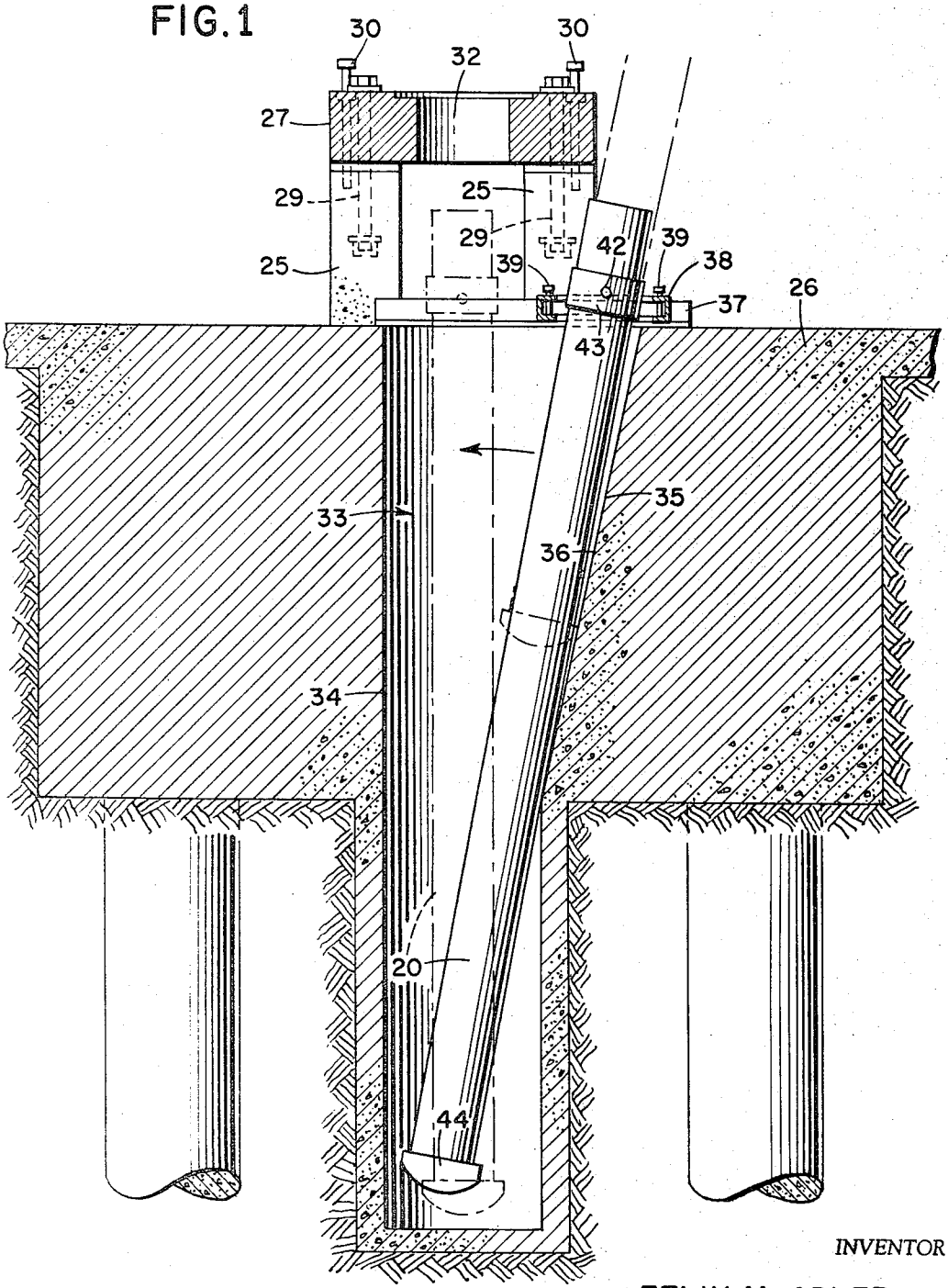
Dec. 17, 1968 F. M. ADLER 3,416,284

METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 1



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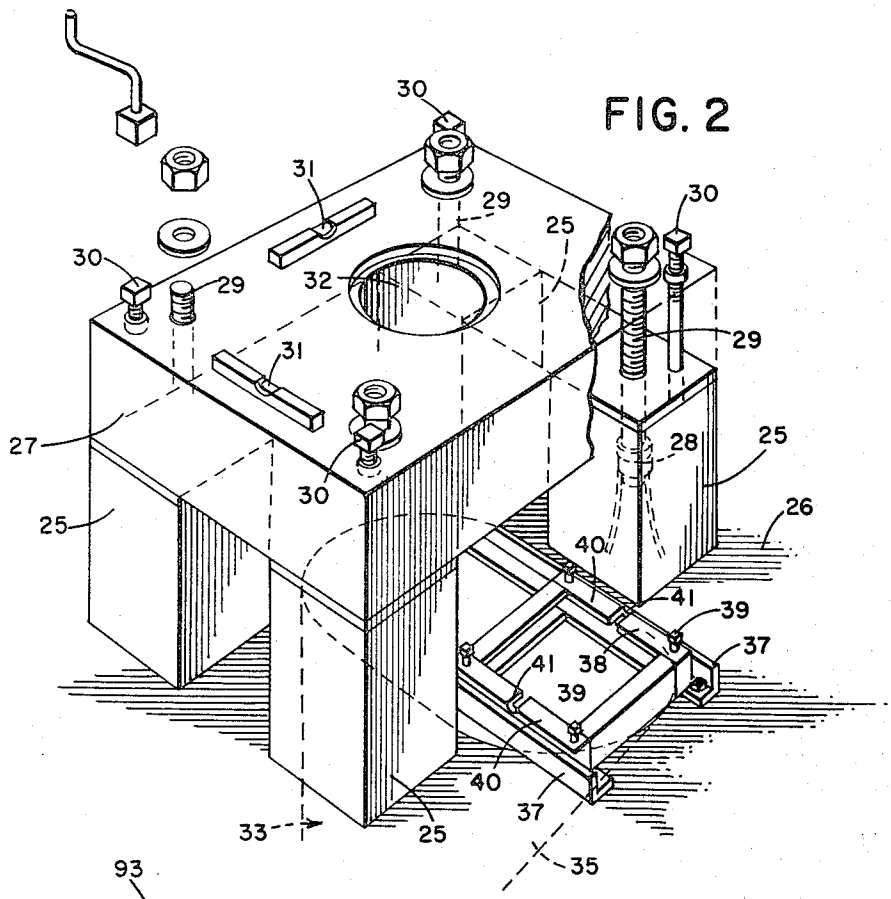
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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 2



