May 1, 1962 S. L. W. HANSEN 3,032,308

ARRANGEMENT IN SUSPENDING IN CORDS OR SIMILAR FLEXIBLE CARRYING MEANS, AN X-RAY TUBE OR THE LIKE

Filed Dec. 19, 1958 3 Sheets-Sheet 1

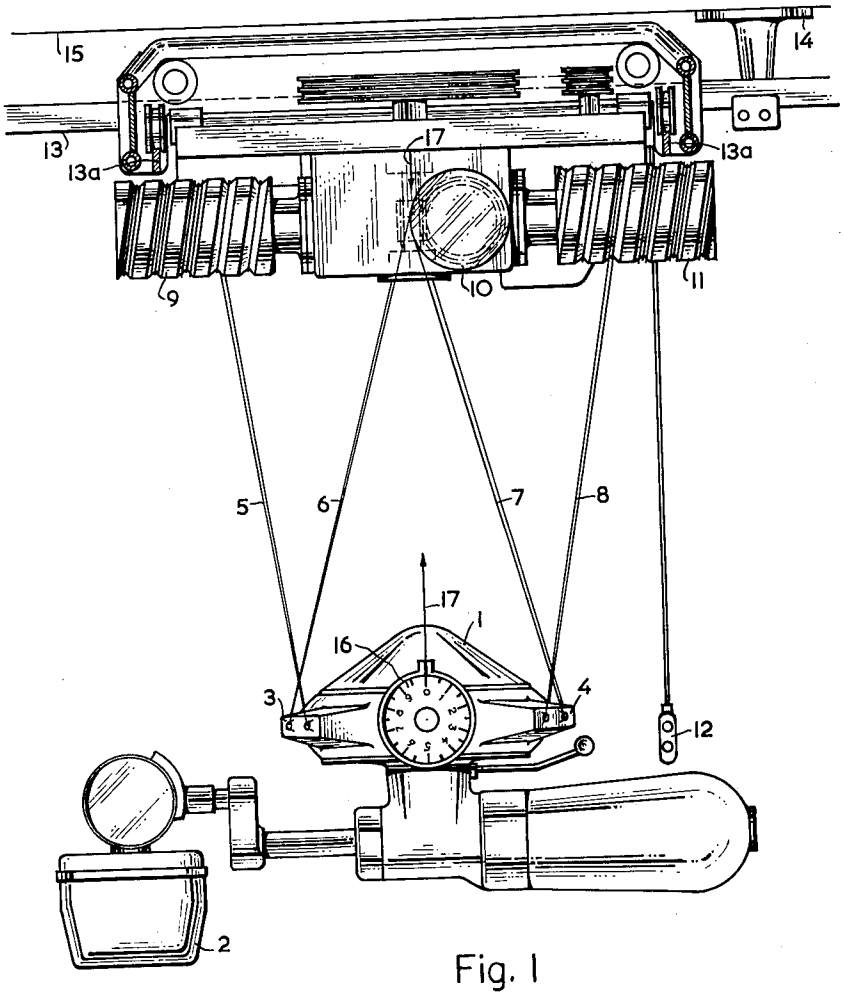


Fig. 1

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Filed Dec. 19, 1958 3 Sheets-Sheet 2

