May 18, 1965 M. MERIAUX ETAL 3,184,206

SUPPORT UNITS ESPECIALLY FOR MINE ROOF

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Fig.1

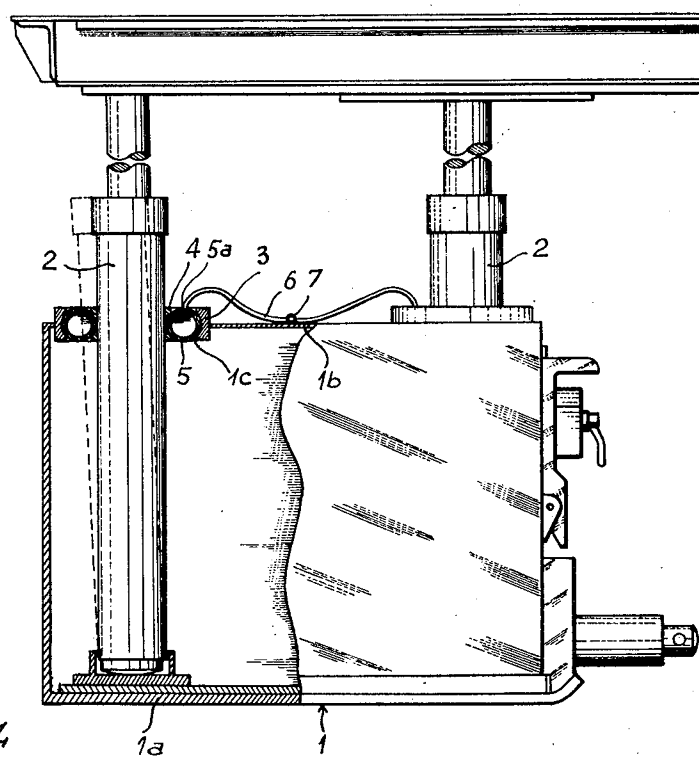
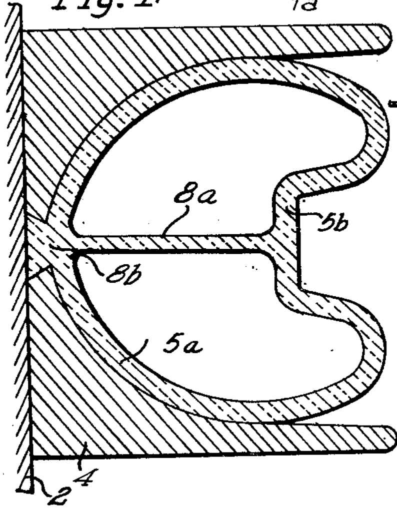


