Feb. 18, 1964 E. P. THOMAS 3,121,793

MOVABLE X-RAY TUBE SUPPORT APPARATUS

Filed March 15, 1961 2 Sheets-Sheet 1

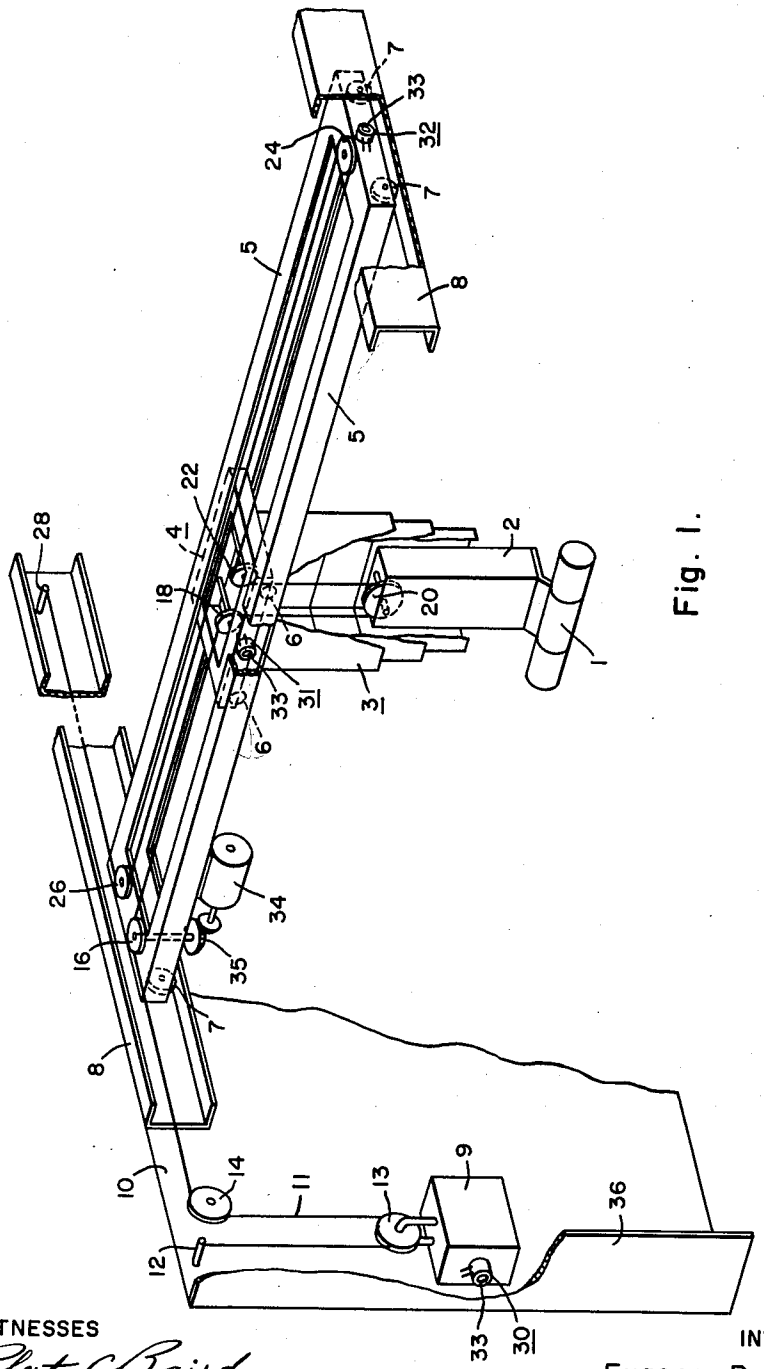


Fig. 1.

