follower wheel the ratchet-follower wheel is prevented from rotating backwards in the lowering direction. Thereupon the piston rods extending substantially tangentially with regard to the ratchet-follower wheel are moved into their respective cylinders while simultaneously the other piston rods are moved outwardly further and are substantially likewise moved into their respective cylinders in such a way that the pawl pivot engages the respective lower tooth space of the ratchet-follower wheel. When the described lifting step is repeated with a new turning of the ratchet-follower wheel in lifting direction by a tooth pitch so that a lifting of the load by means of a plurality of successive lifting steps is possible by a height with which nearly the entire length of the load chain is being taken advantage of.
The lowering of a load starts with the starting position of the cylinder piston unit, of the pawl pivot, and of the holding pawl as they are assumed at the end of a lifting step. In this position, the ratchet-follower wheel rests, on one hand, through the pawl pivot upon the piston rods connected thereto and, on the other hand, rests on the holding pawl. After disengagement of the holding pawl, the tangentially directed piston rods of the cylinder piston units move into their respective cylinders while the second piston rods also move into their respective cylinders. In conformity with this inward movement of the piston rods, the ratchet-follower wheel resting on the pawl pivot rotates and the load is correspondingly lowered by one tooth pitch. As the result thereof, the disengaged holding pawl will be located within the region of the next tooth space of the ratchet-follower wheel and after being disengaged is by the thrust of the respective spring acting thereupon moved into the respective tooth space of the ratchet-follower wheel. In this way a further lowering step is for the time being made impossible. Accordingly, the piston rods of the tangentially directed cylinder piston units are moved further inwardly so that the ratchet-follower wheel tooth resting thereupon will be freed. Thereupon by the outward movement of the piston rods of the outwardly directed cylinder piston units, the pawl pivot is pivoted outwardly and by the outward movement of the tangentially directed piston rods is moved into the region of the next upper tooth space of the ratchet-follower wheel into which it is moved so that the next lowering operation can be effected when the holding pawl again disengages its respective tooth space.

When a plurality of lifting devices for lifting and lowering of a single load is provided with the individual devices being spaced from each other, at a maximum only such differences in height between the individual lifting devices can occur during the lifting or lowering of a load as they correspond to a tooth pitch. This is due to the fact that the lifting or lowering about a further tooth pitch can be made dependent on the completion of a lifting step by one tooth pitch by all of the employed lifting devices. In this connection it is of particular advantage that the lengthening of a chain of corresponding dimensions is practically impossible while, above all, in contrast to tackle systems, a winding up of the chain in superimposed positions does not occur. The free end of the chain is not at all taking part in a lifting or lowering step and can, for instance, without being wound up be placed in a box. A particularly good possibility of arranging the free sprocket wheel in a space-saving manner is obtained by using a roller chain, but also no difficulties will be encountered when using a round link chain.

According to a further development of the invention, it may be provided that at least one radially inwardly directed tension spring engages the pawl pivot and aids the inward movement of the outwardly directed piston rods and the engagement of the ratchet tooth space by the pawl pivot as well as a deep engagement of the bottom of the tooth space by the pawl pivot.

According to another feature of the invention, the holding pawl may be designed as a pivotal pawl engaged by a hydraulic cylinder piston unit for disengagement or for withdrawal of the pawl from the tooth space so that a hydraulic actuation will with the lifting device of the invention apply to all elements to be pivoted.

According to a still further development of the invention, it may be provided that electric limit switches are employed which are adapted to extend into the pivotal paths of the cylinder piston units. The actuation of the limit switches respectively in a predetermined sequence brings about the opening, closing, and the reversal of the valves preceding the hydraulic cylinder piston units in the feeding lines for the pressure fluid. In this way it will be assured that all stepping movements of the piston rods are effected automatically in a predetermined sequence and that the lifting and lowering of a load can be controlled from a central station, even when a plurality of lifting devices is used.

When a plurality of individual lifting devices is employed, the present invention provides that the individual lifting devices are electrically interconnected in such a way that each lifting device will be able to carry out the next load lifting or lowering stroke by means of its cylinder piston unit only after all lifting devices have completed their previous lifting or lowering stroke.