Fig.4



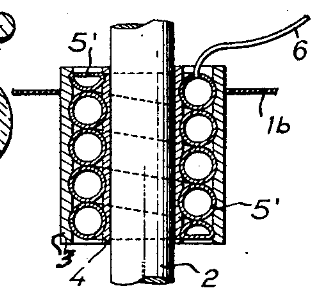


Fig.1a

Fig.2

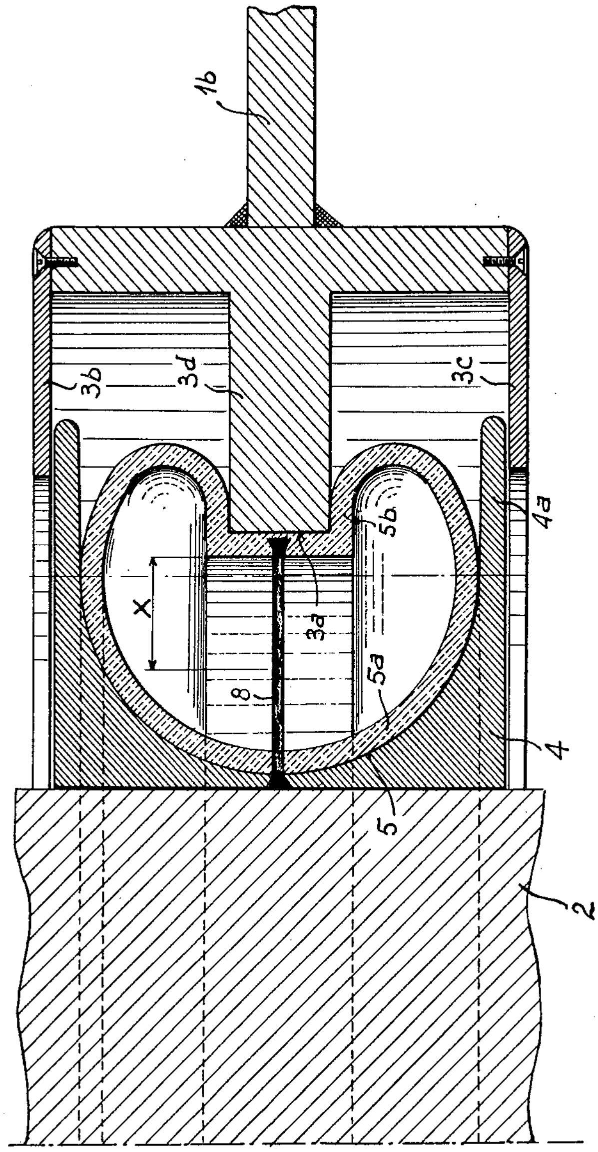


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Fig. 2a

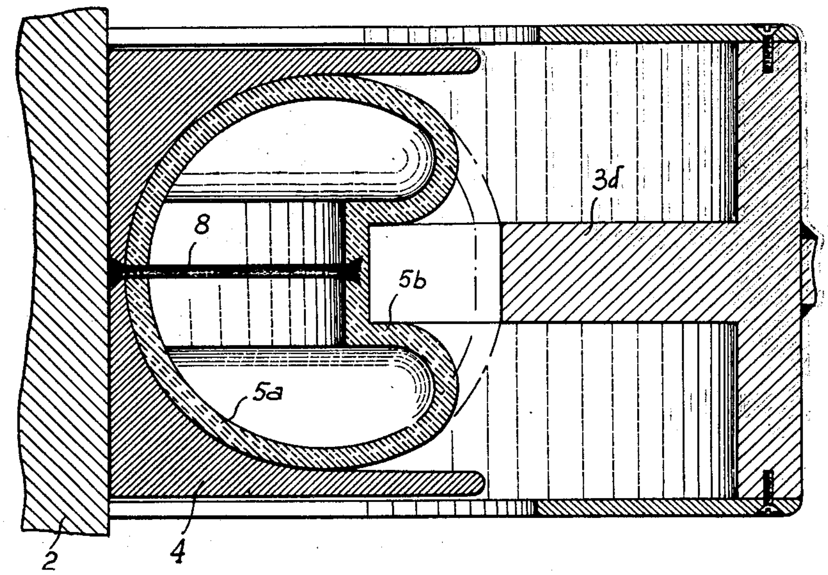
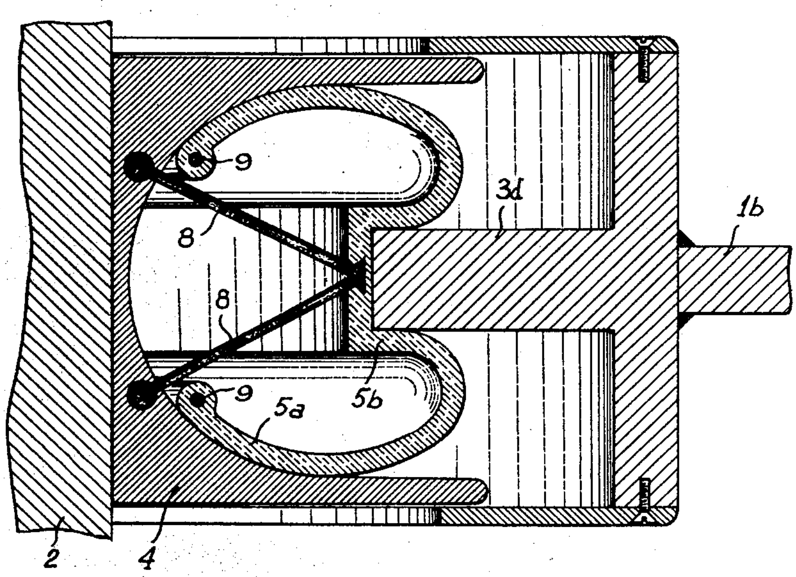


