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Bushnell, Jr.

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[45] **Mar. 18, 1975**

[54] **EXTENDIBLE STABLE WORKING PLATFORM**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 190,052, Oct. 18, 1971, abandoned.

[52] **U.S. Cl.** **182/63,** 182/148

[51] **Int. Cl.** **E04g 1/22**

[58] **Field of Search** 182/141, 148, 63, 66, 67, 182/178; 33/80

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Attorney, Agent, or Firm—Seed, Berry, Vernon & Baynham

[57] **ABSTRACT**

A portable elongated working platform supported by a plurality of pneumatically extendible telescoping cylinders. The opposite sides of the elongated platform are interconnected such that the platform remains substantially level during a shift of weight from one portion of the platform to the other. The interconnection is such that the horizontal stability is a constant factor regardless of the amount of extension of the cylinders. The lowermost stage of the cylinders may be extended first, lifting the working platform above the supporting surface and providing a leg structure enabling the platform to straddle objects which would normally interfere with the use. The control system is responsive to movement of the extending cylinders, terminating flow and thus preventing an excess build up of fluid in the event the cylinders should cease outward movement.

46 Claims, 15 Drawing Figures

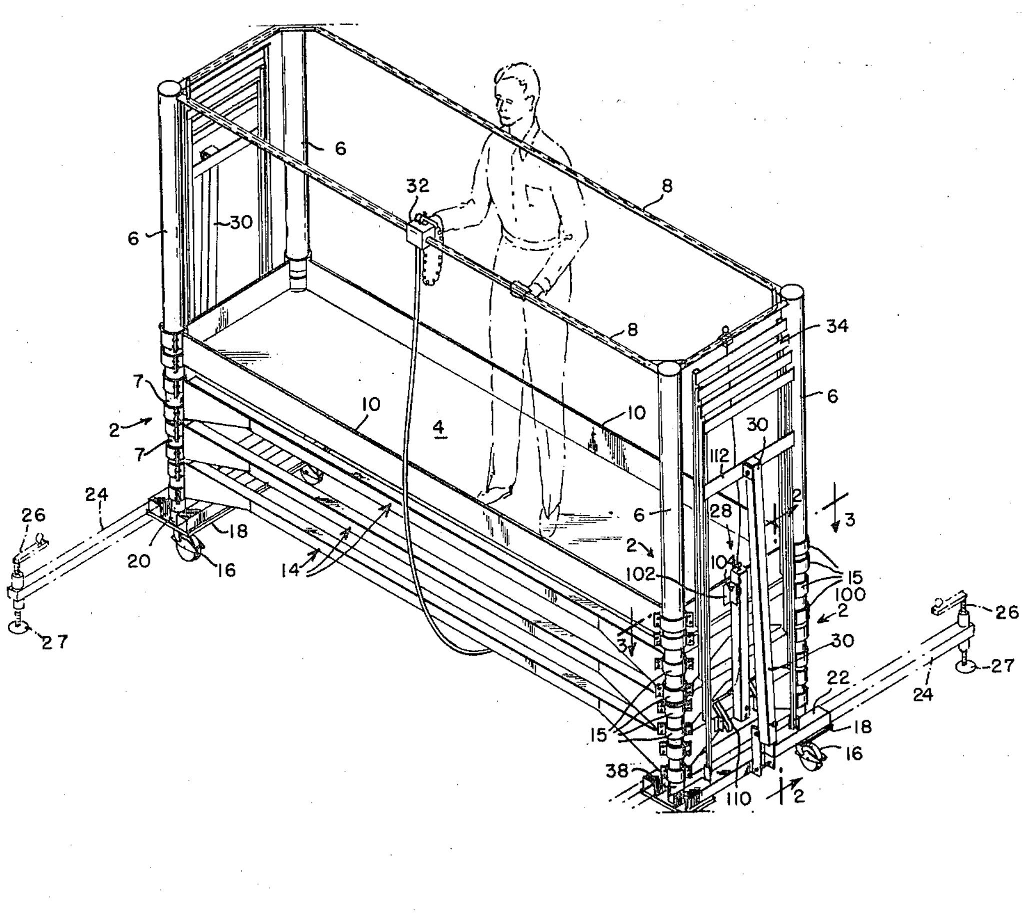
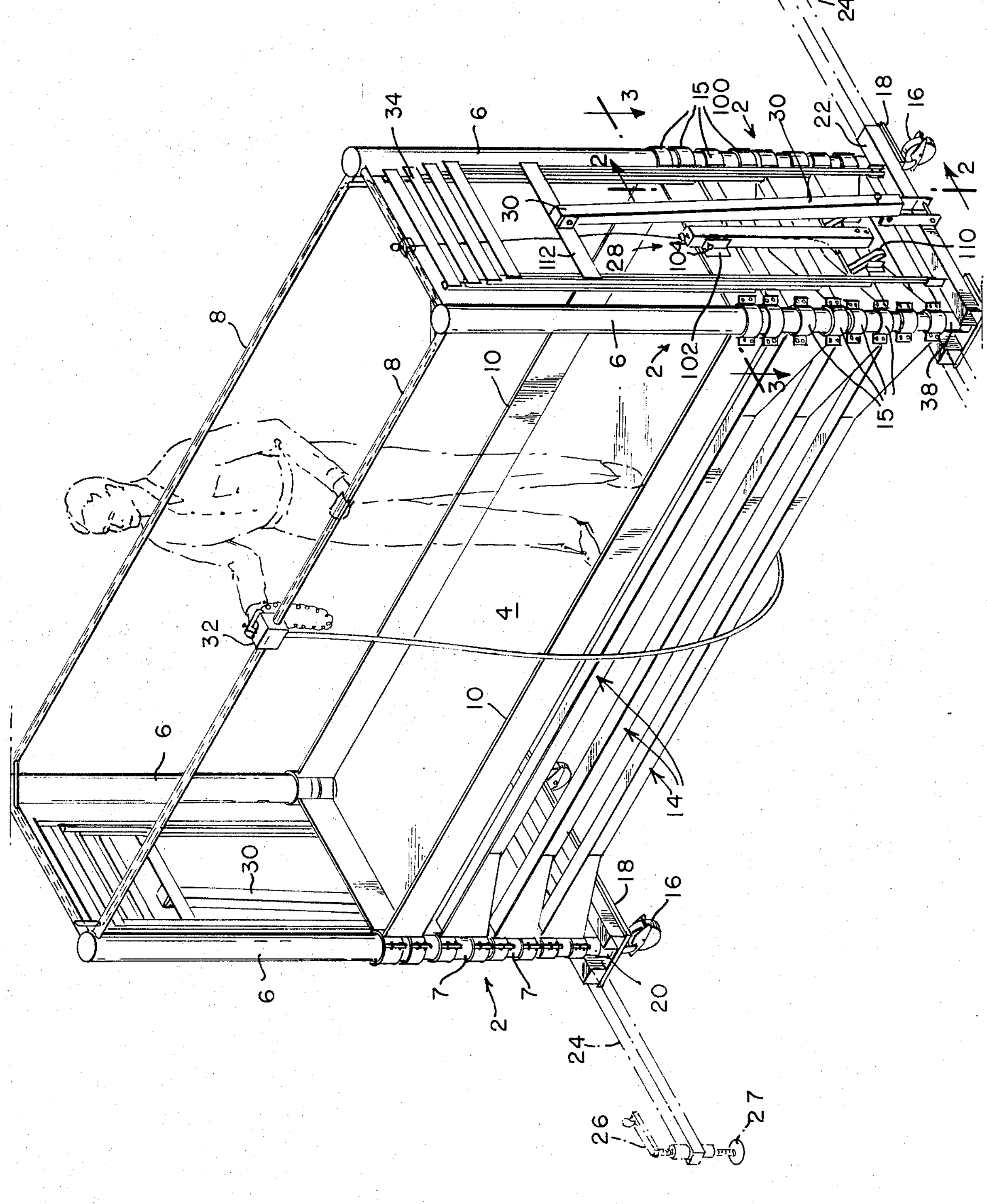


