E. R. SPRINGER.

METHOD AND APPARATUS FOR ERECTING CONCRETE STRUCTURES.

APPLICATION FILED APR. 15, 1918.

1,279,472.

Patented Sept. 17, 1918.

4 SHEETS—SHEET 1.

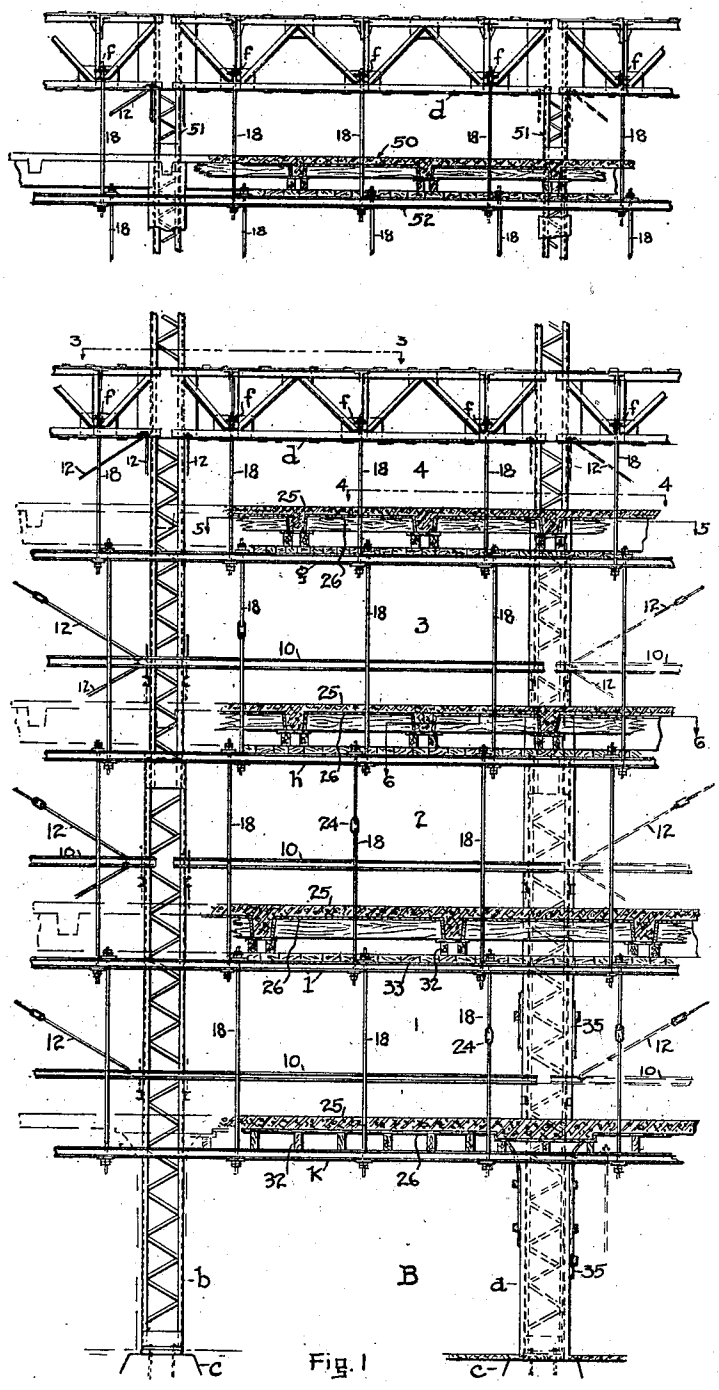


Fig. 1

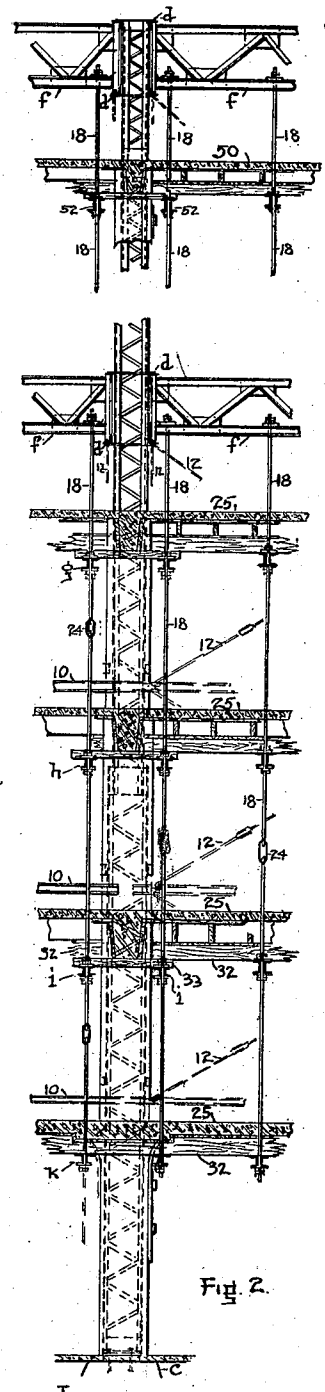


Fig. 2.