Fig. 3



United States Patent Office

3,184,206
Patented May 18, 1965

3,184,206

SUPPORT UNITS ESPECIALLY FOR MINE ROOF

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Filed Mar. 18, 1963, Ser. No. 265,706
Claims priority, application France, Mar. 20, 1962, 891,572, Patent 1,325,740
10 Claims. (Cl. 248—357)

It is known that walking support members generally comprise a number of hydraulic pit props borne by a base frame of varying size and compactness, formed, for example, by a high rigid sheet-metal box, which gives the whole unit great stability and holds the pit props in place very efficiently. It has, however, been found necessary to leave a clearance between each prop and the top of the base frame and to insert a resilient element to protect the prop, e.g., a spring or more simply a rubber shock absorber such as a ring or collar. This arrangement prevents the props from bearing against the frame and being damaged by considerable transverse forces, particularly in sloping strata. The devices also recenter the prop when it is released for the support to be moved forward.

If roof subsidence is likely to be appreciable, however, the prop must be given sufficient freedom after locking. Under these conditions, an impossible situation is very soon reached; very thick rubber is necessary to give a clearance of several tens of millimetres. The resistance offered by the rubber very quickly increases with crushing, the bending strength of the prop is very soon exceeded and it comes into engagement with the frame.

If, on the other hand, a very soft rubber is used whose resistance remains less than the prop bending strength after several tens of millimetres crushing, there is a risk of not producing sufficient force to compensate for the prop weight and recenter it when the unit is released. It is, in fact, of the greatest importance that the necessary clearance should be guaranteed, and this means that when the props are pressurised they must have been restored to the mean position. This condition is not fulfilled if the rubber is systematically compressed in a particular direction during the movement of a unit.

The subject of the invention is a centering device, more particularly for the centering of support props, particularly walking supports, which obviates the aforementioned disadvantages and more particularly fulfills the following two conditions: firstly, centering of the props in their base frame when they are released, i.e., before the movement of the support, and secondly, sufficient clearance between the props and the top of the frame, so that the props are protected from abnormal bending forces if the roof subsides, more particularly in very sloping strata.

Such a centering device can be used of course—without going beyond the scope of the invention—for straightening or centering in relation to a transverse support member a horizontal, vertical or inclined element which may depart from its initial axial position during operation.

According to a first feature of the invention, the resilient element disposed between a member, e.g., a prop of a support unit, and its transverse supporting element, is formed by a sealing-tight deformable chamber comprising at least one aperture which can be connected to a duct for fluid of controllable pressure. The duct can, for instance, be connected to a pump and thus be under pressure when the pump is working and be brought to the pump reservoir pressure when the pump is not operating. Similarly, without going beyond the scope of the invention, the aperture in the sealing-tight chamber could be connected selectively to a duct for fluid under pressure, e.g., a duct communicating with a pressure accumulator, and to an outlet duct for the fluid. The deformable chamber will preferably be substantially toroidal and be disposed between suitably shaped elements borne by the member and its transverse support element respectively.

According to a preferred feature of the invention the cross-section of the sealing-tight chamber is bean-shaped and comprises two parts of opposite concavity disposed inside one another. These two parts are respectively supported on parts of corresponding shape unitary with the member and its transverse support element, the supporting zone for the inner part being disposed in the free state near the centre of the outer part.

Because of this arrangement, as will be shown hereinafter, the force transmitted to the member by the chamber when it is pressurised is substantially independent of the deformation previously undergone by the chamber. Under these conditions the maximum force will always be available to restore the prop member to its initial axial position irrespective of its displacement, more particularly when the props are inclined when they are to be advanced.