FIG. 1



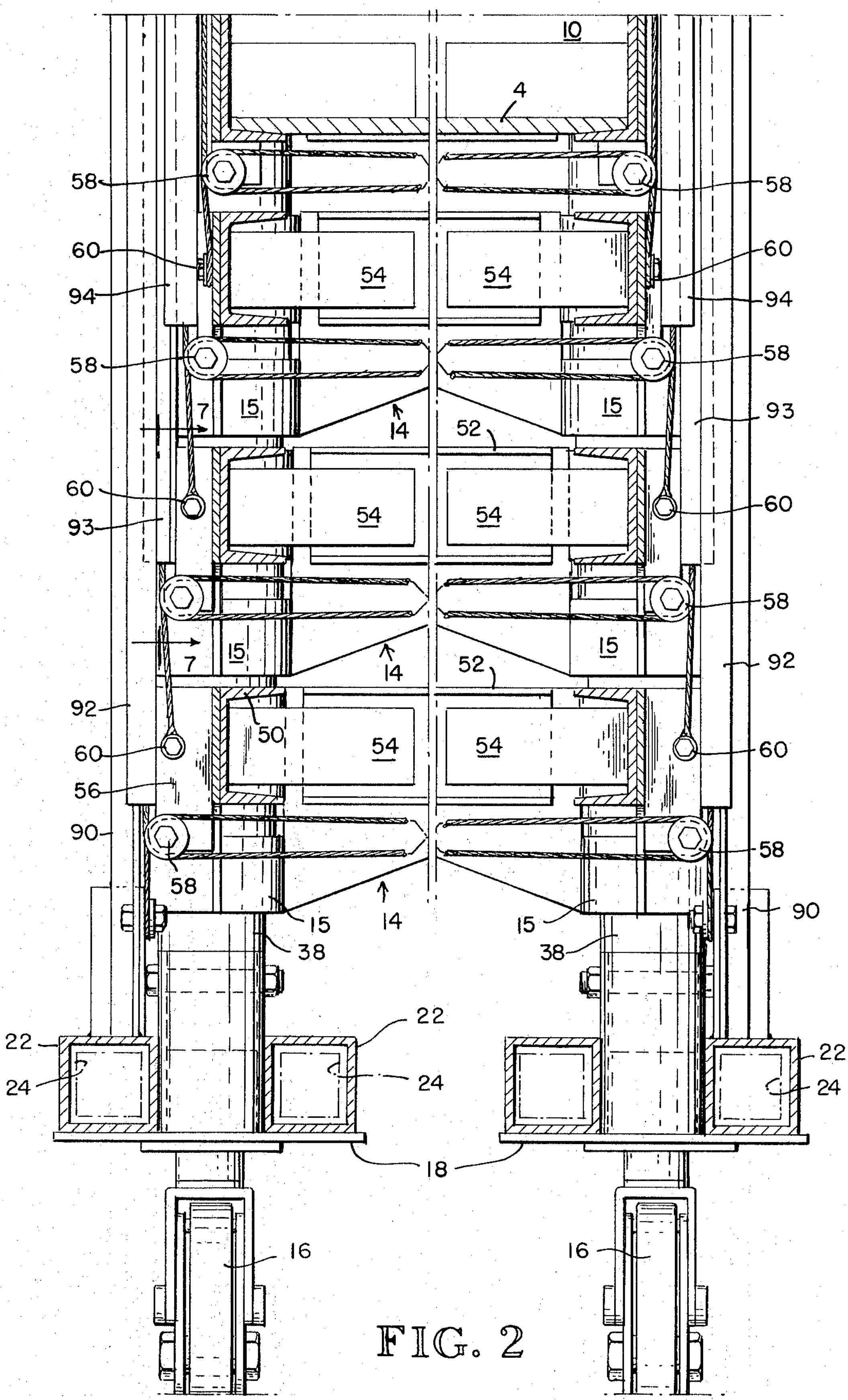


FIG. 2

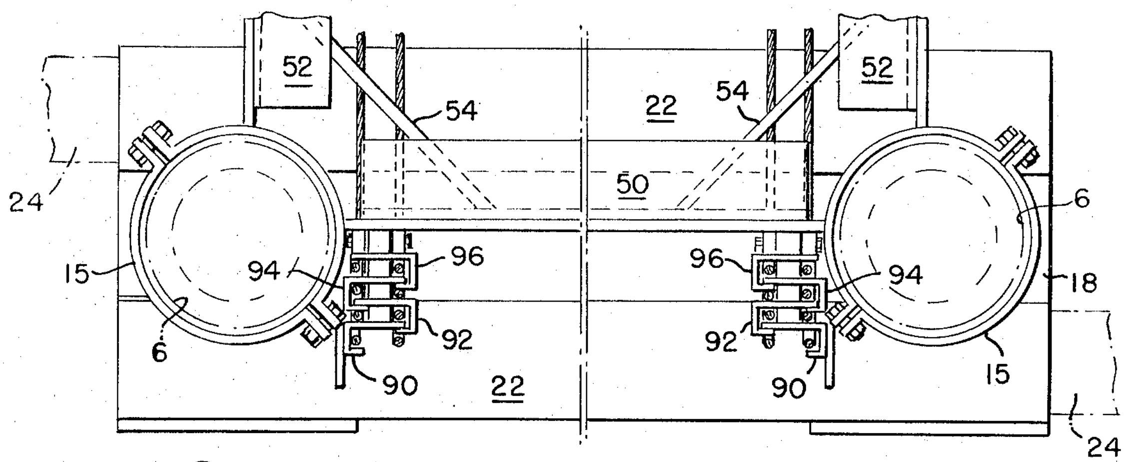

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FIG. 3

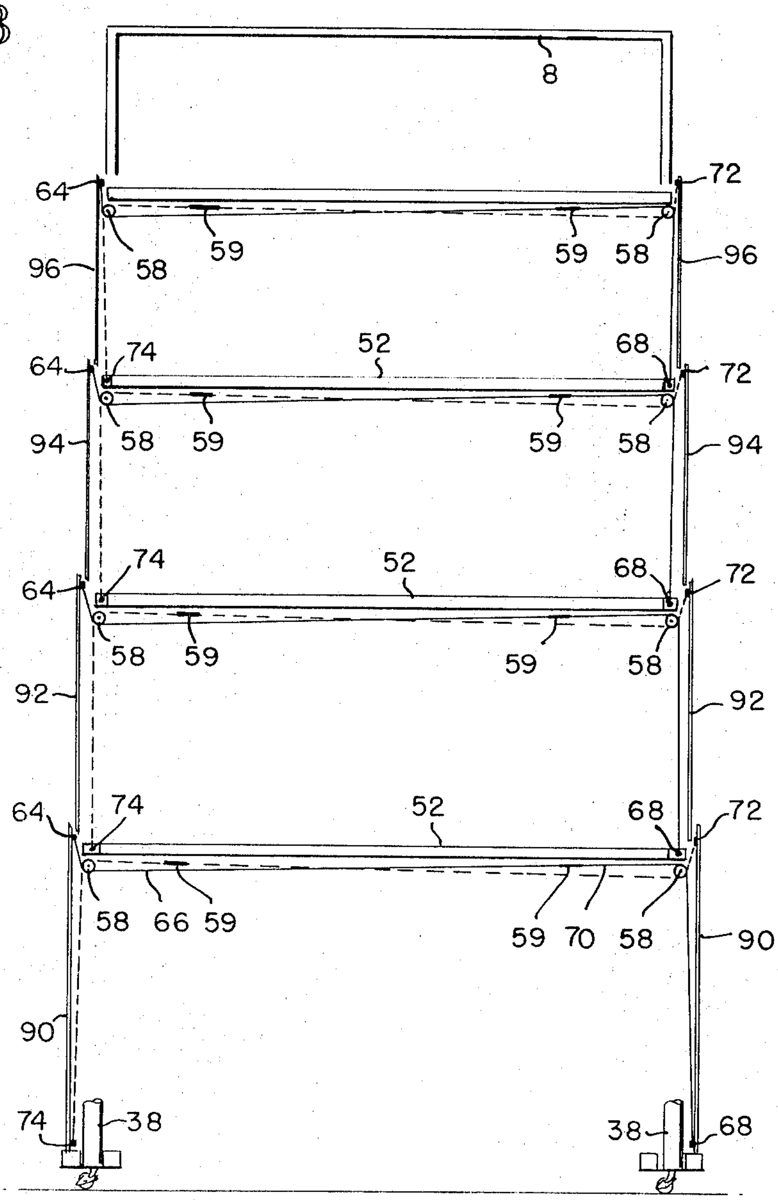
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FIG. 4