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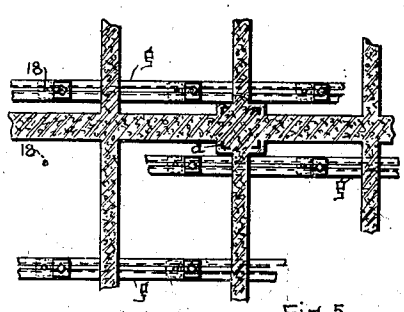


Fig. 5.

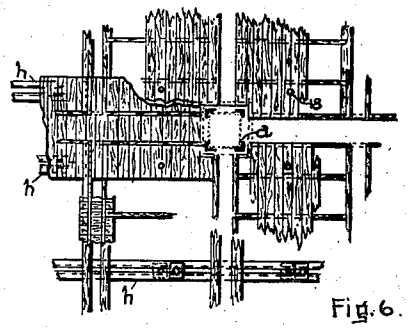


Fig. 6.

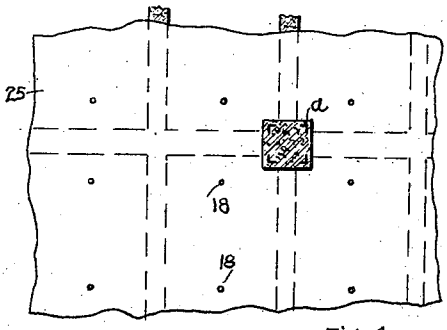


Fig. 4.

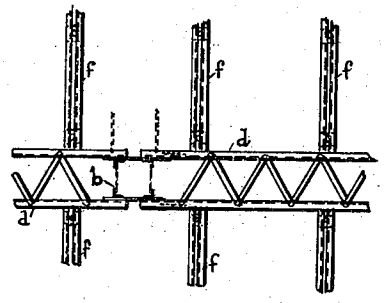


Fig. 3.

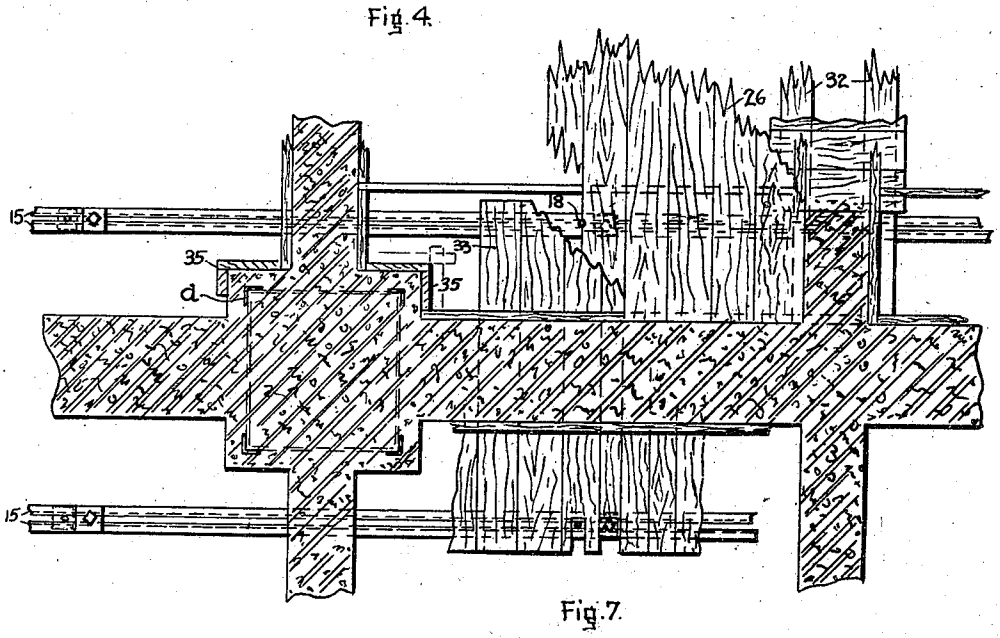


Fig. 7.

