United States Patent [19]

Davis

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[45] **Oct. 9, 1973**

[54] **OUTSIDE ELEVATOR**

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[73] Assignee: **Equipment Systems, Inc.**, Honolulu, Hawaii

[22] Filed: **Apr. 17, 1972**

[21] Appl. No.: **244,803**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 02,094, Jan. 12, 1970, abandoned.

[52] **U.S. Cl.** **187/2**, 187/95

[51] **Int. Cl.** **B66b 9/00**

[58] **Field of Search** 187/2, 6, 95; 212/57, 64

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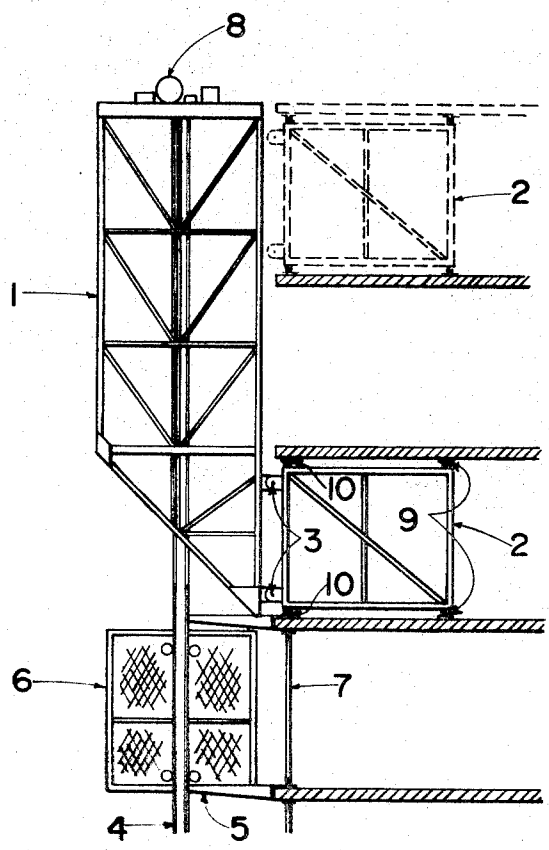
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Assistant Examiner—H. Shane
Attorney—William B. Walter

[57] **ABSTRACT**

An outside elevator used for the purpose of hauling men and materials in and out of a multi-story building during construction or other periods depends solely for the support of its own weight and the payload upon attachments to temporary support frames wedged between floor and ceiling of one story of the building. The elevator supports a power hoist mechanism on the top of an open structure two or more stories in height which is raised into place alongside these temporary support frames on elevator guide rails spaced from the building wall by support brackets at each floor. When this hoist supporting structure is fastened to the building through the support frames, the hoist can then raise and lower the payload on a cage also riding on the guide rails up into the open structure to serve not only the lower stories of the building but those adjacent to the open structure itself. With this elevator in use on a building under construction, not only is the usual four-legged tower obviated, but added stories are easily served. Extension of the elevator upward with the rising structure is also simplified.

