United States Patent

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[54] **PLATFORM POSITIONING MECHANISM**
13 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **182/37,** 182/142, 182/150
[51] **Int. Cl.** **E04g 3/10**
[50] **Field of Search** 182/37, 142, 150, 128, 63, 148; 212/128, 125

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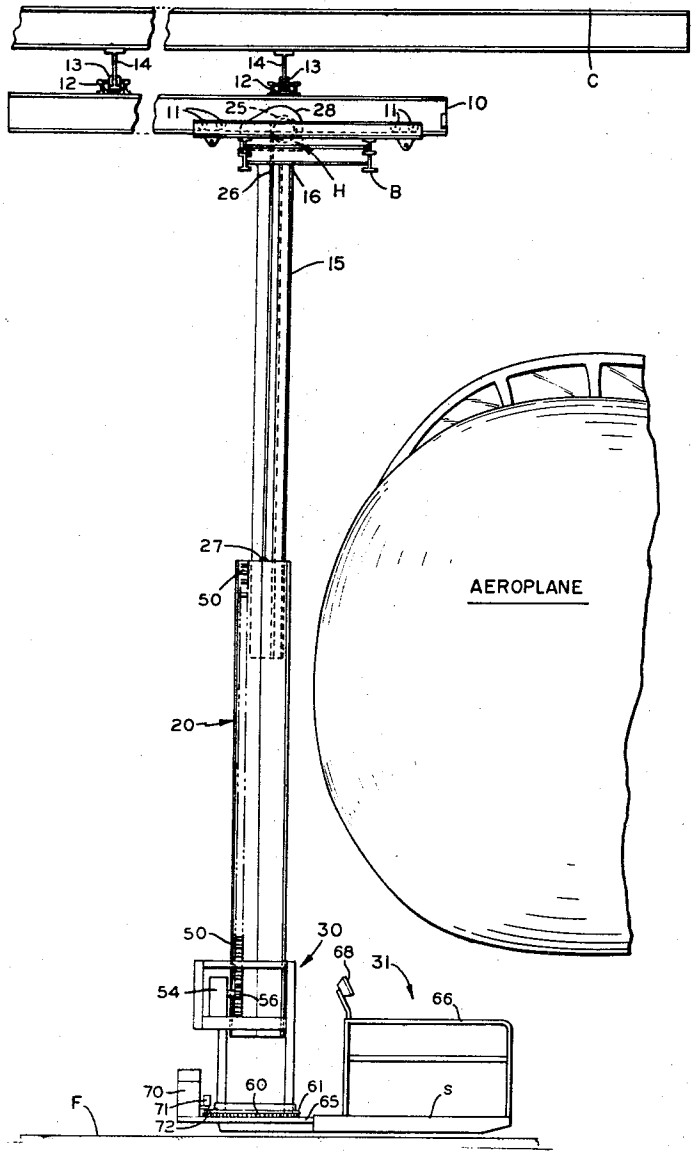
ABSTRACT: Through a system of beams and rollers, an upper base is mounted for horizontal movement at or near the ceiling of a room. A vertical mast is fixed at its upper end to the upper base for integral movement therewith. A movable mast is telescoped about the fixed mast and moves vertically thereon. A carriage slides vertically on the movable mast and has an opening for the passage of both masts so that it may be elevated to the upper end of the movable mast when the movable mast is lifted to its uppermost position on the fixed mast. An operator's platform rotates about the carriage on a circular bearing having an opening through which the two masts extend.