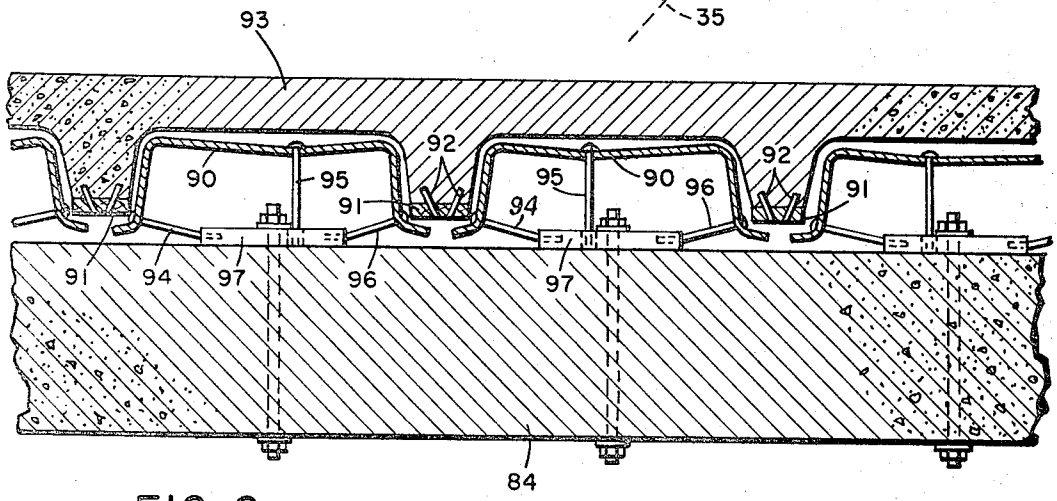


FIG. 6

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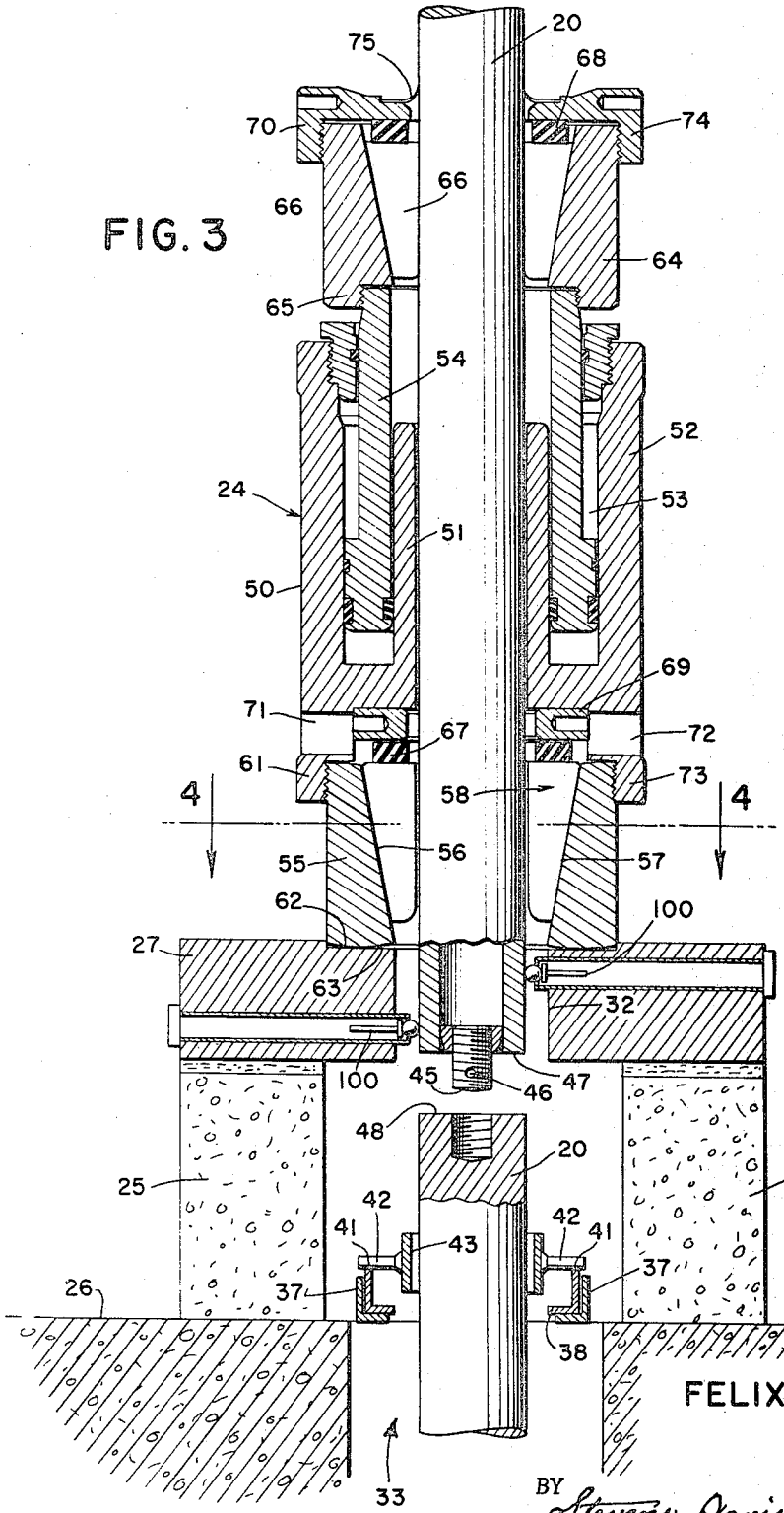
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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 3



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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 5