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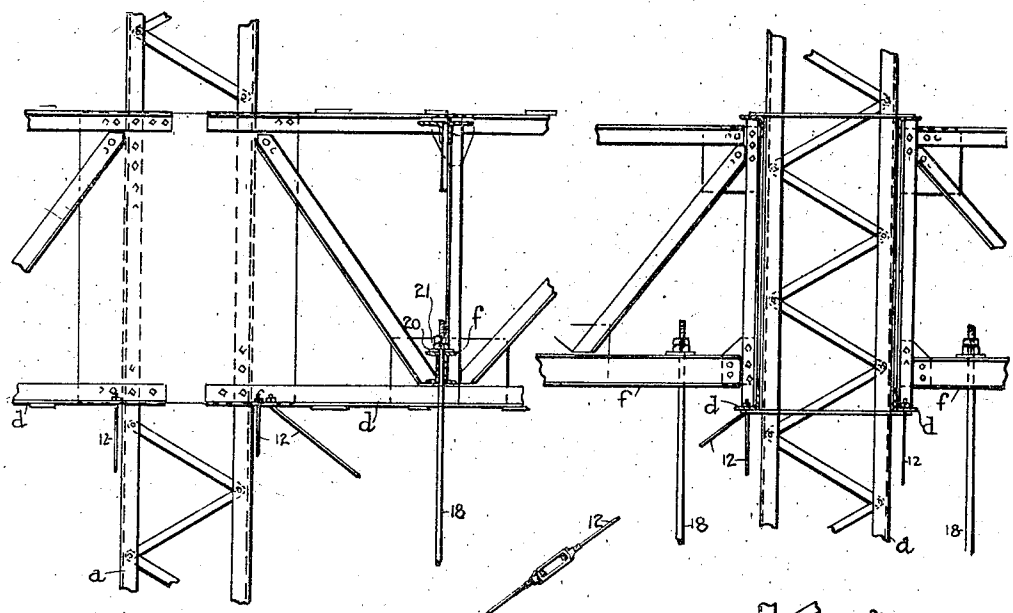
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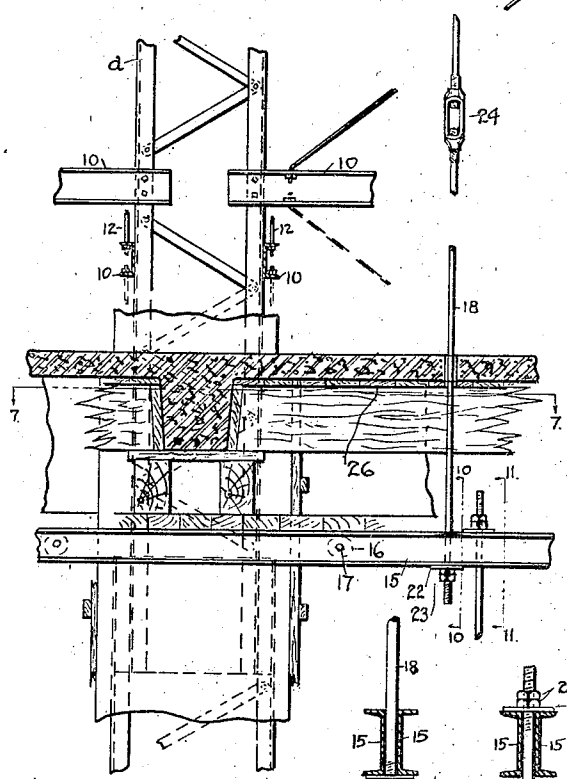


Fig. 8.

Fig. 10.

Fig. 11.