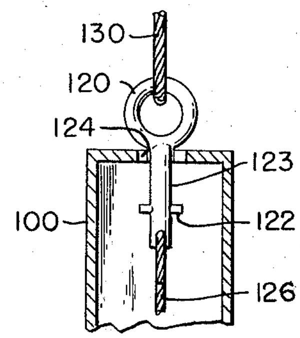

FIG. 6

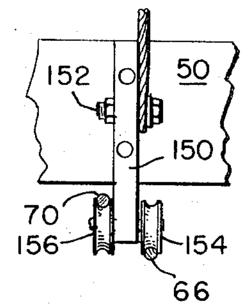

FIG. 7

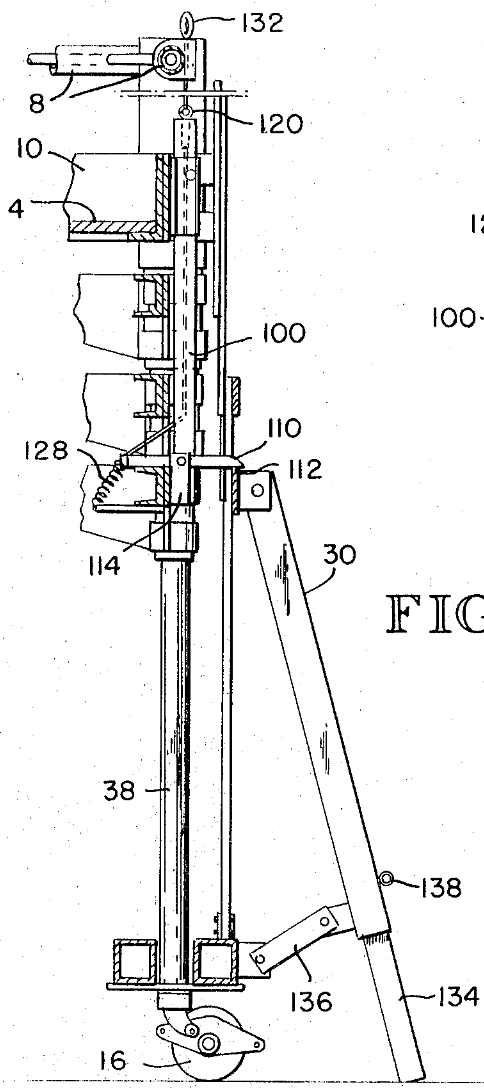

FIG. 5

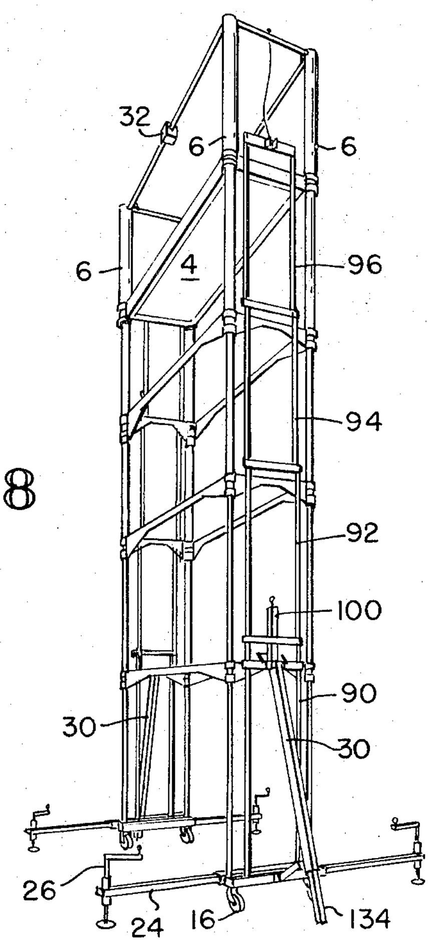

FIG. 9

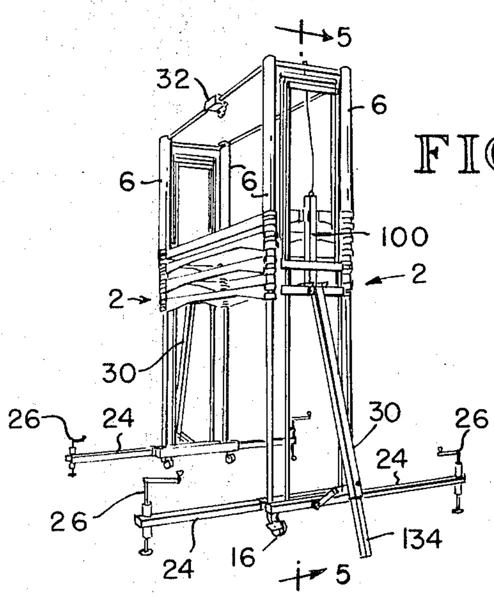

FIG. 8

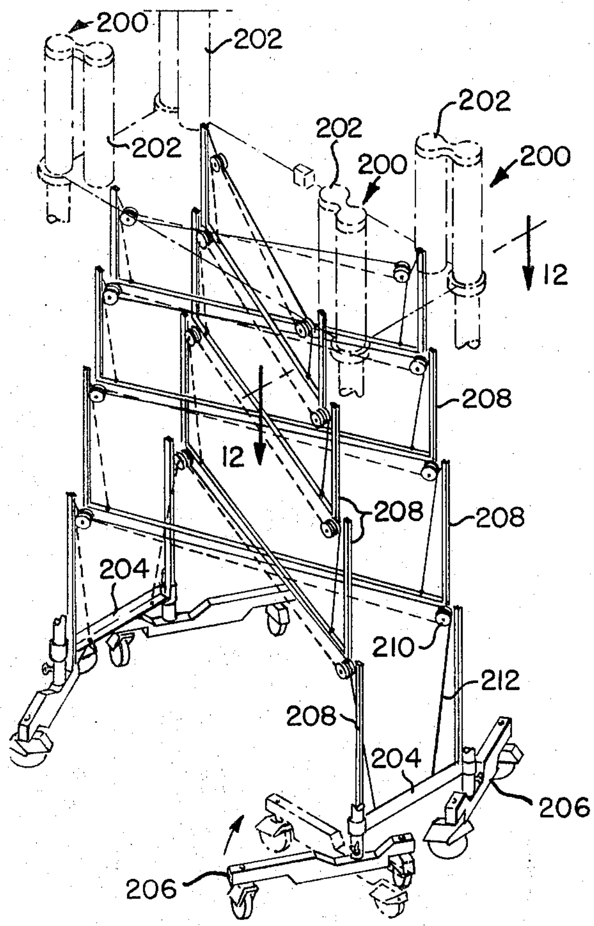

FIG. 10

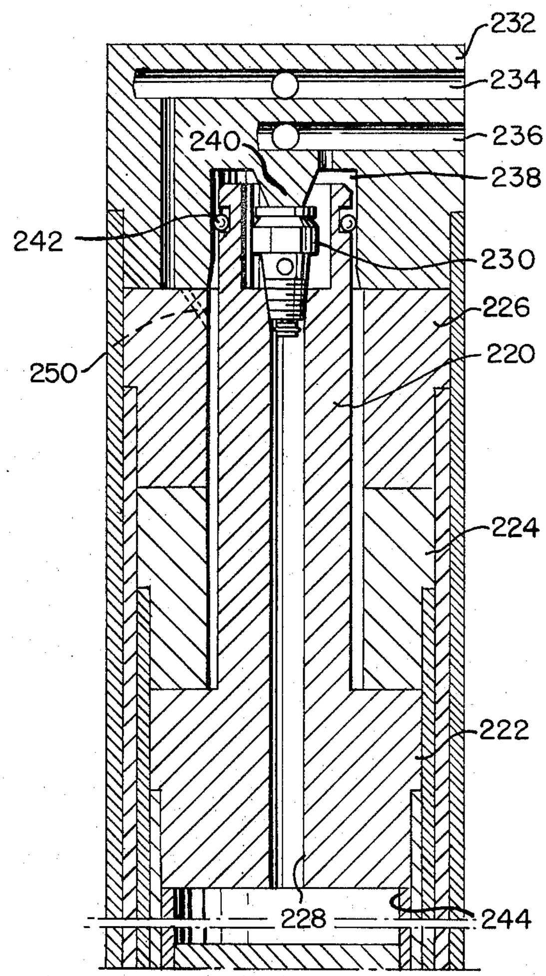

FIG. 11

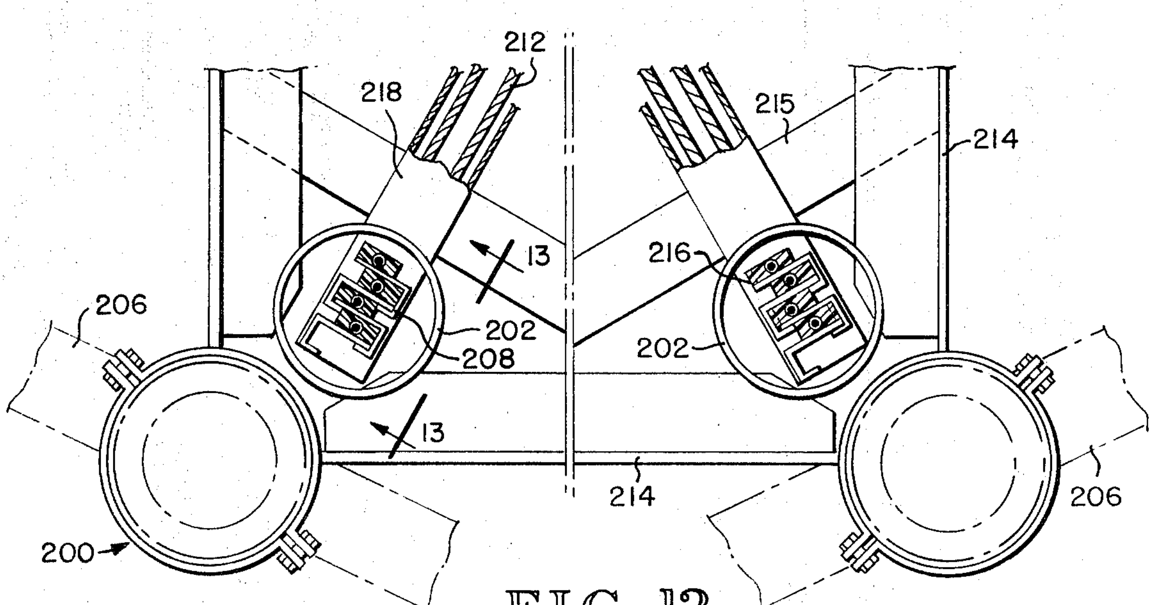

FIG. 12

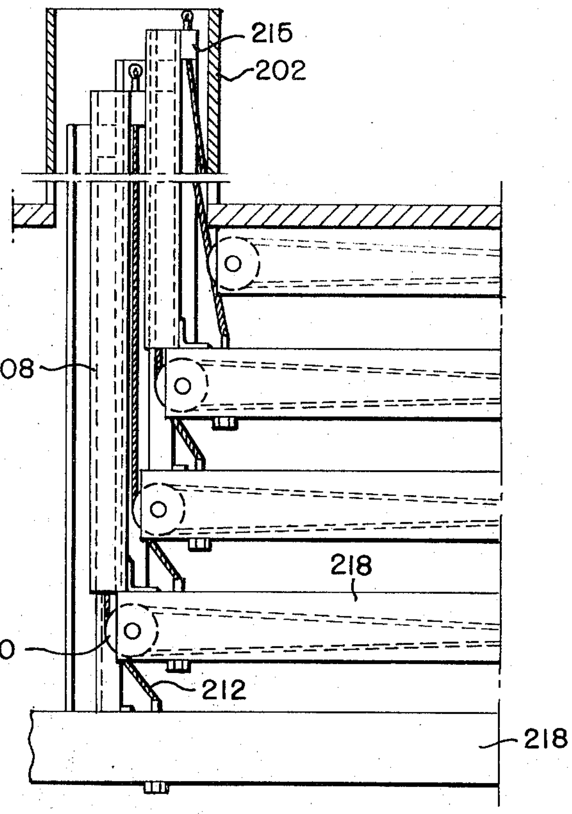

FIG. 13

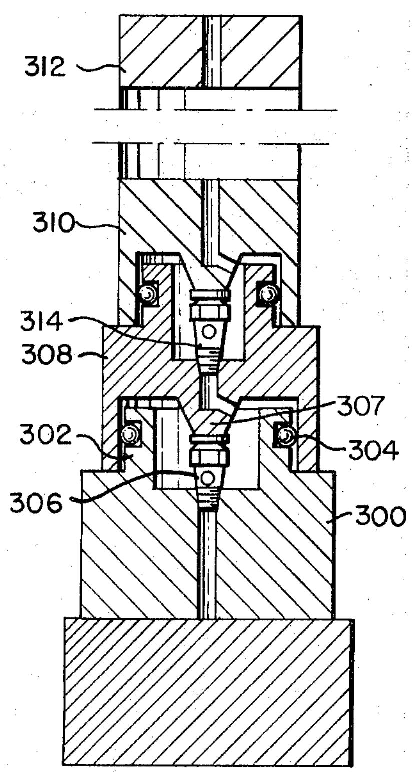

FIG. 14

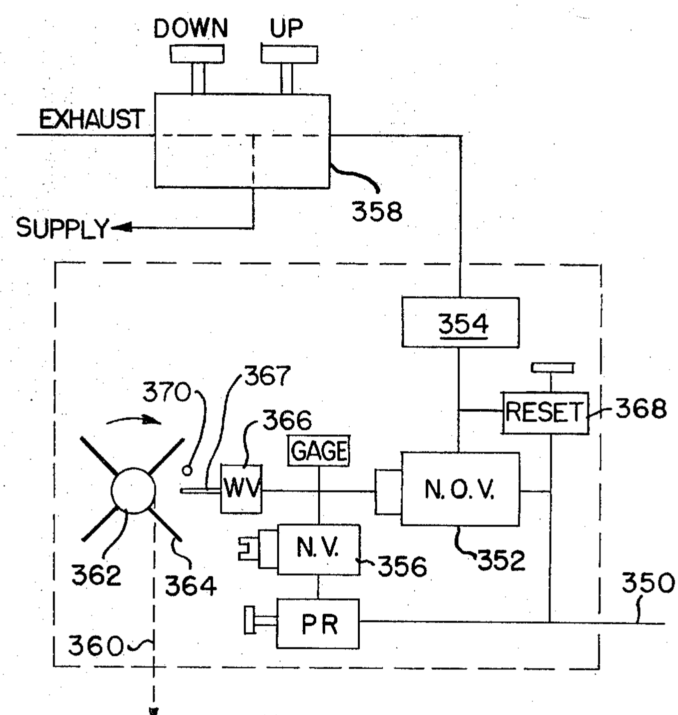

FIG. 15

EXTENDIBLE STABLE WORKING PLATFORM

BACKGROUND OF THE INVENTION

This application is a continuation in part of U.S. Pat. application Ser. No. 190,052 filed Oct. 18, 1971 now abandoned and entitled "Extendible Stable Working Platform."

The need for a working platform which enables a repairman or construction worker to be raised to the ceiling of auditorium-type spaces or alternatively to be raised to a higher elevation for more convenient working conditions is well known. Besides the auditorium factor many other facilities such as banks, office buildings and the like have areas wherein it would be impractical to have a ladder moved around to change light bulbs or do minor repair work.

In order to obviate the inconvenience and time factor inherent in a ladder, there have been provided a plurality of designs of extendible, collapsible platform apparati. These platforms are of necessity portable, such that they may be rapidly moved to the area where they are needed. For reasons of safety, the worker climbs onto the platform when the supports are collapsed and then the supports are extended to a sufficient extent providing a comfortable working height.

The extendible working platforms heretofore known have been elevated by electricity, a liquid such as oil, or a compressed gas. The problem with electrical control is in the fact that the platform is not completely portable. In order for the platform to be operational there must be a source of electrical current, often not the case during new construction. Further, the inconvenience of having to carry the electrical transmission cord necessary for remote usage is undesirable since it introduces the dangers inherent with long distance extension of electrical power on a temporary and not completely safe basis.

The use of liquid, such as oil, presents the problem in that the liquid occupies the same volume in the stored condition as it does when it is in use and it is supporting the platform. This fact introduces a large volume, heavy weight factor to the appparatus at all times, greatly reducing portability.

The use of a compressed gas has proven to be the most portable and thus the most desirable in many applications in that firstly, it occupies less bulk in the compressed state than it does when it is in its working condition and further, it introduces very little extra weight. When the platform is lowered, the air within the cylinders may be vented to the atmosphere with no danger of pollution, thus eliminating the need for storage following use. One of the problems, however, with using a compressed gas is that when weight is shifted upon the working platform the supporting cylinders closest to the weight is compressible and thus responsive to external forces. The partial collapse of some cylinders of a platform supported by several gaseous supported cylinders causes the platform to be at an angle to the horizon. This slope, although quite possibly safe, gives the worker a feeling of relative instability and increases the danger of objects falling from the platform endangering persons working below the platform.

With any of the working platforms hereinabove described it is desirable to be able to move the platform from place to place thus allowing one platform to be used in a plurality of locations, greatly decreasing the total cost factor over having a plurality of such devices. To facilitate the movement of the platform from place to place it is desirable that said platform be collapsed to its utmost in both the vertical and the horizontal direction. Normally the collapsing is done by using telescoping cylinders thus allowing the entire platform to be lowered to close proximity of the wheels allowing movement through doorways and the like.

The total collapsibility of the working platform as hereinabove described introduces another factor, however, in that when the platform is used in areas which are already occupied objects such as desks, bookcases and the like are often immediately below the area needing maintenance or service. Having the platform at the extreme bottom portion of the assembly necessitates the movement of any objects in the way prior to doing the necessary service.