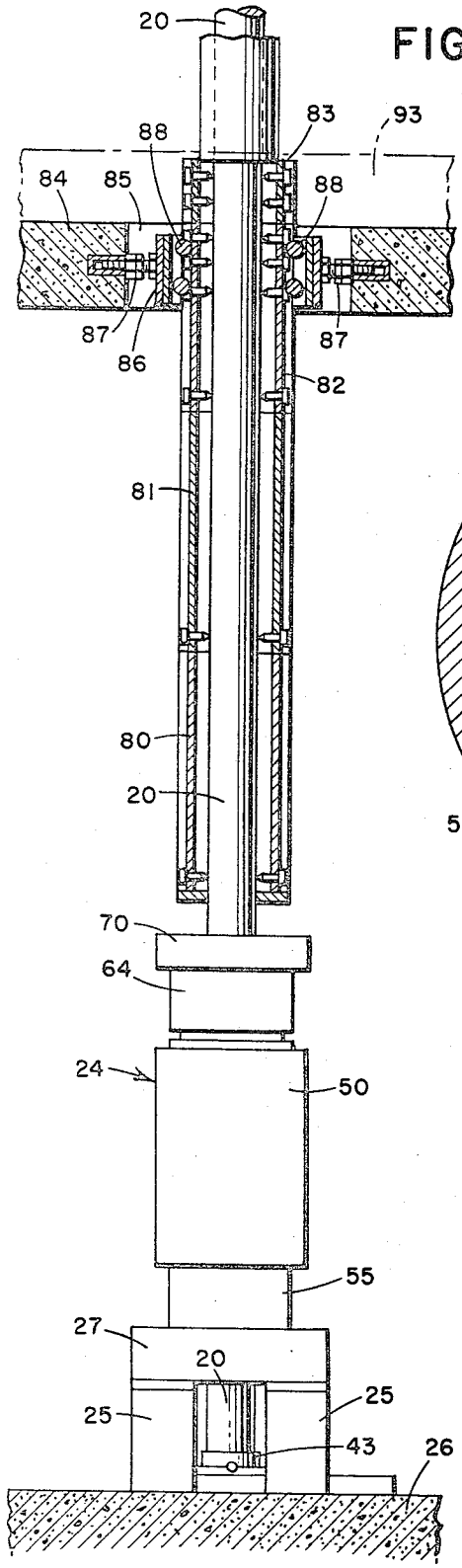
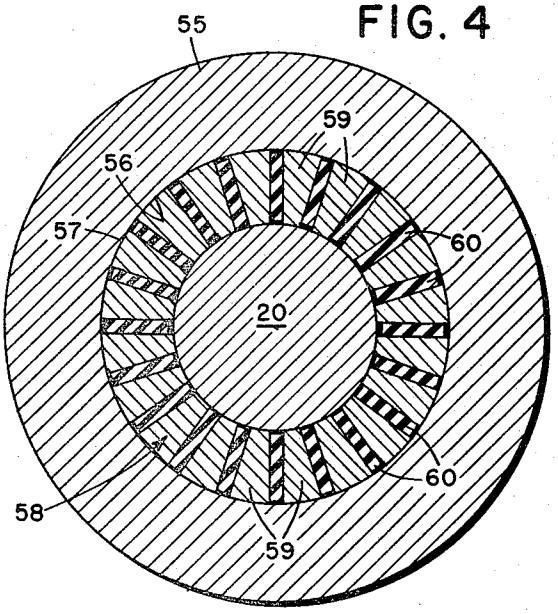


FIG. 4



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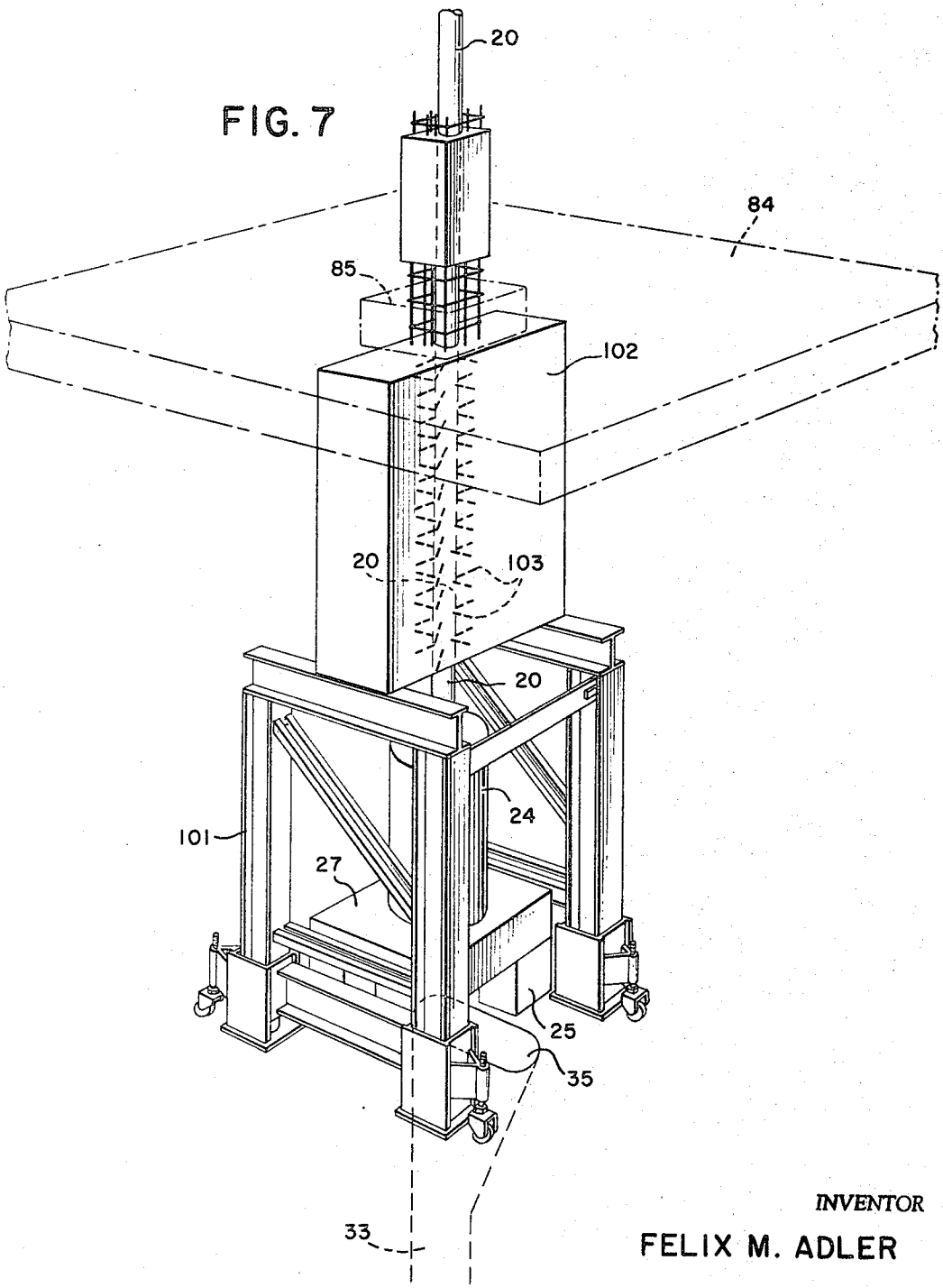
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FIG. 7



