H. S. TAFT.

REINFORCED CONCRETE COLUMN CONSTRUCTION.

APPLICATION FILED MAY 22, 1913.

1,111,194.

Patented Sept. 22, 1914.

4 SHEETS—SHEET 1.

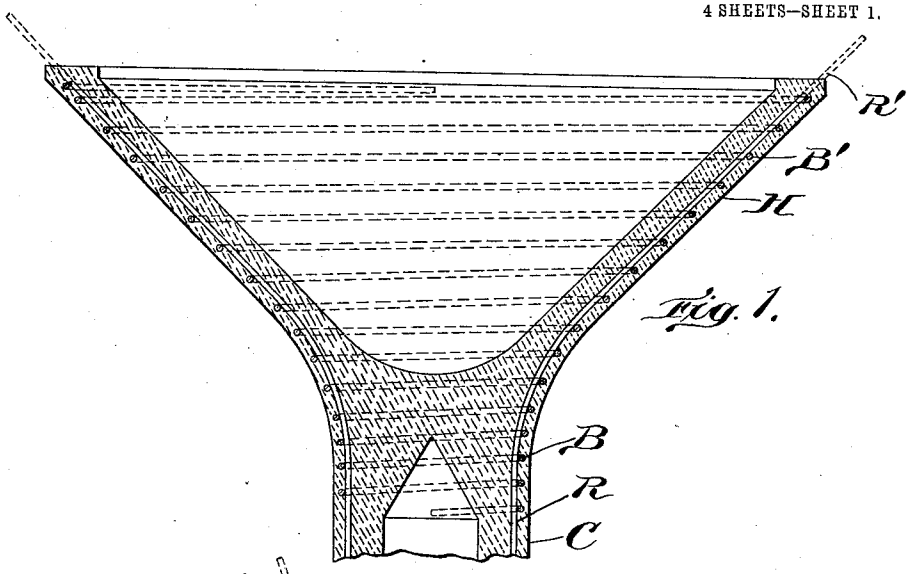


Fig. 1.