In addition to the height of the supporting structure, safety requirements necessitate the inclusion of guard rails about the platform. To assure passage through doors or the like the platform must either be designed to nest between the uprights or the guard rails must be adapted to collapse. Either of the above alternatives introduces severe design restrictions as to the size and shape of the platform. Further, the requirement of having a relatively small base for easy passage through doors presents a stability problem when the platform is extended, simply because of the fact that the height in relation to the width is so great that the entire platform is not stable.

A problem unique to the usage of compressed gas for expanding supporting cylinders is the fact that if the cylinder is prevented from expanding because of a mechanical malfunction or the like and the operator continues to introduce fluid under pressure a dangerous over pressurization may result. For reasons of safety the extreme over pressurization must be prevented since a sudden release of the pressure could easily result in injury.

With the above noted prior art structures and problems in mind it is the primary object of the present invention to provide a working platform which is selectively moved from a collapsed, compact configuration to an extended extremely high working position. The platform is made inherently stable by the use of stabilizing means at the base and further, although the construction takes advantage of the many advantages of compressed gas to support the collapsible cylinders, the platform supporting cylinders are interconnected such that a shift of weight will not cause a noticeable deviation from the horizontal position of the platform.

It is another object of the present invention to provide a collapsible working platform wherein the lower stage may selectively be extended first while retaining the remainder of the stages in collapsed condition thus providing a leg structure allowing the platform to straddle objects located beneath the area to be worked upon. Once the lowermost section is extended it may be locked in position until it is desired to again completely collapse the platform for storage or movement to another location.

Still another object of the present invention is to provide an extendible working platform having a plurality of stabilizing means at the base which are movable from a collapsed portable position to an horizontally extended stabilizing position providing an inherently stable base for the platform when extended and yet allowing ready mobility through doors and the like when in a collapsed condition.

It is still a further object of the present invention to provide at least one pair of cables of fixed length for each stage of the telescoping elevatable platform. The cables are mounted upon elements fixed to each stage, one end above and the other below the associated stage, passing through pulleys such that the weight carried upon the platform is equalized throughout the entire supporting structure of said platform assuring a consistently horizontal platform.

Yet another object of the present invention is to provide means for interlocking some of the stages of a telescoping cylinder supporting the platform whereby a portion of said cylinders may be retained in their collapsed condition while the remainder is extended.

Yet another object of the present invention is to provide an outrigger and stabilizing mechanism for use with the platform whereby the mechanism of the platform is stable when in the extended position.

Still another object of the present invention is to provide telescoping cylinders for supporting a working platform and utilizing said cylinders with the smallest cylinder serving as the base element whereby the uppermost cylinder of each set, which has the largest cross section, serves not only to provide the enclosing shell for the smaller cylinders when in the collapsed condition but also serves as the corner post for the guard rail surrounding the working platform, permitting almost total collapsibility.

Still a further object of the present invention is to provide a control mechanism for a pneumatically extensible set of telescoping cylinder wherein the supply of fluid to the cylinders is terminated a predetermined time following the cessation of outward movement of the set.

