United States Patent

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[54] **SUSPENSION FOR OPERATING ROOM OVERHEAD LIGHTS**
8 Claims, 3 Drawing Figs.

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[51] Int. Cl. **F21v 33/00**
[50] Field of Search 248/17, 16, 333, 336, 337, 338, 326; 318/488, 489, 467, 470, 468, 469, 466; 240/1.4

[56] **References Cited**

UNITED STATES PATENTS

2,754,465	7/1956	Brier	318/488
2,911,519	11/1959	Phillips et al.	240/1.4
3,087,636	4/1963	Weaver	214/1 X

FOREIGN PATENTS

859,162	1/1961	Great Britain	214/1

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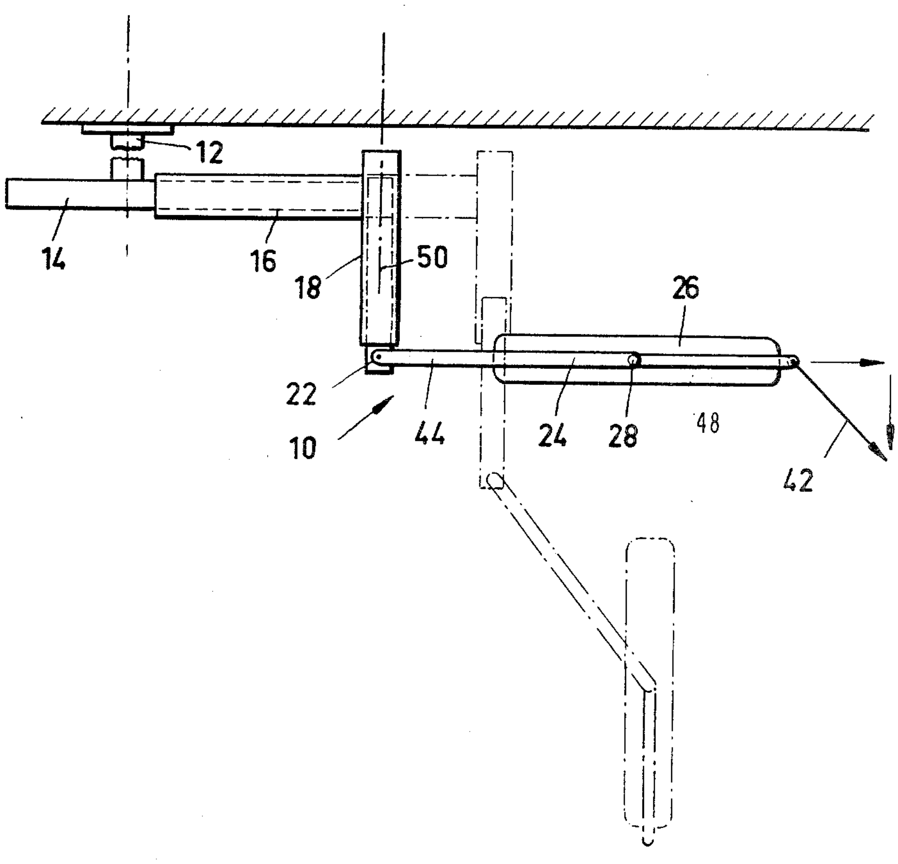
ABSTRACT: A horizontal, telescoping arm and a vertical, telescoping arm are interconnected, one of the arms being fixed to the ceiling and the other supporting an operating light fixture. A motor is connected to the vertical telescoping arm to move the light in a vertical direction, by moving one of the telescoping arm members with respect to the other, the motor being controlled by a sensing element sensing vertical force components applied to the light fixture. The motor may be electric, or a fluid motor (hydraulic or pneumatic), the motor power being controlled over a servoamplifier (or servo valve) which, in turn, is controlled from a bridge circuit of which the sensing element forms a part. The light fixture, itself, is suspended to swing about a horizontal axis, and limit switches are provided to disable operation of the motor when the fixture is deflected about an angle exceeding a predetermined limit.