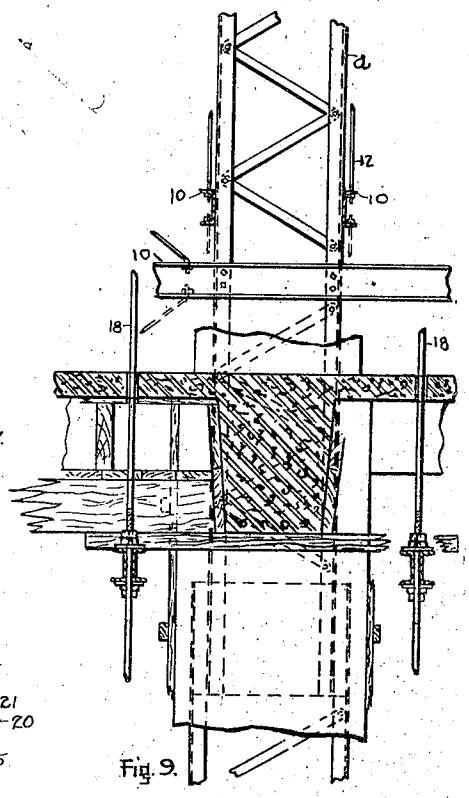


Fig. 9.

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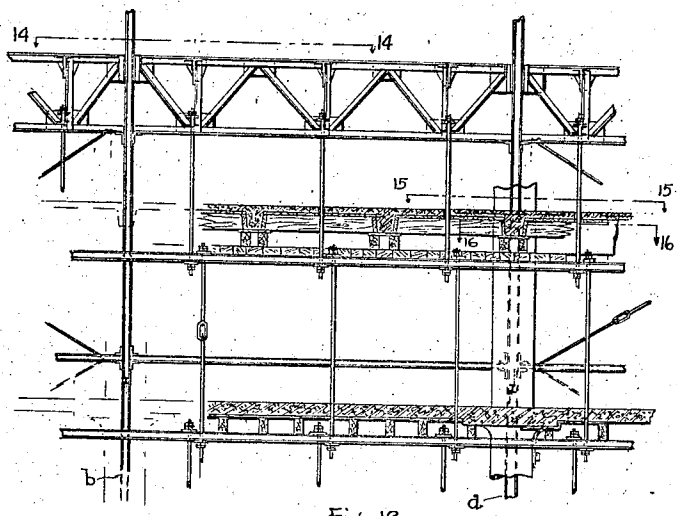


Fig. 12.

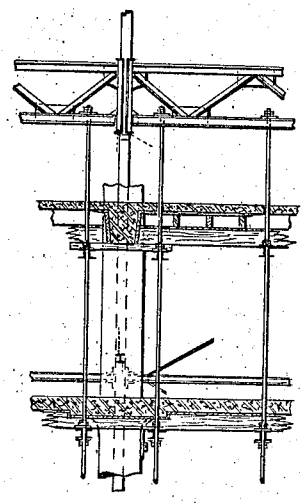


Fig. 13.

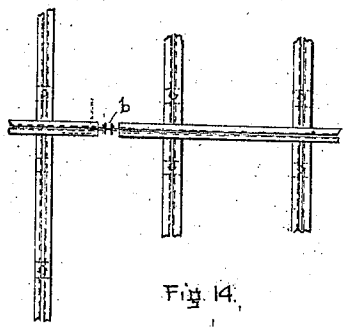


Fig. 14.

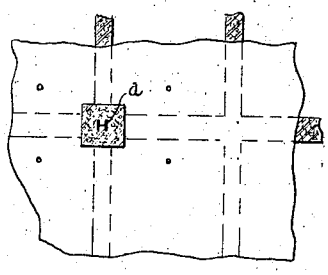


Fig. 15.

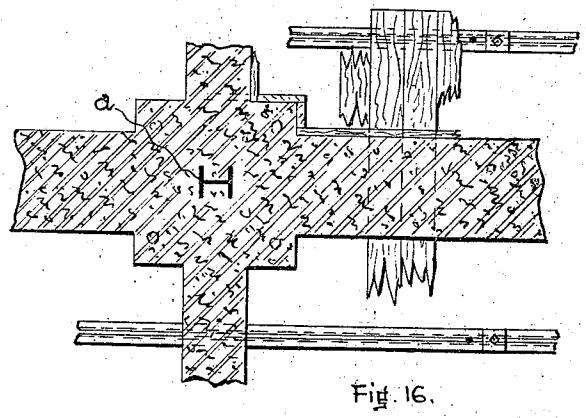


Fig. 16.

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METHOD AND APPARATUS FOR ERECTING CONCRETE STRUCTURES.