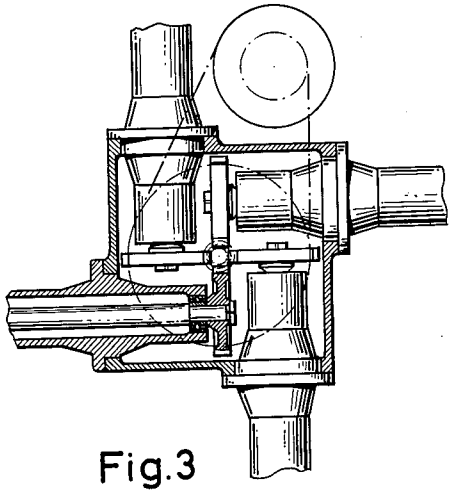


Fig.3

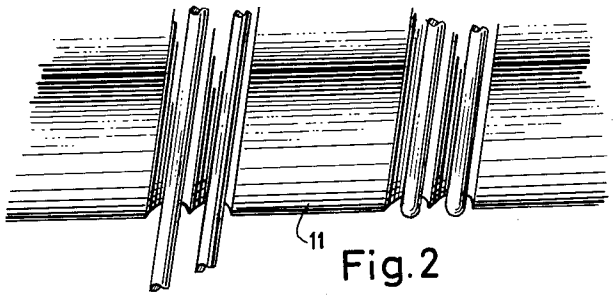


Fig.2

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Filed Dec. 19, 1958 3 Sheets-Sheet 3

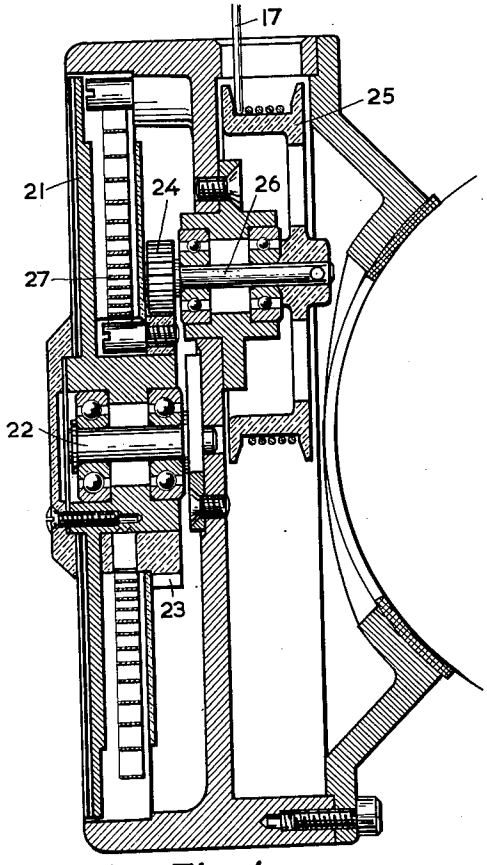


Fig.4

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United States Patent Office 3,032,308 Patented May 1, 1962

3,032,308

ARRANGEMENT IN SUSPENDING IN CORDS OR SIMILAR FLEXIBLE CARRYING MEANS, AN X-RAY TUBE OR THE LIKE

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Filed Dec. 19, 1958, Ser. No. 781,656
Claims priority, application Denmark Dec. 23, 1957
6 Claims. (Cl. 248—329)

This invention relates to an arrangement in suspending in cords or similar carrying members at least one X-ray tube or the like, capable of being raised and lowered by extending or shortening more particularly by winding and unwinding carrying members secured at the lower part, to an X-ray tube or to a support.

In the X-ray apparatus of the prior art the carrying cords are wound up on small winding drums in such a manner that the uppermost extremities on the free-hanging parts of the carrying members practically keep their position in space.

By suitably choosing the number of carrying members and their respective positions it becomes possible to attain a suspension system having a particularly good stability. Under some conditions, it is, however, desirable to acquire a further improved stability so that the X-ray tube when moved away from its position of rest, e.g. by a blow, regains it as soon as possible and subsequently keeps it.

If the apparatus is to be used in a very high room, the carrying members must be very long, since it is required that the X-ray tube can be lowered throughout to the floor.

The longer the carrying members, the more time the tube will take to regain its position of rest.

It is the object of the invention to remedy this inconvenience and according to the invention this is achieved by means which control the carrying members during the extension and shortening in such a manner that the uppermost extremities on the free-hanging parts of the carrying members accordingly move towards or from the vertical line passing through the centre of gravity of the suspended apparatus. The uppermost extremities on the free-hanging parts of the carrying members will subsequently be designated as points of suspension.