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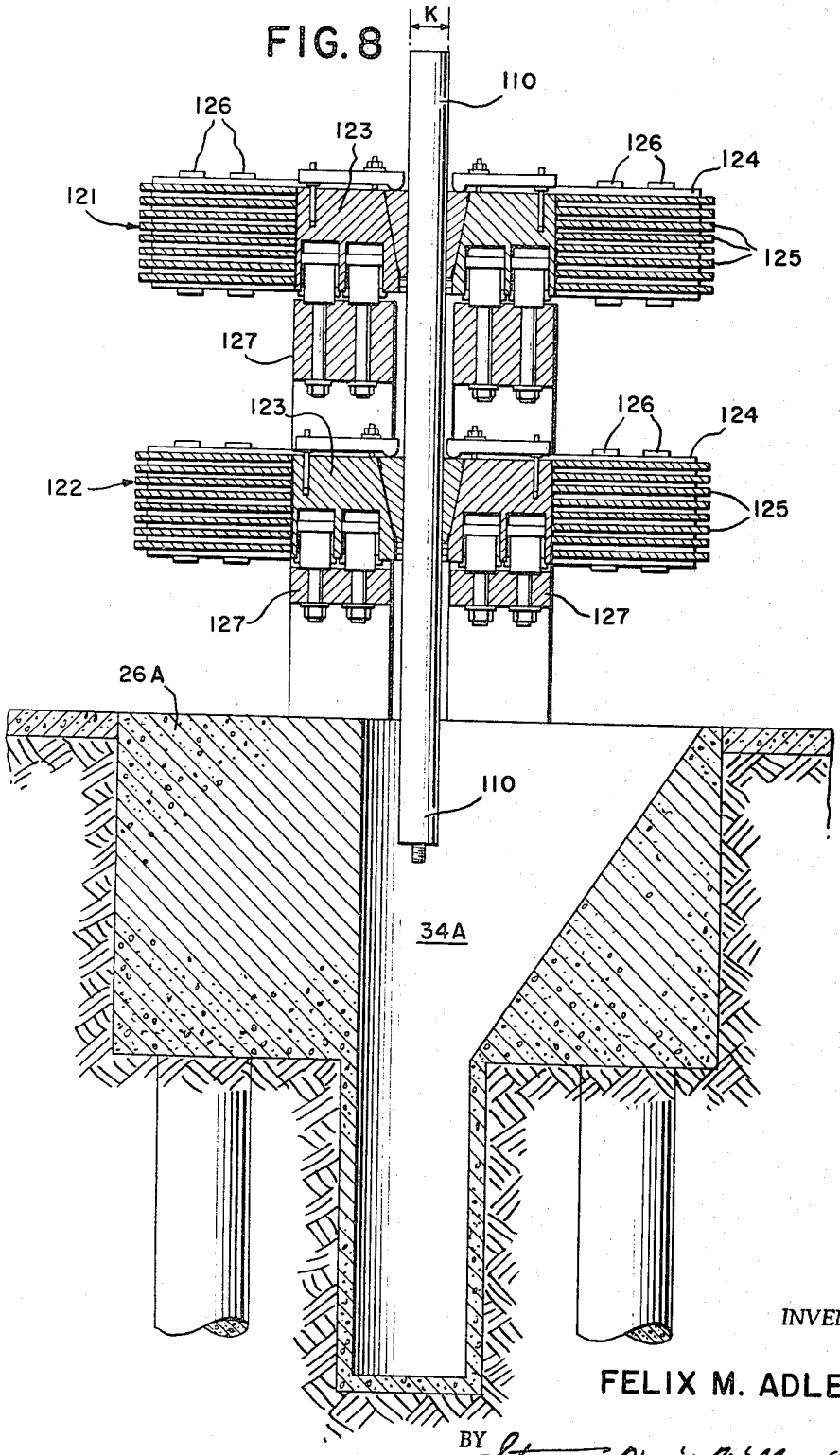
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FIG. 8



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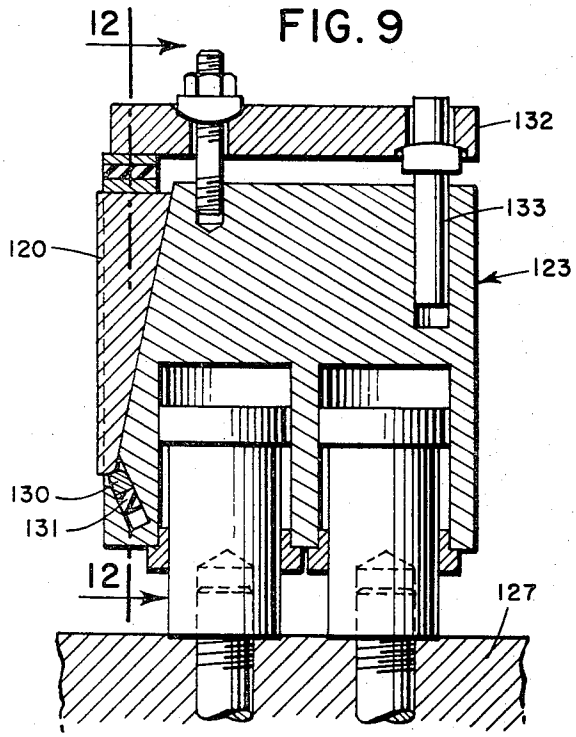
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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 9