1,279,472. Specification of Letters Patent. Patented Sept. 17, 1918.

Application filed April 15, 1918. Serial No. 228,532.

To all whom it may concern:

Be it known that I, ERNEST R. SPRINGER, a citizen of the United States, residing in Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Methods and Apparatus for Erecting Concrete Structures, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to a method of and apparatus for erecting concrete structures of material height and especially reinforced concrete structures having a plurality of stories or sections.

The invention has for its object to increase the speed with which the concrete buildings and like structures may be erected; to materially reduce the cost of the same; to obtain a superior construction both while the building or structure is in process of erection and when completed; and to enable buildings or structures having different heights between floors or sections to be constructed with equal facility.

In the ordinary method of erecting concrete buildings, the building is erected step by step from the ground upward; that is, floor by floor, which requires the lapse of a certain length of time for the concrete used in each floor and the columns therefor to become hardened or set before the forms for the next higher concrete floor and the concrete columns which support it can be erected upon the plastic material of the lower floor and columns.

In some instances, a delay of several days occurs between the erection of the succeeding concrete floors and the concrete columns extended upward therefrom.

Furthermore, in the method now commonly employed, the floor forms, usually of wood, are supported by a large number of wooden struts or pieces, which is expensive not only on account of the number of such supports, required, but also on account of the waste incurred in removing the same after the concrete floors have been laid and set.

In contradistinction to the step by step method now practised and above outlined, I have provided a substantially continuous method for erecting the concrete buildings and other structures by which the long delays above referred to are avoided, and to this end, metal uprights, which are to form a part of the floor supporting columns in the finished building or structure, are erected to the height of a plurality of stories or sections as, for example, four stories, and these uprights are connected in pairs by metal cross members, such as trusses, from which temporary and removable metal supports for the forms of a plurality of floors or other concrete slabs, to wit: the first four floors are suspended, with the temporary metal supports for the floor form of a lower floor or slab suspended from the temporary metal support for the floor form of a higher floor or slab. The temporary floor supports are progressively constructed downward from the cross members as will be described.

The metal uprights for the concrete columns may be suitably tied together by cross and diagonal braces, which may be removable or which may be left to form a part of the finished building or other structure.

After the temporary metal supports for the first group of floors or slabs have been suspended in place, the forms for the concrete floors, beams and girders are laid upon these temporary supports, and the forms for the concrete of the columns are placed about the metal uprights in the basement of the building, and the concrete is poured into said column forms and the concrete for the first floor slab is poured or dumped onto the first floor form and is admixed with and bonds to the concrete in the column forms.

As soon as the concrete for the first floor has been poured, the forms for the concrete columns extended up from the first floor and which are to form the supporting columns for the second concrete floor are erected, and the concrete poured therein, which concrete bonds with the concrete of the basement columns and with the concrete of the first floor slab, and while the first floor concrete column is being poured, the concrete for the second floor slab may also be poured or dumped onto the second floor form.

The same operation is continued for the third and fourth floors.

The metal columns are now extended up another group of floors, say, for instance, to the eighth floor, and are connected at their upper ends by cross trusses or members from which temporary metal supports for the 5th, 6th, 7th and 8th floors are suspended and the floor forms laid thereon, or such extension of the metal uprights and the temporary floor supports may be carried on while the concrete of the first four floors and concrete columns therefor are being formed. When the framework for the second group of floors has been erected, the concrete of the first group of floors will have become hardened or set, and the temporary floor supports, their hangers and cross members may be removed and used again. The operations above described are repeated until the building is completed as will be described.

These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 is a front elevation of an apparatus employed for constructing concrete buildings in accordance with this invention.

Fig. 2, a side elevation of Fig. 1 looking toward the left.

Fig. 3, a section on the line 3—3, Fig. 1, to show in plan the method of suspending the temporary floor supports therefrom.

Fig. 4, a section on the line 4—4, Fig. 1, showing a portion of a floor slab with the hangers extended therethrough.

Fig. 5, a section on the line 5—5, Fig. 1, to show the concrete girders and beams of the floor slab.

Fig. 6, a section on line 6—6, Fig. 1 to show a portion of a floor form and the temporary metal supports therefor.

Fig. 7, an enlarged section on line 7—7, Fig. 8, showing concrete girders and beams, floor forms and temporary floor supports.