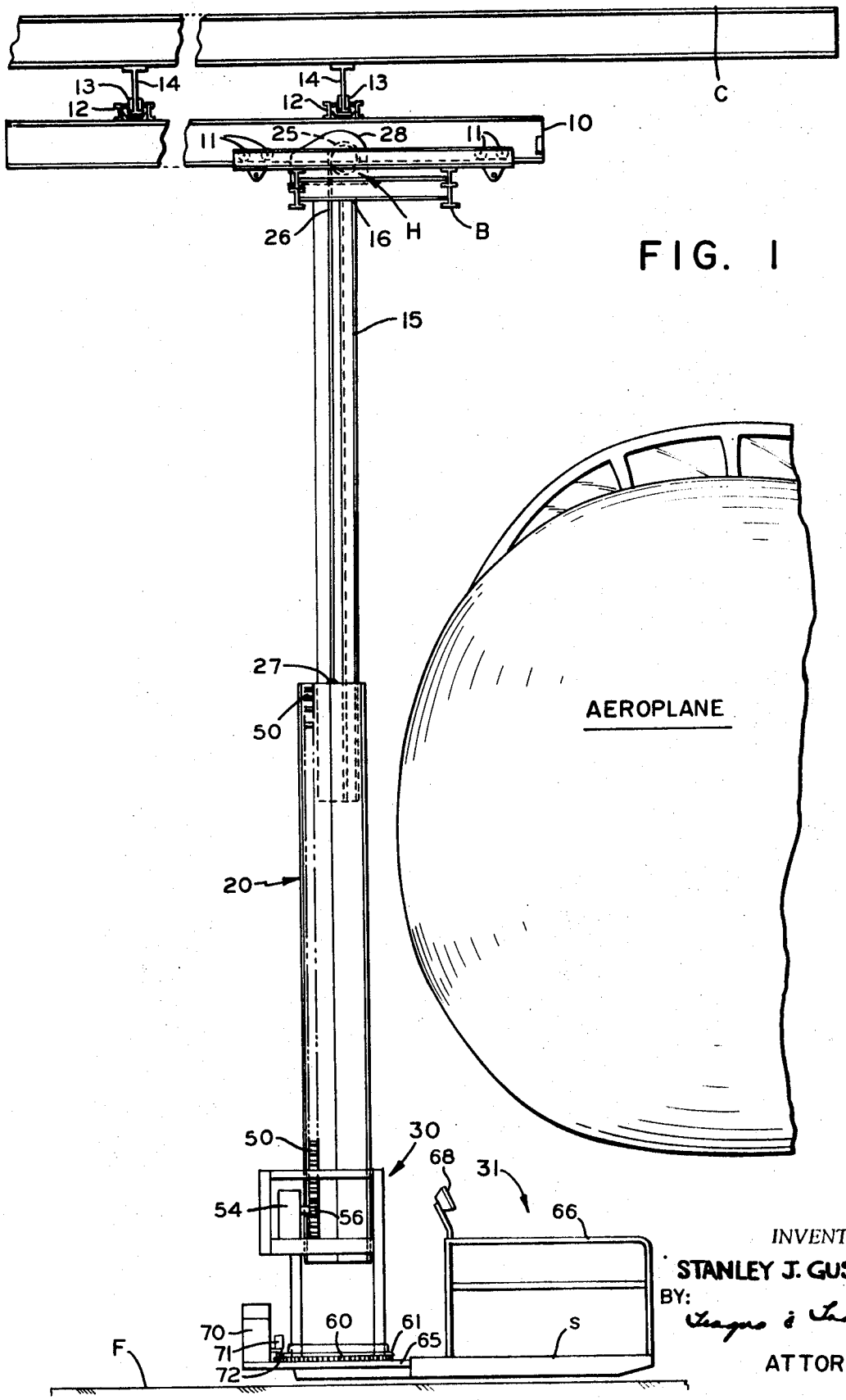


FIG. 1

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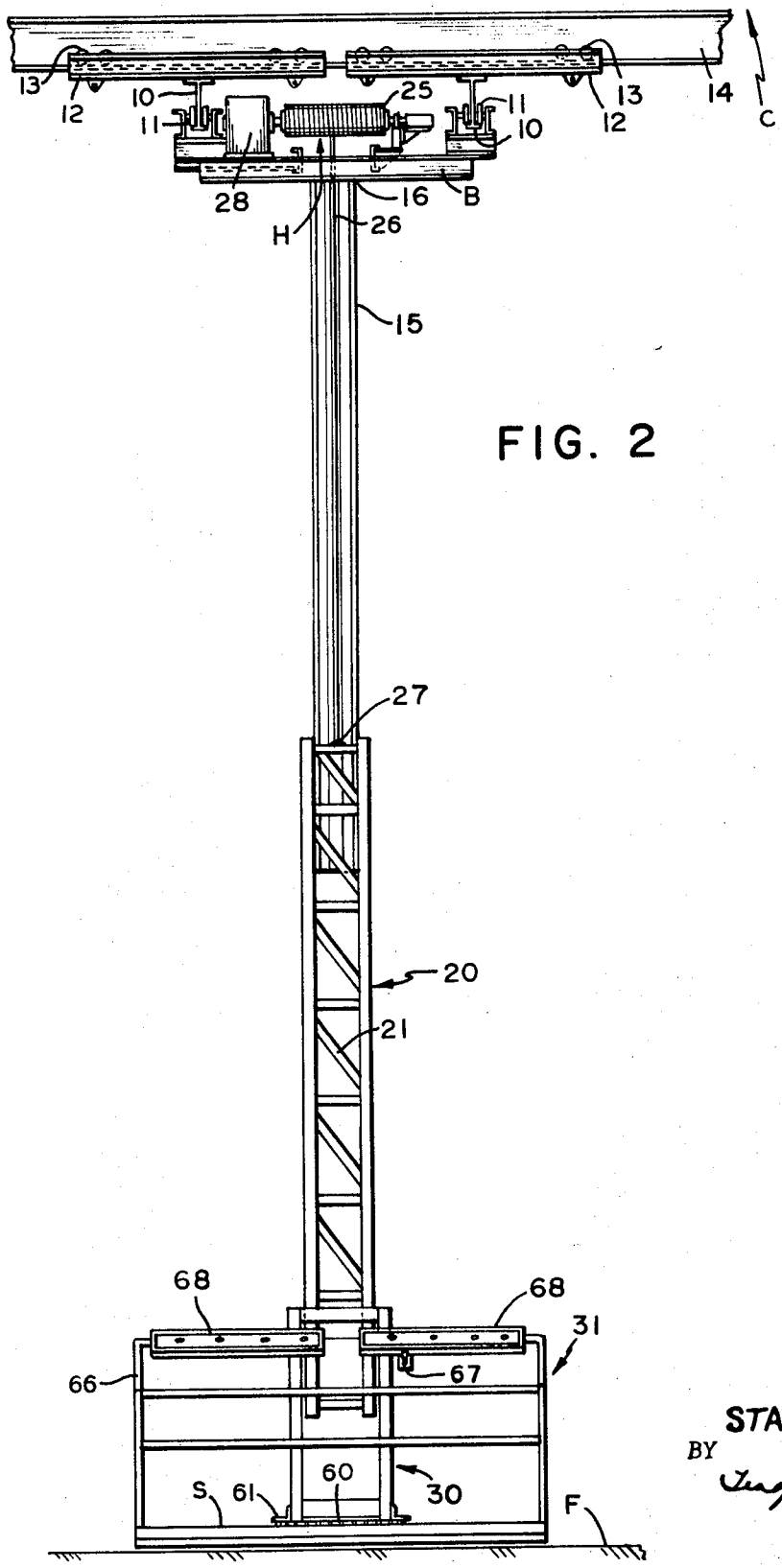