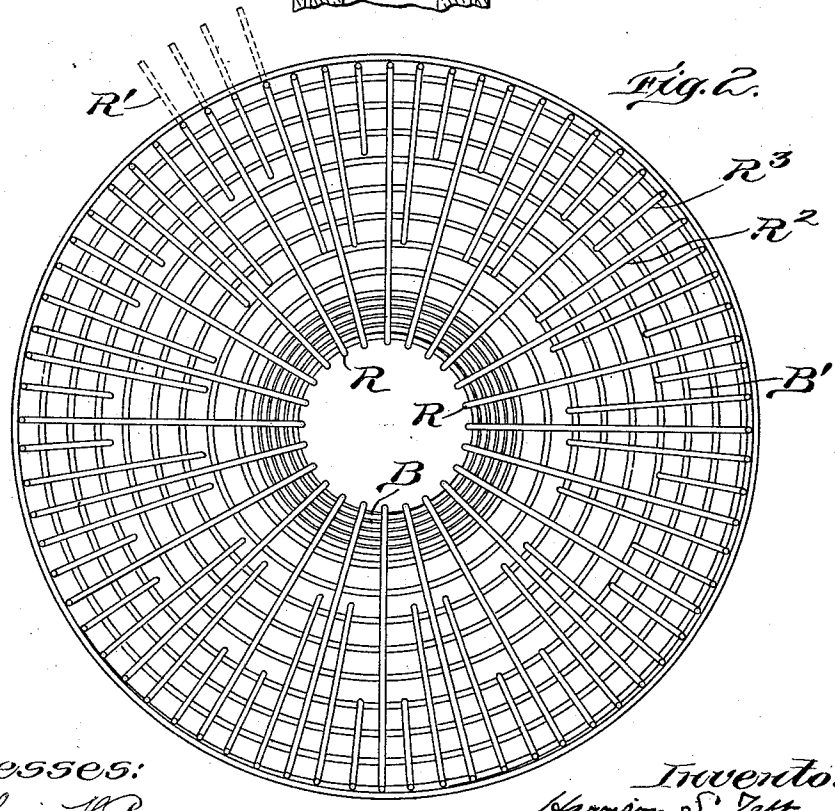


Fig. 2.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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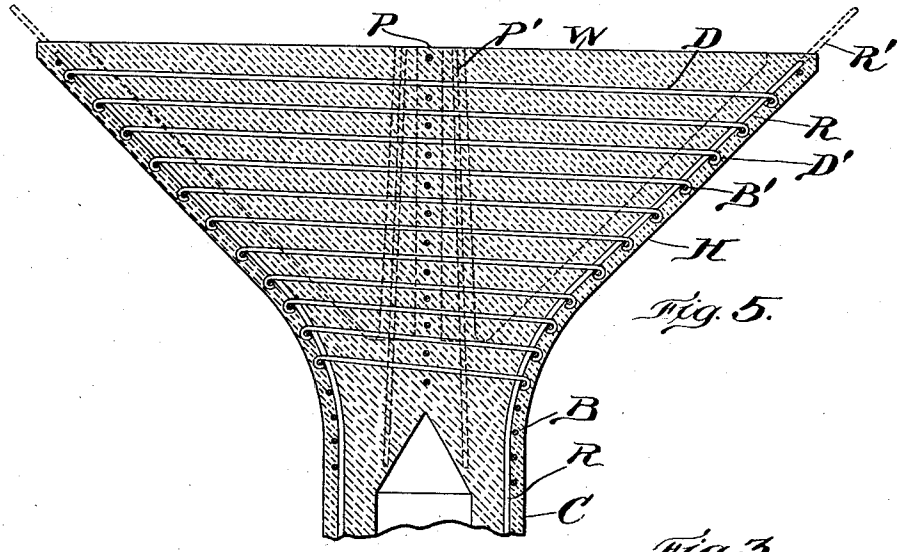


Fig. 5.

Fig. 3.

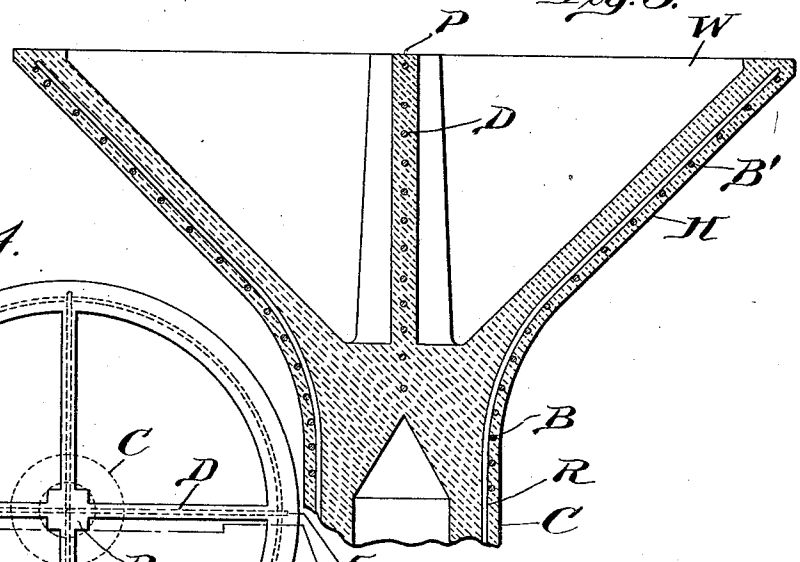
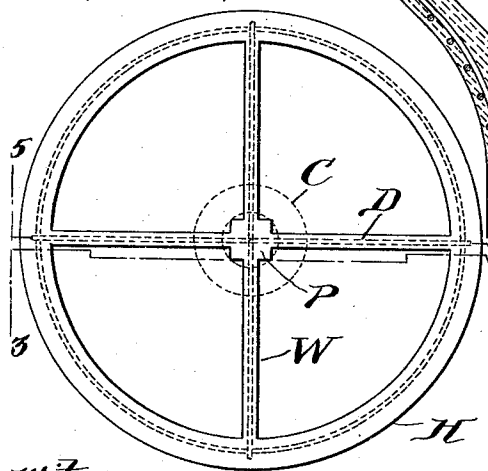


Fig. 4.



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4 SHEETS—SHEET 3.

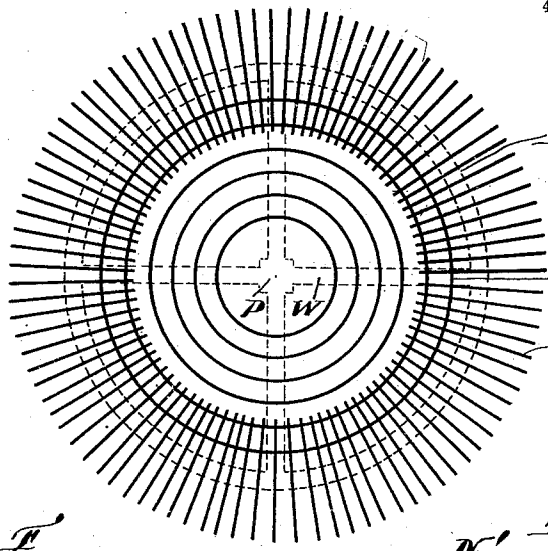


Fig. 6.