8 Claims, 11 Drawing Figures



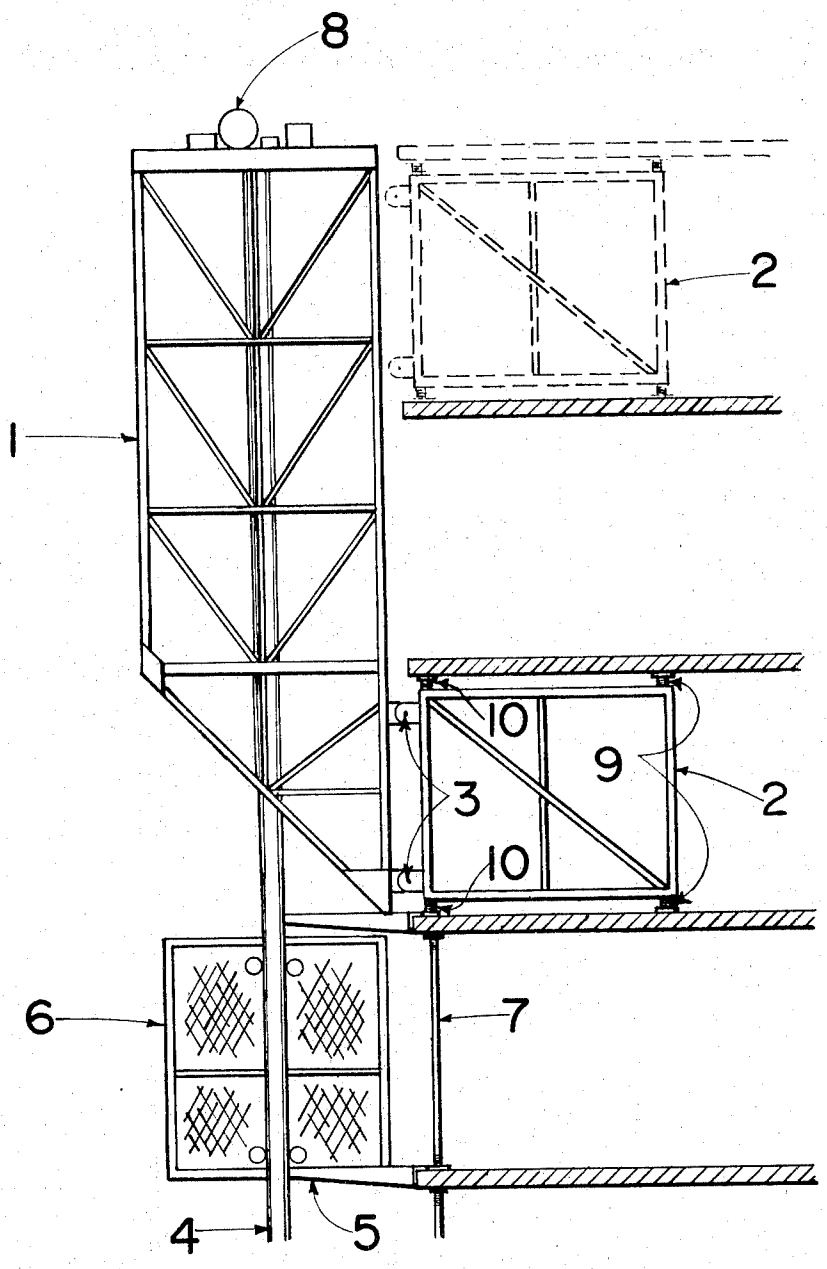


FIG. 1

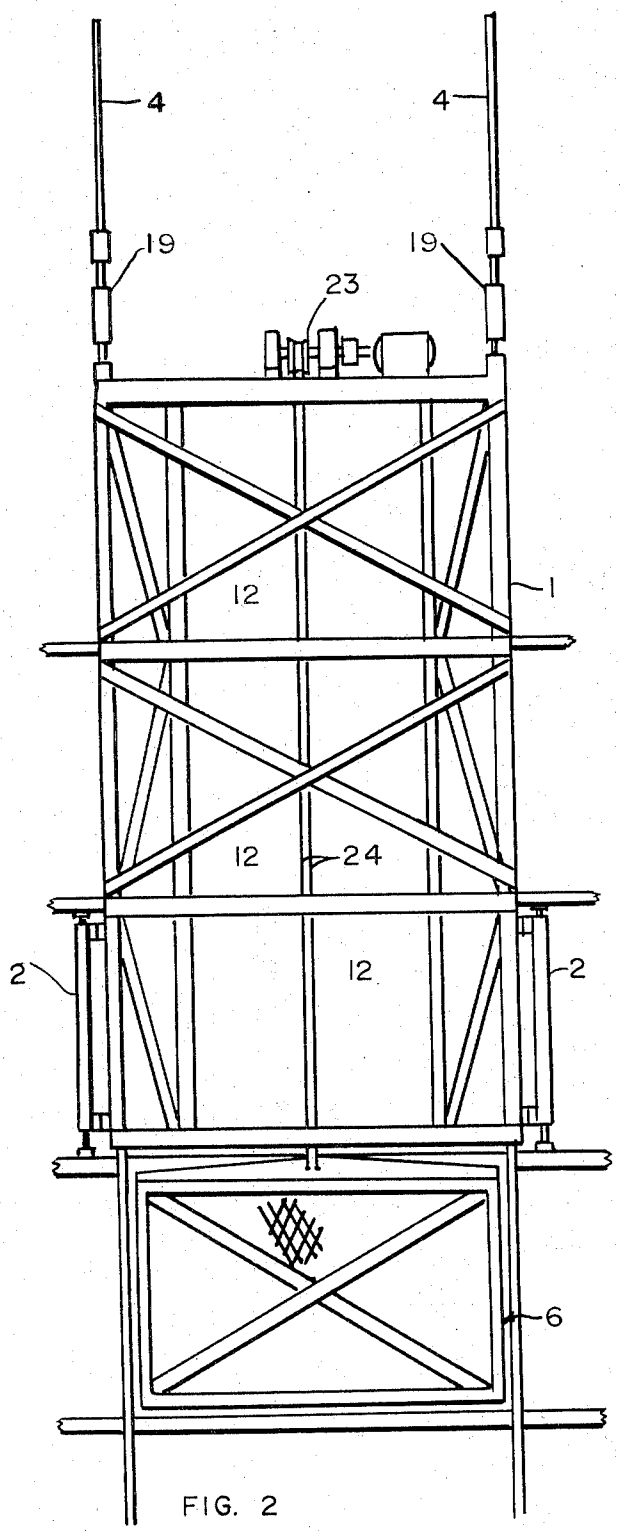


FIG. 2

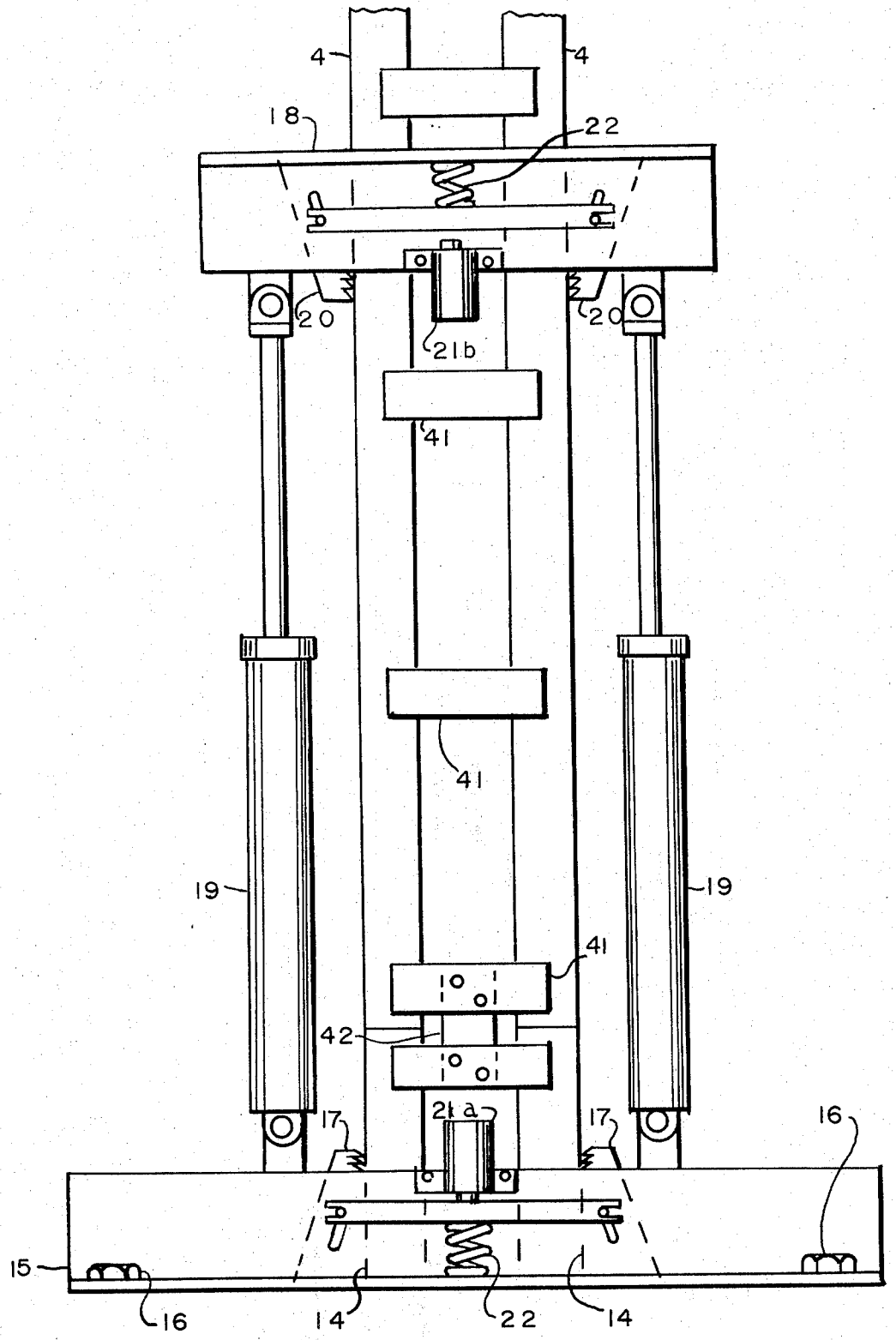


FIG. 3

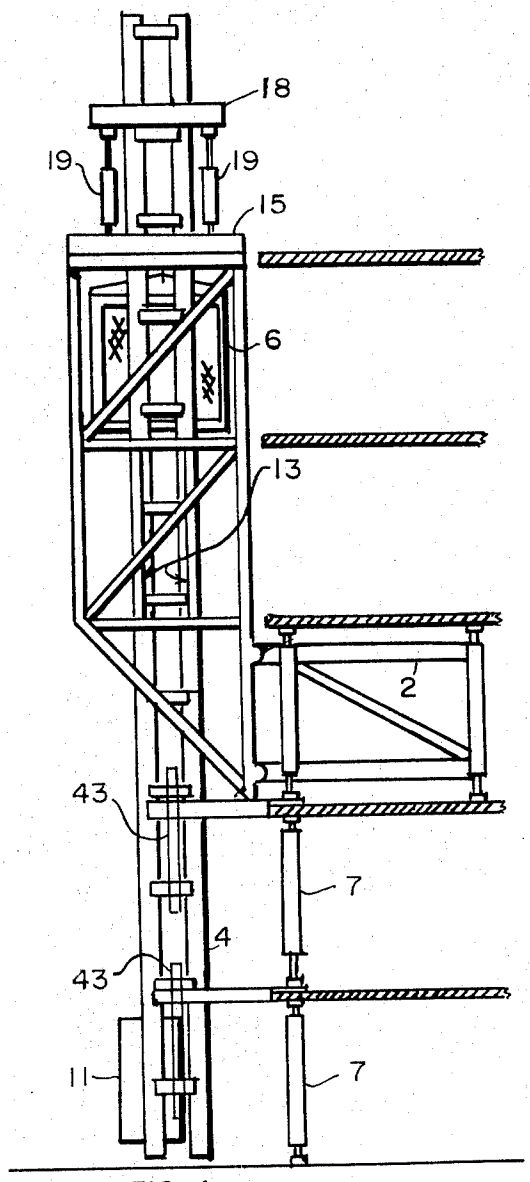


FIG. 4

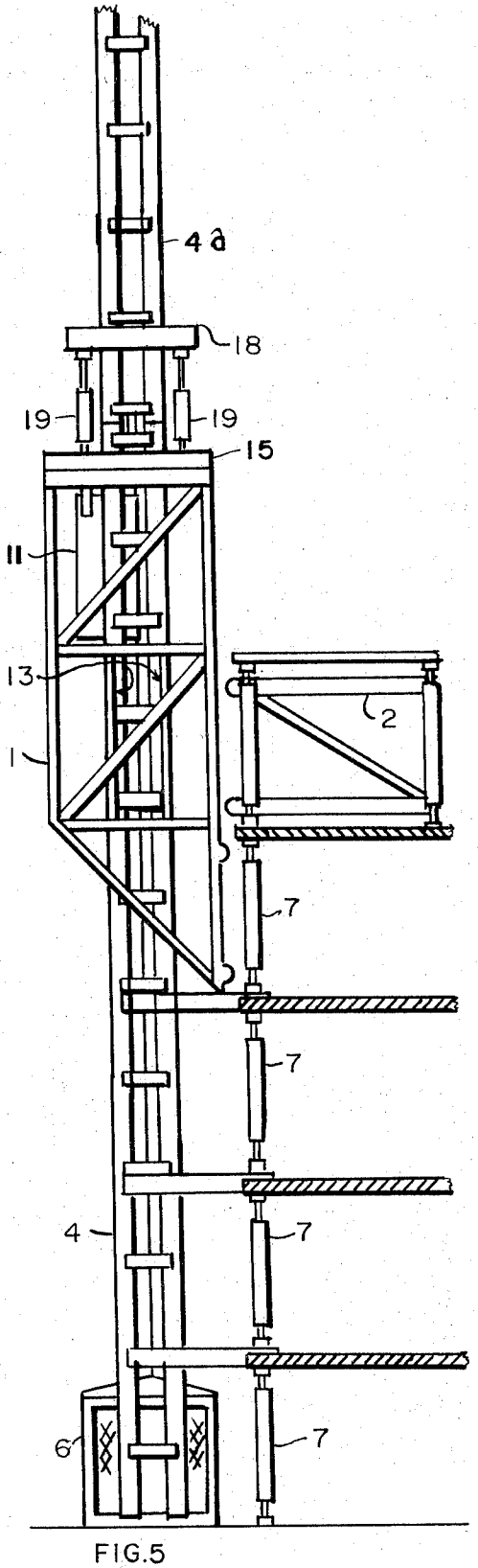


FIG.5

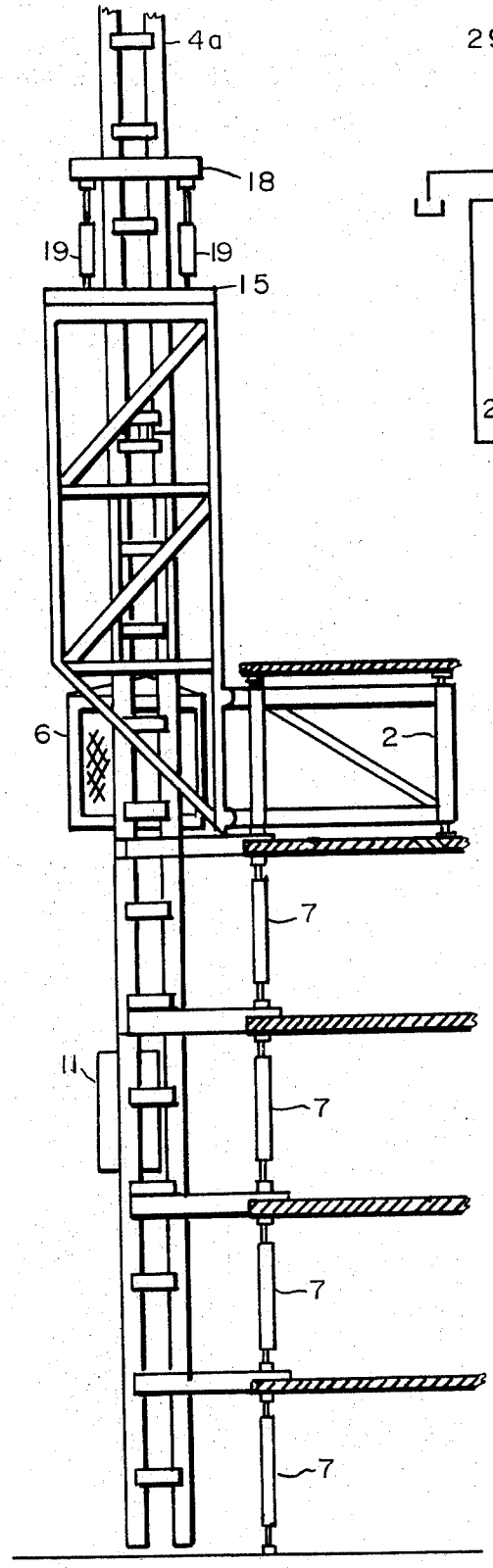


FIG. 6

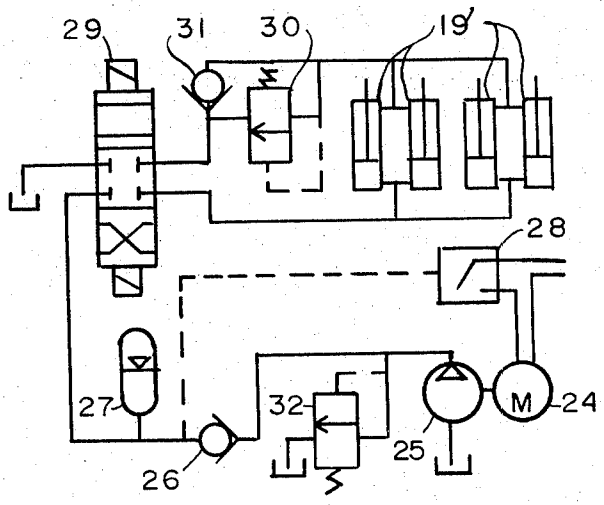


FIG. 8

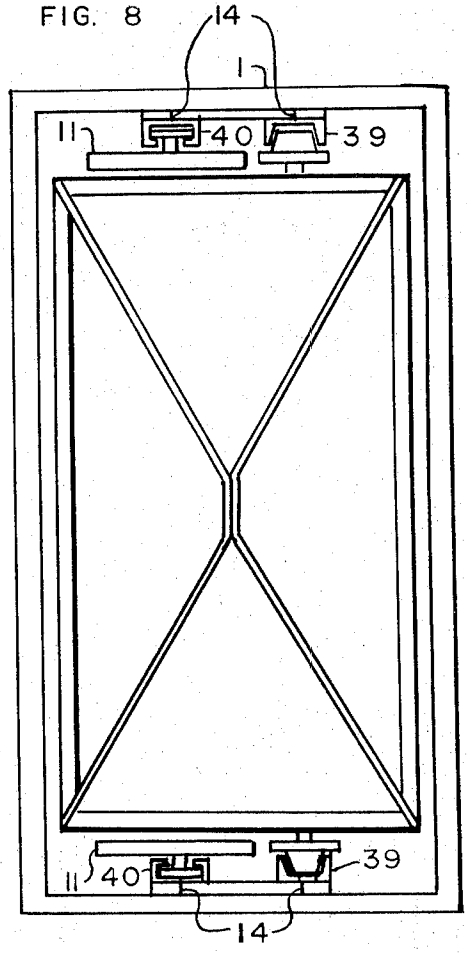


FIG. 7

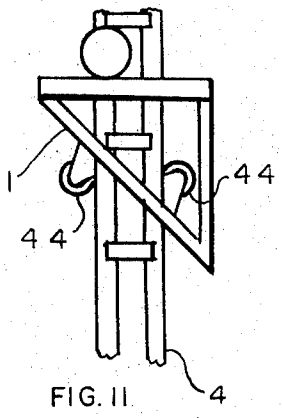


FIG. 11

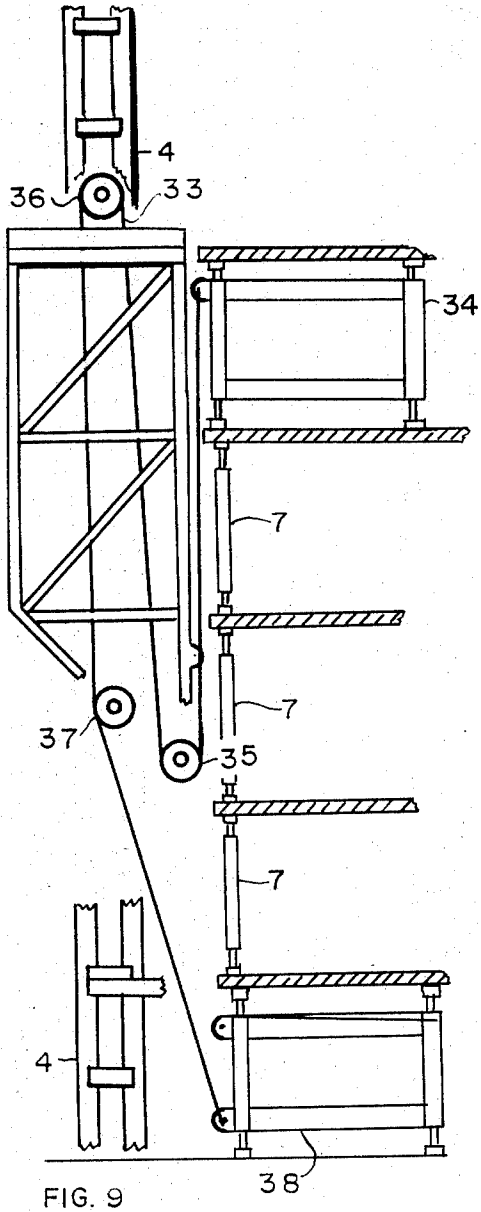


FIG. 9

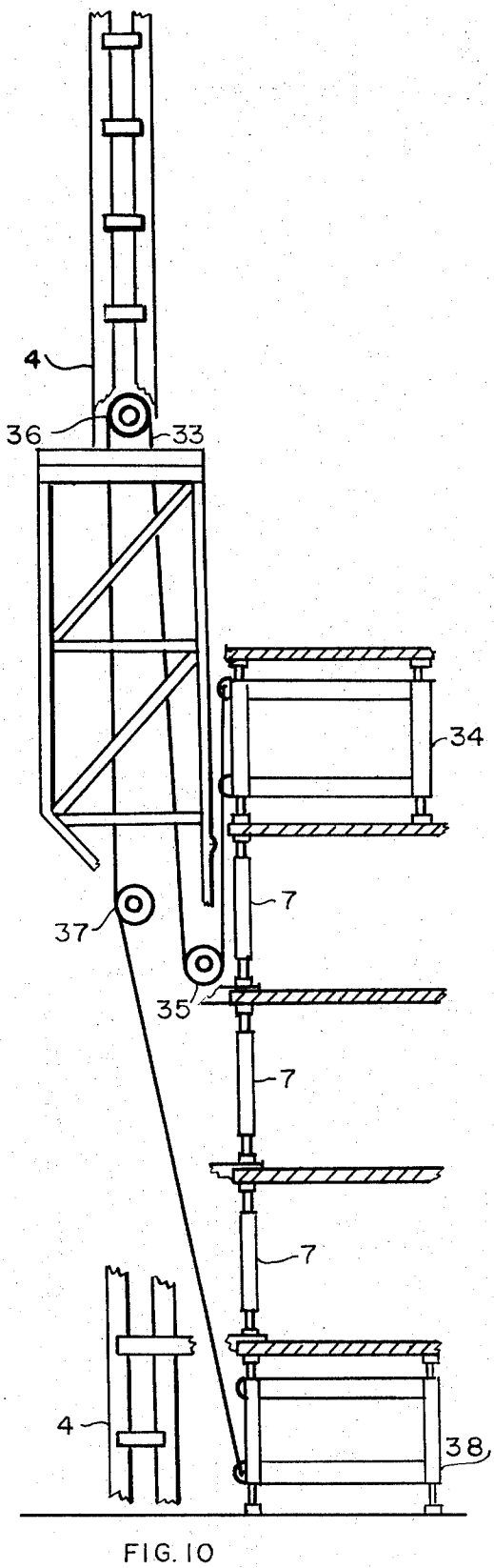


FIG. 10

OUTSIDE ELEVATOR

This is a continuation-in-part of abandoned application Ser. No. 2,094, filed Jan. 12, 1970.

BACKGROUND OF INVENTION