FIG. 2

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FIG. 3

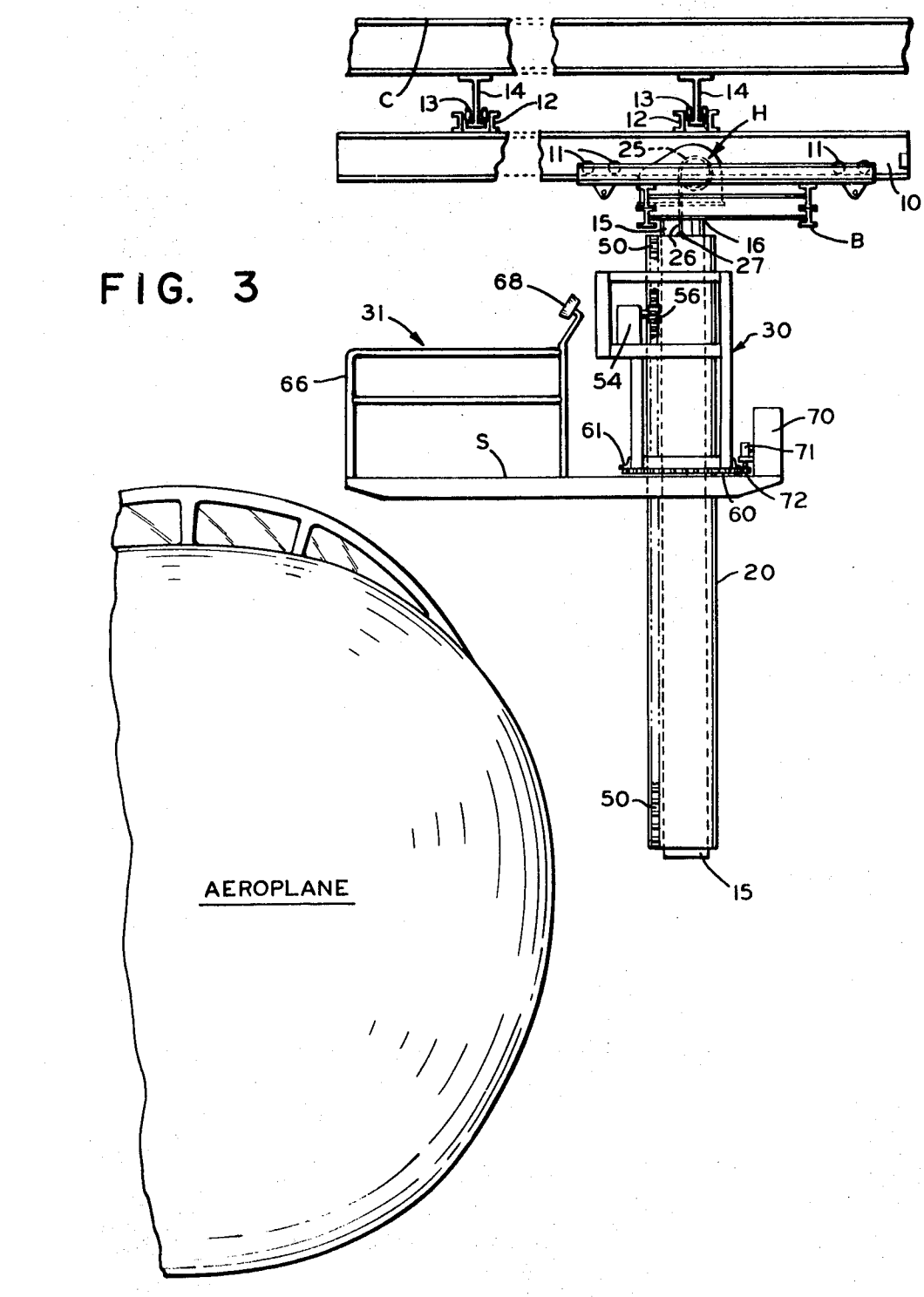

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FIG. 4

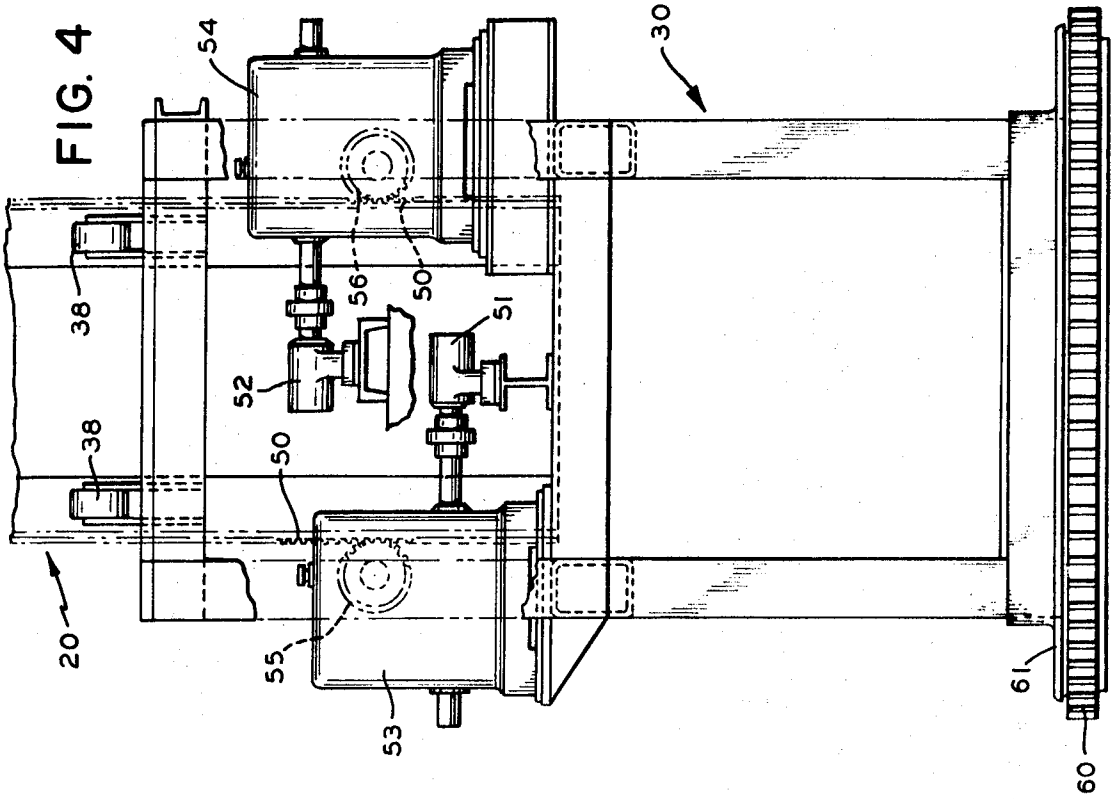

FIG. 5

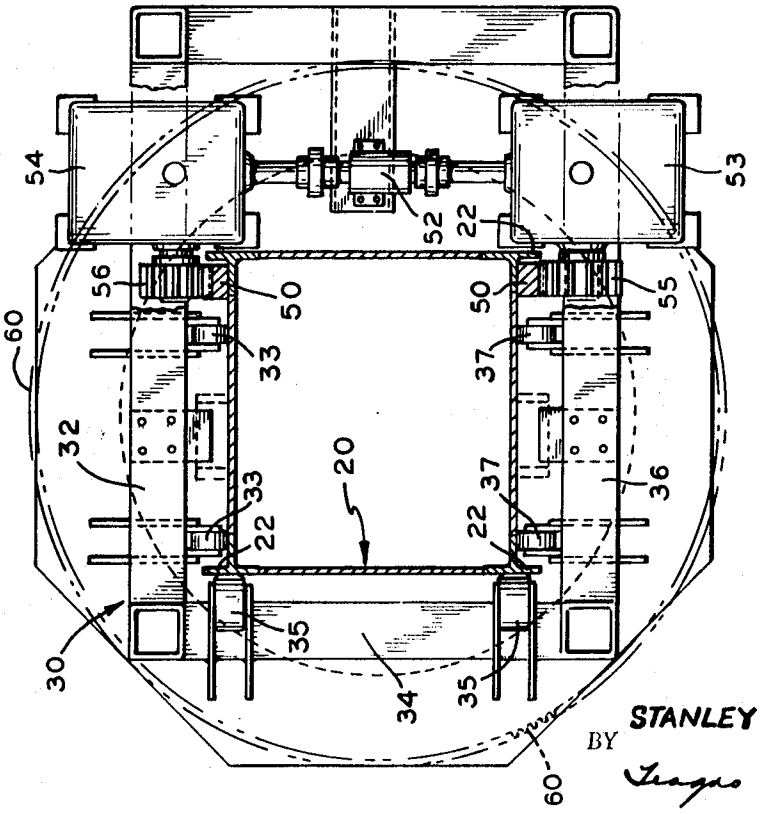

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FIG. 6

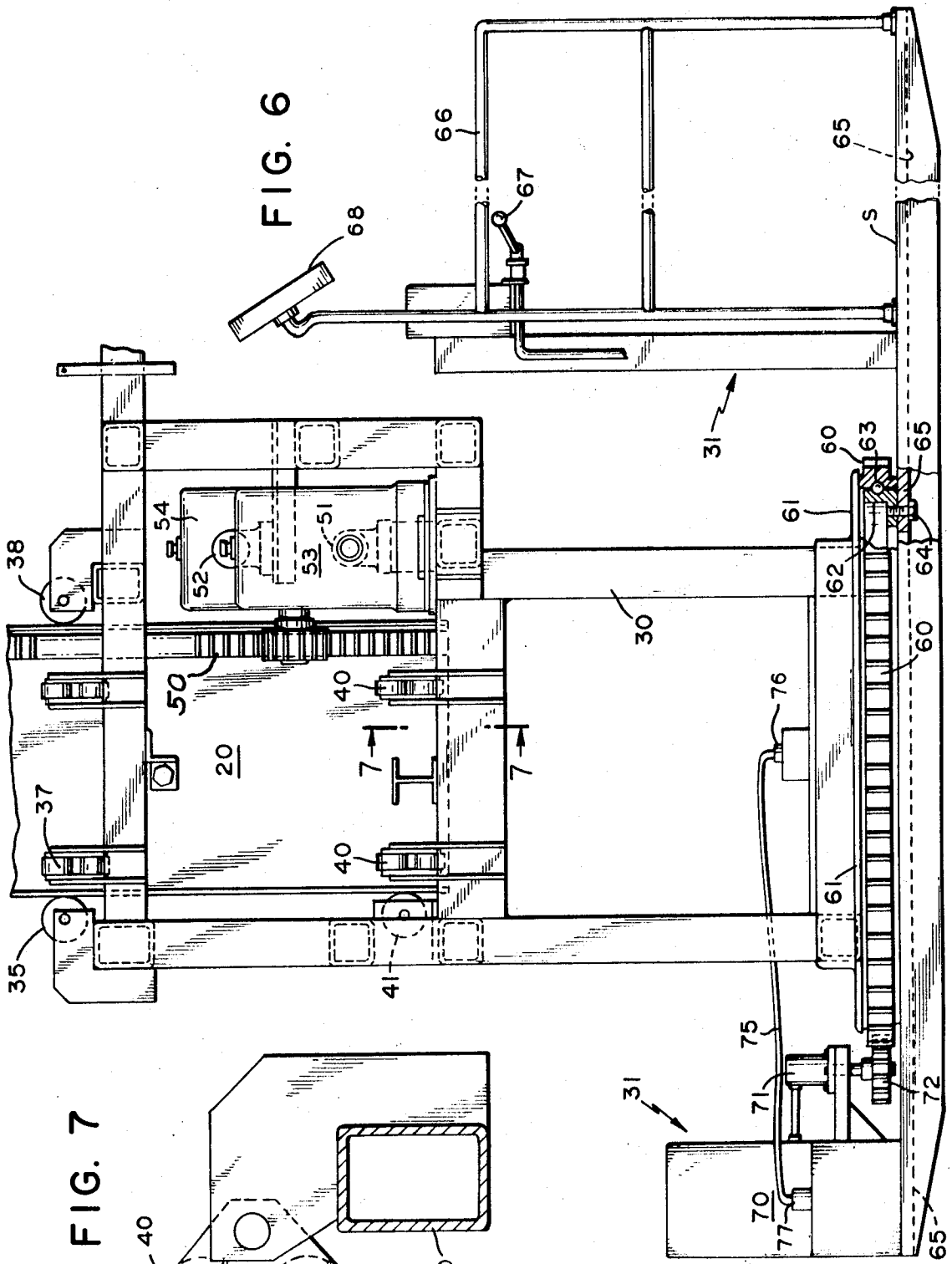

FIG. 7

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FIG. 8

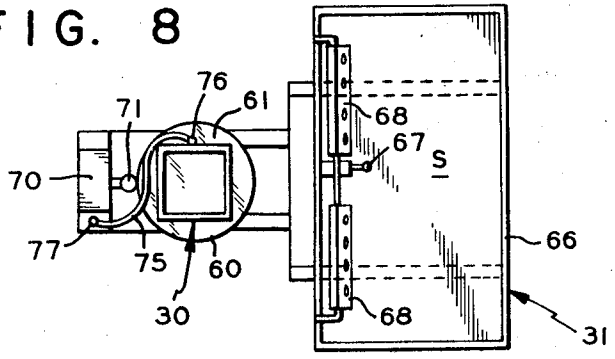


FIG 9

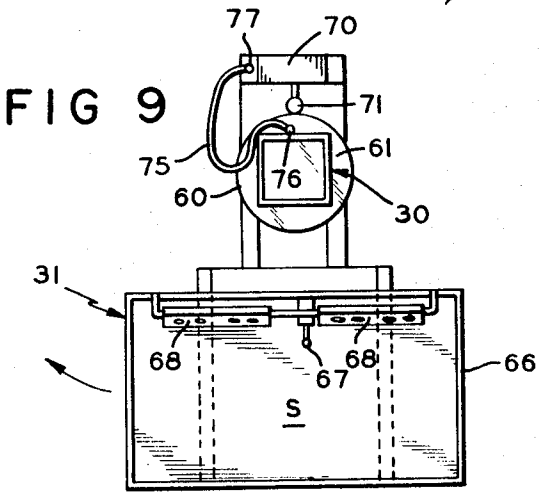
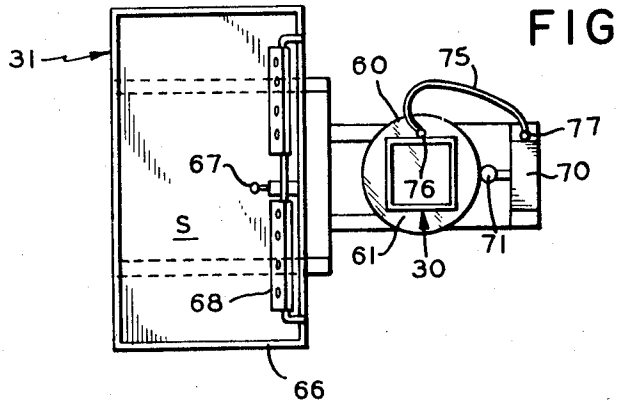


FIG. 10



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PLATFORM POSITIONING MECHANISM

BACKGROUND OF INVENTION

This invention relates to a combination of the class in which a carriage is mounted for vertical movement on a mast, the mast itself being mounted for lateral movement in a room or the like so as to bring the carriage into any position in the room. More particularly, the invention relates to a machine of the particular class in which the carriage is adapted to carry an operator into positions to perform particular operations. Through proper manipulation of the mast and carriage, the operator may be moved to any position laterally and vertically within the room for the carrying out of any desired type of operation.

PRIOR ART

There is much prior art available in this field. Thus, it is quite old in the art to have an upper base mounted for horizontal movement adjacent a ceiling, through the utilization of a system of beams and rollers. On the base, there is usually mounted a downwardly extending mast that is rotatable relatively to the base. The carriage is usually mounted for vertical movement on the mast, and as the mast rotates the carriage rotates therewith.

