Sept. 5, 1967 D. H. HALE 3,339,873

STOOL WITH VERTICALLY MOVABLE SEAT

Filed Oct. 21, 1965 2 Sheets-Sheet 1

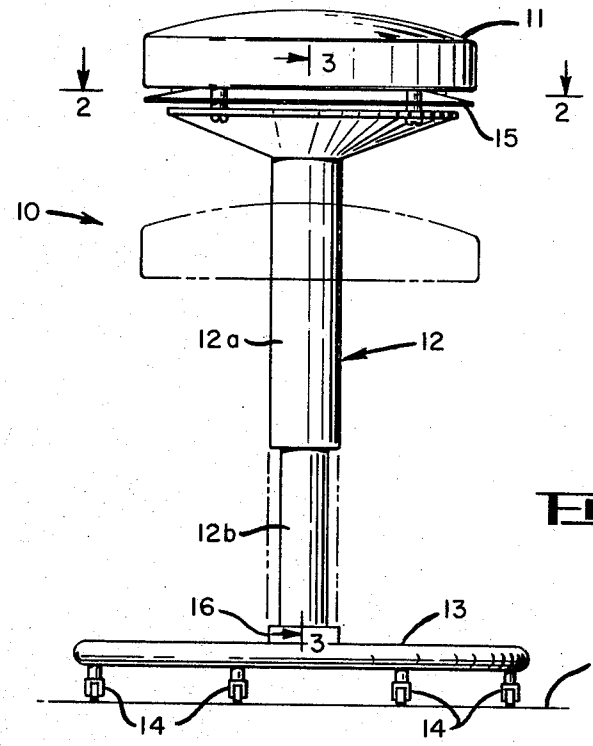

FIG-1

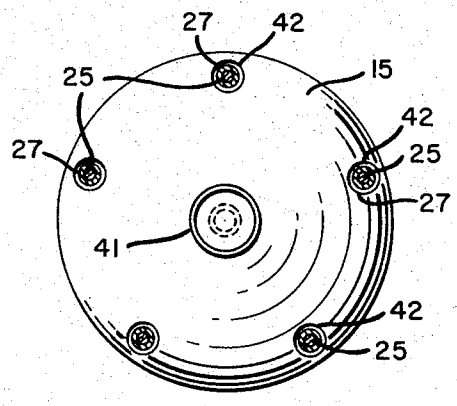

FIG-2

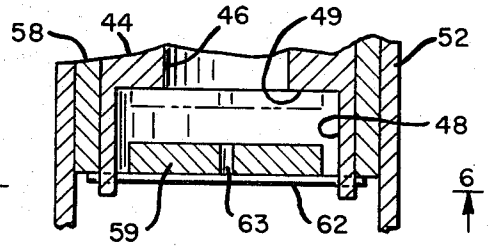

FIG-5

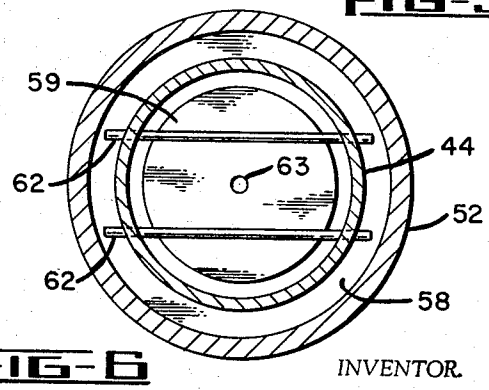

FIG-6

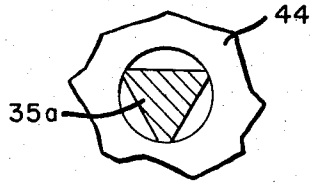

FIG-4

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STOOL WITH VERTICALLY MOVABLE SEAT