The invention will be more readily understood and various advantages and subsidiary characteristics will be apparent from the following description of an advantageous embodiment given by way of example with reference to the accompanying drawings wherein:

FIGURE 1 is an elevation of a walking support unit whose props are provided with the device according to the invention;

FIGURE 1*a* is a partial view similar to FIGURE 1 showing another embodiment of the invention;

FIGURE 2 is a section through an advantageous embodiment of the resilient element disposed between a prop and its transverse support element;

FIGURE 2*a* is a similar view to FIGURE 2 after the prop has been inclined;

FIGURE 3 is a similar view to FIGURE 2 of another embodiment; and

FIGURE 4 is a similar view to FIGURE 2 of another embodiment.

FIGURE 1 shows a walking support unit comprising in known manner a base box **1** whose bottom surface **1*a*** supports a number of props **2** resting pivotally thereon. As shown in the drawing, such unit will generally comprise a number of props retained by appropriate transverse support elements disposed a certain height above the base of the unit; if the base element is a rigid box the props pass through the top surface **1*b*** of such box through appropriate apertures **1*c*** to this end.

In all instances the props must be able to become inclined in relation to the base surface **1*a***, more particularly when roof subsidences take place in very sloping strata. Each aperture **1*c*** or the appropriate prop retaining parts must therefore leave a certain clearance around the latter, so that their inside diameter must be greater than the outside diameter of the prop.

On the edge of each aperture **1*c*** and on the outer surface of the corresponding prop two appropriately shaped parts **3** and **4** are attached with a resilient and sealing-tight chamber **5** between them, which is supported laterally in recesses in each of the parts **3** and **4**. In FIGURE 1 the chamber **5** is toroidal in shape and comprises an aperture **5*a*** to which a duct **6** is attached. The duct is itself connected to a conduit **7** feeding all or some of the props forming the various units. The conduit **7** can be put into communication with a hydraulic or pneumatic pressure fluid source, e.g., a pump or a pressure accumulator.

The device operates as follows: the props **2** are first locked between the mine roof and the base **1*a*** of the box resting on the floor; when roof subsidences have caused the props to become inclined to the position shown in chain lines in FIGURE 1, the conduit **7** is connected to the hydraulic or pneumatic pressure source, e.g., by starting the aforementioned pump. The props are then lowered by reducing the hydraulic pressure inside their cylinder. The inflation of the chambers **5** centers the props while in their lowered positions in relation to the base box. The unit or units are then moved in known manner, whereafter the props **2** are raised, while the pressure in the chamber **5** is maintained. When the props are firmly engaged between the floor and the roof the pressure in the conduit **7** is reduced to zero, e.g., by stopping the pump. Under these conditions the props may possibly again become inclined by transverse forces of various kinds, more particularly, roof subsidences, without encountering parasitic resistances which might cause abnormal bending stresses on the props. This shows the importance of the improvements to walking supports by the present invention and also their simplicity and ease of operation. The method of operation just described could, of course, be modified, according to the particular conditions in which the centring device is used.

FIGURE 1 shows a single sealing-tight chamber formed by a torus, but clearly other embodiments could be envisaged without going outside the scope of the invention. For instance, similar chambers to that shown in FIGURE 1 could be superimposed on top of one another, or the chambers could be replaced by a single flexible conduit **5′** coiled several times around the prop **2** (FIGURE 1*a*).

It should be noted that although this embodiment seems less advantageous than the previously described one, the chambers **5** can be initially inflated either by water or air at suitable pressure to recenter the props as soon as they have been released. In that case the props would undergo bending stresses during inclination, and this would necessitate reinforcement of their structure, or a reduced freedom of movement, but it is clear that such an embodiment also forms part of the invention.

A description with reference to FIGURE 2 will now be given of a centering device according to the invention using a sealing-tight chamber which can be inflated if required or subjected to initial inside pressure, but which is of a shape such as to exert on the prop to be recentered a force substantially independent of the axial off-setting of the prop in relation to its transverse supporting element.