In the arrangement shown it is obtained that the dimensions of the polygon formed in space by the points of suspension vary as a function of the distance from the X-ray tube to the points of suspension. The variation in the position of said points of suspension may be dimensioned with such values that the stability of the apparatus remains constant. Yet, it is also possible to obtain such control means so as to give an increased stability when the distance between the X-ray tube and the points of suspension increases.

The control means of the carrying members may e.g. be effected by pulleys moving away from the vertical middle-axis of the suspending system while the X-ray tube is being lowered, and vice versa. In accordance with the invention the control means consist of winding drums. The latter are provided with grooves for the carrying members, which grooves have such a pitch that said carrying members are wound up along a helical line with an appreciable distance between adjacent turns. This construction is particularly simple because no appreciable modification in the winding mechanism is required in addition to mounting winding drums of suitable dimensions.

The invention is further explained with reference to the accompanying diagrammatical drawing showing an embodiment of a suspension mechanism according to the invention. The suspension mechanism is, moreover, of the type which is the subject matter of Patent No. 2,946,549, Serial No. 378,939.

FIG. 1 shows a side view of an embodiment having four winding drums,

FIG. 2 shows an enlarged part of a winding drum,

FIG. 3 shows a horizontal section in the driving mechanism comprising a motor, a central common worm and four worm wheels at the end of the drum shafts, and

FIG. 4 shows a section through an indicator.

In the drawing **1** refers to a support or holder which carries an X-ray tube **2** which is attached rotatably thereto. Said support has four separate restricted areas of fixation which for the sake of simplicity is denoted points of fixation. Two of said areas or points of fixation can be seen in FIG. 1 viz. points **3** and **4**. From each of said four points of fixation, two carrying cords extend. Two carrying cords **5** and **6** extend from the point of fixation **3**, and two carrying cords **7** and **8** extend from the point of fixation **4**. Two carrying cords extending from the same point of fixation are wound up each on its respective winding drum. Consequently, carrying cord **5** and a carrying cord from one of the two points of fixation not seen is wound up on a winding drum **9** and carrying cord **6** and a carrying cord from one of the two points of fixation not seen on a winding drum **10**. Thus, on each winding drum two carrying cords are wound up but the lowermost extremities of which extend from different points of fixation. The carrying cords **6** and **7** are thus both wound up on the same winding drum **10**.

The driving mechanism of the drums shown in FIG. 3 is of a nature known per se and will not be described further. Mention only will be made to the fact that each drum is provided with a shaft on which a worm gear is fitted. The four worm gears are engaging in one and the same worm which is driven by an electric motor, the motion of which can be controlled by means of push buttons from a handle **12**.

The suspending mechanism may be slidable on track rails **13** which may be suspended from the ceiling **15** by means of a bracket **14**.

If the suspending mechanism is suspended displaceably along a pair of track rails at right angle to the paper and to track rails **13**, the apparatus may be brought into any position within an extent range, if the pair of track rails upon which the suspending mechanism bears is designed as a carriage rolling on rails **13**.

There are two cords leading to each of the winding drums **9** and **11** as shown in FIG. 2, and consequently, each winding drum is double-grooved. The two grooves on one and the same winding drum can be located close to one another and can have the same pitch.

For achieving the object of the invention it is not necessary to have winding drums with grooves of a comparatively high pitch, because, in lieu of said drums, small conventional winding drums can be used whenever it is only required to ensure that the uppermost extremities on the free-hanging parts of the carrying members, according to the distance between the X-ray tube and said points, move respectively towards or from the middle-axis of the suspending system. This result can be achieved, e.g. by means of force-controlled guiding pulleys contacting the carrying members, and, by their contact points with said members determining the position of the points of suspension.