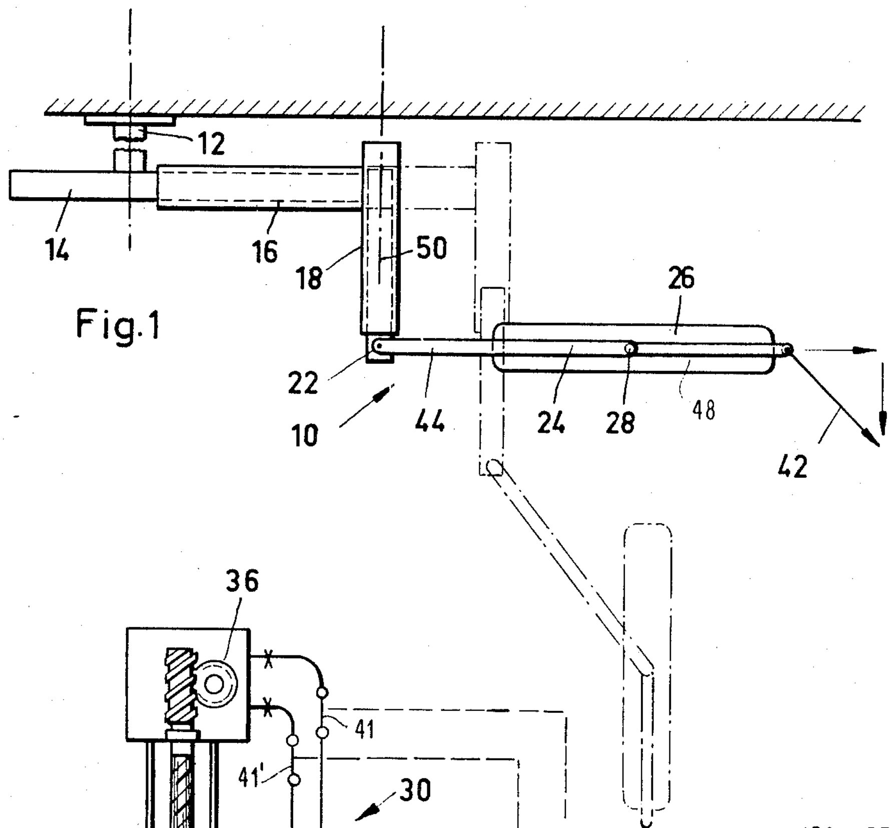


Fig.1

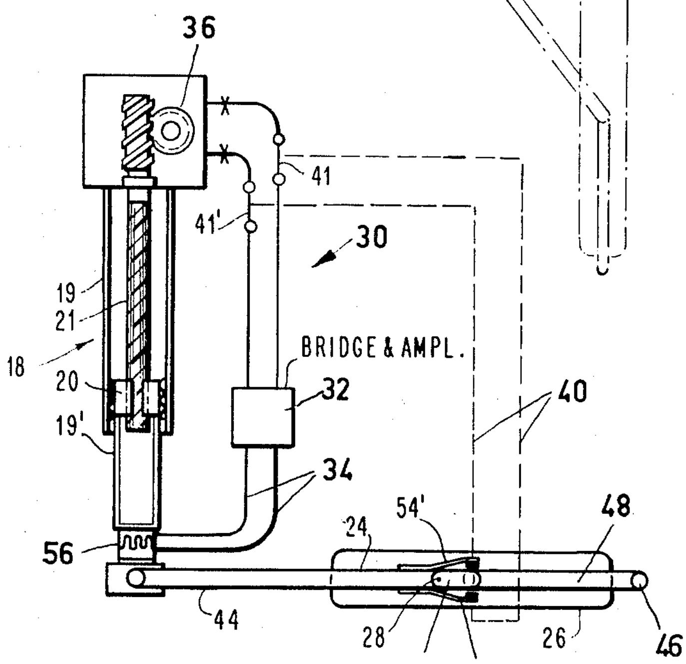


Fig. 2

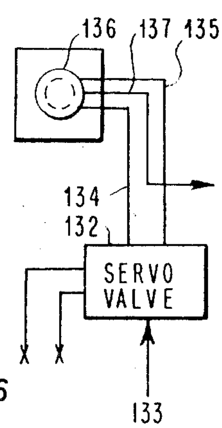


Fig. 3

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SUSPENSION FOR OPERATING ROOM OVERHEAD LIGHTS

The present invention relates to a suspension for an overhead operating room light, and more particularly to a suspension which permits movement of the overhead light in a vertical, as well as a horizontal direction and requiring a minimum of effort on part of the operator.

Operating room lights must be so constructed that the light will reach any desired region at an operating table, and to enable the position of the light fixture itself to be changed without requiring substantial force. Yet, such operating room lights are usually heavy since they are specially designed to provide a large area light source so that shadows can be avoided.