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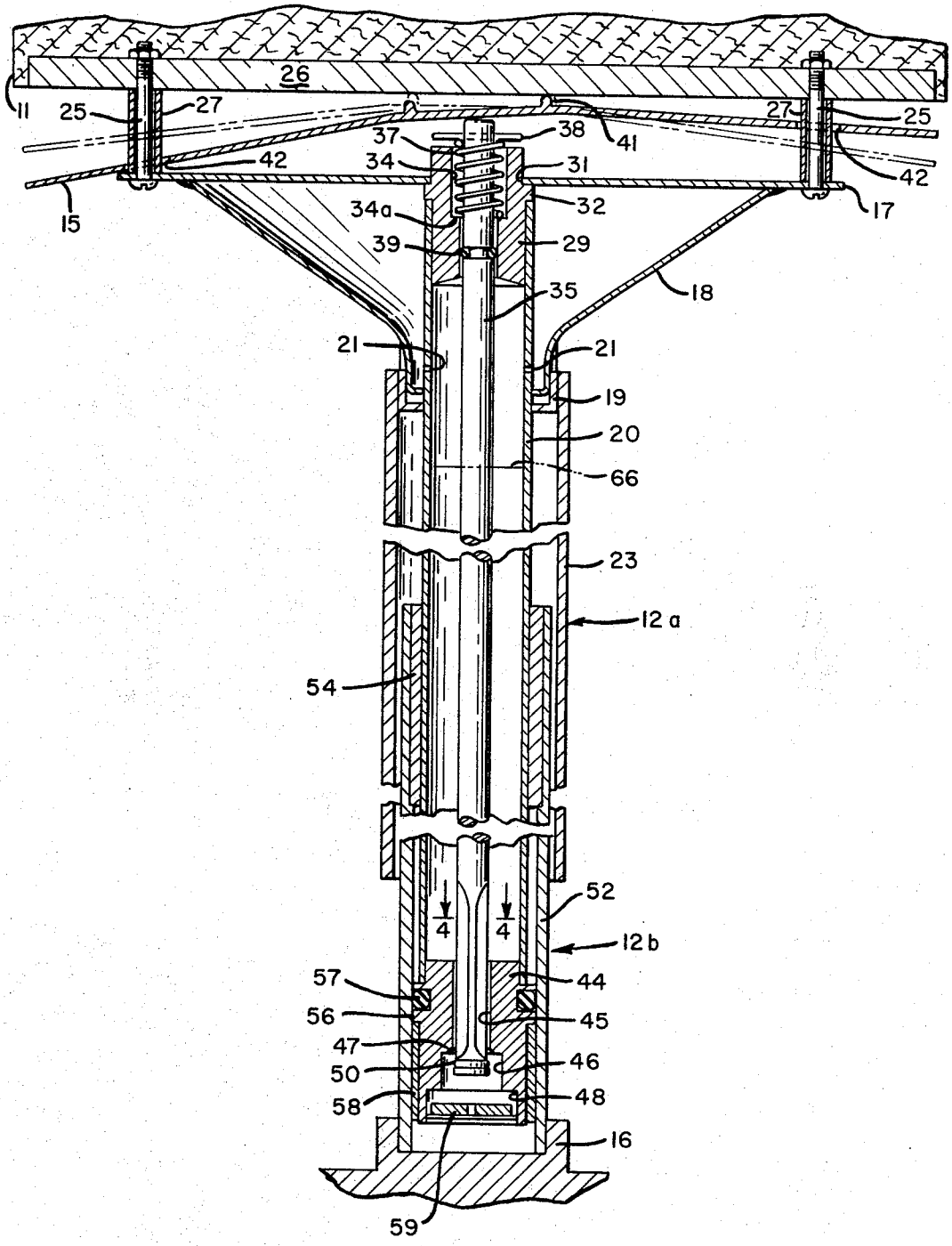

FIG-3

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STOOL WITH VERTICALLY MOVABLE SEAT

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5 Claims. (Cl. 248—404)

ABSTRACT OF THE DISCLOSURE

A stool with a vertically movable seat wherein a tank disposed under the seat at the top of a hollow reciprocable piston rod and containing air under pressure to accommodate, upon opening a valve between the hollow interior of the piston rod and the interior of the surrounding cylinder by actuation of a plate under the seat above the tank, (a) elevation of the piston rod, the actuating plate, the seat and the tank, when the seat is not occupied, by a flow of fluid from the interior of the piston rod through and around a disc flow control into the interior of the cylinder under force of said pressure, and (b) lowering of the piston rod, the actuating plate, the seat and the tank, when the seat is occupied, by flow of fluid from the interior of the cylinder through the disc flow control to the hollow interior of the piston rod counter to said pressure.

This invention relates to stools, and more particularly to a stool with a vertically movable seat.

In my copending application Ser. No. 429,433, filed Feb. 1, 1965, now abandoned, I have described a stool with a self-containing hydro-pneumatic system which stores energy like a spring entirely within the vertical support post in order to facilitate raising of the stool seat, especially while the stool is in use. A single valve controls the flow of fluid between the pressurized reservoir and the hydraulic motor, i.e., the piston and cylinder. Since the valve is formed in the piston, both the valve and piston move vertically as the seat is raised and lowered. In practice, the user of the stool, such as a dentist or technician, while sitting on the stool seat and wishing to elevate it, opens the valve and simultaneously lifts his weight to allow the seat to be powered up to the higher level. If the user desires to lower the seat, he opens the valve and applies his weight to the seat to depress it and the piston against the spring-like resistance of the pressure system. If the full weight of the occupant is on the seat when the valve is opened, the flow of fluid from the cylinder to the reservoir is relatively uncontrolled so that a rapid descent ending in a jolting impact can occur. The alternative of varying the weight which the occupant applies to the seat requires conscious effort which distracts attention from the patient or work being performed.