As those skilled in the art will readily appreciate, the use of a very long mast as may be required in a room having a very high ceiling, and the positioning of a relatively heavy carriage on the mast, will exert great stresses on the bearings that mount the mast for rotation relatively to the base. It is further well to note that the mast, if it is to allow the carriage to move to a low position, will have to be of that length approaching the floor. Therefore, the lower end of the mast is always in a position where it prevents the movement of the entire assembly past machinery or other structures that are on the floor of the room. Any lateral stress exerted at the end of the mast will, through the considerable length of the mast, cause great damage at the uppermost bearing.

OUTLINE OF INVENTION

My invention is particularly adapted for use in a room having an extremely high ceiling, such as a room in which an airplane is to be serviced or assembled. As a feature of the invention, I utilize a mast that is fixed at its upper end to the upper base of my assembly, thereby contributing an extremely rigid construction such as cannot be obtained where the mast is mounted on a bearing for rotation relatively to the base as earlier outlined. As a further feature of the invention, in order to facilitate movement of my entire assembly and carriage without undue hindrance by machinery resting on the floor of the room, the mast is preferably made of two telescoping parts. Thus, there is an outer part adapted for movement on an inner part, which is that part of the mast fixed at its upper end to the base. As a further particular feature of the invention, the outer or movable part is in the form of a tube that is telescoped about the inner or fixed mast, and is preferably raised and lowered relatively to the fixed mast as by conventional hoist drum and cable.