Operating room fixtures are usually supported by both vertical and horizontal arms, interconnected by links or joints. The joints are so constructed that they can be rotated with respect to each other, the links interconnecting the joints being, however, of fixed length. Movement of the light is limited by the length of the arms themselves, and the permitted swinging of the joints themselves is again limited due to the large weight of the light fixture. In order to provide even illumination over a wide region, it is desirable to be able to move the operating room lights over a wider range, which is difficult to obtain when rotating joints are employed.

It is an object of the present invention to provide a suspension for overhead operating room lights which can be easily controlled by a minimum of manual force, and the position of which will be retained after the light is in its desired position.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, a power-assisted suspension is provided; a pair of arms, one horizontal and one vertical, are interconnected, each arm having mutually telescoping members. The vertical arm has a motor secured thereto to move the relatively telescoping members with respect to each other. The operation of the motor is controlled through a control circuit, in turn controlled by a sensor responsive to vertical force components applied to the light fixture. Preferably, the light fixture itself is mounted for swinging movement, with limit switches being provided to inhibit operation of the motor when the fixture is displaced over an angle exceeding a predetermined value. The motor itself may be an electric motor, or a hydraulic or pneumatic motor.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic side view of an operating room light and illustrating the suspension;

FIG. 2 is a fragmentary view, to an enlarged scale, of the suspension of the operating room light; and

FIG. 3 is a part of the fragmentary view of Fig. 2 and illustrating control of the suspension by means of a fluid motor.

The entire light fixture suspension **10** includes a vertical rotary joint **12**, to which a horizontal arm is attached having a pair of telescoping members **14**, **16**. The horizontal arm can swing about the axis of the vertical rotary suspension **12**. All arms and suspensions are hollow, the interior of the arms and suspensions accommodating the electrical supply cable, as well known in the art, to supply electric current to light fixture **26**. Additionally, operating power, which may be electrical, hydraulic, or pneumatic can be conducted to the power assist motor for the vertical suspension, as will appear below.

A vertical arm **18**, likewise formed of an outer and an inner part to telescope within each other is connected to a horizontal telescoping arm. Light fixture **26** is secured to arm **18** by means of a fork **24**. The vertical arm **18** may be secured to the horizontal arm in such a manner that it can swing about a vertical axis.

Illustrated at the end of light fixture **26** is a force triangle, in which a moving force **42** is shown as broken up into a horizontal and a vertical component. To move the lamp in a horizontal direction, for example, from the full line position (Fig. 1) to the chain-dotted position, the horizontal force will cause the telescoping arm 16 to pull away from arm 14. Vertical movement, in accordance with the vertical force component is governed by a motor 36 (Fig. 2). Vertical arm **18** has an outer member **19** and an inner member **19'**. The inner member **19'** has an inside thread **20** formed thereon, which engages a threaded spindle **21**, driven over suitable gearing, for example a worm gear, by the motor 36. Thus, the motor will control the vertical position of the lamp attached to the vertical arm 18. Suitable means are provided to prevent relative rotation between the two members 19, 19'.

The motor is controlled by a control system **30**, which is connected to a sensing device **56**, shown as a pressure-measuring diaphragm having a strain transducer therein. Motor 36, itself, is mounted at the top of arm 18. The strain transducer 56 is mechanically connected to a joint 22 (Fig. 1) to which fixture connecting arm **44** is attached, merging into fork 24. The fixture **26**, itself, can swing about a horizontal axis indicated at **28**. Joint 22 provides for swinging of arm 44 about a vertical axis. By giving maximum freedom of movement for the joints, that is by permitting close to 180° rotation of the relatively movable parts, practically any field can be illuminated, from the top, or from any side. A handle 46 is secured to a fork extension **48**, or to the light fixture itself, to move the light fixture and to apply the force component 42.

Application of force 42 to the handle 46, and thus over fork **48** applies strain to the transducer element **56**. When the transducer element **56** is strained, or deflected beyond a predetermined limit, causes control signal can be derived therefrom. Preferably, the transducer element forms one arm of a bridge circuit, and is connected by means of line 34 to a combination bridge and servoamplifier 32. Under static operating conditions, the bridge is so adjusted that it is in balance, so that servoamplifier 32 will not apply power to electric motor 36. Application of a force 42, however, for example to raise the fixture 26, causes an upwardly directed component of force. As an example, the gauge will deflect, or compress, change its resistance, and apply an error signal over line **34** to amplifier 32, to control the motor to turn spindle 21 in a direction to raise the fixture, the rotation continuing until balance is again reestablished. Applying a pull on the fixture, for example in the direction of force 42 (FIG. 1) causes opposite deflection of the element **56**, a control signal in the opposite direction, and rotation of motor 36 in a direction to lower the fixture **26**. The chain-dotted position in FIG. 1 illustrates the greatest movement possible, both in horizontal as well as in vertical direction. As shown, joint 22 can further be so arranged to swing not only over a vertical axis 50, but also over a horizontal axis to obtain even greater range of possible illumination. The strain gauge is preferably so arranged to have a predetermined threshold value, so that it will not be too sensitive, and not be activated upon touching of the light fixture, or small movements thereof.