Yet a further object of the present invention is to provide an interconnecting means between pairs of extendible telescoping cylinders whereby the cylinders will expand or remain stable with a joining platform continuously in a horizontal plane even though the platform is not evenly loaded.

A further object of the present invention is to provide a configuration for at least one stage of a set of telescoping pneumatically extensible cylinders whereby the lift off pressure for that stage may be accurately predetermined.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of a working platform with the cylinders in their collapsed condition and the outriggers shown in phantom in their extended condition.

FIG. **2** is an elevational view along lines **2—2** of FIG. **1** showing details of construction of one embodiment of the stabilizing means and relative location with respect to the stages of the cylinders.

FIG. **3** is an enlarged sectional view taken along lines **3—3** of FIG. **1** detailing the vertical element which serves as an anchor point for the stabilizing means and is secured to each stage of the cylinder.

FIG. **4** is a schematic view of the working platform in an extended condition, depicting the interconnection of the stabilizing elements and the supporting cylinders.

FIG. **5** is an elevational view of one end of the platform showing a latching mechanism used for retaining the lowermost stage in an extended condition and further showing the tripod type stabilizer.

FIG. **6** is an enlarged view of the deactivating mechanism for the latch means of FIG. **5.**

FIG. **7** is an enlarged view of the pulley, deadhead stabilizer combination which in the preferred embodiment is mounted to each corner of each stage of the telescoping cylinders.

FIG. **8** is a perspective view of the platform in the straddle or lowermost stage extended and with the remainder of the stages retained in their collapsed status.

FIG. **9** is a perspective view of the subject platform in the fully extended position.

FIG. **10** is an isometric view of a second embodiment of working platform with portions shown in phantom to emphasize the stabilizing means and the interconnection between the cylinders and the outrigger supports.

FIG. **11** is a sectional view through the telescoping cylinders depicting the internal structure which allows selective expansion of the respective cylinders.

FIG. **12** is an enlarged partial sectional view taken along lines **12—12** of FIG. **10.**

FIG. **13** is a vertical section taken along lines **13—13** of FIG. **12.**

FIG. **14** is a schematic view of a probe piston over pressurization system which may well be incorporated in the hereinabove described platform.

FIG. **15** is a schematic of a pneumatic circuit which prevents dangerous over pressurization of the telescoping cylinders.

DETAILED DESCRIPTION OF THE DRAWINGS

As can be seen in FIG. **1** a preferred embodiment of the subject working platform includes four telescoping cylindrical support members **2** having secured to the uppermost and largest diameter stage **6** a working platform **4.** The largest cylinder **6** serves as the corner post and supports a guard rail **8.** There is further provided an upstanding edge **10** around the entire periphery of the platform **4** preventing the accidental falling of small objects which may roll or be bumped toward the edge of the platform.

Although the present structure is shown with four stages it is to be understood that the number of stages and the size of the cylinders will be determined by the amount of weight which the platform will support, the height at which the platform will be used or other design factors. The platform **4** also serves as a rigidifying framework for the uppermost stage **6** and each of the supporting stages **7** have a rectangular framework **14** around their entire periphery secured to the stage by clamps **15.** The bottom of each of the telescoping cylinders supporting the working platform is supported by a wheel **16** mounted upon a plate **18.** The lowermost stage of the collapsing cylinder is secured to a socket **20** mounted to said plate but could also be secured to a stud or post.

Mounted upon the plate **18** in a position which generally parallels the ends of the working platform and abuts the outside of the socket **20** are a pair of parallel, hollow rectangular cross pieces **22.** A pair of outriggers **24** are telescopically fitted within cross pieces **22** of each end. The outriggers in each piece being extensible in opposite directions to provide a very wide base. The outboard end of the outriggers **24** includes a threaded surface-contacting support means **26.** It will be apparent that when the outrigger **24** is extended from each side of each end of the platform and the floor contacting member **26** is rotated to a point where its bottom plate **27** is in contact with the floor the effective base of the entire platform is approximately three times the telescoped movable width.

Further, to be seen in FIG. **1**, and to be described in greater detail hereinafter are the stage interlocking and latch mechanism **28** and the tripod type stabilizing element **30.** Likewise seen in this Figure is the control element **32**, mounted for convenience upon a portion of the guard rail **8** such that it may be moved from one end of the platform to the other as necessary, and the collapsing rigid uprights **34**, to be described in much greater detail hereinafter. The collapsing uprights provide one of the anchoring points, assuring the stability of the platform when the cylinders are in their extended condition.

Referring now to FIG. **2** it can be seen that the lowermost cylinder **38** is the smallest of the group and has mounted thereto at each end of the platform a rigid vertical upright **90,** which is a part of the stabilizing system to be described hereinafter. The lowermost cylinder **38** which, as explained hereinafter, serves as the legs when the platform is in the straddle condition, is fixedly mounted to the plate **18** between the horizontal stabilizing members **22.** As noted above, the stabilizing members have the outriggers **24** telescoped therein. As can be seen in this view, each of the telescoping stages is interconnected by a framework **14**, as noted above, including horizontally placed channel members **52** running along the long dimension of the platform joined by interconnecting channel members **50** at the ends thereof. It is to be understood that if the platform is relatively square, members **50** and **52** will be along adjacent sides. For strength and rigidity an interconnecting plate **54** is welded to the interior portions of frame members **50** and **52** at an angle to both of them forming a triangular structure. A generally vertical member **56** is rigidly secured to the exterior portion of the frame member **52** and serves as both a mounting plate for a double pulley **58** as well as an anchor point **60** for the stabilizing cables as explained hereinafter, reference being had to FIG. **7.**

Referring to FIG. **4** it can be seen that each of the stages of the telescoping platform, in addition to the framework **14** comprising members **50, 52** and **54**, includes a vertical upright designated generally as **34** in FIG. **1** but herein specifically noted as **90** for the lowermost upright. Secured to the upper portion of the lowermost upright **90** is an anchor bolt **64** which secures one end of cable **66** which passes downwardly over a double pulley **58** transverses the entire length of the frame member **52** passes over a second double pulley **58** and then proceeds vertically downwardly to a second anchor point **68.** The cable **66** is of fixed length and the movement of the frame section **52** upwardly or downwardly under the control of the operator causes the cable member **66** to move through both of the pulleys **58** thus keeping the cable in constant tension and stabilizing the particular stage. A turnbuckle **59** is provided to assure a constant tension on the cable. Through the use of counteracting cables, as described above, downward pressure on one end of the platform results in an equal downward pressure on the other end and thus assures a continuous horizontal disposition of the platform.

As will be seen in FIg. **5** a similar stabilizing apparatus is included for each stage and it is to be noted at this point that for the purposes of end to end stability of the platform one such cable extending in opposite directions from end to end would be sufficient. The second cable is denoted as **70** and it passes over the same double acting pulleys and is anchored at points **72** and **74.** To reiterate, one such pair is all that is absolutely necessary for stability in the other dimension, it has been found to be desirable to use a pair of such stabilizing cable mechanisms along each longitudinal edge of the platform thus providing stability in all directions.

Referring now to FIG. **3**, the elements necessary to provide the vertical upright or upper anchoring point for the stabilizing cable can be seen. As seen in this view, which as noted above is along line **3—3** of FIG. **1**, the vertical member for the lowermost or smallest cylinder is the outboard support and is denoted as **90.** Successively upward stages and thus larger cylinders include upright members **92, 94, 96** respectively, securely attached to their respective stages. It is to be noted that each of the upright supports has a cross sectional shape of a J and are interlocking thus providing a self-guiding structure as well as allowing the supports to occupy less overall space. It is to be noted that each of the upright supports **90** and **92–96** includes a pair of cables generally enclosed therein said cables being guided to either of the upper or lower fixed securements to conform with the secific description regarding the lowermost stage. Located generally at the bottom of each of the vertical support members is the double pulley hereinafter described. Thus it can be seen that the entire support mechanism including the vertical stabilizer as well as the stabilizing cables are all contained within a relatively compact package.

When it is desired to use the platform in its straddle position as shown in FIGS. **5** and **8** the interlocking apparatus, denoted generally as **28** in FIG. **1**, is placed in operational position. As can be seen in FIGS. **1, 5, 8** and **9** the essential elements of mechanism **28**, one means for accomplishing the straddle position, comprise a vertical post **100** rigidly mounted to the lowermost framework which surrounds the platform **4** and a complementing angle bracket **102** secured to the adjoining portion of the platform border **10.** A pin **104** is adapted to interlock with the bracket **102** and the vertical rod **100** thus interconnecting all of the stages of the telescoping elements with the exception of the bottommost or one with the smallest diameter. Gas under pressure is introduced to the system following the interlock of mechanism **28** forcing the lowermost cylinder to extend, raising the assembly to the position as shown in FIG. **5.** When the lowermost cylinder is extended to its fullest a spring biased latch mechanism **110** hooks over a horizontal bar **112** which, as to be described hereinafter, also serves as a support for the third tripod leg **30.** Once the latch mechanism **110** is locked over **112** the interlocking apparatus is released by removal of pin **104** and if desired the platform can then be extended to any desired height without affecting the rigidity of straddle legs **38.**

The latch **110** is pivotally mounted to a support **114** attached to the frame and is normally spring biased to the position shown in FIG. **5.** To retain the latch **110** in its disengaging position ring **120** at the top of vertical hollow bar **100** is pulled upwardly and turned (See FIG. **6**) so that ears **122** extending diametrically outboard from pin 123 cannot pass through the hole 124 in the top of the bar 100. Attached to the lower portion of the pin 123 of loop 120 is a cable 126 which extends downwardly through the interior of vertical hollow bar 100 and thence outwardly to the back end of latch 110. It will be obvious that the pulling upwardly of pin 120 causes the latch to pivot about its axis moving the latch 110 to a position whereat it will not engage bar 112. The movement of latch 110 to a disengaging position extends spring 128. When the latch is in the disengaged position, as hereinabove described, the entire tower may be collapsed for movement. For purposes of convenience of the operator, a second cable 130 may be attached to the loop 120 and extend upwardly to the top of the rail whereat there would be provided a second ring 130 allowing operation of the latch by an operator on the platform 4 from a standing position.