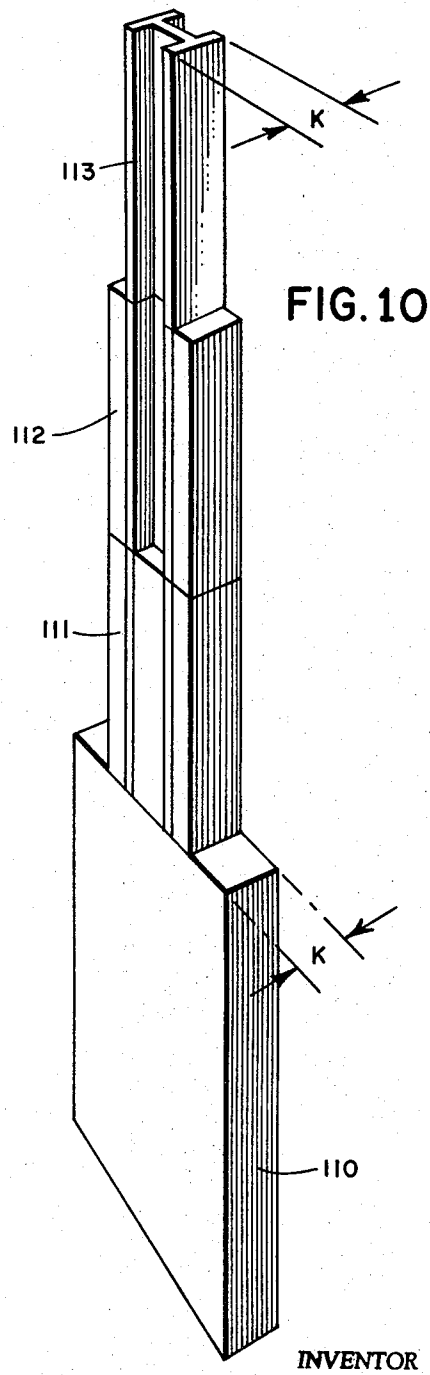
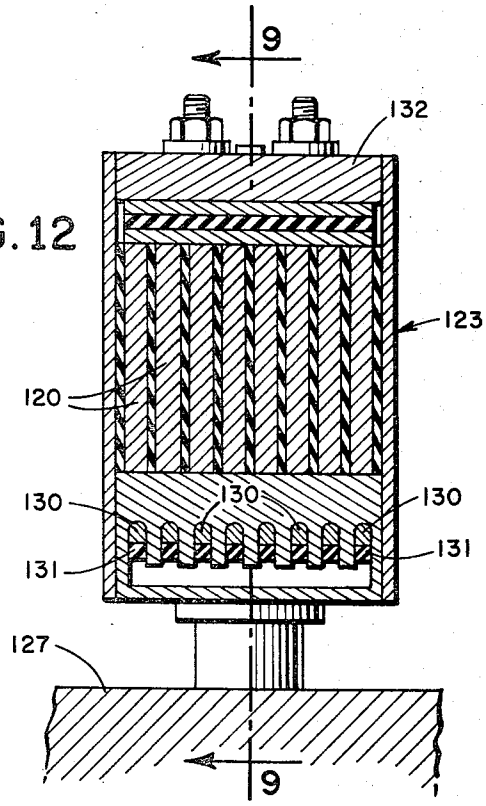


FIG. 10

FIG. 12



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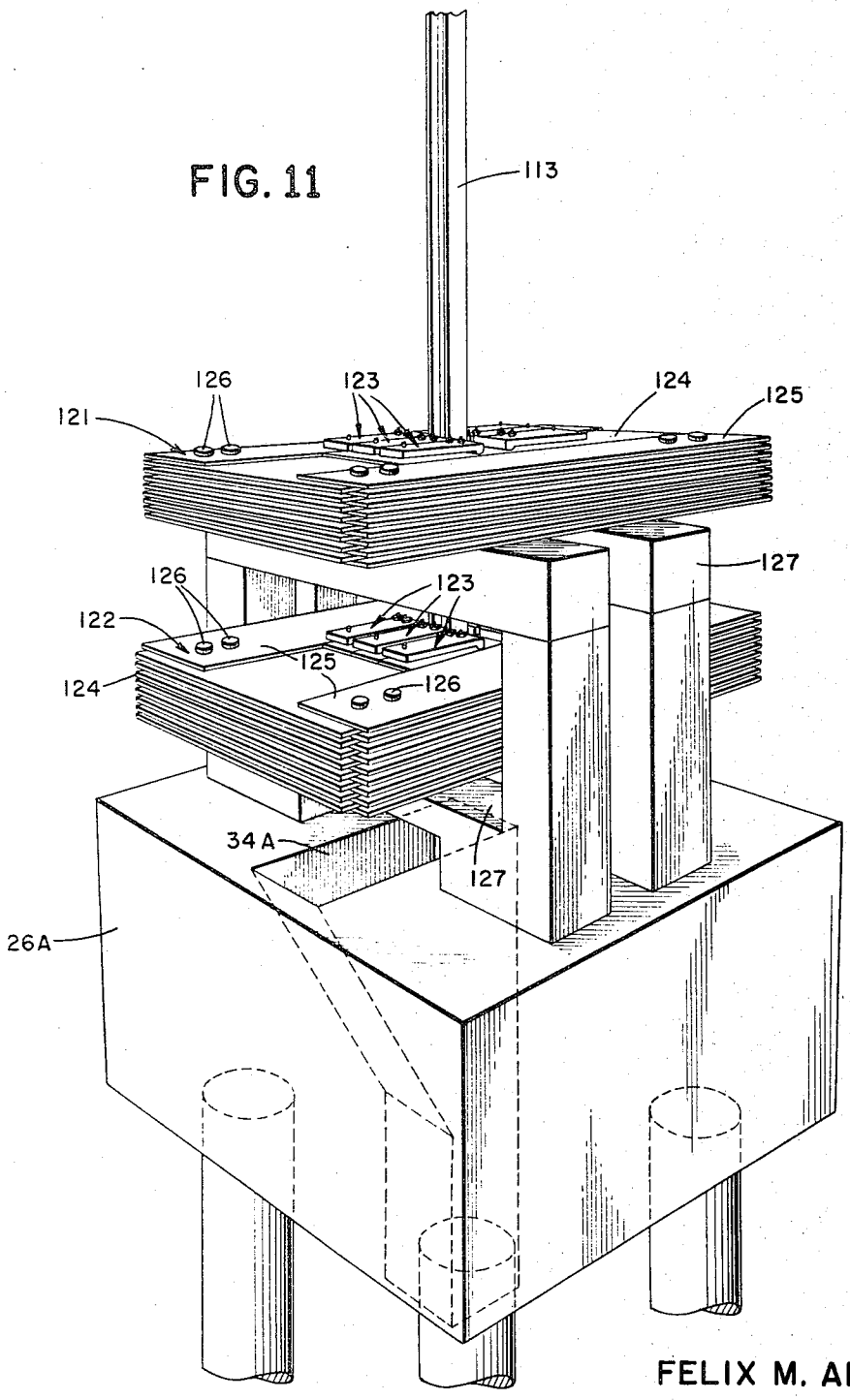
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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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FIG. 11