An object of this invention is the provision of an automatically operable control for limiting the rate of descent of the seat structure in the stool described in the above identified application.

Another object is the provision of a simple, inexpensive flow control device which operates to inhibit flow of fluid between the hydraulic motor and the reservoir only on descent of the seat structure.

A further object is the provision of such control device which may readily be added to existing stools to incorporate the feature of controlled descent.

The objects and advantages of the invention are realized by providing a floating disc flow control within a recess in the piston in series with the control valve. The disc flow control has a small opening or orifice therein and is free to move axially within the recess between a closed position in abutment with the bottom of the recess and an open position at the opposite end of the recess. When the flow control is opened to cause fluid to flow from the reservoir to

the cylinder to elevate the seat, the disc flow control is moved by the fluid flow to the open position where it offers substantially no resistance to the flow. Upon reversal of the flow, however, when the seat is descending, the disc flow control is seated against the bottom of the recess and constrains the flow of fluid through the orifice so that a safe rate of descent is achieved even though full weight of the occupant is on the seat.

These and other objects of the invention will become apparent from the following description of a preferred embodiment thereof, reference being had to the accompanying drawings in which:

FIGURE 1 is a side elevation of a stool embodying the invention, the seat of the stool being shown in the elevated or extended position;

FIGURE 2 is a transverse section taken on line **2—2** of FIGURE 1 showing the control valve actuating plate;

FIGURE 3 is an enlarged vertical section taken on line **3—3** of FIGURE 1 showing details of the seat lifting pressure system;

FIGURE 4 is a greatly enlarged section taken on line **4—4** of FIGURE 3 showing the valve stem configuration adjacent the piston head;

FIGURE 5 is an enlarged view of part of FIGURE 3 showing the floating disc flow control within the piston recess; and

FIGURE 6 is a section taken on line **6—6** of FIGURE 5.

Referring now to the drawings, a stool **10** embodying the invention comprises a seat **11** on the upper end of a vertical post **12** and a base **13** on casters **14** for supporting the post and seat for lateral movement on a floor F. Post **12** has an upper part **12***a* which telescopes over and is movable vertically relative to a lower part **12***b* secured to a hub **16** on base **13**. The seat is thus movable between the solid line and broken line positions shown to accommodate the preference and convenience of the user. An actuating lever or plate **15** directly under the seat **11** is manually movable or pivotable toward the underside of the seat to permit elevation of the seat by a fluid pressure system described below or to permit lowering of the seat.

The upper part **12***a* of post **12** comprises a seat mounting plate **17**, see FIGURE 3, secured by downwardly tapering conically shaped housing **18** through a cup-shaped ring **19** at the lower end of the housing to an elongated vertical tube **20**. A plurality of openings **21** in the wall of tube **20** above ring **19** provides fluid communication between the interiors of housing **18** and tube **20**. An exterior tube-like skirt **23** secured to and depending from ring **19** extends over a substantial portion of the post length to protect the operating parts from dust and other foreign objects.

Plate **17** is secured by bolts **25** to the rigid bottom board **26** of the seat **11**, and tubular spacers **27** coaxially disposed about the bolts maintain appropriate spacing of these connected parts.

The top of tube **20** is closed by a plug **29** which extends into the tube and projects upwardly therefrom through an opening **31** in mounting plate **17**. A ridge **32** on the exterior of the plug abuts against the end of the tube and seals the underside of plate **17**. Plug **29** has a stepped bore **34** through which an elongated valve rod or stem **35** extends. A compression spring **37** bottomed against the shoulder **34***a* of the bore presses upwardly against a pin **38** in rod **35** to urge the latter upwardly. An O-ring **39** seals the rod to the reduced part of the plug bore.

Actuating plate **15** engages the top of rod **35** and has an annular projection **41** on its upper side for engaging seat board **26**. The outer portions of plate **15** taper downwardly from the projection so that the plate has an in-

verted dish-like configuration, and oversize openings **42** are provided therein to accommodate the seat bolts **25** and spacers **27**. Projection **41** constitutes a fulcrum about which plate **15** may be rocked as shown on solid line in FIGURE 3 to depress rod **35** against the pressure of spring **37**. It will be noted that plate **15** preferably has approximately the same diameter as seat **11**. Thus the marginal portions of the plate may readily be grasped by the fingers of the occupant with the edge of the seat serving as a guide so that the plate may be rocked and the rod depressed with a minimum of effort or distraction of the occupant. The taper angle of the outer portion of plate **15** and the radial spacing of the rod from the annular fulcrum are selected to provide a predetermined axial displacement of the rod for control of the seat lifting pressure system described below.

