

W. M. PRATT.
REINFORCED CONCRETE FLOOR CONSTRUCTION.
APPLICATION FILED MAR. 19, 1915.

1,244,641.

Patented Oct. 30, 1917.

3 SHEETS—SHEET 1.

FIG. 1.

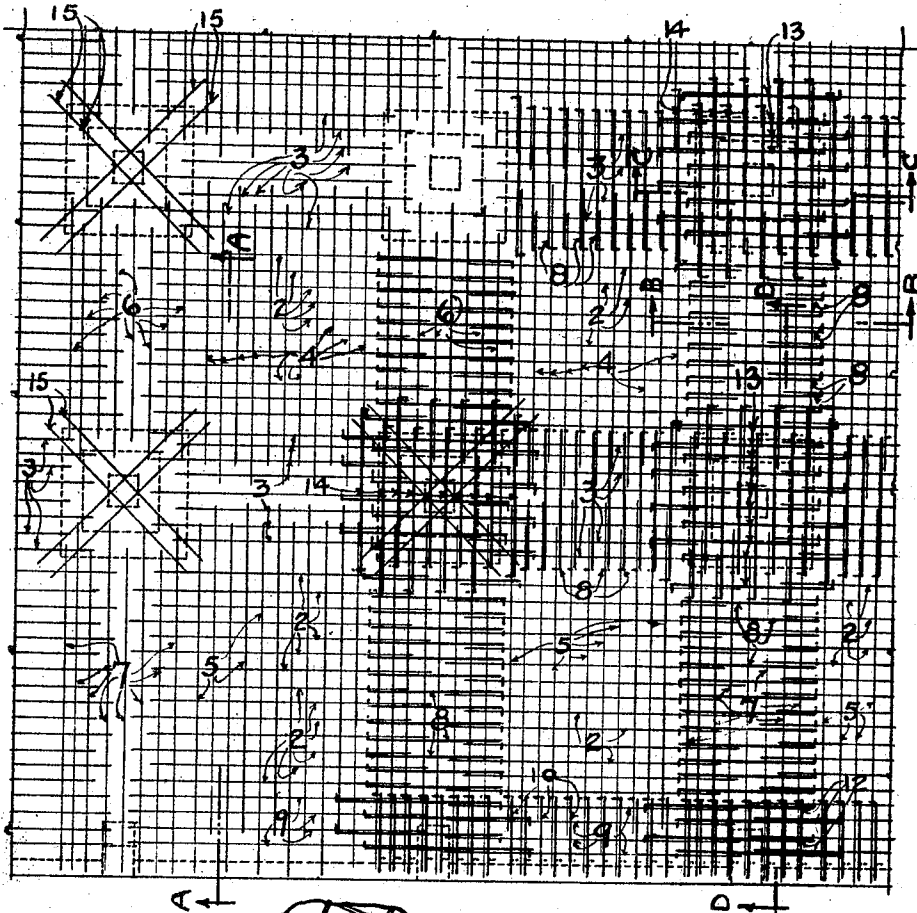
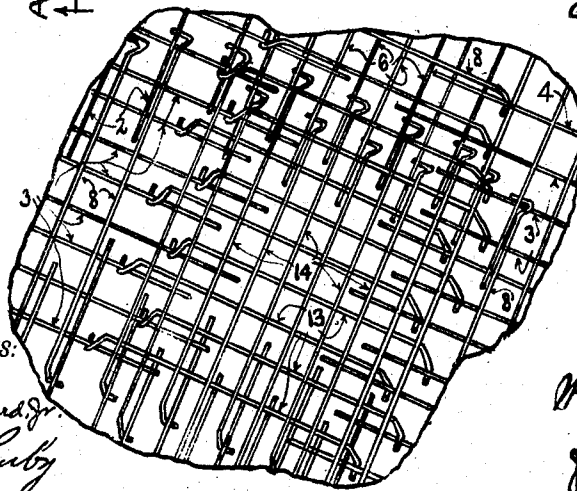


FIG. 6.