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METHOD FOR CONSTRUCTING A BUILDING INCLUDING FEEDING A PLURALITY OF END CONNECTED COLUMN SECTIONS UPWARDLY THROUGH A JACK SYSTEM

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Claims priority, application Great Britain, July 24, 1964, 29,785/64; Sept. 3, 1964, 36,217/64
9 Claims. (Cl. 52—745)

ABSTRACT OF THE DISCLOSURE

A method of constructing a building comprising feeding a plurality of steel column sections, joined end-to-end, through a plurality of jacks, each jack having two gripping devices for alternately gripping the columns, and operating the jacks to raise the columns and therewith a roof and floors attached, at a single assembly level, to the columns.

This invention relates to methods of building and to apparatus for carrying out the method.

More particularly, the present invention relates to a method of and apparatus for constructing buildings, especially adapted for use in constructing buildings, having floors and roofs made of concrete slabs, but applicable also to the construction of buildings the floors and roofs of which are of materials other than concrete, such as steel, timber or any combination thereof with concrete.

In constructing buildings it is desirable that the majority of work is carried out at a low level in comparative safety and with full protection from the elements, creating working conditions suitable for the organisation of "assembly lines" (as known in the car or automobile industry) for the fixing, fitting and finishing of the building with all services and fixtures.

There has heretofore been disclosed a method of constructing a multi-story building which consists of constructing a floor at or near ground level, raising said floor, constructing therebeneath at said level another floor and constructing or erecting compression support means between the lifted floor and said another floor, said compression support means forming part of a central core structure for supporting the building, raising said another floor together with the already constructed part of the building thereabove, and repeating the operation until all the floors and the central core structure are constructed, the raising operations being effected by jacks positioned to lift the already constructed part of the central core structure and through it the floors which project outwardly in cantilever fashion around the central core structure.

An object of the present invention is to provide a novel and improved method of constructing a building using steel column sections to support the roof and floors of the building.

The present inventive method of constructing buildings comprises axially and incrementally elevatiing steel columns in end-to-end interfitting sections by hoisting apparatus embracing and gripping same, and building around column sections in intervals between lifts and at a single level the roof and the floor or floors.

The column cores are individually encased to form reinforced concrete columns or they are encased and joined into groups by reinforced concrete walls. Alternatively the column cores can be clad in some other way (non-structural) or be joined into groups of columns by structural steel bracings to form vertical trusses.

An embodiment of the invention will now be described,

by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a vertical section through a pile cap;

FIG. 2 is a perspective view, partly broken away illustrating the mounting of the base plate of a jack;

FIG. 3 is a vertical section through a jack;

FIG. 4 is a section on the line **4—4** of FIG. 3;

FIG. 5 is a vertical section illustrating the formation of a column cladding and a roof or floor;

FIG. 6 is a vertical section illustrating roof and floor shuttering;

FIG. 7 illustrates how the fully erected building is parked;

FIG. 8 is a view corresponding to FIG. 3 of a modified form of jack;

FIG. 9 is a vertical section on the line **9—9** of FIG. 12 through a wedge device forming a part of one of the gripping devices of the jack shown in FIG. 8;

FIG. 10 is a fragmentary view of a column core with which the jack of FIG. 8 can be used;

FIG. 11 is a perspective view illustrating the jack of FIG. 8; and

FIG. 12 is a section on the line **12—12** of FIG. 9.

Referring now to the drawings, a twenty-one storey building is constructed by axially and incrementally elevating steel column cores in end-to-end interfitting sections by hoisting apparatus embracing and gripping same, and building around column core sections between lifts and at a single level, the column casing, the roof and the floors.

The column cores are cylindrical and the lowermost sections **20** thereof are solid. The other sections of each column core are, however, hollow and thus tubular with the wall thickness thereof each uniform in itself, gradually decreasing in the height direction of the columns.

All column cores have uniform external dimensions. The columns are strategically positioned about the building site and each is elevated at appropriate times by a hoisting apparatus or jack **24**, the jacks being synchronously operated and each being mounted on four reinforced concrete plinths **25** disposed at the apices of a rectangle on a concrete pile cap **26**.

Each jack includes a base plate **27** which is a solid steel slab mounted on the four plinths **25**.

The latter have each a cast-in ferrule **28** which is engaged by a holding-down bolt **29** extending through a vertical bore therefor in the base plate **27**.

Levelling bolts **30** also extend into the plinths through tapped bores in the base-plate **27**, spirit levels **31** being shown in FIG. 2.

The column core sections **20** are presented to the jacks **24** in a vertical direction from below, and for this purpose the base plates **27** have centrally-disposed vertical cylindrical openings **32** through which a column core section can freely pass and immediately therebelow the pile caps have column-core-section feed pits **33** each consisting of a tubular vertical portion **34** of substantially greater diameter than the column core sections and of length, added to the height of the plinths a little greater than the lengths of the column core sections, and a feed-in portion **35** extending laterally from the tubular portion centrally between two of the plinths, with a guide wall **36** opposite to the tubular portion and inclined downwardly and inwardly from its upper end.

Associated with each column-core-section feed pit is a feed sledge comprising a pair of parallel rails **37** of L-section located on the pile cap to bridge over the top of the feed pit **33** between the guide wall **36** and the opposite side of the pit.