In operation one of the two push-buttons for up and down movement in the handle **12** is pressed whereby the motor is activated in one or the other direction. When the up-button is pressed the drums are rotated to wind the cords and consequently the suspension points are moving towards each other, or in other words the upper ends of the free parts of cords touching the drums are displaced in the direction of the vertical centerline of the complete medical unit. Thus the area of the polygon defined by the suspension points decreases when the X-ray tube and

holder is hoisted and vice versa. Thereby a detrimental stress in the cords can be avoided. On the other hand when by pressing the down-button the suspension points are moved in the opposite directions and the X-ray tube lowered an increasing stability is attained.

An indicator for indicating the position of the X-ray tube in relation to the floor or any other reference level may be arranged either on the carriage or on the tube holder as shown at **16**. A cord **17** operates the indicator. The indicator which is shown in FIG. 4 consists of an indicator disc **21** rotatable around an axle **22** and driven through gear wheels **23**, **24** by a cord drum **25** rotatable around a fixed axle **26**. A spring **27** counteracts the action of a draw in the cord **17**.

The overhead carriage may be moved by hand by pulling the handle **12** or by a separate motor. In the embodiment shown the fixation points are represented by the ends of four brackets or arms in fixed connection with the tube holder but areas representing the fixation points on the tube holder need not be situated on separate protruding parts. The drums are preferably mounted on shafts the ends of which carry worm wheels all in mesh with a common motor driven worm.

I claim:

1. In a device for suspending a unit for medical work, an overhead movable carriage, motor and winding means mounted in said carriage, a number of suspending cords passing in at least three diverging pairs from different restricted areas of suspension of the winding means on the carriage and passing also in at least three diverging pairs from different restricted areas of fixation on said unit, said suspension cords being in fixed connection with said unit, and guiding means for guiding the position of all of said restricted areas of suspension in a path away from and towards the vertical centerline of the unit said path leading said areas of suspension away from said centreline along a line corresponding to a line of areas of suspension representing positions in which the stability of the unit is at least approximately constant.

2. In a device for suspending an X-ray tube, a tube holder, an overhead carriage, motor and winding means mounted in said carriage, restricted areas of fixation on the tube holder, a plurality of flexible carrying means in fixed connection with said tube holder and passing in at least three diverging pairs from different restricted areas of suspension on said winding means and passing also in diverging pairs from said different restricted areas of fixation always leading to different areas of suspension and drum means comprising said restricted areas of suspension within which said carrying means are attached for winding and unwinding the carrying means, said drums having helical grooves for guiding all of said carrying means the pitch of said helical grooves having a value at least corresponding to that required for maintaining the stability of said unit when lowered.

3. In a device for suspending an X-ray tube and a tube holder, four restricted areas of fixation points on said tube holder, two flexible carrying cords fixably attached at one end within each restricted area of fixation to said tube holder and at the other end within one of four separated restricted areas of suspension in an arrangement in which two carrying cords from one of said restricted areas of fixation always lead to different ones of said restricted areas of suspension, and two carrying cords from one of said restricted areas of suspension always lead to different ones of said restricted areas of fixation, movably mounted means comprising said restricted areas of suspension within which carrying cords are attached, and guiding means for guiding all of said areas of suspension away from the centerline during unwinding of the carrying cords and towards the centerline during winding of the cords along a helical path having an appreciable pitch for guiding said areas of suspension through positions in which the stability is maintained constant independently of the length of the cords between the areas of fixation and the areas of suspension.

4. In a device for suspending a unit for medical work, an overhead movable carriage, motor and winding means mounted in said carriage, said winding means comprising winding drums with a double set of helical grooves each having an appreciable distance between adjacent turns, a number of suspending cords extending downwards from said drums to separated restricted areas of fixation on said unit, said suspending cords being arranged in such pattern of at least three pairs that from each separate restricted suspension area on each drum is passing a single diverging pair and from each separate restricted area of fixation on said unit is also passing a diverging pair.

5. In a device as claimed in claim 4 drums mounted on shafts, worm wheels fixed at the ends of said shafts, a common worm in mesh with all said worm wheels, said motor coupled to said common worm.

6. In a device as claimed in claim 4 an indicator for indicating the position of the medical unit in relation to a reference level.

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