Fig. 8, an enlarged elevation to show more clearly a metal column or upright, cross truss, temporary floor support and hanger therefor.

Fig. 9, a side view of the structure shown in Fig. 8.

Figs. 10 and 11, sections on an enlarged scale on the lines 10—10, and 11—11, Fig. 8, to show the temporary floor support and hangers.

Fig. 12, an elevation of a portion of the building using a different form of metal upright from that shown in Fig. 1.

Fig. 13, a view looking at the left in Fig. 12.

Fig. 14, a section on line 14—14, Fig. 12.

Fig. 15, a section on line 15—15, Fig. 12, and

Fig. 16, a section on line 16—16, Fig. 12.

Referring to Figs. 1 to 11, *a*, *b*, Fig. 1, represent two adjacent metal uprights, which are typical of the metal uprights employed in concrete buildings or like structures, and which in practice are distributed over the area of the building in a manner well understood to form spans or bays, one of said uprights being usually located at each corner of a span or bay.

In accordance with the present invention, the metal uprights, which may be of any suitable or usual construction, are erected from the foundation *c*, for a height sufficient to include a plurality of stories or sections of the building, and in Fig. 1, the uprights are represented as extended upward to include four stories 1, 2, 3, 4.

The metal uprights *a*, *b*, which are in line with each other on one side of the square bay, are connected together by a metal cross member, herein shown as a truss *d*, and the metal uprights which are in line with each other on the opposite side of the square bay are connected by a like truss or member (not shown).

The members or trusses *d* may be riveted or otherwise permanently secured to the uprights, but it is preferred to bolt or otherwise detachably secure them to the metal uprights, so that, they may be used over again. The metal uprights *a*, *b*, may be further tied together and braced temporarily at each story by cross braces or bars 10 and diagonal bars or rods 12, which may be of any suitable or desired construction.

The parallel trusses *d* connecting the uprights *a*, *b*, of each bay or span, support a plurality of metal floor sustaining members *f*, shown in Fig. 1 as three in number and as forming part of cross trusses secured to the trusses *d*, but they may be separate from either truss.

The metal members *f* extend from a truss *d* on one side of the bay to a like truss on the opposite side, so that the members *f* extend in one direction across the bay. The members *f* may, and preferably will be composed of two parallel channel irons or bars 15 separated by a relatively narrow space which is formed by washers 16, (see dotted lines Fig. 8) which are secured in place by rivets 17 or otherwise.

The metal members *f* supported by the trusses *d* have suspended from them by hangers 18, like members *g*, which are extended across the bay or span substantially at right angles to the members *f*. The hangers 18 may be made in the form of metal rods, which in the present instance are extended through the space between the channel irons 15 of the members *f* and *g*, and are threaded at their upper ends to receive a washer 20, and nuts 21, (see Figs. 8 to 11), by means of which the hanger rods are suspended from the metal members *f*. The threaded lower ends of the hanger rods 18 receive a washer 22 and nuts 23, which support the metal member *g*. The hangers 18 may be made as single rods or in two

parts adjustably connected by turnbuckles 24 or otherwise.

The hangers 18 suspended from the members *f* supported by the trusses *d*, sustain the members *g* a sufficient distance below the trusses *d* to enable the members *g* to support wooden or other forms 26 for the concrete floor or slab next below the trusses, which as shown in Fig. 1 is the fourth floor.

The members *g* which are to support the fourth floor, in turn support like members marked *h* for the third floor forms, by means of hangers 18 extended through the spaces between the members *g* and *h* and provided with the washers and nuts in the same manner as are the hangers 18 for the members *g*. The members *h* likewise support members *i* for the second floor by hangers 18, and the members *i* likewise support members marked *k* for the first floor by hangers 18.

The members supported by the hangers 18 are temporary supports for the forms for the slabs 25 of the different floors, to wit: 1, 2, 3 and 4, and are designed to be removed after the floor slabs 25 have set. The floor forms 26 may be of any desired construction, and in the present instance, the floor form for the first floor is what is known as the flat slab or mushroom type, whereas the forms 26 for the 2nd., 3rd. and 4th floors are of the beam and girder type. In either case, the floor forms are supported above the channel bars 15 by wooden bars 32, which in the mushroom construction may rest directly upon the channel bars 15 of the members *k*, or they may rest upon a temporary wood floor 33, which in turn rests on the channel bars 15 of the members *g*, *h*, and *i*, in the beam and girder construction of concrete floor shown in floors 2, 3 and 4.