As mentioned above, according to the invention, there are on the load side provided one or two pawl pivot units for engagement with one or two tooth spaces of the ratchet-follower wheel. There has been described above in detail only the employment of one pawl pivot. When two pawl pivots are employed for respectively engaging two tooth spaces of the ratchet-follower wheel, while the pawl pivots connect the ends of the piston rods of each two hydraulic cylinder piston units linked at both sides to the bearing support, there exists the possibility of having the individual lifting strokes follow each other directly and in this way to operate so to speak in a stepless manner, namely so that, when one pawl pivot turns the ratchet-follower wheel by one tooth pitch, simultaneously the second pawl pivot will after moving out from one tooth space engage the next following tooth space and in that instance will initiate the further rotation of the ratchet-follower wheel when the first pawl pivot has completed its lifting stroke and in its turn by moving out of its respective tooth space is moved into the next free tooth space. In this instance the holding pawl merely has a safety function and becomes effective when a disorder should occur during the movement of the pawl pivots. Also when two pawl pivots are provided for alternately turning the ratchet-follower wheel, it is possible by means of the limit switches in cooperation with the control valves to synchronize the movements of a greater number of lifting devices in such a way that each lifting step of each lifting device will start only after all lifting devices have completed the preceding lifting step by one wheel pitch. The lowering operation is carried out correspondingly.

Referring now to the drawings in detail, there will first be discussed in connection with FIG. 1 an example of an application of the device according to the invention. More specifically, it is assumed that the elevating platform 1 of a ship is to be lifted or lowered, and it is further assumed that the elevating platform 1 is located in a channel 4 into which the ship is to be floated, the ship being fixed to the platform by means of supports. The ship can then together with the platform be lifted out of the water or channel and can with the platform, if the latter is provided with wheels, be transported into
a repair building. The lifting of the platform 1 is effected by means of lifting devices which are arranged on both sides of the channel and which are anchored at the banks of the channel to the ground 2, in which a box-shaped pit 3 may be provided for receiving the free ends of the chain.

The construction of the lifting device according to the invention will be evident from FIGS. 1 and 2 and the lifting device will be described in connection with the remaining figures as to its mode of operation. As will be evident from the drawings, the lifting device comprises a bearing block 5 having side plates 6 and 7. The axle by means of which or on which the sprocket wheel 3 is freely rotatably journaled is provided between these plates 6 and 7. Coaxially connected to the sprocket wheel 10 is a ratchet-follower wheel 10 the ratchet teeth 11 of which are directed in the rotational direction for a lowering operation. Accordingly, the teeth 11 are undercut in customary manner. The chain 12 forming a roller chain is looped around the sprocket wheel 9 over an angle of 180° while the load section extends vertically downwardly into the channel 4. Here the load section is looped around the reversing sprocket wheel 13 which is journaled in a bearing block 14 connected in its turn to the elevating platform 1. The upwardly directed chain end is linked at 15 to the bearing block 5. In this way the lifting device works in the manner of a block and tackle in which the lifting stroke of the chain 12 ahead of the reversing sprocket wheel 13 is twice as long as the lifting stroke of the elevating platform 1.

On the load side, the ratchet-follower wheel 10 has associated therewith the pawl pivot 16 which forms a joint connection between the ends of the piston rods 17 and 18 respectively pertaining to the hydraulic cylinder piston units 19 and 20. The cylinder piston units 19 and 20 are in pairs and on both sides of the bearing block 5 linked to the cylinders 21 and 22 and, more specifically, on both sides of the ratchet-follower wheel 10 as clearly shown in FIG. 2. The free central section of the pawl pivot 16 corresponds to the width of the ratchet-follower wheel 10. The cylinder piston units 19 extend upwardly approximately tangentially with regard to the ratchet-follower wheel 10, whereas the cylinder piston units 20 are directed upwardly at an angle thereto. The tension spring 23 which has one end 24 connected to the bearing block 5 pulls the pawl pivot 16 against the ratchet-follower wheel 10 and assures a complete engagement in the bottom of the ratchet tooth when the piston rods 17 and 18 carrying the pawl pivot 16 have assumed a corresponding position.