FIGS. 1 and 2 illustrate the arrangement utilizing an electric motor. FIG. 3 illustrates the adaptation of the system with a fluid motor, for example a hydraulic motor. The output of the servoamplifier 32 is broken at point X–X and applied to a servovalve **132**, having a pressure input 133, the output from pressure input 133 being conducted over either an "up" line **134** or a "down" line 135 to the fluid motor 136. Return line **137** connects to the source of pressure supply, not shown, for recirculation to input line 133. All other parts may be similar to those shown in FIG. 2 and therefore are not further illustrated because they have been previously completely described. The potential resulting from imbalance of the bridge, applied to the servoamplifier, controls the servovalve which is a multipath, multiposition valve (for example a well-known servo spool valve) forming a fluid circuit to the "up" or to the "down" line from the input, as desired, in order to control the operating force to fluid motor 136 in accordance with the desired direction and extent of motion.

Immediate stopping, or interruption of motion of motor 36 (or 136) is frequently desired, particularly when the joint 22

(FIG. 1) permits swinging about a horizontal axis. If the operator wishes to avoid movement of motor 36 for displacement in a vertical direction, a disabling circuit formed of member 52 and contacts 54, 54', together with an electrical circuit line 40 and switches 41, 41' is provided, the switches being shown in closed position. Switches 54, 54' are limit switches attached to a pair of extending diverging members and secured to fork 24. Upon movement of fork 48 over the axis 28 beyond a predetermined angle, limit switches 54, or 54', respectively, will be contacted, causing operation of switches 41, 41', respectively, as indicated by the dashed lines, for example over a relay connection as well known. Operating force 42 can thus be applied to handles 46 and will cause vertical displacement until additional swinging motion is imparted to the light fixture whereupon motor 36 is stopped immediately. Of course, a similar interrupt system can be applied to the embodiment illustrated in connection with FIG. 3.

The power assisted vertical movement permits placement of even heaviest operating room light fixtures in any desired position with a minimum amount of force being necessary on part of the operator, while permitting a wide choice of field to be illuminated. Various modifications and changes may be made within the scope of the inventive concept.

I claim:

1. Operating room overhead light suspension adapted to be mounted on a ceiling to support an operating room light fixture comprising:

a horizontal arm (14, 16) having two mutually telescoping members;

a vertical arm (18) having two mutually telescoping members, one of said arms being mounted on the ceiling and the other arm having a light fixture secured to an end thereof;

a motor (36) secured to said vertical arm and connected to move one of said vertical telescoping members with respect to the other;

sensing means (56) sensing a vertical movement force component applied to said light fixture and additional to the dead weight suspended on said other arm;

and control means (32, 34) connected to and controlling operation of said motor under command of said sensing means when the sensed movement force in the vertical direction exceeds a predetermined level.

2. Suspension according to claim 1, wherein said sensing means is a pressure gauge (56) having an electrical strain transducer therein and mounted inside said vertical arm, said control means including a bridge network having said strain transducer connected in one arm thereof.

3. Suspension according to claim 1, wherein said motor is an electric motor.

4. Suspension according to claim 2, wherein said motor is an electric motor, said bridge network is connected to a servoamplifier, said motor being controlled in amount and direction by an unbalance signal of the bridge transmitted to said servoamplifier.

5. Suspension according to claim 1, wherein said motor is a fluid motor.

6. Suspension according to claim 2, wherein said motor is a fluid motor, the output of said bridge network controlling a servovalve, said servovalve being connected to control fluid supply to said motor.

7. Suspension according to claim 1, wherein said light fixture (26) is swingably mounted to swing about a horizontal axis (28);

means (52, 54) sensing swinging movement of said fixtures are provided, said swing-sensing means being connected to said motor and inhibiting operation of said motor upon sensing of swinging of said fixture above a predetermined angle.

8. Suspension according to claim 7, wherein said means sensing swinging movement of said light fixture includes a pair of limit switches located adjacent the axis about which the light fixture may swing, said limit switches being connected to interrupt application of power to said motor when deflection of the light fixture about said axis exceeds a predetermined limit.