The crushing force curve has been experimentally determined and calculated for a chamber inflated with air or water in relation to the movement of an element supported on the inner or outer periphery of such chamber. It was found that the crushing force passes through a maximum when the movement of the part supported on the periphery is close to the radius of the chamber section. In that case, the crushing force is substantially equal to the product of the pressure inside the chamber and the apparent surface thereof in a diametric section. The force is therefore substantially independent of the shape and dimensions of the supporting surface on the chamber periphery. It follows that the optimum shape of the chamber **5** of the device described above is for the cross-section of such chamber to be bean-shaped as shown in FIGURE 2.

It can be seen from the drawing that the cross-section of the chamber **5** comprises two parts **5*a*** and **5*b*** of opposite concavity to one another, and the part **5*b*** is disposed inside the part **5*a*** which is itself semicircular. In the free state, i.e., when there is no pressure inside the chamber, the part **5*b*** extends almost to the center of the part **5*a***. The part **4** fixed on the shaft of the prop **2** has an outwardly open annular groove which strictly matches the shape of the part **5*a*** of the chamber **5**.

The supporting part **3** unitary with the top surface **1*b*** of the base box comprises an annular plate **3*d*** cooperating with the inner part **5*b*** of the chamber **5**. It should be noted that when the prop **2** is properly centered the inner periphery **3*a*** of the plate **3*d*** is near the center of the cross-section of the annular groove in the part **4**. When the prop **2** is inclined in relation to the base box, the part **4** will move towards or away from the annular plate **3*d***, i.e., the inner periphery **3*a*** of the annular plate **3*d*** will be moved in relation to the part **4** over a distance X in FIGURE 2. The distance X corresponds on the one hand to the clearance necessary to absorb roof subsidences, and on the other to the deformation of the chamber **5** during which it may be considered that the force transmitted by said chamber to the part **4**, i.e., the force of the part **5*b*** of the chamber on the inner periphery **3*a*** of the annular plate **3*d*** remains substantially constant.

It was observed during preliminary tests, however, that the device described above could be further improved.

When the prop **2** has become inclined in relation to its base frame (FIGURE 2*a*) the inner part **5*b*** which is normally supported on the inner periphery **3*a*** of the plate **3*d*** has left such periphery in the opposite zone to the inclination. When the inside of the chamber **5** is pressurized, the part **5*b*** disposed in the opposite zone to the inclination first of all tends to become deformed and to resume an equilibrium shape, i.e., the circular shape shown in chain lines in the figure. This may cause some delay in the recentering of the prop and risk of damage in the chamber **5**.

To obviate this disadvantage, according to the invention means are provided to prevent the inner part **5*b*** from becoming displaced beyond its initial position close to the center of the outer part **5*a***. To this end flexible but inextensible elements are used which connect the inner part **5*b*** to the recess for the outer part **5*a***. As shown in FIGURES 2 and 2*a*, metal braid **8** is preferably fixed in the center of the part **5*b***, passes through the part **5*a***, and is fixed on the element **4** by any appropriate means. In place of metal braids a flexible diaphragm **8*a*** could be placed in the chamber **5** during manufacture, such diaphragm having means **8*b*** for fixing in the element **4** unitary with the prop on the outside of the part **5*a*** (FIGURE 4).

According to the embodiment shown in FIGURE 3, the center of the part **5*a*** can be cut out. In that case the chamber **5** is fixed in the element **4** in a manner similar to a tire without an inner tube, and the two free ends of the part **5*a*** will preferably be reinforced by metal rings **9** or the like. This arrangement makes it very easy to fix metal braid in the element **4**. In this embodiment two series of braids **8** are provided and are inclined in relation to the equatorial plane of the chamber **5**.

It is clear that the number and arrangement of the braids, diaphragm or the like, are not limited to the above, but can be determined in relation to the particular conditions of use and also assembly requirements. It should be emphasized that in the embodiment shown in FIGURE 3, the braids or diaphragms **8** can be fixed directly on the braces **9** of the part **5*a*** which are themselves substantially fixed in relation to the piece **4**. The positions of the inner and outer parts of the bean-shape could be inverted without going outside the scope of the invention. Similarly, either of such parts could be associated with the movable member, or with its transverse supporting element, as circumstances require.