The lower end of tube **20** is permanently connected to a head **44** having a bore **45** which intersects an intermediate coaxial recess **46** of larger diameter to form a valve seat **47**. Recess **46** intersects an outer coaxial recess **48** of still larger diameter and forms therewith a shoulder **49**. The lower part **35***a* of rod **35** preferably has triangular cross-section, see FIGURE 4, and extends through bore **45** of head **44** to connect to valve head **50** which is adapted to engage and disengage seat **47** with vertical movements of the rod. The valve is shown in FIGURE 3 in the open position.

The lower portion **12***b* of the post comprises an outer tube or cylinder **52** which is secured in and closed by hub **16** of base **13**. Cylinder **52** extends upwardly from the hub for a substantial part of the height of post **12** and has a sleeve **54** secured to the inside of the upper end thereof. The inside diameter of sleeve **54** is such as to snugly and slidingly engage the outer surface of tube **20** whereas the inside diameter of cylinder **52** is slightly greater than the outside diameter of tube **20**. Head **44** on the lower end of tube **20** has a ridge **56** which slidingly engages cylinder **52**. An O-ring member **57** carried in a groove in the ridge **56** makes a fluid-tight seal between the head and the cylinder. The outside diameter of the remainder of the head **44** is smaller than the inside diameter of the cylinder. A bearing sleeve **58** on the lower part of head **44** limits lateral play between the parts.

The upper limit of movement of the upper portion **12***a* of the post structure relative to the lower portion **12***b* is determined by abutment of ridge **56** of the head **44** against the lower end of the sleeve **54**, and the lower limit of such movement is provided by abutment of the lower end of head **44** with the bottom of hub **16** on base **13**.

In accordance with this invention, the lowermost or outer recess **48** in head **44** contains a disc flow control **59**, see FIGURES 5 and 6, having a diameter less than that of recess **48** and greater than the diameter of recess **46**. Flow control **59** is thus free to move axially or "float" within recess **48** between an elevated position in engagement with shoulder **49**, which is the bottom of recess **48**, and a lowered position spaced from that shoulder. Outward movement of the disc flow control from recess **48** is limited by a stop shown as transverse pins **62** which extend through and are supported on the wall of head **44** at the mouth of recess **48**. A small central opening or orifice **63** is formed in the disc flow control to provide a bleed passage for fluid when the flow control is elevated. The relative diameters of disc flow control **59** and recess **48** are such that fluid flow between the flow control and the side of the recess is substantially unrestricted when the flow control is lowered, and yet the flow control always fully overlays recess **46** when in the closed position. When the flow control is elevated as indicated in broken line in FIGURE 5 fluid flow is restricted by orifice **63** to safely limit the rate of descent of the seat structure.

Fluid under pressure is contained within a reservoir comprising the conically shaped chamber enclosed within housing **18** and plate **17** and the exterior of the upper part of tube **20**, together with the interior of tube **20** between plug **29** at the top and head **44** at the bottom. The upper portion of this reservoir, for example the portion above the broken line **66** in FIGURE 3, may be and preferably is filled with a gas such as compressed air, and the remainder of the reservoir contain a hydraulic fluid such as oil. When the seat and upper post structure are in the lowest position, the fluid under pressure is contained within the structure having minimum volume. Spring **37** urges rod upwardly to close valve head **50** against seat **47** and valve actuating plate **15** is equally spaced from the marginal edge of the seat **11**.

In order to elevate the seat, plate **15** is pivoted about annular fulcrum **41** to depress rod **35** and move valve head **50** off seat **47**. Because the pressure of fluid within tube **20** is greater than the pressure below head **44**, the hydraulic fluid flows through bore **45** of the head and recesses **46** and **48** and around the periphery of disc flow control **59** to the underside of the head. This creates a differential pressure between the underside of the head and the annular space between cylinder **52** and tube **20** and causes the entire seat structure including the head and tube **20** to rise until **56** on the head abuts sleeve **44** on the inside of the cylinder or until valve head **50** is closed by release of actuating plate **15**. If the seat is to be so elevated while it is occupied, the user lifts his weight from the seat sufficiently to allow the latter to rise to the desired height, and closing of the valve head **50** then traps the hydraulic fluid under the head where it supports the full weight of the user.