The rigidifying tripod leg 30 extends from and is pivotally secured to horizontal member 112. The leg 30 has located therein a telescoping extension 134. The connection between the framework at the base of the platform and the stabilizing leg 30 comprises a hinged connecting bar 136 interconnected with leg 134 such that the amount of extension of leg 134 will control the angle at which a leg 30 has with respect to the vertical. The leg 134 can be locked in any one of a number of positions by means of a thumb screw or pin 138. Hinged connecting bar 136 allows the leg 30 to be pivoted to a position adjacent the ends of the platform when not in use. Further, leg 30 is of a length that it has sufficient clearance from the floor when extension 134 is retracted allowing ready movement of the platform.

Referring now to FIG. 7 the actual structural details of the fixed securement and double pulley combination for the stabilizer can be seen. Mounted to a horizontal frame member 50 is a vertical plate 150 having at one portion a bolt 152 extending therethrough to serve as an anchoring point for one end of the cable stabilizing means. Likewise secured to plate 150 are a pair of coaxial pulleys 154, 156 which serve as the guide means for a pair of opposed cables as described hereinabove.

As seen in FIG. 8, the working platform is shown in its straddle position, i.e., with the lowermost cylinder extended and with the outriggers and stabilizing tripod leg in operational position. It is to be understood that when the platform is in this position, it could be placed over a desk or other object beneath the desired working location. Once the lowermost stage of the platform is locked in position, as described hereinabove, the remaining stages may be extended to the heighth desired. As seen in FIG. 9 the tower is shown in a completely extended position and it will be readily seen that although the heighth is quite great with respect to the actual dimension of the platform base the addition of the tripod stabilizes the leg and outriggers provide a perfectly stable working condition.

Reference is now made to FIGS. 10, 12 and 13 wherein a second embodiment of the invention is shown. As seen in FIG. 10, the collapsible cylinders which support and control the heighth of the working platform are shown in phantom and broken away, leaving only the top section of the Figure so that the stabilizing structure may be seen. Telescoping cylinders, generally denoted as 200, are located at the outermost corners and operate in substantially the same fashion as the telescoping cylinders hereinabove described. Diagonally, inwardly of the telescoping cylinder 200 is a hollow cylindrical case 202 which serves as a container for the necessary rigid supports, as described in detail hereinafter, when the platform is in its collapsed condition. It is to be noted at this time that although the structure is shown somewhat schematically, it is well within the contemplation of this species as well as that described hereinabove that there be safety features such as guard rails and the like.

The basic structure of the embodiment now described as somewhat different from, but the concept of the stabilized platform is identical to, that hereinabove described. As will be recalled, the platform as described hereinabove had upright end supports 90–96 which provided a base for the stabilizing cables. Further, as will be recalled, the platform described hereinabove included a pair of opposing cables which were of fixed length and threaded through pulleys and their mirror image stairstep fashion at each side of the platform. Shifting of a load from one end of the platform to the other, because of the non-expandability of the cables, effectively balanced the load over the opposite cylinders assuring a stable platform. As the shape of the working area of the platform approaches the shape of a square rather than a rectangle the possibility of a weight movement causing a slanted work surface becomes more probable. An excess of weight along one edge may cause the platform to tip in a direction transverse to the direction of placement of the cables.

In order to alleviate this possibility of instability in even one direction, the stabilizing cables as shown in FIG. 10, although operating on the same principle, pass a configuration beneath the platform as well as at the upper portion of each stage of the expandible supporting elements. As can be seen, the platform is of a generally rectangular configuration having a base with linking members 204 and further having wheels for ease of mobility of the platform. The wheels in this embodiment are mounted upon pivotal generally horizontal arms 206 which move from a position whereat they generally underlie the platform as shown in phantom to an outwardly extending position as shown in solid whereat they extend outwardly of the uprights and serve as outriggers. It is to be understood that the wheels may be locked in a variety of positions such that once they are in a position preferred for stability in the particular operation they will not be inadvertently moved resulting in unexpected instability.

Extending upwardly from the wheel supports 206 and linking members 204 are a plurality of nesting individual uprights 208 each of which is linked to the base of each individual cylindrical section of each stage. The uprights 208 provide a rigid relatively fixed member supporting the pulleys 210 and thus assuring the stair step configuration. The stabilizing cable 212 is secured to the base member, extends upwardly through pulley 210 passes under the platform along a line diagonal to the rectangular shape of the platform and passes through a second pulley and then upwardly to the top of the upright 208. This configuration is repeated for each stage and for each corner such that the stabilizing cables cross in a X configuration beneath the platform as well as the top of each stage. It is to be understood that for greater rigidity as well as safety the cables as they pass in the X configuration at each stage may well be encased in a shield member such that they are not exposed. The shielding member thus provides a stiffening force in addition to the safety factor.

Reference is now had to FIG. 12 which is a section along lines 12—12 of FIG. 10 and shows the collapsing cylinder shown denoted as **200** mounted directly above the arm **206** which supports the wheels. The rectangular framework **214** of the structure can be seen and it is to be understood that this framework **214** can be of any rectangular shape, will normally support the working platform. Further rigidifying corner braces **216** assure rectangularity and rigidity of the structure.

The generally J shape of the rigid upright supports **208** in their nesting condition can be seen and are shown within the confines of shielding tube member **202**. It is to be noted that the J shape of elements **208** permits the elements to move relative to each other in a vertical direction and yet retain a substantial amount of lateral contact rigidifying the members **208** even when the elements are extended. The top of each J shaped member **208** is provided with a stop **215** which not only prevents over-extension of the elements **208** but also serves as the anchor point for the cable **212** as described hereinabove.

Further to be seen in this picture, as noted above, is the encompassing shield member **218** which extends from corner to corner beneath the platform confining the cables **212** as well as providing additional rigidity to the entire structure.

Reference is now had to FIG. **13** wherein the relative location of the rigid support members **208** encompassing tube **202** and the cable enclosing rigidifying members **218** can most readily be seen.

As noted above, it is often necessary and certainly desirable that the working platform be able to go into a straddle condition so that it may be used around desks or the like without necessity of movement of the objects in the way. FIG. **11** depicts an alternative approach to the straddle position as differentiated from the mechanical approach described hereinabove.

As seen in FIG. **11** the telescoping cylinder assemblies are shown somewhat schematically, however, the internal mechanism is clearly shown. The upper portion **220** of piston **222** of the next to lowest cylinder has the configuration of a probe which extends upwardly through the pistons **224, 226** respectively of the second and third stages of the collapsed cylinder assembly. It is to be understood that although it is shown with only five stages, the mechanism could easily be applied to as many stages as is desired. The probe **220** has an interior bore **228** which has secured to its upper portion a spring biased normally closed piston valve **230.** The uppermost piston **232** has a pair of conduits **234, 236** for supplying air and has a cavity **238** to receive the upper portion of the probe **220.** Piston **232** has a downwardly extending protrusion **240** which rests upon the top of valve **230** when the cylinder assembly is in its collapsed condition holding valve **230** in its open condition. An O-ring **242** seals the area around the exterior of probe **220** preventing leakage about this probe.

Air introduced through conduit **236** passes downwardly into the cavity **238** through the normally closed but held open valve **230** and down conduit **228.** The air forced onto piston **244** of the bottom cylinder assembly beneath piston **222** causes piston **222** to elevate i.e., lifting the next to lowest stage first. This movement is contrary to what would normally occur since the cylinder assemblies as described herein and above is inverted, i.e. the larger cylinder is at the top and the smaller cylinder is at the bottom. By introducing air downwardly through the larger pistons **224, 226,** it then becomes obvious that piston **222** is the largest as far as the area which is acted upon by the compressed gas and it is raised first. Following the introduction of sufficient air into the next to lowest stage there will occur a slight lifting of the uppermost stage closing valve **230** and thus sequentially allowing the expansion of the other stages of the cylinder assembly. It is to be understood that the relative size of the uppermost surface of the cavity **238** will determine the amount of over-pressurization of the loweremost stage in this assembly sequence. However, this over pressurization can be avoided by introducing gas through conduit **234** as soon as the next to lowest stage is fully extended.

If it is desired to elevate the uppermost stage first this can be done by simultaneously introducing gas through both conduits **234** and **236** thus exposing pressure to the entire area of piston **232,** which is the greatest.

As noted above, in the pneumatic lift utilizing one or more telescoping cylinder assemblies, the extended column may be made stiffer and hence more rigid or stable by increasing the pressure in the column in excess of the pressure needed to lift the predetermined load. For the best result, this should be done one stage at a time over pressurizing each lower stage before allowing the stage above it to extend and maintaining the pressure in each stage until the lift lowers again to that point.