WITNESSES

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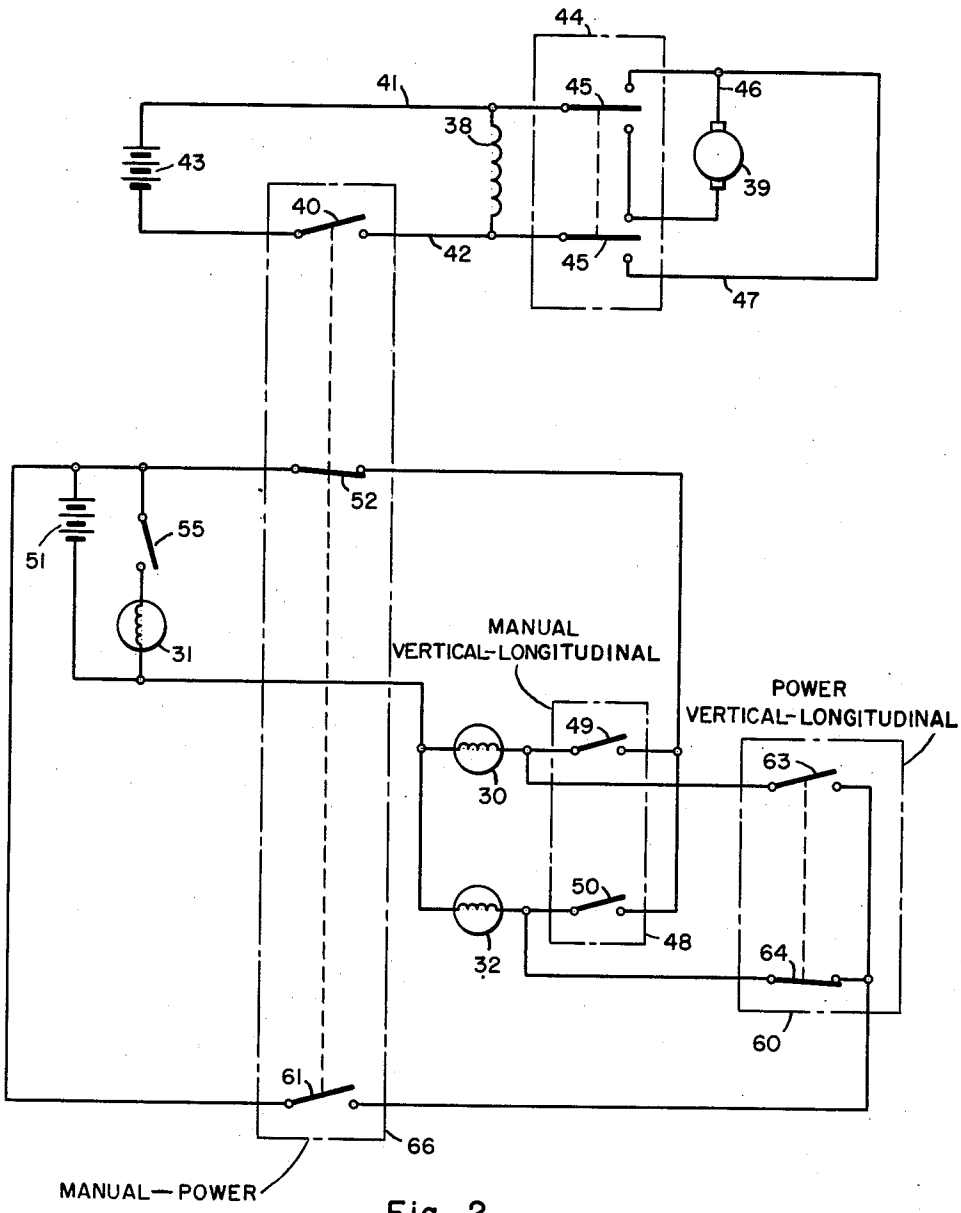


Fig. 2

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MOVABLE X-RAY TUBE SUPPORT APPARATUS

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The present invention relates to X-ray apparatus and more particularly to an actuating system for overhead X-ray tubestands.