It will be observed, that the metal uprights *a*, *b*, are erected from the ground upward, and that the temporary metal supports for the different floors are constructed from the overhead support *d* downward.

The metal uprights *a*, *b*, are surrounded with the usual forms 35 for the concrete which is to form the columns in the basement B of the building, and when these columns have been poured up to substantially the level of the forms for the first floor, the concrete for the latter may be poured at the same time to form the floor slab 25, which bonds with the concrete of the basement columns. The wood forms 35 for the columns of the first floor are then erected and the concrete for the first floor columns is poured into said forms and the concrete for the second floor slab 25 is also poured and bonds with the concrete of the first floor columns. In the same manner, the columns and floor slabs for the third and fourth floors are formed.

It will be understood, that the metal reinforcement for the concrete columns and floor slabs, now commonly employed in concrete construction may be used in the construction herein shown in the same manner as now employed, but for sake of clearness it has been omitted from the drawing.

While the concrete for the first four floors is being hardened or set, the metal uprights *a*, *b*, are and may be extended upward for a distance equal to a second group of floors as, for instance, four floors more and connected at their upper ends by other trusses like *d*, and the temporary metal floor sustaining members for the 5th, 6th, 7th and 8th floors suspended from said second set of trusses, in the same manner as for the first four floors, after which the wood forms for the floors are laid and the concrete for the columns and floor slabs for the 5th, 6th, 7th and 8th floors poured in a continuous manner.

When the uprights have reached the level of the roof 50 (see Fig. 1), temporary extension 51 of the metal uprights are erected which are connected by cross trusses *d*, and the temporary roof sustaining members marked 52 in Fig. 1 are hung from the roof trusses, and after the roof 50 has been poured the temporary upright extensions 51 and trusses *d* connecting them are taken down.

By reference to Fig. 4, it will be seen that in the present instance the hangers 18 extend through the floor slab 25 and when taken down they leave small openings in the slab which are readily filled with concrete by hand, and openings in the roof are also so filled.

In Fig. 1, the metal uprights *a*, *b*, are shown as of a lattice construction, but it is not desired to limit the invention in this respect, as the metal uprights may be of any desired construction, as, for instance, it may be in the form of an H-section as shown in Figs. 12 to 16, inclusive, wherein the structure is shown in other respects, the same as in Fig. 1.

I have herein described one way in which the concrete columns and floor slabs may be poured or formed in a substantially continuous manner, but it is not desired to limit the invention in this respect, as the removable floor supporting members enable the continuous pouring to be accomplished in other ways. For instance, the concrete for the first four floors may be simultaneously poured and the columns simultaneously poured and bonded with the floor slabs, but in each instance, the forming of the concrete portion of the building is a continuous operation.

After the concrete in the floors has set, the metal floor supporting members 15 and the hangers 18 can be readily removed, as it is only necessary to remove the nuts 21 and washers 20 and lower the hangers through

the holes in the floor slabs, and if made in a single piece, they are sufficiently flexible to be slightly bowed to facilitate removal.

If made in two pieces and adjustably connected, they can be shortened by means of the turnbuckle or the parts may be disconnected.

By removing the nuts from the lower ends of the hanger rods, the channel bars 15 are free to be taken down.

The supporting trusses *d* may also be removed and used over again.

It will be observed that the temporary floor supporting members and their hangers can be used indefinitely, thereby reducing the cost of material required in the construction of concrete buildings. Furthermore these parts are standards and can be made of any size or length according to the height of the stories or sections of the building and the width of the bays or spans, and as they can be erected with little trouble and in a minimum time, speed in the erection of the building is obtained.

So also a minimum number of parts for supporting the floor forms are required, which reduces the cost of material and also of the labor employed, and as the waste of the temporary floor supports is practically nothing, the cost of construction is very materially reduced in this respect.

The hangers used on any one floor are of the same length, and therefore the floor forms are laid evenly and accurately.

When the temporary hangers and floor sustaining members are erected, they are practically immovable until it is desired to take them down, consequently they afford stable supports for the floor forms and avoid liability of accidents in cases where work is being carried on with the hangers in their operative position.

Furthermore, by making the hangers adjustable the floor supporting members can be used for buildings having stories of different heights.