On that side which is located opposite the cylinder piston units 19 and 20, the ratchet-follower wheel 10 has associated therewith the pivotable pawl 25 which at 26 is linked to the bearing block 5 and by the tension spring 27 is pulled against the ratchet-follower wheel 10. A pivoting in opposite direction is possible by means of the hydraulic cylinder piston unit 29 which is linked to the bearing block 5 at 28. The piston rod of the cylinder piston unit 29 has its free end linked at 30 to the pivotable pawl 25. Moreover, the cylinder piston units 19 and 20 as well as the pivotable pawl 25 have limit switches associated therewith which will be discussed later in connection with the description of the operation of the device.

As mentioned above, that end of chain 12 which is not under load is located in a pit 3, while in case a roller chain is used, there exists the possibility to arrange the chain links in a space-saving manner as shown in FIG. 1 and to distribute the chain links uniformly adjacent to each other.

As indicated in FIG. 2, the cylinder piston units 19 and 20 are provided in pairs, namely on both sides of the ratchet-follower wheel 10. Expediently, also a double arrangement of the cylinder piston unit 29 may be provided in order to assure a uniform point of attack of the force at the joint area 30 of the pivotable pawl 25.

The lifting device according to the invention operates as follows. It may be assumed that the lifting device occupies the position shown in FIG. 1 which may be termed the basic or rest position in which the pawl pivot 16 engages a tooth space of the ratchet-follower wheel 10 while a complete engagement at the bottom of the tooth space will be assured by the tension spring 23. The engagement of the pawl pivot 16 is determined by the outwardly moved position of the piston rods 17 and 18 of the cylinder piston units 19 and 20. As will be evident from FIG. 1, the piston rod 17 has moved outwardly by approximately one fourth of the total possible stroke.

Also the pivotable paw 25 has its pawl pivot 31 arranged at its free end in engagement with a tooth space of the ratchet-follower wheel 10, the free end being held in the tooth space by the thrust of the tension spring 32. For purposes of carrying out the first lifting step, the piston rods 17 are moved outwardly whereby through the intervention of the pawl pivot 16 the ratchet-follower wheel 10 and thus also the sprocket wheel 9 are rotated in a clockwise direction. In this connection, the pawl pivot 31 of the pivotable paw 25 slides against the tension of spring 27 over the head of the adjacent ratchet tooth until the pawl pivot 31 drops into the next tooth space. As a result thereof, the ratchet-follower wheel 10 has rotated by one tooth pitch. The sprocket wheel 9 has also correspondingly turned so that by means of the reversing sprocket wheel 13, the elevating platform 1 has been lifted by approximately half the stroke of the piston rod 17. The end position following the first lifting stroke is illustrated in FIG. 3 which shows that with the outward movement of the piston rod 17 also a corresponding outward movement of the piston rods 18 was effected inasmuch as all piston rods are linked together to the pawl pivot 16. For the duration up to the initiation of the next lifting stroke, the ratchet-follower wheel 10 remains secured against a backward turning by the holding paw or pivotable paw 25, whereas the piston rods 17 and 18 with the pawl pivot 16 move into the cylinder piston units 19 and 20 in conformity with FIG. 1 while carrying out a pivoting movement. Now a new lifting cycle may be started which again brings about a rotation of the ratchet-follower wheel 10 by one tooth pitch and thereby lifts the platform 1 by a further lifting stroke or step.

The individual movements of the piston rods 17 and 18 cannot automatically be carried out hydraulically, but the electrohydraulic control provides the possibility, when a plurality of lifting devices according to the invention are provided, to bring about a complete synchronism of the lifting devices in such a way that a lifting step can be initiated only after all lifting devices have completed the preceding lifting step. For purposes of control, there are provided limit switches 32, 33, 34, 35 and 36 which cooperate with the multi-way valve 37 and with the valves 38, 39, Fur-
thermore, the device according to the invention comprises a control valve 40, a check valve 41 and a pressure relief valve 42. The supply of pressure medium is effected by means of a pump 43.