The usual overhead X-ray tubestand employs a vertically-arranged telescopic column which carries at its lower end an X-ray tube and is mounted at its upper end on a cross carriage. The cross carriage is transportably mounted on overhead cross rails which in turn are transportably mounted at opposite ends on overhead side rails. A somewhat complex counterweight-cable-and-pulley arrangement is embodied in these overhead tubestand equipments to counterbalance the X-ray tube while affording its freedom for vertical, longitudinal, and cross travel movement. A plurality of selectively-energized electromagnetic locks provide for locking the X-ray tube against movement in selected directions.

Heretofore in order to provide for powered operation of the several mutually-perpendicular movements of the X-ray tube, it has been the practice to employ a plurality of motors according to the number of such movements desired to be power-actuated.

In view of the foregoing remarks, a prime object of the present invention is the provision of a simplified system for power actuation of the X-ray tube in an overhead tubestand in at least two mutually perpendicular directions by a single motor.

In accord with the preceding object, it is another object of the present invention to employ the counterweight-cable-and-pulley arrangement and the electromagnetic locks in a manner which affords the power actuation of the X-ray tube in the several directions by a single motor.

Other objects and advantages of the invention will become apparent from the following description when taken in connection with the accompanying drawings in which:

FIGURE 1 is an isometric three-dimensional view of an overhead X-ray tubestand embodying the invention; and

FIGURE 2 is a circuit diagram exemplifying a control system which may be embodied in the invention.

Description

Referring to FIG. 1, the overhead X-ray tubestand in which the invention is embodied comprises an X-ray tube head 1 which is carried by the innermost and lowermost column section 2 of a telescopic tube column 3. Tube column 3 depends downwardly from a cross carriage 4 overhead which is transportably mounted on overhead cross rails 5 through the medium of rollers 6, only several of which are shown, but at least four of which are employed in the well-known manner. The cross rails 5 in turn are supported, via rollers 7 at opposite ends, by side rails 8 which provide for longitudinal movement of the X-ray tube in unison with cross carriage 4 and rails 5.

The counterweight 9 for the X-ray tube 1 and movable sections of the column 3 etc. is disposed preferably along a wall 10 of the room in which the apparatus is located and is usually hidden from view in a suitable enclosure.

The preferred rigging for counterweight 9 and its cable 11 includes an anchor 12 for one end of the cable which extends downwardly and around a counterweight-supporting pulley 13, upwardly therefrom to a pulley 14, thence horizontally along the respective side rail 8 to a pulley 16

on the cross rail 5 assemblage, thence along one cross rail 5 to a pulley 18 on the cross carriage 4, thence downwardly within column 3 around a pulley 20 carried by the innermost column section 2, thence upwardly and over a second pulley 22 on the cross carriage 4 to a pulley 24 at the opposite end of the cross rail assemblage, thence back over such assemblage to a second pulley 26, and thence to the second cable anchor 28 at one end of the overhead side rail 8 located at the wall 10. This arrangement, in well-known manner, enables the X-ray tube 1, while fully counterbalanced, to be moved vertically in coincidence with telescopic movement of the column 3, longitudinally by movement of cross rails 5 along side rails 8, and transversely by movement of the column carriage 4 along such cross rails.

For locking the tube 1 in any selected position, electromagnetic locks 30, 31 and 32 are provided. Each lock is of well-known construction which responds to energization of its coil to cause attraction of its armature 33 to the adjacent steel structural member of the apparatus for effecting a locking action.

One lock 30 is carried by the counterweight 9 for locking engagement with such as a vertical steel member 36 at one side of the counterweight. Another lock 31 is carried at one side of the cross carriage 4 for locking engagement with one of the cross rails 5, and the third lock 32 is carried at the end of the cross rail 5 assemblage for locking engagement with the adjacent side rail 8.

During manual operation, by selectively energizing one or more of the locks 30, 31 and 32, the three mutually-perpendicular movements of the X-ray tube may be arrested selectively.