As a further particular feature of the invention, I utilize a carriage that is adapted to be raised and lowered relatively to the tubular movable mast, with the movable mast extending through an opening of both the carriage and a platform that is a part of the carriage assembly. The platform is rotatable relatively to the carriage as well as the mast, and carries the operator and the various controls of my assembly. As a particular feature of this portion of the invention, the platform is counterbalanced by novel means.

Both the movable tubular mast and the fixed or rigid mast may extend through the central opening in the carriage and the operator's platform in order to permit the movement of the carriage between an extreme low position and an extreme upper position. This feature is of extreme importance.

As a still further particular feature of the invention, the carriage is adapted to be lifted relatively to the movable mast through the utilization of racks mounted on the movable mast and contacted by pinions rotated by hydraulic motors carried on the carriage. It will be well to emphasize that the utilization of hydraulic motors and pinions, makes possible the elimination of relatively heavy electric motors on the carriage, which it will be emphasized, does not rotate relatively to the movable mast. On the carriage platform that does rotate relatively to the mast, I prefer to mount the motors and pumps for generating the hydraulic pressure that is required to operate the pinions that move the carriage vertically on the movable mast. The motors and pumps contribute balance as will be set forth. Obviously, the movable mast is movable on the rigid mast independently of the movement of the carriage on the movable mast.