The present invention relates to a type of hoist and elevator which is usually erected outside of and adjacent to a multi-story building under construction to carry a variety of materials and craftsmen to each floor for plumbing, wiring, heating, air-conditioning, and the many aspects of interior finishing. Most elevators of this type and function depend upon a four-legged tower to support vertical forces or loads composed of payload, elevator platform or cage, counterweight, hoist mechanism, guide rails, and elevator framework. Such tower is normally adjacent to the building, has light structural ties to the building, and rests upon its own foundation.

In many cases the foundation and the base legs of this tower obstruct traffic in confined areas. The tower has a multitude of joints and connections to suit a variety of building heights, and to facilitate transporting from one jobsite to another, erection, disassembly, and temporary storage. These joints and connections must be carefully maintained and inspected to insure structural integrity and safety. The foundation must also be carefully prepared to adequately support the tower and its loads.

This type of tower must be extended upwardly as stories are added to the building thus requiring considerable erection labor and components. Yet such a work elevator is to be preferred to masts with swinging booms, particularly when carrying personnel since the cage is raised and lowered on stationary guide rails and safety gates at each floor allow passage between floor and cage only. Use of a mast and boom then would be limited to carrying materials, and its usual function is to carry such materials to the top floor of the building at each stage of construction. A characteristic contrast between the mast type of hoist and the construction elevator is that in the former the payload is carried outside of the tower structure and is not guided from swinging, while in the latter, the payload is carried within the tower structure and is positively guided for the full length of its passage therein. In the construction elevator the fixed guide rails normally serve also as a structure which the safety brakes grab when required.