To afford power actuation of the X-ray tube vertically as well as longitudinally, for example, in accord with a feature of this invention, a motor 34 carried by the cross rail assemblage is provided for driving the pulley 16 through the medium of suitable gearing 35, for example, and preferably a clutch (not shown) which enables the motor to be decoupled from the pulley 16 when manual positioning is employed. By locking the counterweight 9 against vertical movement, operation of the motor 34 will cause the cross rail 5 assemblage to move along the side rails 8, and by locking the cross rail 5 assemblage against movement along the side rails 8 while the counterweight is unlocked, the turning of pulley 16 by motor 34 causes the X-ray tube 1 and column section 2 to be moved vertically through the medium of the cable 11 which is caused to pass around all pulleys of the system.

Referring to FIG. 2, the motor 34 is reversible and is preferably a direct current motor having its field 38 connected in shunt with its armature 39. A switch contact 40 provides for connection of motor leads 41 and 42 to a direct current source 43, and an on-off reversing motor control switch means 44 provides for effecting operation of the motor in the desired direction.

Presuming switch contact 40 to be closed, in the upper closed position of contacts 45 of switch means 44 current will flow in one direction through the armature 39 via conductor 46, and in the lower closed position of contacts 45 current flow through the armature will be in the opposite direction via conductor 47.

To provide for selective control of energization of the counterweight lock 30 and the cross beam lock 32 during manual adjustment of the X-ray tube height and longitudinal position, MANUAL Vertical-Longitudinal control switch means 48 including separately actuable contacts 49 and 50 are provided to establish an energizing circuit with a direct current source 51 via a switch contact 52 which is opened to disable switches 49 and 50 when power adjustment of X-ray tube height and longitudinal

position is desired. In the chosen exemplification, the cross carriage 4 is exclusively moved manually, and accordingly its lock 31 is controlled by a switch 55 which is not subject to disablement by contact 52.

To provide for control of the locks 30 and 32 for selecting direction of power actuation of the X-ray tube 1 as either vertically or longitudinally, a POWER Vertical-Longitudinal selector switch means 60 is provided, which, when rendered effective by switch contact 61, affords selective control of energization of counterweight and cross beam locks 30 and 32 via ganged switch contacts 63 and 64 which parallel the manual control switches 49 and 50, respectively.

Switch contacts 40, 52 and 61 are ganged for operation in unison in a MANUAL-POWER selector switch means 66 which in the manual position in which it is shown with contacts 40, 61 open and contact 52 closed, assures disablement of the motor on-off reversing switch means 44, the rendering effective of the MANUAL Vertical-Longitudinal lock control switch means 48, and the disablement of the POWER Vertical-Longitudinal selector switch means 60. In the power position of selector switch means 66, with contacts 40 and 61 closed and contact 52 open, the motor control switch means 44 and POWER Vertical-Longitudinal selector switch means 60 are rendered effective while the MANUAL Vertical-Longitudinal lock control switch means 48 is disabled.

The control circuit means as shown in FIG. 2 is by way of exemplification, and it will be understood that the several switch means and contacts may take the form of a number of relays which may vary as to the number of contacts according to availability or convenience, without departing from the invention.

A particular embodiment of the invention has been described in conjunction with the motor driving of the pulley 16 for power actuation of the X-ray tube 1 in the vertical and longitudinal directions. If, however, another pulley is chosen, pulley 18, for example, as the one that is power driven, the single motor driving such pulley may be made to effect even the third motion of the X-ray tube 1, namely, transverse movement in unison with the cross carriage 4 along cross tracks 5, by selective control of the three locks 30, 31 and 32.

While the invention has been described with a degree of particularity, it will be appreciated that it is intended to embrace modifications which will hereafter occur to those skilled in the art within the spirit and scope of the appended claims.