FIG. 7 diagrammatically shows the control elements at the time of the start of a lifting step in conformity with FIG. 1. At the start of a lifting step, the multi-way valve 37 is set for throughflow so that the cylinder piston units 19 are actuated upon by pressure fluid with the result that the piston rods 17 move outwardly. Accordingly, the ratchet-follower wheel 10 carries out one revolution and the elevating platform 1 is lifted accordingly. When the piston rods 17 move outwardly, the cylinder piston units 20 have been subjected to a corresponding pivoting movement. In the end position, the limit switch 34 responds with the result that the multi-way valve 37 is reversed. While the ratchet-follower wheel 10 is by a holding pawl or pivotable pawl 25 prevented from turning backwardly in conformity with FIG. 3, after the valve 37 has been shifted, the piston rods 17 move into their respective cylinder piston units 19 and again reach their starting position according to FIG. 1 in which the limit switch 33 is shifted and initiates the next lifting stroke by changing the position of the multi-way valve 37.

When a lowering operation is effected in conformity with FIGS. 4 to 6, the control valve 39 designed as a magnetic valve is shifted into a position for throughflow of the pressure medium so that the cylinder piston units 20 are actuated upon by the pressure medium. Accordingly, the piston rods 18 move outwardly so that, by pivoting the cylinder piston units 19, the pawl pivot 16 passes into the position shown in FIG. 4. In the end position of pawl pivot 16, the limit switch 32 will control the reversing valve 37 in view of the pivoting of the cylinder piston units. By the pressure fluid entering the cylinder piston units 19, the piston rods 17 are moved outwardly in conformity with FIG. 5 while the pawl pivot 16 pivots together with the cylinder piston unit 20 about the pivot point 22 and moves into the next upper tooth space. In the end pivoting position of the cylinder piston unit 20, the limit switch 34 is actuated upon thereby adjusting the magnetic valve 40 for throughflow of the pressure medium and sets the magnetic valve 39 for return flow of the pressure medium. Through the intervention of the magnetic valve 40, the cylinder piston unit 29 is actuated by pressure fluid, and the piston rod 44 moves outwardly while permitting the pawl pivot 21 of the holding or pivotable pawl 25 to move out of the tooth space against the thrust of spring 27. In its end position, the limit switch 36 cooperating therewith shifts the reversing valve 37. As a result thereof, the flow of pressure fluid will unblock the check valve 41, and the piston rods 17 which are controlled as to their speed by the lowering brake valve 38 move into the cylinder of the cylinder piston units 19 and again return to the starting position according to FIG. 6. In this connection the limit switch 33 responds with the result that the valve 40 is shifted so that the piston rod 44 returns into its cylinder and consequently the pawl pivot 31 of the pivotable pawl 25 will due to the thrust of spring 27 drop again into a tooth space so that now again the ratchet-follower wheel 10 is held in its position by the pawl pivot 31. Consequently, the next lowering step may follow in the just described manner.

As mentioned above, a plurality of lifting devices according to the invention may be controlled in synchronism during the lifting as well as during the lowering operation. Each initiated lifting or lowering step is through limit switches checked on all lifting devices. Only after all limit switches have sent back a pulse, is the next command released. In this way it will be assured that the maximum error during a lifting or lowering operation, in case one lifting device should fail, can amount only to the magnitude of a lifting step. The lifting step, in view of the reversing of chain 12 about the sprocket wheel 13 will amount to half the circumferential stroke of the ratchet-follower wheel. In practice, only a few centimeters are involved which fact is irrelevant in case of an elevating platform of great length.

The described embodiment according to FIGS. 1 to 7 always employs only one pawl pivot 16 with the associated cylinder piston units 19 and 20. In differentiation therefrom, it is possible to associate two pawl pivots 16 with the ratchet-follower wheel 10 and to arrange the same in spaced relationship to each other over the circumference. In this connection the second pawl pivot is actuated by means of an additional pair of cylinder piston units 19 and 20. With a double arrangement of the pawl pivot 16, lifting and lowering operations can be carried out automatically in a continuous manner inasmuch as during the engagement of one tooth space of the ratchet-follower wheel 10 by one pawl pivot and during the lifting and lowering operation the second pawl pivot is disengaged from the tooth space and is moved into the starting position for the next lifting or lowering operation, so that it will be able immediately to bring about the next lifting or lowering step after the other pawl pivot has finished its lifting or lowering step and, without affecting the ratchet-follower wheel 10, pivots back into its starting position. Also in this instance the lifting and lowering operation is carried out in small steps while the individual steps follow each other immediately because idling strokes of the piston rods 17 and 18 do not bring about an interruption of the lifting or lowering operation. In such an instance the holding pawls 25, 31 merely have a safety function in case one of the cylinder piston units 19, 20 should fail.