WITNESSES:

Frank S. Packard Jr.
Joseph A. Bulby

INVENTOR

Walter M. Pratt

BY

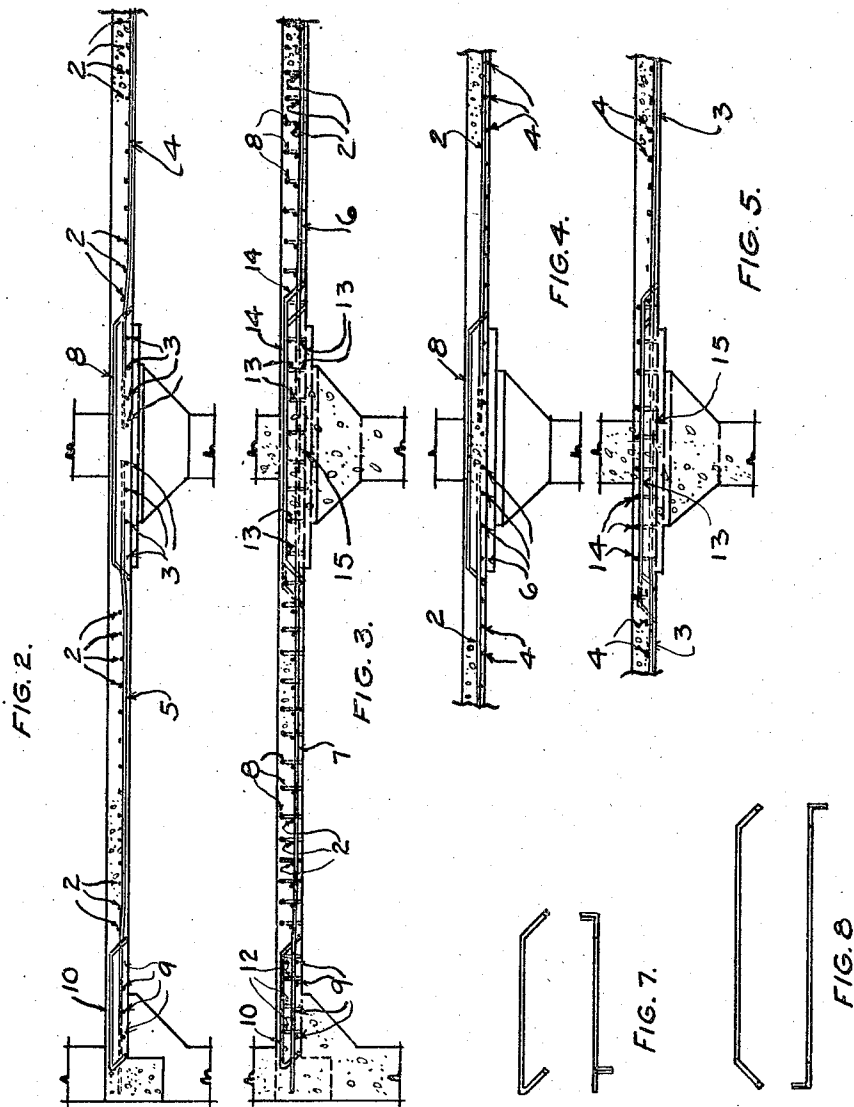
John S. Murray
ATTORNEY

W. M. PRATT.
 REINFORCED CONCRETE FLOOR CONSTRUCTION.
 APPLICATION FILED MAR. 19, 1915.

1,244,641

Patented Oct. 30, 1917.

3 SHEETS—SHEET 2.



WITNESSES:

Frank L. Packard Jr.
 Joseph L. Ruby

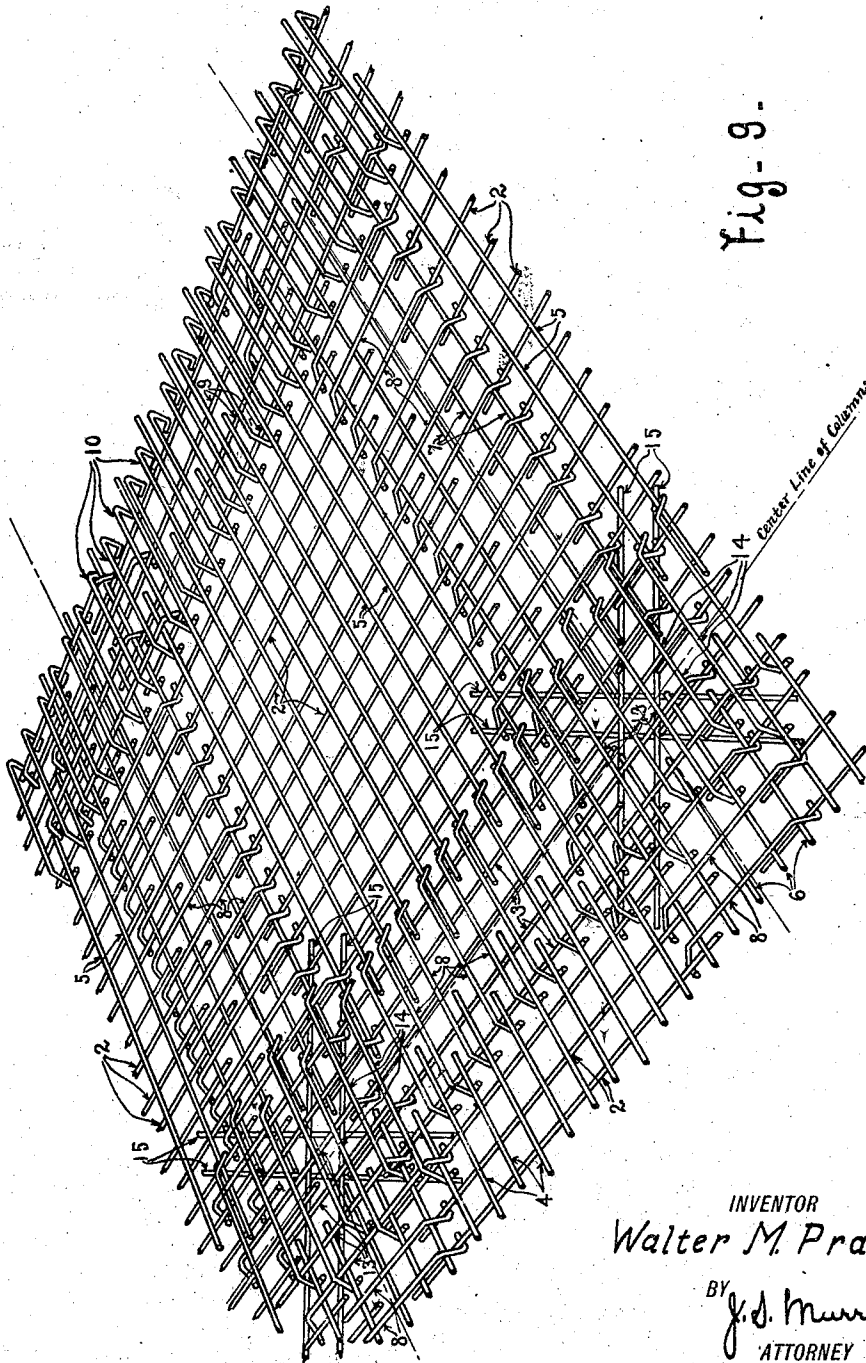
INVENTOR

Walter M. Pratt
 BY John S. Murray
 ATTORNEY

W. M. PRATT.
REINFORCED CONCRETE FLOOR CONSTRUCTION.
APPLICATION FILED MAR. 19, 1915.

1,244,641.

Patented Oct. 30, 1917.
3 SHEETS—SHEET 3.



INVENTOR
Walter M. Pratt
BY
J. S. Murray
ATTORNEY

UNITED STATES PATENT OFFICE.

WALTER M. PRATT, OF DETROIT, MICHIGAN.

REINFORCED-CONCRETE FLOOR CONSTRUCTION.

1,244,641.

Specification of Letters Patent.

Patented Oct. 30, 1917.

Application filed March 19, 1915. Serial No. 15,531.

To all whom it may concern:

Be it known that I, WALTER M. PRATT, a citizen of the United States, and a resident of the city of Detroit and State of Michigan, have invented a new and useful Improvement in Reinforced-Concrete Floor Construction, of which the following is a specification.

My invention relates to a new arrangement of reinforcing bars in concrete floors of the flat slab type. In floors of this type, a concrete slab of substantially uniform thickness is supported on columns or struts, said columns having flaring heads. No girders are used in the usual sense of the term; *i. e.*, a depression of greater depth than the depth of the slab.