The structure of FIG. **11** may easily be modified to form an anti-bounce exhaust system. To form the anti-bounce exhaust, the set of cylinders will be inverted, the supply and exhaust lines will be connected to the largest cylinder of the set and vent **250,** shown in phantom, will be added. During operation, the supporting gas is exhausted from the larger and thus lower of a pair of contiguous cylinders, the probe will cause the opening of the next succeeding valve. This structure permits the gas to escape gradually and thus not causing a sudden upward movement when the gas from the smaller cylinder rapidly enters the larger cylinder.

The probe piston over pressurization system as shown in FIG. **14** accomplishes this desired result by providing a means for accurately predetermining the pressure to be reached in each stage and a means for preventing the next step or stage from extending until this pressure is maintained. This system also provides a means for maintaining the pressure in each stage independent of any others until that particular stage is to be lowered.

In FIG. **14** there is shown a multi-stage telescoping cylinder assembly in its retracted or lowered position. The upper portion of piston **300** forms a probe **302** and is sealed by an O-ring **304.** Spring-loaded valve **306** is held in an open position by protuberance **307** on piston **308.** This interacting assemmbly is repeated between piston **308** and adjacent piston **310.** It is to be understood that this system may be used for as many additional stages as desired.

Air introduced through the top of the cylinder assembly denoted **312** passes through the pistons **310, 308** and **300** and open valves **306** and **314** causing the largest stage to lift off since piston **300** has the greatest area. After the second stage is fully extended there will be no further movement until the pressure has increased enough against the cavity area of piston **308** to cause the third stage to extend. This transitional period is known as the over-pressurized period. The O-ring seal **304** prevents the pressure from acting on the total area of piston **308** thereby assuring that the area of the cavity portion only will determine the lift-off pressure needed. With piston **308**, lift-off valve **306** will close locking the pressure in the first stage.

By controlling the cavity area or the diameter of the probe it is possible to keep the top state from extending until a predetermined pressure is reached in the remainder of the set of cylinders without the need of a flow control valve.

Referring now to FIG. **15**, there is depicted a schematic of a time delay overload control. Air under pressure passes through conduit **350**, enters normally open valve **352** and fills the volume chamber **354** before the time delay controlled by needle valve **356** can actuate the pilot actuator closing the valve **352** and cutting off supply pressure to foot control valve **358.**

To operate the lift, the up valve on control **358** is depressed applying pressure to the system from volume chamber **354** which is sufficient to start motion. Spring loaded reel **362** which is connected to the base of the lift by a cable **360** starts turning causing the spring leaf extensions **364** to wipe whisker valve **366**, bleeding the circuit and allowing pilot operated valve **352** to open and continue the supply pressure to the system.

If the upward motion ceases while the foot control **358** is depressed, reel **362** will cease rotation permitting a pressure increase through the needle valve to actuate the pilot actuator and closing valve **352** within a preset time delay. Supply to the foot control **358** is now cut off preventing a dangerous over-pressurization. The overload is reset by lowering the lift causing spring extensions **364** on reel **362** again to contact the whisker valve **366** sufficiently to exhaust the pilot circuit and open the valve **352** or alternatively by a manual reset valve **368.**

The key feature of this mechanical reel assembly is the post or spring snap pivot **370** which is located in relation to the sensor probe **367** on the whisker valve **366** so that the spring leaf extensions **364** are momentarily stopped as the reel rotates and then they snap past this pivot momentarily activating the whisker valve sensor sufficient to keep the pilot and circuit exhausted. This snap pivot point is absolutely necessary to assure that the reel would not accidentally stop at a position where the spring leaf extensions would be holding the whisker valve sensor permanently open and thereby preventing the time delay control from operating.

Thus it will be noted that the present invention provides a working platform which has a versatility of being able to straddle objects immediately below the area to be worked and further is stable in that a shifting of weight from one end of the platform to the other will not significantly effect the attitude of the platform. The combination of horizontal stability in conjunction with the floor contacting outriggers and tripod mechanisms provides a platform supported by pneumatic cylinders with a stability heretofore unknown. It is to be understood that the air used to extend the telescoping cylinders may be from a portable container or may be directly from a compressor. It is to be understood that minor changes could be made, such as placing the controls upon the floor of the platform and have them adapted to be foot operated.

The embodiments of the invention in which a particular property or privilege is claimed are defined as follows:

1. An elongated rectangular working platform secured to four extendible telescoping cylinders, one at each corner, having an inherently stable base, said base comprising;

framework rigidly interconnecting two of the lower cylinders,

a vertical rigid upright member parallel to the cylinders secured to the framework,

extendible bracing means pivotally secured to the upright member adapted to be extended to contact the floor at an angle to the cylinders providing a rigid base, and

means rigidly interconnecting the lower section of the bracing means with the framework, pivotally mounted to both the framework and the bracing means whereby the interconnecting means may be pivoted upwardly, collapsing the bracing means against the framework, and

telescoping outrigger means mounted for horizontal extension in the same direction as the axis of the framework to provide a broader, more stable base.

2. A working platform as in claim **1** wherein the lowermost stage of the cylinders is independently extendible serving as legs in the event it is necessary to straddle an object.

3. A portable working platform capable of straddling material beneath the working position comprising;

a platform,

a plurality of telescoping extendible cylinders carrying the platform, only part of which are interconnected at the base portion to thereby provide straddle space beneath the platform,

locking means for selectively interconnecting all of the stages of the cylinders excepting the lowermost whereby the introduction of fluid will extend only the lowermost stage of each cylinder,

latch means for securing the lowermost stage of each cylinder in its extended position whereby the fluid may be evacuated leaving a rigid platform spaced from the ground supporting surface, and

control means for further extending the cylinders following the release of the locking means whereby the platform may be used either in the normal or the straddle position and the entire unit may be collapsed for portability.

4. A working platform as in claim **3** wherein the locking means comprises a rigid selectively engageable means to prevent extension of the locked stages.

5. A working platform as in claim **3** wherein the smallest of the telescoping cylinders is lowermost.

6. A working platform as in claim **3** wherein the latch means is operative from on top of the platform and may be selectively left in the operational or non-operational position.

7. A working platform as in claim **3** wherein the cylinders are interconnected such that a shift in weight will be equalized over all of the cylinders retaining the platform in a horizontal configuration at all times.

8. A hoist comprising;

two pairs of upright parallel spaced extendible cylinder units adapted to be extended by compressed gas, a platform carried at opposite ends by said cylinder units and adapted to be raised responsive to extension thereof,

a pair of column units near said ends of the platform, means for selectively supplying or exhausting compressed gas to or from said cylinder units for responsively raising or lowering said platform, and

a load-equalizing reeving system connected to said column units and interconnecting said cylinder units whereby the latter are caused to raise and lower in unison to keep the platform level irrespective of the manner in which the platform is loaded.

9. A multi-stage hoist comprising;

base support means,

two pairs of upright parallel spaced multi-stage telescopic cylinder units mounted on said base support means and adapted to be extended by compressed gas, a platform carried at opposite of its ends by said cylinder units and adapted to be raised responsive to extension thereof,

a pair of multi-stage telescopic column units near said ends of the platform, there being a column stage for each cylinder stage and the vertical extension of each column stage geing greater than the extension of the respective cylinder stage, means for selectively supplying or exhausting compressed gas to or from said cylinder units for responsively raising or lowering said platform, and a respective load equalizing means for each cylinder stage connected near the top of the respective column stage whereby the cylinder units are caused to raise and lower in unison to keep the platform level irrespective of the manner in which the platform is loaded.

10. A multi-stage hoist according to claim **9** in which said telescopic cylinder units have their largest cylinders at the top whereby the upper stages of the cylinder units extend first and retract last, a manifold connected to said largest cylinders and arranged to raise and lower with the platform, a flexible supply line for transmitting compressed gas to said manifold, and valve means adjacent said platform for selectively charging and venting said manifold whereby operation of the hoist can be controlled by an operator located on the platform.

11. A multi-stage hoist according to claim **9** in which the bottom stages of said column units and of said pairs of cylinder units are not structurally interconnected along the dimension between said pairs whereby the hoist can straddle objects therebetween.

12. A multi-stage hoist according to claim **11** in which the respective stages of said cylinder units above the bottom stage are interconnected in a manner whereby such interconnection does not interfere with the vertical travel path of said platform.

13. A multi-stage hoist according to claim **9** in which each said pair of telescopic cylinder units has its cylinders interconnected at each stage, and in which said pairs are interconnected at each stage above the bottom stage.

14. A multi-stage hoist according to claim **9** in which the bottom stages of said pairs of cylinder units are not connected whereby the hoist can straddle objects, and said telescopic cylinder units have their largest cylinders at the top whereby the upper stages of the cylinder units normally extend first, first locking means for selectively locking said telescopic column units from extension whereby the lowest stage of the cylinder units extend first; and second locking means selectively locking said lowest stage in extended position whereby the platform is given a higher straddle height from which to operate when said first locking means is then released.

15. A multi-stage hoist according to claim **9** in which the respective stages of said cylinder units above the bottom stage are structurally interconnected, and the respective stages of the column units above the bottom stage are also structurally interconnected.

16. A multi-stage hoist according to claim **9** in which the column units are located between the cylinder units and the platform, and in which the respective stages of the column units above the bottom stage are structurally interconnected by horizontal cross-bracing extending diagonally below the platform.