It is, of course, to be understood that the present invention is, by no means, limited to the particular showing in the drawings but also comprises any modifications within the scope of the appended claims.

I claim:

1. In a power transmitting device, especially for use with heavy loads; at least one sprocket wheel, a load chain entrained about a portion of the periphery of said sprocket wheel and having a reach leading away from the sprocket wheel in one circumferential direction thereof for connection to a load, support means on which said sprocket wheel is rotatably supported, a ratchet wheel coaxial with and nonrotatably connected to said sprocket wheel and having ratchet teeth facing in said one circumferential direction of said sprocket wheel, first pawl means adjacent said ratchet wheel, first fluid operated cylinder piston means having a first piston rod outwardly tangentially connected to said first pawl means and operable to move said first pawl means substantially in the circumferential direction of said ratchet wheel, second fluid operated cylinder piston means having a second piston rod connected to said first pawl means to move outwardly at an angle with regard to said first piston rod and operable to move said first pawl means in a direction substantially radially of
said ratchet wheel, said first piston rod having a double function in being both a tangentially engaging drive element and also an element to hold back accordingly, second pawl means adjacent said ratchet wheel and supported against movement in the circumferential direction of said ratchet wheel but moveable radially of said ratchet wheel, and means resiliently urging said second pawl means radially inwardly of said ratchet wheel whereby said second pawl means will ratchet from one tooth space of said ratchet wheel to the next when said ratchet wheel is moved upon actuation of said first pawl means by said first fluid operated means.  

2. A device according to claim 1 which includes means resiliently urging said first pawl means radially inwardly of said ratchet wheel.  

3. A device according to claim 1 which includes third fluid operated means connected to said second pawl means and operable to move said second pawl means radially outwardly of said ratchet wheel to disengage said second pawl means from said ratchet wheel.  

4. A device according to claim 3 in which each of said first, second and third fluid operable means comprises piston-cylinder devices each having one of the cylinder and piston thereof pivotally connected to said support means and the other connected to the respective pawl means, a source of fluid pressure, control valve means connecting said source of fluid pressure to said cylinders, and limit switch means operatively associated with said control valve means and sensitive to the positions of said pawl means for controlling said control valve means.  

5. A device according to claim 1 which includes a plurality of said sprocket wheels each having a respective chain entrained about a portion thereof and leading therefrom for connection to said load, a said ratchet wheel coaxial with and nonrotatably connected to each sprocket wheel, a first pawl and a second pawl adjacent each ratchet wheel and resiliently biased radially toward the respective ratchet wheel, first and second fluid motors connected to each first pawl for moving said first pawl circumferentially and radially respectively of the respective said ratchet wheel, a third fluid motor connected to each second pawl for moving the said second pawl radially of the respective ratchet wheel, a source of pressure fluid, control valve means connecting said motors to said source, electromagnetic actuator for said control valve means, and limit switch means in circuit with said actuators and positioned to be actuated by said pawl means in limit positions thereof, said limit switch means being interconnected to permit energization of a said actuator only when all of said pawls are in corresponding limit positions.  

6. A device according to claim 1 in which each said pawl means is a pin-like element extending in the axial direction of said ratchet wheel, and a said first fluid motor means connected to each end of the pin-like elements forming at least said first pawl means.  

7. A device according to claim 1 in which said reach extends downwardly from said sprocket wheel, an idler connected to said load, said one reach being entrained about said idler and extending upwardly therefrom to said support means and being connected to said support means.  

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,791,229 Dated February 12, 1974

Inventor(s) HEINZ LIETZKE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:


Signed and sealed this 13th day of August 1974.

(SEAL)

Attest:

McCOY M. GIBSON, JR. C. MARSHALL DANN
Attesting Officer Commissioner of Patents