A rectangular cradle **38** is mounted on the rails for sliding movement therealong and has levelling screws **39** to ensure that its upper surface **40** is horizontal.

Notches **41** of semi-circular section are provided in the upper surface **40** centrally of its opposed sides which are parallel to the rails, the axes of the notches being in alignment.

These notches provide a trunnion mounting for stub axles **42** extending diametrically outwards from a collar **43** which is temporarily fitted about a column core section fed into the pit in order properly to position the core section **20** in axial alignment with the opening **32** in the base plate **27**.

Column core sections are fed into the pit from above and at that time a collar **43** is fitted therearound by symmetrically-disposed pinch screws so that the stub axles **42** engage in the notches **41** when a section has been lowered by the proper amount.

A protective cap **44** temporarily fitted on the lower end of a column core section being fed into a pit **33** slides on the surface of the guide wall **36** of the pit as the section is lowered until the stub axles **42** engage in the notches **41**.

The cradle **38** is then slid along the rails **37** until the core section is in the proper position for connecting to that one immediately thereabove and already engaged by the jack.

FIG. 3 indicates how a typical joint between column core sections is made by a threaded locating pin **45** which is engaged in a tapped socket provided axially in the lower end of the upper one of the two sections, using a tommy bar to engage a hole **46** in the pin, and on to which is then screwed the lower of the two sections which has an axial tapped socket for the purpose.

The bearing surfaces **47** and **48** of the two core sections are machined smooth so that they fit together impeccably.

Core sections which are at upper levels in the finished columns have closed ends when the wall thicknesses are adequate and the same jointing method is used.

However, with thinner wall thickness, a steel sleeve is engaged in the adjacent ends of the core sections to be joined and the sections are welded together.

Referring now particularly to FIG. 3, each jack **24** comprises a cylinder **50** having inner and outer cylindrical walls **51** and **52**, respectively, defining an annular chamber **53** in which a double-acting ram **54** is fitted.

A column core can slide through the vertical bore defined by the inner wall **51**.

The cylinder **50** seats on a lower wedge housing **55** having a downwardly- and inwardly-inclined inner surface **56** against which bears the downwardly- and inwardly-inclined outer surface **57** of a wedge device **58** comprising (see FIG. 4) circumferentially-alternating wedge members **59** and radial pressure pads **60** of elastomeric material.

The cylinder **50** has a socketed end **61** for seating purposes and the wedge housing **55** seats in a locating socket **62** in the upper surface of the base plate **27**, the bearing surface **63** of the socket **62** being cambered.

An upper wedge housing **64** seats on the upper end of the ram **54** and has a socketed lower end **65** for this purpose.

The housing **64** is similar to the housing **55** and co-acts with a wedge device **66** similar to the wedge device **58**.

Annular pressure pads **67** and **68** of elastomeric material bear on the upper ends of the wedge devices **58** and **66** respectively, and adjusting nuts **69** and **70**, respectively, exert a pressure onto the pads.

Slots **71** and **72** in skirt **73** of the cylinder wall provide for access to the nut **69**, and the nut **70**, which is accessible, has a downwardly-extending peripheral flange **74** which is tapped to engage a thread on the upper exterior of the wall of the housing **64**.

A seal **75** of elastomeric material covers the space between the top of nut **70** and the core section passing through the jack.

The double acting ram **54** is, of course, hydraulically operated, the hydraulic connections and circuits not being shown in the drawings.

When the ram is moved upwards, the upper wedge device **66** grips the column core section then in the jack and the lower wedge device is relaxed and releases the core section—the condition shown in FIG. 3. Accordingly, the core section is raised as the ram is moved upwards.

When the ram reaches the end of its upward stroke and the stroke of the ram is reversed, the lower wedge section **58** grips the section so that it remains in the position to which it was raised and the upper wedge section **66** relaxes and travels down with the ram.

The pressure pads **67** and **68** provide a lag between one wedge section gripping and the other relaxing so that the column core section is never released by both wedge sections at the same time.

The elevation of the column core sections and hence of the columns is thus stepwise and incremental.

Columns are encased at the same time as the roof and floors are cast, shuttering units **80**, **81**, **82** and **83** being mounted about the core for the purpose as indicated in FIG. 5 where a floor casting bed is denoted **84**.

The latter is appropriately supported in position and is apertured for passage of the columns as indicated at **85**.

Into the apertures **85** project rolling devices **86** which bear on the column shuttering **80–83**, provision being made in the roller mountings at **87** for adjusting the rollers **88** into proper position.

The units **80–83** fit on to one another so that they can be removed, one at a time, as the columns are elevated and fitted into their next positions about the columns.

FIG. 6 shows a typical section through a floor or roof and shuttering therefor on a casting bed during elevation of the columns and with them the cast roof and floors.

The ceiling and floor shuttering comprises resilient members **90** of steel and of inverted channel section disposed in parallel relationship with small intervals between adjacent members.

Wooden battens **91** from which extend upward angularly-disposed steel prongs **92** are located in the intervals between the members prior to casting of the roof or floor **93**.

As can be seen the shuttering is released from the roof or floor **93** as the latter is elevated by flexible ties **94**, **95** and **96** anchored at their ends to the shuttering members **90** and an anchorage member **97** integrated with the casting bed **84**.

In the creation of the building, the pile caps **26** with their plinths **25** are first of all located and the casting bed **84** is then constructed.

Jacks **24** are then set up in position.

The first column core sections **20** are then inserted and elevated to the level where the roof is to be cast, and appropriate reinforcement is then fixed in position with the shuttering units **80–83** and the roof and floor shuttering members **90**.

The column core sections are plumbed vertically and the rollers **88** adjusted to position.

Concrete is then poured to form the column casting and the roof.

After curing of the concrete, jacking is commenced and shuttering unit **80** is removed and the first part of the next storey column reinforcement is fixed underneath together with unit **83** and a spare unit **82**.

When height permits, units **82**, **81** and **81** can be removed above the casting bed **84**. Before jacking to storey height, units **81**, **81** and **80** together with remaining reinforcement are fitted in position.

After jacking to storey height, the unit **83** is removed and the column cladding and the floor is poured. After curing of this concrete, jacking is re-commenced, and so on.