Heretofore, various methods of reinforcing flat slabs have been used. These have ordinarily been of the four-way system or the two-way system or a combination of the two. My invention relates primarily to the two-way system; *i. e.*, a system in which two series of reinforcing members are used at substantially right angles to each other. Not only have I developed an analysis of flat-slab stresses, which gives considerable variance in placing reinforcing bars as compared with previous practice, but I have also developed an economy in the amount of material and labor necessary to the making of the slab. Some other designers have often used bars of considerable length, which bars have been difficult to handle, particularly in buildings of several stories in height. Others have used bars bent at one end only, practically all bars in the slab being bent. Still others have used approximately one half of the bars bent, the bent bars usually being bent at both ends. In all these other cases, separate supporting bars and sometimes concrete blocks have been necessary in order to keep the top reinforcing in the regions above the neutral axis. In my method of reinforcing, all top bars or reinforcement for negative moments are self-supporting, and to all intents and purposes can not be dislodged from their proper places.

In the drawings, Figure 1 through Fig. 6, like numbers denote like parts. Fig. 1 is a plan view, showing exterior and interior panels. All concrete is assumed removed, the bars showing as if resting on forms. Fig. 2 is a cross-section on line A—A. Fig. 3 is a cross-section on line D—D. Fig. 4

is a section on line B—B. Fig. 5 is a section on line C—C. Fig. 6 is a perspective of reinforcing over and adjacent to the columns. Fig. 7 is an elevation and plan of top bars used in the top region of exterior sides of exterior panels, or around openings which break up the continuity of the floor construction. Fig. 8 is an elevation and plan of top bars used over the columns and in the top regions between columns and enclosing the panels. Fig. 9 is a perspective view showing the arrangement of bars which I employ for reinforcing a portion of a floor including a panel adjacent one of the floor margins.

In my method of construction, all top bars are self-supporting. This is accomplished by extending the top reinforcement downward at each end and then extending each end horizontally and laterally in opposite directions. This is shown in Fig. 7 and Fig. 8, and elsewhere in the drawings. These out-standing legs may rest on the forms or on suitable chairs, when it is desired to keep the out-standing legs off the forms. Furthermore, these same out-standing legs, form a seat for supporting bars in the bottom region of the slab, or regions of positive moment. At least one top bar corresponds to one bottom bar. In this way, a virtual connection is formed between all bottom and top reinforcement, not only at one end of any bottom bar, but at both ends, thus practically doubling the anchorage relation between top and bottom reinforcement, as compared with any other type that I know of. In addition, it has been necessary heretofore, to provide numerous supports to keep bottom steel off the forms. My method reduces the number of such supports to a large extent, owing to the fact that the out-standing legs of top bars form natural seats or supports for the ends of all bottom bars.

It is well known that negative moments normally fall off or reduce more rapidly than do positive moments. By using separate reinforcement for negative moments, rather than by extending steel used for positive moments up into negative moment regions to take care of negative moment stresses, the tonnage of bent steel is reduced, my method saving approximately 10% in this particular, over any other system with which I am familiar.

Furthermore, positive and negative mo-

ment stresses are variable quantities. In the middle of the slab, at points substantially equidistant from column centers, there exist positive moments. The stresses due to these moments are taken care of by bars 2 and 4, and in the exterior panels by bars 2 and 5. By exterior panels are meant those adjacent a supporting wall or a supporting beam bordering an opening or break in the floor. There is no need to run these bars to the center lines of columns, and I have used the "stagger principle", so common in the use of plate-girders. Thus one bar 2 will be staggered a short distance as compared with the next bar 2; similarly for bars 4. Top bars over the columns may also be staggered, thus giving better shear reinforcing in the regions near the column heads. This use of the stagger principle results in a further economy of material, with no loss in strength.

Again, my investigations indicate that it is desirable to place bottom steel diagonally in the regions over the columns. This reinforcing provides for reinforcing due to the merging of two lines of contraflexure, and this reinforcing crosses the juncture of these lines at substantially right angles to the same. In my opinion, this reinforcing will tend to prevent the unsightly cracks sometimes occurring in flat slabs in this region. The bars referred to are marked 15.

My flat slab makes a further saving in that practically all bars are spaced substantially at equal intervals apart. For instance, all bars 2 are at equal distances apart. So it is for bars 5, or bars 4, or bars 6, or bars 7, or bars 8. It is true that bars 7 are likely to be larger bars than bars 2, which is entirely in accord with my analysis. My general scheme gives a simplicity and ease of erection embodied in no other type to the same degree. Heretofore, in two way flat slabs there have been used various methods of proportioning steel in the central portion of the slab. One school groups the bars closet together in this region; another school groups the bars farthest apart where the first school groups the bars closet together. My method involves the middle ground between the two, and, I believe, gives a better distribution of the reinforcement.