As part of the concept of my invention, I mount the motors and pumps on that side of the rotating operator's platform opposite the side on which the operator stands, thereby effecting counterbalancing of the carriage and platform assembly.

As a still further feature of the invention, I utilize a very novel and simple means for transmitting hydraulic pressure from the rotating carriage platform to the nonrotating carriage, utilizing a single hose connected in an extremely novel manner between the carriage and its platform.

DESCRIPTION OF DRAWINGS

FIG. **1** is a vertical view of the assembly of my invention showing its relation to the fuselage of an airplane to be serviced. FIG. **2** is an end view of the assembly of FIG. **1**. FIG. **3** shows the assembly of FIG. **1** with the platform rotated 180° and the carriage lifted to a relatively high position to service the upper portion of an airplane. FIG. **4** is an enlarged elevation of the nonrotating carriage on which the platform is mounted for rotation. FIG. **5** is a view looking downwardly on the assembly of FIG. **4** showing the manner in which the nonrotating carriage is mounted for vertical movement on the tubular movable mast. FIG. **6** is an enlarged view in elevation showing the assembly of the rotating platform to the nonrotating carriage as well as parts of means for mounting the carriage on the tubular mast. FIG. **7** is a section along the line **7—7** of FIG. **6**. FIGS. **8, 9** and **10** are diagrammatic views showing the hydraulic line connecting the nonrotating carriage and the source of hydraulic fluid pressure on the rotating platform.

DESCRIPTION OF A PREFERRED MODIFICATION OF INVENTION

Referring now more particularly to the drawings, and especially FIG. **1** and **2**, the ceiling of the room in which the assembly of my invention is operated is designated by the reference letter C, while the floor is designated by reference letter F. The upper base of the machine is designated by the reference letter B and is manufactured from various structural steel members as is common in the art, and when completely assembled, is adapted to be mounted on rails **10** through use of rollers **11**. The rails **10** are in turn secured to roller carriages **12** that through rollers **13** are mounted on a beam **14** secured in a suitable manner to the ceiling C. The mounting is such that the base B may move in a longitudinal direction relatively to the ceiling, and also in a transverse direction relatively to the ceiling, so that the base B may be positioned anywhere in the room relatively to the ceiling C. The manner in which the base B is mounted for movement is so very well known in the art, that I have not shown the construction in detail nor will I describe it in detail, it obviously being not a particular feature of my invention.

The fixed or rigid mast of my invention is designated by reference numeral **15**, and it is secured at its upper end at **16** to the base B so as to be integral with the base and to move integrally with the base. The mast **15** may be fabricated in any manner desired, but in the main, it will be such as to present, for the purpose of my invention a rectangular cross section

preferably square. The movable mast of my invention is designated by reference numeral **20** and it is fabricated from structural members to present the cross-sectional shape best illustrated in FIG. **5**. Naturally the cross section will be such that the mast **20** will fit about mast **15** and will move freely vertically relatively thereto. The manner in which the movable mast is fabricated is not particularly important, but it is quite necessary, however, that it be light and strong. In order to contribute to its strength, angular struts such as illustrated at **21** in FIG. **2** may be utilized. Also, flanges **22** may extend at each corner from the mast **20** as particularly shown in FIG. **5**.

For lifting and lowering the tubular mast **20** relatively to the rigid or fixed mast **15**, I utilize a hoist assembly designated by reference letter H, and embodying a hoisting drum **25** and a hoisting cable **26** fastened at one end to the movable tubular mast **20** at **27**. The drum **25** itself is rotated by the usual electric motor **28**. It is quite obvious, that operation of the motor **28** will cause the cable **26** to lift and lower the outer tubular mast **20** relatively to the fixed mast **15**. I have not illustrated the means for guiding mast **20** relatively to mast **15** because any suitable system of rollers may be used.

The carriage assembly of my invention, as already outlined, includes a nonrotating carriage designated by reference numeral **30**, and a rotating operator's platform designated generally by reference numeral **31**, and mounted on carriage **30** for rotation as from the position of FIG. **1** to the position of FIG. **3**. The nonrotating carriage **30** may be fabricated in any suitable manner, but its important necessary feature is a square central opening for the movable tubular mast **20**, as probably best seen in FIG. **5**. There, it will be noted that this central opening is formed by an assembly of horizontal beams, suitably welded or bolted to one another. Thus, there is a beam **32** on which are mounted rollers **33** that cooperate with one surface of the rectangular movable tubular mast **20**. The carriage has a further beam **34** at right angles to beam **32** on which are mounted rollers **35** that cooperate with another surface of the tubular movable upright **20**. A further beam designated by reference numeral **36** is shown with rollers **37** that coact with a third surface of the tubular mast **20**. In FIGS. **4** and **6** further upper rollers **38** are shown on the carriage **30** for cooperating with a fourth side of the movable mast **20**. These rollers do not appear in FIG. **5** because a portion of the structure in FIG. **5** is not shown in order to better illustrate other mechanism.

Further, as shown in FIG. **6**, there are additional rollers mounted on the carriage **30** below the rollers described above, and these additional rollers include two pairs of rollers **40** that are also well illustrated in FIG. **7**, these rollers cooperating with the rollers already described for securely mounting the nonrotating carriage **30** about the tubular upright **20**. Still more rollers **41** are also shown in FIG. **6**, these lying directly below the rollers **35**. It will now be well appreciated that the relationship of the rollers to the mast is such that the nonrotating carriage **30** will be well-mounted for vertical movement on the tubular mast **20**, and that the tubular mast will move through a central opening in the carriage **20**.