17. A hoist comprising:

a base support means,

first and second spaced columns on said base support means,

a platform having first and second ends facing respective of said columns,

first and second sheaves during their journals fixed relative to said first and second ends, respectively,

third and fourth sheaves having their journals fixed relative to said second and first ends, respectively,

a first cable anchored near the top of the first column, passing beneath the first sheave, and over the second sheave, and anchored near the base of the second column,

a second cable anchored near the top of the second columns, passing beneath the third sheave and over the fourth sheave, and anchored near the base of the first column, and

a pair of upright spaced extendible cylinders on the base connected to the ends of said platform and adapted to be extended by supplying compressed gas thereto.

18. A multi-stage hoist comprising,

a base support means, spaced upright first and second multi-stage telescopic cylinder units on the base support means and adapted to be extended by compressed gas; a first group of columns on the base support means, each column of such group being connected to the base of a respective stage of the first cylinder unit and projecting to a level well above such stage when the stage is retracted;

a second group of columns on the base support means, each column of such group being connected to the base of a respective stage of the second cylinder unit and projecting to a level well above such stage when the stage is retracted;

a platform between said groups and carried by the upper stages of said cylinder units; and

a respective load-equalizing means for each stage of the cylinder units and anchored to the respective columns of each stage whereby the platform is maintained in a level condition.

19. Means to prevent excess building up of pressure within a pneumatically expandable cylinder comprising;

means to detect relative movement of the parts of the cylinder;

a source of fluid under pressure,

valve means to selectively control the flow of fluid into the cylinder,

override means responsive to non-movement of the parts of the cylinder to prevent flow of air to the valve means.

20. Means as in claim **19** wherein means to detect relative movement comprises a flexible means secured to one end of the cylinder and passing over a rotatable member secured to the other end whereby relative movement will cause rotation of the rotatable member.

21. Means as in claim **20** wherein rotatable means causes a release of pressure when rotating but allows a pressure buildup during non-rotation, said override means being normally open and closed by a pressure buildup caused by lack of relative movement of the parts of the cylinder.

22. Means as in claim **19** wherein the override means is a normally open, pressure closed valve and where non-movement of the parts causes a pressure buildup which closes the valve.

23. A pneumatic lift comprising,
a supply of air under pressure,
hollow telescopic cylinders closed upon their lower end to form a respective piston for each cylinder,
hollow probe means integral with the larger of two of said pistons extending toward the smaller of the two,
valve means controlling the flow of fluid through the hollow probe, said valve means being biased toward a closed position,
a cavity in the smaller piston surrounding the probe means in the larger piston, said cavity being of a predetermined size to control the sequence of movement of the two pistons responsive to the introduction of air under pressure.

24. A lift as in claim **23** wherein the valve is located in the bottom of a cavity in the larger piston and a protrusion extends downwardly from the smaller piston for engaging said valve to open it.

25. A stable extendable working platform comprising;
a relatively planar working surface supported at the periphery by a plurality of multi-stage telescoping pneumatic cylinders,
fixed length cable means secured to each stage and extending to an upright member at the opposite side of the stage, said cable means passing through pulley means secured to the next upper stage whereby extension or contraction of a stage causes the cable means to linearly translate from one side of the platform to the other and the fixed length of the cable means transmits any downward force upon one portion of the platform to the other side assuring a substantially horizontal platform irrespective of the loading.

26. A working platform as in claim **25** wherein the working surface is rectangular in configuration and the cables extend along the diagonal thereby transmitting downward forces to the opposite corner.

27. A working platform as in claim **25** wherein the uprights are interlocking and telescoping channel members which each have one end of the cable secured at the upper end thereof.

28. A working platform as in claim **25** wherein the corresponding stage of each telescoping cylinder is interconnected by a rigid framework.

29. A platform as in claim **25** wherein the lowest stage includes a plurality of outriggers to increase the stability when the cylinders are extended.

30. A platform as in claim **29** wherein the outriggers have rollers thereon and are pivotable from a position whereat they are no wider than the platform to a position whereat they extend substantially outward from the frame and are in contact with the supporting surface.

31. A pneumatically operated telescoping platform supporting cylinder comprising;
a plurality of closed ended nesting cylindrical elements, the one with the largest diameter being uppermost,
an upwardly extending hollow probe integral with the next to the smallest element, said probe extending the full thickness of the closed ends of those elements located between the probe and the element with the largest diameter when such elements are in a collapsed condition and said probe having a normally closed valve at its upper end, said valve being held open so long as the elements excepting the one with the smallest diameter are collapsed, the probe presenting an exposed surface smaller than the surface of the closed end of the element with the smallest diameter whereby upon introduction of air under pressure the element with the probe extends first.

32. A multi-stage hoist comprising:
a platform,
a pair of upright multi-stage cylinder means interconnected at each stage and adapted to be extended by compressed gas, said cylinder means being located at opposite sides of the platform and having their uppermost stages connected to the platform,
a pair of multi-stage extendible column means at said opposite sides of the platform and interconnected at each stage, said column means each having a stage corresponding to each stage of the cylinder means, the interconnections between like stages of said cylinder means being at substantially the same level as the interconnections between the respective stages of said column means,
means for selectively supplying or exhausting compressed gas to or from said cylinder means for respectively raising or lowering said platform, and
load-equalizing reeving means connected to both said column means and operatively associated with both said cylinder means whereby the latter are caused to raise and lower in unison to keep the platform level.

33. A multi-stage hoist according to claim **32** in which the interconnections at each stage between the pair of cylinder means and between the pair of column means collectively comprise a respective rigid generally rectangular frame, said frames being arranged to vertically nest beneath the platform when the platform is in lowered position.

34. A multi-stage hoist according to claim **33** in which said frames have diagonal cross-braces which also serve as guideways for cables in said reeving means.

35. A multi-stage hoist according to claim **33** in which said reeving means comprises at each stage four respective cables of fixed length each connected at one of its ends at the top of a respective one of the four columns at the stage and each connected at its other end to the respective said frame at the diagonally opposite side thereof, and respective guide sheaves for said cables journaled on the frame of the next higher stage.

36. A multi-stage hoist according to claim **32** in which each said pair of column means comprises a pair of extendible interfitted column units interconnected at the bottom of each stage, said column units being located at the corners of the platform inwardly of the hoist means.

37. A multi-stage hoist according to claim 36 in which each of said column units is housed in a respective tube projecting upward from the platform when the platform is in lowered position.

38. Means to prevent excess pressure from building up within a gas expandable cylinder comprising:

a source of fluid under pressure, valve means to selectively control the flow of said fluid into the cylinder,

a normally-open valve arranged to be closed by predetermined pressure build-up,

a whisker valve arranged to prevent said build-up by venting when the whisker valve is periodically opened,

flexible means fixed relative to one end of the cylinder and passing over a rotatable means fixed relative to the other end of the cylinder, and

projecting resilient arm means on said rotatable means arranged to periodically wipe and open said whisker valve during rotation of the rotatable means responsive to relative endwise movement of the parts of the cylinder.

39. Means according to claim 38 in which retarding means is located adjacent said whisker valve such that engagement of the arm means with the retarding means will cause the arm means to flex and be retarded until the rotatable means has advanced sufficiently to cause the flexed arm means to then contact and pass the whisker valve by spring action of the flexed arm means.

40. In combination,

an elongated rectangular working platform secured to two pairs of extendible cylinder units, one pair at each end,

a base framework rigidly interconnecting the lower ends of one of said pairs and having a rigid upright member parallel to said units,

an extendible tripod leg pivotally secured at its upper end to said upright member and adapted to be swung outwardly from such member in a swing plane at an acute angle to the plane of said one pair of cylinder units, and be extended to contact the ground,

inwardly collapsible link means pivotally interconnecting the lower portion of the tripod leg with said framework and adapted to limit said acute angle when said bracing means is in ground contact, and

a pair of telescoping outrigger means mounted on the base framework for selected opposite horizontal extension from the framework at right angles to said swing plane.

41. In a lift,

a telescopic cylinder assembly including cylinders with pistons at one end, one of said pistons having a probe with a passage continuing through the piston, and another of said pistons having a cavity with a supply passage thereto and being arranged to receive said probe,

sealing means for sealing the cavity around the probe when occupied by the probe,

normally-closed valve means controlling the flow of gas through the probe,

valve opening means for responsively opening the valve means when the probe occupies the cavity,

and means for selectively introducing pressurized gas to said cavity through said supply passage.

42. A lift as in claim 41 in which there is a piston located between the probe and the cavity and having an opening therethrough for passage of the probe.

43. A lift as in claim 42 in which said piston with the probe is smaller than the piston with the cavity.

44. A lift as in claim 41 in which the probe has a recess in which the valve means is housed, and in which said valve opening means comprises a protrusion in said cavity for engaging the valve means.

45. A lift as in claim 41 in which said piston with the probe is larger than the piston with the cavity.

46. A lift as in claim 41 in which the piston with the cavity has a second probe at its opposite end and with said supply passage extending therethrough,

the next piston having a second cavity with a respective supply passage thereto and arranged to receive said second probe,

second sealing means for sealing the second cavity around the second probe when occupied by the second probe,

normally-closed second valve means controlling the flow of gas through the second probe,

second valve opening means for responsively opening the second valve means when the second probe occupies the second cavity,

and means for selectively introducing pressurized gas to said second cavity through its supply passage.

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