I claim as my invention:

1. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; in combination therewith a motor operatively connected to one of said pulleys, a plurality of locks for selectively locking relative movements of the aforenamed components of said tubestand to selectively lock movement of said X-ray-tube-carrying column section against vertical, transverse and longitudinal movement, respectively, the motor driven pulley and locks being so constructed and arranged that the aforesaid motor may be made to effect at least two of the three mutually-perpendicular directions of movement of the X-ray-tube-carrying column section via said cable means by selective control of said locks.

2. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move, for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; in combination therewith a motor operatively connected to one of said pulleys, a plurality of locks for selectively locking relative movements of the aforenamed components of said tubestand to selectively lock movement by said X-ray-tube-carrying column section against vertical, transverse and longitudinal movement, respectively, the motor driven pulley and locks being so constructed and arranged that the aforesaid motor may be made to effect at least two of the three mutually-perpendicular directions of movement of the X-ray-tube-carrying column section via said cable means by selective control of said locks, and control means for said motor and locks constructed and arranged to provide for such motorized operation of said X-ray-tube-carrying column section or manual operation with selective control of the aforesaid locks.

3. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; the combination therewith of a motor operatively connected to a pulley on said cross rails, a counterweight lock operable to lock said counterweight means against vertical movement, a cross rail lock operable to lock said cross rails against movement along said side rails, and means controlling operation of said motor and selective operation of said counterweight lock and cross rail lock, so constructed and arranged that both vertical and longitudinal movement of the aforesaid X-ray-tube-carrying section of said column may be effected selectively by such single motor via said cable means.

4. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; the combination therewith of a motor operatively connected to a pulley on said cross rails, a counterweight lock operable to lock said counterweight means against vertical movement, a cross rail lock operable to lock said cross rails against movement along said side rails, a cross carriage lock operable to lock said cross carriage

against movement along said cross rails, and control means controlling operation of said motor and selective operation of the aforesaid counterweight, cross rail and cross carriage locks, so constructed and arranged that said X-ray-tube-carrying column section may be free for or locked against manual movement in any selected direction or actuated by said motor via said cable means in the vertical and longitudinal directions.

5. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; the combination therewith of a motor operatively connected to a pulley on said cross rails, a counterweight lock operable to lock said counterweight means against vertical movement, a cross rail lock operable to lock said cross rails against movement along said side rails, and control means controlling operation of said motor and selective operation of the aforesaid counterweight, and cross rail locks, said control means including switch means permitting operation of one or the other but not both of the aforesaid counterweight and cross rail locks when said motor is in operation, whereby actuation of said X-ray-tube-carrying column section in both the vertical and longitudinal directions by such single motor via such cable means may be effected selectively.

6. In an overhead X-ray tubestand comprising a telescopic column including an X-ray-tube-carrying section, an overhead cross carriage carrying said telescopic column, overhead cross rails along which said cross carriage may travel for transverse movement of said column, side rails along which said overhead cross rails may move for longitudinal movement of said column, vertically-movable counterweight means, cable means supportedly connected to said counterweight means and to said X-ray-tube-carrying column section, and a plurality of pulleys disposed on said cross rails, cross carriage and X-ray-tube-carrying column section around which said cable passes in a manner permitting vertical, transverse and longitudinal positioning of said column section; the combination therewith of a motor operatively connected to a pulley on said cross rails, a counterweight lock operable to lock said counterweight means against vertical movement, a cross rail lock operable to lock said cross rails against movement along said side rails, a cross carriage lock operable to lock said cross carriage against movement along said cross rails, and control means controlling operation of said motor and selective operation of the aforesaid counterweight, cross rail and cross carriage locks, said control means including switch means permitting operation of one or the other but not both of the aforesaid counterweight and cross rail locks when said motor is in operation and permitting operation of any and all locks when said motor is rendered ineffective for manual operation of the column positions, whereby said X-ray-tube-carrying column section may be selectively freed for or locked against manual movement in any direction or power actuated by said motor selectively vertically and longitudinally.

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