Construction elevators have conventionally had the power hoist mechanism and traction wheel at ground level. A disadvantage of such an arrangement lies in the two additional lengths of rope required between traction wheel at the bottom and idler sheaves at the top of the tower.

The prior art includes work elevators which are permanently attached to the outside wall and completely supported by the building. These permanent elevators have not been designed to solve the problems of attachment to a variety of structures, moving from one jobsite to another, and storage when not in use. Also disclosed in prior art have been a variety of building-supported temporary hoists having support brackets bolted to floors, clamped to window frames, and even a small boom crane which can be wedged between floor and ceiling with wheels retracted for temporary support by a building.

SUMMARY OF INVENTION

A primary object of my invention is to provide an elevator to be temporarily used alongside a building during the finishing phases of its construction which does not require its own full height elevator tower and thus eliminates most of the disadvantages thereof.

My invention resides in the use of the building itself for the foundation and the lower and major portion of the elevator tower. Since the elevator platform or cage and its guide rails must still be adjacent to and outside of the building, in order to provide for this I have provided a short elevator tower module and placed it high and outside the building at about the same level as the upper portion of the conventional tower. For ease of installation and to provide a strong structural tie to the building I have also provided upright support frames which extend into the building at an access opening adjacent to the desired placement of my elevator tower module. Jacks built into these frames are used to firmly wedge and lock the frames into place between floor and ceiling. Simple pin connections are used to attach the elevator tower module to the frames. My elevator tower thus becomes an integral part of the building through its connection to the support frames and extends out from the building in a cantilever relationship. All other elements of my elevator except for the guide rails depend upon the module for support.

In order to reduce delays upon extension of the elevator tower to serve each new story added to the building, I have made my elevator tower module three stories high. Thus when installed alongside one story it is ready to serve that story and each of two stories above as they are completed structurally. I have also provided simple means to raise the module as the building is constructed and lower it when no longer required.

Although a primary use for the elevator of my invention is for use on a building under construction its climbing action on a building suggests usage on a completed building for periodic maintenance, refurnishing, or emergency use. In such a configuration the guide rails are permanently attached to the building, the elevator tower module becomes essentially a hoist support which can climb the building on the elevator rails as high as required, and then obtain its structural attachment to the building with permanent brackets or temporary support frames. The support frames can be slidably attached to the tower module, carried with it to the desired level, and then inserted into the building to be wedged between floor and ceiling. For this use a simple single story tower module may suffice.

DRAWINGS OF PREFERRED EMBODIMENTS

The invention is as shown in the accompanying drawings in which FIG. 1 is a schematic side elevation of the tower module as installed in an upper story of a building. The floors of the building are shown in cross section to better illustrate the relationship of my elevator to the building to which it is attached.

FIG. 2 is a schematic elevation of the tower module installed as in FIG. 1 as seen when viewing the building from a distance.

FIG. 3 is a detail of a portion of a climbing mechanism which is used to raise or lower the elevator tower module on the guide rails.

FIGS. 4, 5, and 6 are a series of elevational schematics showing one method of raising and lowering the elevator tower module.

FIG. 7 is a partial section of the elevational schematic of FIG. 6.

FIG. 8 is a schematic diagram of a hydraulic system.

FIGS. 9 and 10 are a second series of elevational schematics showing another mechanism for raising and lowering the elevator tower module.

FIG. 11 is an elevational shematic of a simpler tower module for use on permanently installed guide rails.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the FIG. 1 of the drawings, the device described is normally intended for use as an elevator or material hoist which can be used on either an existing structure or a structure under construction. The device is so designed that in the case of a building or other structure under construction, the basic tower module 1 can be supported from any two floors above the ground by support frames 2. The tower module 1 is attached to the support frames 2 by attachment pins 3. The support frames 2 are held firmly in place between the floors by pressure developed when jacks 9 and 10 are expanded. It should be noted that the horizontal distance from the center of load at the guide rail to the innermost jacks 9 is at least twice the distance from load to the outermost jacks 10. This provides a favorable mechanical advantage for the loads on weight support frames 2 to minimize bending moments thereon and to minimize contact forces at all jacks 9 and 10. Likewise the distance between pin connections 3 is kept at a maximum to reduce the shear forces on the pins 3 and to place the loads as close to the corners of the frames as possible. It will be appreciated that the drawing is an elevational or side view of the elevator and thus only the support frame which is closest to the viewer is seen. Actually I would use two such frames, one being at each side of the elevator tower module 1 as is shown in FIG. 2.

The cage is lifted and lowered by the hoisting machinery 8 mounted on the machinery platform on the upper extremity of the tower module 1. The cage 6 consists of a platform properly sized and stressed to haul both material and men within the limits of the safety code which is used as a basis for acceptance of hoisting equipment on fixed structures. The cage assembly 6 is enclosed by the necessary safety enclosures and is equipped with safety devices which grip the guide rails 4 in the event of a failure of the lifting devices or cables. The guide rails 4 serve to hold the cage 6 within a specific dimension at all times from the floors and/or walls of the structure while ascending or descending. Support brackets 5 at each floor hold the guide rails 4 at the required distance from the building and prevent the guide rails 4 from buckling due to off-center loading of the cage 6 at the time of emergency braking. The brackets 5 are attached to the guide rails 4 by clamps 43 to allow for differences in builiding design and distance between floors.

These clamps 43 are shown in FIG. 4 only for drawing clarity. The brackets 5 are held in place by uprights 7 which are wedged between floor and ceiling in similar manner to weight support frames 2. The uprights 7 serve to shore or support the downwardly acting load from the support frames from floor to floor to the foundation. They are also used as door frames upon which safety gates at each floor are hung.

The cage 6 is equipped with rollers contoured to fit the guide rail channel 39 as seen in FIG. 7. The periphery of these rollers are covered with a resilient material to lower the noise level in operation and tends to limit shock and vibration when the cage 6 moves from section to section of the guides 39.