When the occupant desires to lower the elevated seat, he opens valve head **50** with finger pressure on plate **15** and permits his weight to force fluid in a reverse direction through valve seat **47** and into the reservoir. As soon as this reverse flow of fluid occurs, however, disc flow control is urged by the flow against seat **49** and the flow is blocked except to the extent permitted by orifice **63** in the disc flow control. This restricted flow thus limits the rate of descent of the seat structure regardless of the load applied and the parts and the occupant are always assured of a gentle bottoming of the seat at the end of the descent.

The capacity of the pressurized reservoir is substantially increased through provision of the conical housing **18** which additionally gives symmetrical support to the outer portions of the seat and thereby enhances the stability of the seat. The larger reservoir enables achievement of a relatively constant lifting force over the full extension of the seat post and still retains the compactness and simplicity of a pressure system wholly contained within the post structure.

What is claimed is:

1. A vertically movable stool comprising

a seat,

a vertically extending post supporting said seat and having an upper portion and lower portion,

a base secured to said lower portion of the post,

said upper portion of the post comprising

an elongated vertical tube,

a seat supporting plate secured to and extending transversely of said tube adjacent the upper end thereof,

a conical housing secured at its maximum dimension to said plate and tapering downwardly to a connection at its minimum dimension to said tube, said plate and said housing defining a fluid-tight chamber, said tube having an opening in the side wall thereof providing fluid communication between said chamber and the interior of the tube,

means for securing the peripheral portion of said plate to said seat adjacent the periphery of the seat,

a rod coaxially disposed within said tube and supported for axial movement relative to the tube,

means for sealing the upper end of the tube, and

a head secured to the lower end of said tube,

said head having a central bore with a valve seat and an outer recess,

said rod having a valve head adapted to engage and disengage said valve seat with vertical movements of the rod for sealing and unsealing the interior of the tube,

a disc flow control axially movable within said outer recess between an open position for permitting relatively free flow of fluid through the recess and a relatively closed position,

said disc flow control having an orifice therein for limiting fluid flow through the recess when the disc flow control is in the closed position,

said lower portion of the post comprising an upright cylinder mounted on said base and disposed coaxially about said tube,

means for sealing said head of the tube to said cylinder, and

means for vertically moving said rod whereby fluid under pressure within said tube moves through the bore of the head with minimum resistance to the outside of the tube whereby to move the tube axially out of the cylinder and fluid moves from the cylinder outside of the tube through the bore with maximum resistance to the interior of the tube when the tube is moved axially into the cylinder.

2. The stool according to claim **1** in which said last named means comprises a pivot plate disposed between said seat supporting plate and said seat and engaging the end of said rod adjacent said plug, said pivot plate having peripheral portions adjacent the periphery of the seat.

3. The stool according to claim **2** in which said outer recess has a diameter greater than the adjacent bore of the head whereby to define a shoulder, said disc flow control having a diameter less than the diameter of said recess and being engagable with said shoulder in said closed position and being spaced from said shoulder in the open position.

4. In a vertically movable stool,

a cylinder adapted to be secured to and project vertically from a base,

the lower end of said cylinder adapted to be adjacent said base being closed,

a reciprocable tube slidably sealed within said cylinder and adapted to move axially thereof,

valve means carried in the lower end of said tube for selectively permitting and preventing fluid communication between the interiors of the tube and of the cylinder, comprising

a coaxial rod supported within and coextensive with said tube for axial movement relative thereto in response to manual actuation whereby to control said fluid communication,

a reservoir adapted to contain pressurized gas in pressure communication with the fluid interior of the tube, secured to the upper end of said tube so as to move up and down with the tube, having a central top opening through which said rod extends and adapted to support a seat for integral up and down movement,

a valve actuating plate which moves up and down with the seat for selectively actuating said rod by fulcrum action to control said fluid communication and having a periphery immediately beneath the periphery of the seat, and

a perpetually open disc flow control housed at the lower end of the tube, having a central orifice and vertically displaceable relative to the tube between two extreme positions,

said disc flow control at one extreme position restricting fluid communication between the interiors of the tube and the cylinder to flow through the orifice as the seat is lowered, and at the other extreme position permitting less restricted communication between the tube and cylinder interiors through the orifice and around the periphery of the disc flow control as the seat is elevated.

5. In a stool as defined in claim **4** wherein said valve actuating plate engages the exposed upper end of the rod to accommodate depression of the rod and thereby open the valve means by fulcrum leverage against the seat singularly caused by pushing down or pulling up the valve actuating plate at one location.

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