I have herein shown the invention as employed in the construction of a building, but it is not desired to limit the invention to this particular form of concrete structure.

I have herein described the invention as embodied in a concrete structure, and by the term "concrete" I desire to be understood as including other materials suitable for building purposes and of a plastic nature such as gypsum.

Claims:

1. The method of erecting concrete structures, which consists in erecting metal uprights for the height of a plurality of stories or sections of the structure, connecting the upper ends of said uprights by cross members, hanging removable floor supports for a plurality of floors from said members in the space between said uprights, laying the forms for a plurality of floors upon said removable floor supports, and forming concrete columns about said uprights and concrete floors on said floor forms in a substantially continuous manner from the foundation upward.

2. The method of erecting concrete structures, which consists in erecting metal uprights for a height equal to a plurality of sections or stories of the structure, connecting the said uprights at their upper ends by cross members, hanging from said cross members removable supports for the lower floor forms, with the supports for a lower floor suspended from the supports for a higher floor, laying the floor forms upon said removable supports, pouring the concrete for the columns and floors in a substantially continuous manner from the ground upwardly, and removing the said hangers and floor supports.

3. The method of erecting concrete structures, which consists in erecting metal uprights for a height equal to a plurality of sections or stories of the structure, connecting the said uprights at their upper ends by cross members, hanging from said cross members removable supports for the lower floor forms, with the supports for a lower floor suspended from the supports for a higher floor, laying the floor forms upon said removable supports, pouring the concrete for the columns and floors in a substantially continuous manner from the ground upwardly, extending the uprights above said cross trusses for a height equal to a plurality of floors, connecting said upright extensions by cross members, hanging removable floor supports from the second mentioned cross members, laying the floor forms upon said removable supports, pouring the concrete for the columns and floors for the second group of floors, and removing said hangers and floor supports.

4. The method of erecting concrete structures, which consists in erecting metal uprights to the height of the roof of the said structure, detachably securing to said metal uprights extensions thereof which project above the level of the roof, connecting said extensions by cross members, suspending removable supporting members for the roof forms from said cross members, pouring the plastic material to form the roof, and removing said extensions and supporting members after the plastic material for the roof has been poured.

5. The method of erecting concrete structures, which consists in erecting an overhead support for a plurality of floors of the structure, suspending from said overhead support removable temporary supports for a plurality of floors, supporting floor forms upon said removable supports, pouring concrete on said floor forms to form the slabs

for a plurality of floors while said floor forms are supported from the overhead structure, and removing said temporary supports when the floor slabs have set.

6. Apparatus for the erection of concrete structures, comprising metal uprights, cross members connecting said uprights, supports extended across the space between said cross members and sustained by the latter, hangers depending from said supports within said space, floor-supporting members sustained by said hangers, hangers suspended from said floor supporting members within said space, and floor forms sustained by said floor-supporting members.

7. Apparatus for the erection of concrete structures, comprising metal uprights, cross members connecting said uprights, a plurality of spaced metal bars extended across the space between said cross members and sustained by the latter, hanger rods extended up between the spaced metal bars and supported by the latter, spaced metal floor supporting bars between which the lower ends of said hanger rods are extended, and means at the lower ends of said hanger rods for supporting said spaced floor supporting members.

8. Apparatus for the erection of concrete structures, comprising metal uprights, cross members for connecting the said uprights, supporting members extended across the space between said cross members and sustained by the latter, hangers depending from said supporting members within said space, floor supporting members sustained by said hangers, and a floor form supported by said floor supporting members and through and below which said hangers are extended.

9. Apparatus for the erection of concrete structures, comprising removable floor supporting members, removable hangers supporting said members, and removable supports for said hangers located above and within the area of the floor supported by said members.

10. Apparatus for the erection of concrete structures, comprising removable floor supporting members, removable hangers supporting said members, and removable supports for said hangers.

11. Apparatus for the erection of concrete structures, comprising metal uprights of a height equal to a plurality of sections or stories of said structure, an overhead support sustained by said uprights, and a plurality of removable temporary supports for a plurality of floors below said overhead support, and removable means for suspending said temporary floor supports from said overhead support.

12. Apparatus for the erection of concrete structures, comprising metal uprights, detachable extensions therefor, cross members connecting said extensions, and supporting members for the concrete roof forms suspended from said cross members.

In testimony whereof I have signed my name to this specification.

ERNEST R. SPRINGER.