In cases where no reinforced concrete encasing is re-

quired the rolling devices **86** are set to engage directly on to the face of the column core and shuttering units **80–83** are omitted.

Connectors are then to be clamped on or stud welded to the column cores to positively engage with the floor and/or wall structure.

FIG. 3 illustrates devices **100** for transmitting amplitude of movement of the column core to signal generators mounted on the sides of the base plates **27** whence they are relayed to a central control from which operation of the jacks **24** is synchronised.

In parking the fully erected building (see FIG. 7), connectors are to be stud welded to form "hedgehog" **103**.

Reinforced concrete block **102** is constructed, fully encasing the "hedgehog" **103** and extending upwards to the undersurface of the casting bed **84**.

Temporary support units **101** are rolled into position, positively located and jacked up to temporarily support concrete blocks **102**.

The bottom core sections **20** are uncoupled and are withdrawn from the jacks.

The jacks are removed, concrete is poured to fill the pits **33**, and reinforced concrete piers are constructed to integrate the pile caps with the blocks **102**.

The support units **101** are then removed.

For very tall buildings the lower column cores are rectangular and solid as shown at **110** in FIG. 10. Other sections of each column core are shown at **111**, **112** and **113**, the former two being broad flange stanchions.

All sections of each column core are uniform in themselves with the longer dimension of the rectangle in plan gradually decreasing in the height direction of the column.

The short dimension K of the rectangle in plan of each column core is constant throughout the full height of the building, i.e. equals the shorter dimension of each rectangle and the width of the broad flange stanchion.

The lifting apparatus FIGS. 8, 9, 11 and 12 is modified to grip the column core along the two races or sides which are at right angles to the constant shorter dimension faces. Many features of the modified lifting apparatus are similar to that described with reference to FIGS. 1 to 7 of the drawings and have the same reference numerals applied thereto with the suffix A added.

The grip is effected by power driven wedges **120**. Upper and lower gripping devices **121** and **122** cooperate in the elevation of the column core in the manner hereinbefore set forth in relation to the wedge devices **58** and **66** of the first-described embodiment.

The hydraulic blocks **123** are held by ties **124** and yokes **125** of laminated steel construction. Pins **126** are used to connect the yoke plates and tie plates to enable dismantling of the lifting apparatus after the erection of the building has been completed.

The two grips **121**, **122**, which together form the lifting apparatus, are supported by a pair of parallel solid steel frames **127** of which that closer to the feed pit **33** is locally interrupted in its lower limb immediately above the feed pit to allow access for column core connection.

The method of feeding, connecting, guiding, and encasing of the column cores is similar to the one described previously with reference to FIGS. 1 to 7.

The mechanism for releasing the wedge devices **120** comprises a hardened steel pin **130** operated by a hydraulic ram **131**. The wedge devices are operated through a fulcrumed lever **132** actuated by a ram **133**.

The roof and any floor built about the columns at a level just above the foundations may have secured thereto, by hinge units, wall panels built on the horizontal and adapted to swing progressively downwards through arcuate paths as the roof or floor is elevated, until the wall sections are vertical.

A unit includes a part which travels upwardly through an arcuate path as a floor is raised and is forced into a slot provided therefor in the lower end of the wall panel thereabove, and filled with an expanded polystyrene infill which is crushed by the entering hinge part.

Diagonal dowels or bolts are finally driven through the upper wall panel and the hinge part to provide a permanent connection.

The column cores could, of course, be of any desired cross section, other parts being modified to suit FIGS. 8 and 9.

The invention is applicable to the extension of columns in directions other than vertically upwards as in building, for example vertically downwards as in drilling and horizontally as in pipe-laying.

I claim:

1. A method of constructing a building comprising mounting a plurality of column hoisting apparatuses at spaced points at the building site, said column hoisting apparatuses each comprising vertically aligned first and second handling devices and lifting means for effecting relative vertical movement of said first and second handling devices, comprising the steps of feeding steel column sections in succession to said hoisting apparatuses, joining said steel column sections in end-to-end relation to form columns, operating said first handling devices in first positions to grip said column, operating said lifting means to raise said first handling devices and therewith said columns relative to said second handling devices, operating said second handling devices to grip said columns, releasing said first handling devices from said columns, whereby said columns are supported by said second handling devices, moving said first handling devices relative to said second handling devices back to said first positions, securing a roof and a plurality of floors to said column at a single level and in succession during intervals between the raising of said columns, whereby said roof and said floors are raised by said columns from said single level in succession and spaced apart, providing walls between said roof and said floors, constructing a foundation, and supporting said columns on said foundation after said columns have been fully raised.

2. A method as set forth in claim **1**, wherein the gripping of each of said columns by each of said first and second handling devices includes disposing relatively movable wedge portions in contact with each of at least two opposite zones of said column.

3. A method as set forth in claim **1**, wherein the gripping of said columns by said first and second handling devices includes urging wedge members by hydraulic pressure into wedging engagement with said columns.

4. A method as set forth in claim **1**, wherein the gripping of said columns by said first and second gripping devices includes using wedge members in gripping engagement with the columns, and retaining the wedge members around the columns by yoke and tie assemblies, said yoke and tie assemblies being dismantled after erection of the columns.

5. A method as set forth in claim **1**, including sensing the upward movement of each of said columns to facilitate synchronization of the elevation of said columns.

6. A method as set forth in claim **1**, including guiding said columns above said hoisting apparatuses to provide lateral support for the columns.

7. A method as set forth in claim **1**, including feeding said steel column sections to said hoisting apparatuses from pits below said hoisting apparatuses.

8. A method as set forth in claim **1**, including joining a plurality of said columns into a single structural system by connecting said columns together.

9. A method of constructing a building, a plurality of jacks at spaced points about a building site, feeding steel column sections in succession through said jacks, joining said steel column sections in end-to-end relation to form vertical columns, operating said jacks to raise said columns, securing a roof and a plurality of floors to said column at a single level and in succession during intervals between the raising of said columns, whereby said

roof and said floors are raised by said columns from said single level in succession and spaced apart, providing walls between said roof and said floors, constructing a foundation, and supporting said columns on said foundation after said columns have been fully raised.

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U.S. Cl. X.R.

24—263; 254—31, 106; 52—126, 296