For lifting carriage **30** relatively to the mast **20**, I apply to each of two opposed surfaces of the tubular mast, a rack **50**. The racks **50** may be welded to the surfaces of the mast so as to become integral portions thereof as clearly shown in FIG. **5**, as well as in FIG. **3** and **6**.

Mounted on the carriage **30**, as best seen in FIG. **4** and **5**, is a lower hydraulic motor **51**, and an upper hydraulic motor **52**. Motor **51** operates a gear reduction unit **53**, while upper hydraulic motor **52** operates a gear reduction unit **54**. Gear reduction unit **53** rotates a pinion **55** that is in engagement with one of the racks **50**, while gear reduction **54** operates a pinion **56** that is in engagement with the other of the racks **50**. It will be obvious that rotation of the pinions by the gear reduction units and the hydraulic motors **51**, **52** will bring about the lifting of the carriage **30** relatively to the tubular mast **20**. As a particular feature of the invention, the gear reduction units **53**, **54** are irreversible, so that should there be a failure of the hydraulic system, as a breakage of a hose transmitting fluid to the motors **51**,**52** the carriage **30** will not drop since the gears will hold the pinions **55** and **56** against rotation. The system of rollers I described earlier, securely hold the pinions **55**,**56** against the racks.

I shall now describe the mounting of the operator's platform **31** on the carriage **30** to complete my carriage assembly. At the lower end of the nonrotating carriage **30** there is mounted a circular gear **60**, as is well illustrated in FIG. **4**. This gear is in the form of a ring, and as can also be seen in FIG. **6**, it is secured to the nonrotating carriage **30** through welding to a collar **61** that is integral with the carriage **30**.

The rotating operator's platform **31** of the carriage assembly has a circular ring portion **62** that is inserted into the central opening of the circular gear **60**, as best seen in FIG. **6**. The part **62** is formed with a circular bearing groove on its periphery that coacts with the series of ball bearings **63** lying in a bearing groove formed on the inner surface of the gear **60**. Through the particular arrangement, it is readily seen that ring **62** will rotate relatively to the gear **60**, and will also be supported by the gear **60**. I shall shortly describe how gear **60** is utilized to rotate the operator's platform **31**.

A series of bolts **64**, one of which is shown in FIG. **6**, secure to the ring **62** for movement therewith, the baseplate **65** of the operator's platform **31** which extends laterally at both sides of the tubular upright **20**. As illustrated in FIG. **6**, the right-hand portion of plate **65** carries the operator's stand S on which may stand an operator. Suitable railings **66** are formed on the stand to protect the operator, and at **67** and **68**, the various controls for the several motors required to manipulate the platform **31**, the carriage **30**, and the masts **15** and **20**, as well as the upper base B, will be mounted.

In counterbalancing relation to the parts of the platform **31**, I utilize an assembly **70**, in which may be included motors and pumps for developing the hydraulic pressure that is required for the operation of the two hydraulic motors **51**, **52** described in connection with FIG. **4**, these being motors that actuate the pinions **55**, **56** for lifting and lowering the carriage relatively to the tubular upright **20**. I shall presently describe the manner in which fluid is directed from assembly **70** towards the motors **51**, **52**.

The fluid pressure developed at **70** is also directed to a hydraulic motor **71** best illustrated in FIG. **6**. This motor, which is carried on platform **31**, drives a pinion **72** that is in engagement with the gear **60**. Obviously, by rotation of the pinion **72**, the rotatable platform **31** of the carriage assembly including base **65** and ring **62** will rotate on the ball bearings **63** relatively to the ring gear **60**.

Because the source of fluid pressure at **70** rotates relatively to the hydraulic motors **51**, **52** which are on carriage **30**, it is necessary to develop means for transporting the fluid under pressure from the source **70** to the motors **51**, **52**. As earlier outlined, because the electric motors and the pumps for developing fluid pressure at **70** are located opposite the operator's stand S, they act to counterbalance the weight at S in a most effective manner. Were the apparatus at **70** positioned on the nonrotating carriage **30**, the lack of counterbalancing would require the use of more massive and heavier parts, as is obvious. It is also important to consider, that the locating of the hydraulic motor **71** as shown in FIG. **6**, places it very close to the supply of fluid pressure **70**, so that fluid pressure need only be directed through relatively more complex means to the two motors **51**, **52**.

This last is accomplished best as is illustrated in FIG. **8**, **9** and **10** taken in conjunction with FIG. **6**. I have, for simplification, not shown the feature in other figures. Thus, in FIG. **6** there is shown a hose **75** extending from apparatus **70** to a connection at **76** on nonrotating carriage **30** from which connection fluid is directed to the two hydraulic motors **51** and **52** by rigid conventional means not shown. The utilization of the hose **75** in my combination is extremely novel as will appear from a study of diagrammatic FIGS. **8**, **9** and **10**. In FIG. **8** the rotating platform **31** is in its position relatively to the nonrotat-

ing carriage 30, that is illustrated also in FIG. 6. The connection of one end of the hose 75 to the source of fluid pressure at 70 is designated by reference numeral 77. As already indicated, the hose 75 is secured at its other end to a connection 76 fixed relatively to the nonrotating carriage 30. Let us assume now that the rotating platform portion 31 is rotated relatively to the ring gear 60 by motor 71 and pinion 72 (FIG. 6) from the position of FIG. 8 to the position of FIG. 9. In FIG. 9 it will be noted that the hose 75 has the shape substantially that of a U, and has not in anyway interfered with rotation of the platform 31. The extreme rotation of the platform 31 from FIG. 8 is illustrated in FIG. 10, where there has been about 90° further rotation from the position of FIG. 9. In this final position, it will be noted again that hose 75 has in no way interfered with the movement of the rotating platform 31 of the carriage assembly. It is rather obvious that by the very simple means that I have shown and described, it is possible to actuate the motors 51, 52 for operating the pinions 55, 56 to raise and lower the carriage 30, while utilizing a source of fluid pressure that rotates relatively to the motors and may contribute a counterbalancing function.