The tower module 1 is hollow, and open on the bottom to allow the passage of the cage 6 and counterweights 11 up into it. Openings 12 (FIG. 2) are also provided on the building side of the tower module 1 to allow passengers and other payload to pass between cage 6 and the adjacent story. Guides 13 and 14 (FIG. 7) in the tower module 1 support the guide rails 4 when the tower module is secured to the support frames 2 in the building. The guides 13 and 14 also serve to guide the tower module 1 on the guide rails 4 when the tower module 1 is being raised or lowered. A portion of a preferred form of climbing mechanism for raising and lowering the tower module 1 is shown in FIGS. 3, 4, and 5. This mechanism comprises a base frame 15 secured to the tower module 1 at 16 and forming guide 14, the purpose of which is described above. Jaws 17 which selectively secure the tower 1 to the guide rails, prevent the tower module from dropping when the pull beam 18 is raised; pull beam 18, hydraulic cylinders 19, and jaws 20. Jaws 20 selectively secure pull beam 18 to the guide rails 4. Solenoids 21*a* and 21*b* are provided for disengaging the jaws in opposition to springs 22 which raise jaws 17 and 20 into wedged engagement with the guide rail 4.

In the hydraulic system shown in FIG. 8 an electric motor 24 driven pump 25 and check valve 26 maintain the pressure required for lifting the tower module 1 in accumulator 27 as controlled by pressure switch 28. Solenoid actuated directional control valve 29 selectively supplies oil from the system to extend and retract the four cylinders 19 as required. A counterbalance valve arrangement comprised of relief valve 30 and check valve 31 control the release of oil from cylinders 19 upon lowering the elevator tower module 1. Relief valve 32 is used in conventional manner to protect pump 25.

The cage is raised and lowered by the hoisting machinery 8 which rotates the traction wheel 23 as shown in FIG. 2 over which the rope 24 connecting cage 6 to counterweights 11 is placed in driving arrangement. In an alternative form of climbing device shown in FIGS. 9 and 10 a second flexible rope 33 is anchored at the top of the building to a support frame 34, wrapped under an idler pulley 35 at the bottom of the tower module 1, over a traction wheel 36 driven by the hoisting mechanism, and down over a guide pulley 37 to be anchored to a support frame 38 at the foot of the building. In this form of climbing device it is essential that the rope be drawn tight enough to provide tractive effort at the traction wheel as friction between traction wheel 36 and rope 33 is the only force available to prevent the module from falling. In another form of climbing device as shown in FIG. 11 power driven traction wheels 44 mounted in the tower module 1 and forced against the left and right sides of the guide rails 4 are used to raise and lower the module 1. A more positive drive would use rack teeth on the guide rails engaged with pinion teeth on the power driven climbing wheels 44.

A very simple form of guide rail **4** is shown in FIG. **1.** A preferred form of guide rail (FIG. 7) comprised of a channel **39** to guide the cage **6** and a second channel **40** to guide the counterweights **11** are joined by a series of ties **41.** This type of guide rail is made up in standard lengths, joined together by a tie bar **42** as shown in FIG. **3.**

MODE OF OPERATION

A set of support frames **2** are installed between floor and ceiling of the highest story of the building which at this stage of construction is strong enough to support it. The tower module **1** is preferably high enough to allow the cage **6** to be raised to each of two stories above the support frames **2** when sufficiently completed for the transportation of workmen and materials thereto without a loss of time for moving the tower module **1.** When the story immediately below the hoist **8** is sufficiently completed and strong enough to support the elevator, a second set of frames **2** as shown in dashed lines on the FIG. **1** is installed at that floor. The tower module **1** can then be disconnected from the lower set of frames **2,** raised two stories, and pinned to the upper set of frames **2.** When installation of my elevator has been completed, the hoisting mechanism **8,** upon demand of the operator, raises and lowers cage **6** on guide rails **4,** stopping at desired floors to discharge and receive passengers and cargo. Safety gates in accordance with regulations on both front and back of the cage **6** and at each floor of the building are used as required. In the event that the hoist rope **24** fails, safety brakes on the cage **6** seize the guide rails **4** bringing the cage to a halt. When permanent elevators have been installed and there is no further use for an outside elevator, my elevator can be removed and dismantled. When removed from the building, my elevator can be readily handled and stored as even its largest component, the tower module **1,** can be designed as a legal load for hauling on flatbed truck or trailer. The device for raising and lowering, also termed climbing, the tower module on the building according to my invention and shown in FIGS. **3, 4, 5, 6,** and **8** functions as described below.

In FIG. **4** the elevator is shown with the cage **6** in position to discharge and pick up payload from the second story above the story to which the tower module is secured by support frames **2.** When the floor and ceiling of this story is sufficiently strong to support it the tower module **1** is prepared for raising to this story by joining an extension **4***a* to the guide rail (FIG. **5**), lowering the cage **6** to the ground, anchoring the two counterweights to the top of the tower module **1,** and releasing the rope **24** from its clamping engagement to the top of the cage **6** thus allowing additional rope, stored on the top of the cage **6,** to pay out as the tower module is raised.

Making sure that the tower module **1** is locked to the guide rails **4** by jaws **17,** the operator then releases jaws **20** by solenoid **21**b. Starting hydraulic pump **25,** he directs oil into the head end of the four cylinders **19** to raise pull beam **18** to the full extension of the cylinders **19.** Using the directional control valve **29,** he then reverses the direction of the oil to the rod end of the cylinders **19** sufficiently to lock the pull beams **18** to the guide rails **4** with the jaws **20.** Pins **3** are then removed so that the support frames can be removed and reset at the top floor, two stories above. He then releases the lower jaws **17** with solenoids **21**a and continues to direct oil under pressure into the rod end of the four cylinders **19** retracting the cylinders **19** to their full retraction stroke and raising the tower module **1** by this increment. He then reverses the flow for an instant, extending the cylinders **19** sufficiently to jam the lower jaws **17** into locking engagement with the guide rails **4** thus again supporting the tower module **1** on the guide rails **4** at the base frame **15** of the of the climbing mechanism. This action is repeated until the tower module **1** has been raised sufficiently to pin it to the support frames **2** at their new location as shown in FIG. **6.** The module is shown in transit to that location in FIG. **5.** Also as shown in FIGS. **5** and **6** as soon as the tower module **1** has risen sufficiently for clearances at each said another set of support brackets **5** and shoring posts **7** are installed. When the tower module **1** has been secured to the building by pinning it to the support frames **2** the rope **24** is tightened and again clamped to the top of the cage **6.** The counterweights **11** are then released from being clamped to the tower module **1** and thus again supported on the rope **24.** The elevator is now ready to serve all stories of the building from the ground up to the story to which it is attached and the two stories above that as soon as they are completed.