My improvement consists in placing the bars substantially parallel to lines through column centers or to other supports, said bars running in substantially two directions at substantially right angles to each other, and in the detail placement of said bars or reinforcement in two separate series using separate bars for negative moment stresses as compared with those for positive moment stresses, and as shown on the drawings accompanying this specification and forming a part thereof.

My improvement would also apply to the detail use of reinforcement for metal, clay or shale tile, plaster composition, tile and concrete floors, with or without the use of deepened girders.

Referring to Fig. 1, all concrete is assumed removed, with the bars lying on the forms. Light dotted lines show the concrete below. Light lines show bars in the bottom regions. Heavy lines show bars in the top regions. The bars 2, 5, and 4 are bottom bars, grouped in approximately 70% of the panel width, and extending nearly to the column centers in length, the bars in any one series being staggered. Similarly, bars 3, 6, 9 and 7 are bottom tension bars and are staggered at their ends. Bars 12, 13 and 14 are top bars over columns or supports, and are self-supporting each bar for itself. Bars 8 are top bars and are self-supporting. Bars 10 are exterior top bars and are not only self-supporting, but are sure to develop any stress in them owing to the hook at the out-side end. All top bars are bent so that their longest dimension is at the proper height off the forms. Bars 15 are bottom bars running diagonally across the columns.

The lines of contraflexure near the columns are approximately at the quarter or fifth distance from center to center of columns. Between columns, the lines of contraflexure are at approximately the distance of the distance center to center of columns. There exist two sets of lines of contraflexure at substantially right angles to each other. Since all loads must travel along the lines of reinforcing, each line of contraflexure marks the line of suspension of transverse loads coming upon it. Therefore, the top steel around the columns should have greater extent than the top steel between columns. This is shown on the accompanying drawings, bars 13, 14 and 12 being longer than bars 8. This results in an economy of steel, and a logical provision for the top regions of tension. Exterior panels are somewhat different, since continuity is lost in one direction, which will sometimes require additional bottom steel in regions covered by bars 7.

Having thus described my improved floor system, what I desire to claim and secure by Letters Patent is as follows:—

1. A reinforced concrete floor supported by rows of columns, and comprising a plurality of slabs each reinforced by two series of long bars extending substantially at right angles to each other, and adjacent the lower surface of the slab, the adjoining marginal portions of the slabs being reinforced near the top surface with short bars extending transversely of said portions, the bottom bars extending parallel with these top bars and overlapping same, said series of

short bars forming a grillage over the column heads, and said series of short bars having downwardly bent end portions whereby said short bars are supported during formation of the floor, diagonal bottom bars crossing each other at substantially right angles being provided over the column heads and in substantially the same plane of said long bottom bars.

2. A reinforced concrete floor, supported by rows of columns, and comprising a plurality of slabs, each reinforced by two series of long bars extending substantially at right angles to each other and adjacent the lower surface of the slab, the adjoining marginal portions of the slabs being reinforced near the top surface with comparatively short bars extending transversely of said portions, said bottom bars extending substantially parallel with said top bars and overlapping the same, said series of short bars forming a grillage over the column heads, diagonal bottom bars being provided over the column heads, crossing each other at substantially right angles and in substantially the plane of the bottom bars.

3. A reinforced concrete floor, supported by rows of columns and comprising a plurality of slabs, each reinforced by two series of long bars extending substantially at right angles to each other and adjacent the

lower surface of the slab, of two series of comparatively short bars respectively substantially parallel with said long bars and arranged adjacent the top of the slab in the regions above the columns, and two bars arranged substantially in the plane of said long bars above the columns, in a substantially transverse relation to each other and in a substantially diagonal relation to said top bars, providing reinforcing against the stresses due to merging of the two lines of contraflexure.

4. In a concrete floor supported by columns, a series of short bars crossing a line of centers between columns adjacent the top surface of the floor, and a series of long bars parallel to said short bars and extending adjacent the bottom surface of each of the panels adjoining said line of centers, the ends of said short bars being bent down to have an anchorage engagement with said long bars, the long bars being extended beneath the short bars into proximity to said line of centers.

In testimony whereof I affix my signature in presence of two witnesses.

WALTER M. PRATT.

Witnesses:

FRANK S. PACKARD, Jr.,

JOSEPH L. RUBY.