It will be well now to summarize the manner in which the parts of my invention operate to contribute the various features earlier outlined. As can be seen in FIG. 1, the carriage and platform 31 can be lowered to an extremely low position where a workman on stand S is actually under part of the fuselage of the airplane shown in that figure. The carriage may also be located as shown in FIG. 3, where the operator on stand S is able to contact the upper portion of the fuselage of the airplane. It will be appreciated that to reach the position of FIG. 3 from the position of FIG. 1, the carriage 30 has been moved upward by operation of the pinions 55, 56 in coaction with the racks 50. At the same time, by manipulation of the controls at 68, the operator has brought about the operation of the hoist H for raising the tubular mast 20 relatively to the fixed rigid mast 15. It will be appreciated that during movement of the movable mast 20 relatively to the mast 15 by hoist H, the carriage is elevated independently through operation of the pinions 55,56 as just described. This independent action of the hoist and pinions will contribute extremely swift lifting movement to the carriage, since the electric motor 28 of the hoist H will be operating the same time that the two hydraulic motors 51, 52 are operating to bring about the lifting movement of the carriage on mast 20. Further, operation of suitable controls at the console 68 will also bring about the rotation of the platform 31 relatively to carriage 30 through pinion 72 and gear 60 as the said carriage is being elevated. An operator on stand S may now work on the upper part of the airplane as seen in FIG. 3.

It will be noted that in FIG. 3 the movable mast 20 and fixed mast 15 are both in the central opening of carriage 30 and platform 31. This has made possible the upward movement of the carriage and platform. It will also be noted that the lower end of mast 20 is far above the floor F so as to make possible its free movement with the upper base B and fixed mast 15. Thus, the novel use of telescoping rigid and movable masts, together with the novel carriage 30 and its opening for the masts, contributes extremely valuable features.

I do believe that the very considerable merits of my invention will now be apparent to those skilled in the art.

I now claim:

1. In a combination of the class described, an upper base mounted for horizontal movement relatively to an upper structure, a vertically positioned mast fixed at its upper end to said base so as to become an integral rigid part thereof, a movable mast mounted for vertical movement on said rigid mast, means for imparting vertical movement to said movable mast relatively to said rigid mast, a carriage mounted for vertical movement on said movable mast, means whereby said carriage is moved vertically relatively to said movable mast and together with said movable mast relatively to said rigid mast, said carriage having a vertical opening for the passage of both said masts whereby said carriage may be lifted vertically relatively to both said masts while completely encompassing both said masts, said carriage having a horizontal circular bearing formed outwardly about said vertical opening, and a platform rotatably mounted on said circular bearing and also formed with an opening for said masts.

2. In the combination of claim 1 the feature that said means whereby said carriage is moved vertically comprises a rack secured to a vertical surface of said movable mast and a motor driven pinion on said carriage.

3. In the combination of claim 2, the feature that the motor driving said pinion is a hydraulic motor, a source of hydraulic pressure for said motor on said platform, and means for connecting said source of hydraulic pressure to said motor.

4. In the combination of claim 4, the feature that said means for connecting said source of hydraulic pressure to said motor is a hose connected at one end thereof to said hydraulic pressure source and at the other end to a conduit fixed on said carriage, said fixed conduit and hydraulic pressure source being so positioned relatively to said hose that said hose forms a substantial U between said fixed conduit and said hydraulic pressure source when said platform is rotated to a point substantially midway of two extreme points relatively to said carriage.

5. In the combination of claim 1, the feature that the means for imparting vertical movement to said movable mast are power operated, independent power means comprising the means for lifting and lowering said carriage, power means for rotating said platform relatively to said carriage on said bearing, and control means for all said power means on said platform.

6. In the combination of claim 1, the feature that said platform has an operator's stand at one side of the axis of rotation of said platform, and a source of hydraulic pressure on a diametrically opposed side of said platform, said means whereby said carriage is moved vertically comprising a hydraulic motor on said carriage, and means connecting said hydraulic motor to said source of hydraulic pressure.

7. In the combination of claim 1, the feature that said carriage has a hydraulic motor and said platform has a source of fluid pressure thereon, and a hose connected at one end thereof to said hydraulic pressure source and at the other end to a conduit fixed on said carriage, said fixed conduit and hydraulic pressure source being so positioned relatively to said hose that said hose forms a substantial U between said fixed conduit and said hydraulic pressure when said platform is rotated to a point substantially midway of two extreme points relatively to said carriage.

8. In a combination of the class described, a mast, a carriage, a horizontal circular bearing on said carriage, a platform mounted on said bearing for rotation relatively to said carriage, said carriage and platform having each an opening within the area outlined by the circumference of said circular bearing, means mounting said carriage for vertical movement on said mast with said mast extending through both said openings so that said carriage and platform may be elevated relatively to said mast, and means for moving said carriage vertically relatively to said mast.

9. In the combination of claim 8, an upper base, a mast mounted at its upper end on said base and extending downwardly from said upper base, and means mounting said first mast for vertical movement relatively to said second mast with said second mast also extending through the said openings so that said carriage and platform may be elevated relatively to both masts.

10. In the combination of claim 8, the feature that said platform has an operator's stand at one side of the axis of rotation of said platform and a source of hydraulic pressure on a diametrically opposed side of said platform, said means whereby said carriage is moved vertically comprising a hydraulic motor on said carriage, and means connecting said hydraulic motor to said source of hydraulic pressure.

11. In the combination of claim 8, the feature that said carriage has a hydraulic motor and said platform has a source of fluid pressure thereon, and a hose connected at one end

thereof to said hydraulic pressure source and at the other end to a conduit fixed on said carriage, said fixed conduit and hydraulic pressure source being so positioned relatively to said hose that said hose forms a substantial U between said fixed conduit and said hydraulic pressure source when said platform is rotated to a point substantially midway of two extreme points relatively to said carriage.

12. In the combination of claim **8**, the feature that said means whereby said carriage is moved vertically comprises a rack secured to a vertical surface of said mast and a motor driven pinion on said carriage.

13. In the combination of claim **12**, the feature that said pinion is driven through the intermediary of irreversible gears.