A reverse action is used to lower the tower module upon dismantling the elevator. Again the cage **6** is first lowered to the ground and the counterweights clamped to the tower module **1.** In this action, with the tower module **1** still pinned to the support frames **2** the operator starts up the hydraulic system, releases jaws **20** on the pull beam **18** by solenoids **21***b* and retracts the cylinders, lowering the pull beam **18.** As the pull beam **18** reaches the bottom of its stroke he then deactivates the solenoids **21***b* and sets the jaws **20** locking the pull beam **18** to guide rails **4.** The lower solenoids **21***a* can then be activated to release jaws **14** on the base frame **15** of the climbing mechnism so that the tower module **1** may be released from the support frames by raising and lowering the module sufficiently to relieve the load on the pins **3.** The tower module **1** is then lowered by allowing the oil to leave the rod ends of the cylinders **19** being restrained by action of the counterbalance valve **30–31.**

In order to raise or lower the tower module **1** by the climbing mechanism shown in FIGS. **9** and **10,** the operator first makes sure that a brake is set on the traction wheel **36.** He then removes the pins **3** securing the tower module **1** to the support frames **2,** and then raises it by turning the traction wheel **36** counterclockwise or lowers it by a clockwise motion with the hoist mechanism. As in the other climbing mechanism it is necessary to first take the steps of extending the guide rails, lowering the cage **6** to the ground, securing the counterweights to the tower module, and releasing the rope **24** from the top of the cage.

A similar action is used in the climbing mechanism shown in FIG. **11** in which case the driving wheels are driven to raise or lower the module **1** as desired.

I claim:

1. An elevator for use in raising and lowering men and materials on a multistory building comprising:

a. a sectional vertical guide rail means secured to a building structure exteriorly thereof to become a structural part thereof,

b. an elevator cage slidably mounted on said guide rail means,

c. means slidably mounting an elevator tower module on said guide rail means,
d. an elevator tower module supporting means comprising means to temporarily attach said tower module to the building at a plurality of selected building levels,
e. a first hoisting means mounted on said elevator tower module,
f. a hoist rope connecting said elevator cage to said hoisting means whereby motion imparted to said rope by said hoisting means causes said cage to be raised or lowered,
g. a second hoisting means mounted on said elevator tower module for raising and lowering said tower module, and
h. means to engage said second hoisting means to an upper section of said guide rail means whereby driving motion of said hoisting means through engagement with said guide rail means is adapted to raise and lower said tower module along the guide rail means.

2. An elevator as claimed in claim **1** further comprising a counterweight slidably mounted on said guide rail means and attached to said hoist rope whereby motion imparted to said hoist rope by the hoisting means raises and lowers the counterweight in a direction opposite that of the elevator cage.

3. An elevator as claimed in claim **1** wherein said elevator tower module is hollow and wherein said guide rail means passes through said hollow elevator tower module.

4. An elevator as claimed in claim **1** wherein said second hoisting means comprises power driven traction wheels engaging said guide rails adapted for guiding and tractive rotation thereon whereby rotation of said traction wheels is adapted to raise or lower said module on said building.

5. An elevator as claimed in claim **1** wherein said elevator tower module supporting means comprises support frames secured thereto and adapted to be inserted within the building to be supported thereby.

6. An elevator as claimed in claim **1** wherein said second hoisting means comprises a first part attached to said elevator tower module, means to selectively lockingly engage and disengage said first part to said guide rail means, extensible hydraulic cylinders attached at one end thereof to the module, pull beams, means to selectively lockingly engage and disengage siad pull beams to said guide rail means, means to attach the other ends of the respective cylinders to said pull beams, a hydraulic power source, said hydraulic controls connecting the hydraulic power source to said extensible cylinders so that the module can be raised and lowered on the guide rails by locking the pull beams to the guide rail means and then lengthen or shorten the effective length of said extensible cylinders with the first part free from engagement with said guide rail means and whereby the first part may be locked to said guide rail means to support the module thereon so that the pull beam may be moved by the cylinders to a new point of locking engagement with said guide rail means.

7. An elevator as claimed in claim **1** wherein said tower module is at least two stories high relative to the building to which it is attached so that said elevator cage can be raised and lowered within said module throughout its height.

8. An elevator for use in raising and lowering men and materials on a multistory building comprising:
a. a sectional vertical guide rail means secured to a building structure exteriorly thereof to become a structural part thereof,
b. an elevator cage slidably mounted on said guide rail means,
c. means slidably mounting an elevator tower module on said guide rail means,
d. an elevator tower module supporting means comprising means to temporarily attach said tower module to the building at a plurality of selected building levels,
e. a first hoisting means mounted on said elevator tower module,
f. a hoist rope connecting said elevator cage to said hoisting means whereby motion imparted to said rope by said hoisting means causes said cage to be raised or lowered,
g. a second hoisting means mounted on said elevator tower module for raising and lowering said tower module,
h. said second hoisting means comprising a traction wheel selectively driven by said first hoisting means,
i. a driving rope held in driving engagement with said traction wheel,
j. an idler pulley mounted on said elevator tower module over which said driving rope is trained,
k. an anchoring means for one end of the rope near the top of said building, and
l. a first anchoring means for one end of the rope and a second anchoring means for the other end of the rope near the bottom of said building whereby rotation of said traction wheel engaged with said driving rope is adapted to raise and lower said elevator tower module on said building.

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