Finally, it is clear that the total dimensions, more particularly the diameter of the cross-section of the bean shape should be determined accordingly firstly to the forces necessary to recenter the prop, and secondly the necessary clearance corresponding to the movement of the prop in relation to its transverse supporting element. It should be emphasized that since the chamber **5** is a relatively fragile device it should have a protective casing when used on a mine support unit. To this end, prolongation **4*a*** (FIGURE 2) are provided on the edges of the annular groove in the element **4**, such prolongations engaging slidably between the top and bottom surfaces **3*b*** and **3*c*** of an annular casing unitary with the annular plate 3*d*. The two surfaces 3*b* and 3*c* are disposed on either side of the annular plate and the distance of the prolongations 4*a* of the supporting element 4 from the bottom of the casing is enough to allow the prop to be moved over a distance X in relation to the base box.

It is clear that the various embodiments described above are only advantageous examples of embodiments of the invention, which covers all variants. The engineer in the art will realize that the device according to the invention can be used in numerous cases, but the present case should again be emphasized, viz. shift jacks for walking support units in mines, which will advantageously be provided with a device according to the invention.

What we claim is:

1. A support unit comprising a support element, a support structure defining an aperture which receives the support element, the support element being movable within the aperture relative to the support structure, a sealing-tight resilient deformable chamber located between the rim of said aperture and said support element and means for coupling the interior of said chamber with a source of fluid pressure to recenter said support element relative to said aperture after displacement of said element from a co-axial position relative to said aperture.

2. A support unit according to claim 1 in which the chamber is of toroidal shape.

3. A support unit according to claim 1 in which the chamber comprises a flexible conduit coiled in a plurality of turns about said support element.

4. A support unit comprising a support element, a support structure defining an aperture which receives said support element, a seal-tight resilient deformable chamber which in cross-section includes opposite concave walls facing in like direction, one of said walls lying within the limits of the other, and a pair of support members respectively carried by said element and said structure and of shape corresponding to the exterior of said walls, in the rest state said walls engaging said members, said element being co-axial with said aperture and the innermost part of said inner wall being adjacent the center of said outer wall, means being provided to couple said chamber to a source of fluid pressure to recenter the element relative to said support structure after displacement of said element relative to said aperture.

5. A support unit according to claim 4 including anchoring means secured to said inner wall and to means static relative to said outer wall to limit displacement of the innermost part of said inner wall away from said outer wall.

6. A support unit according to claim 5 including anchoring means between said inner wall and means static relative to said outer wall, said anchoring means comprising metal braiding.

7. A support unit according to claim 5 including anchoring means between said inner wall and means static relative to said outer wall, said anchoring means comprising a diaphragm.

8. A mine roof support unit comprising a base frame, a plurality of telescopic props pivotally supported by said frame, a support structure fast with said frame and defining apertures each receiving and limiting pivotal movement of one of said props, a resilient deformable seal-tight chamber supported by the rim of each aperture, each of said chambers including oposite walls which are concave and like facing, one lying within the other, said inner wall being concave on the exterior and engaging the rim of said aperture and said outer wall being concave on the interior and seating against a concave element carried by said prop means being provided for coupling the interior of each of said chambers with a fluid pressure source.

9. A support unit according to claim 8 including a pair of spaced guide surfaces on said structure in respect of each aperture, said surfaces slidably receiving said concave element of said prop received by said aperture.

10. A support unit comprising a support element, a support structure defining an aperture which receives said support element, a seal-tight resilient deformable chamber which in cross-section includes opposite concave walls facing in like direction, one of said walls lying within the limits of the other, and a pair of support members respectively carried by said element and said structure of shape corresponding to the exterior of said walls, and the support member in respect of the outer wall forming a part of that wall, in the rest state said walls engaging said members, said element being co-axial with said aperture, and the innermost part of said inner wall being adjacent the center of said outer wall, means being provided to couple said chamber to a source of fluid pressure to recenter the element relative to said support structure after displacement of said element relative to said aperture.

References Cited by the Examiner

UNITED STATES PATENTS

2,985,419 5/61 Duncan -------------- 248—361

FOREIGN PATENTS

1,070,311 2/54 France.
1,034,568 7/58 Germany.

CLAUDE A. LE ROY, *Primary Examiner*.