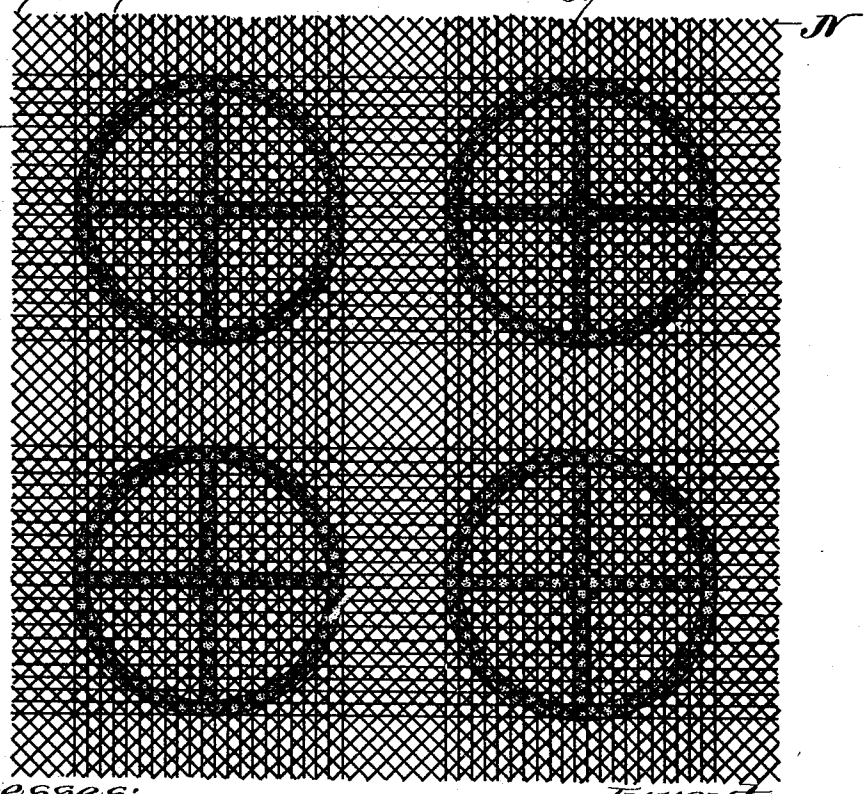


Fig. 7.

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4 SHEETS—SHEET 4.

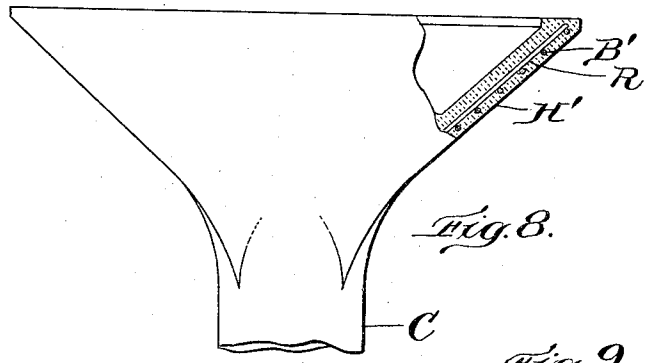


Fig. 8.

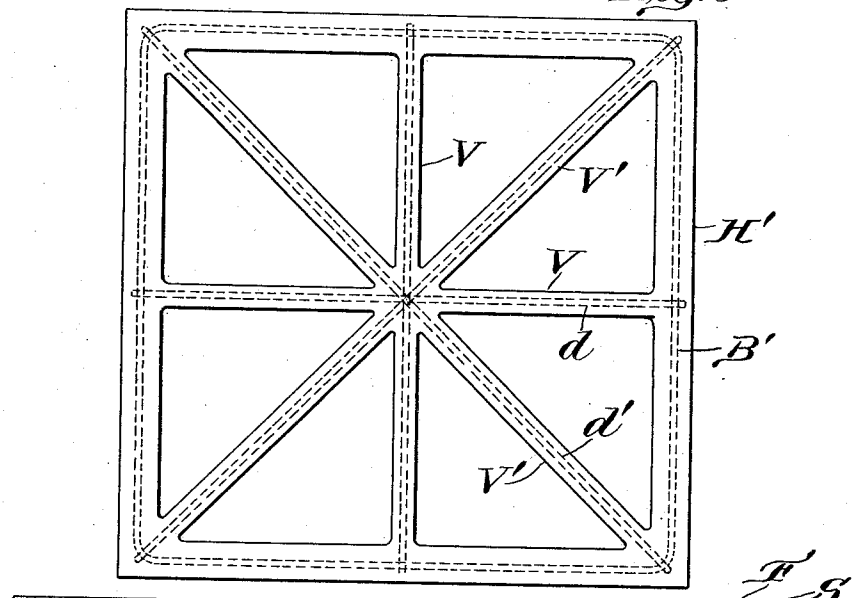


Fig. 9.

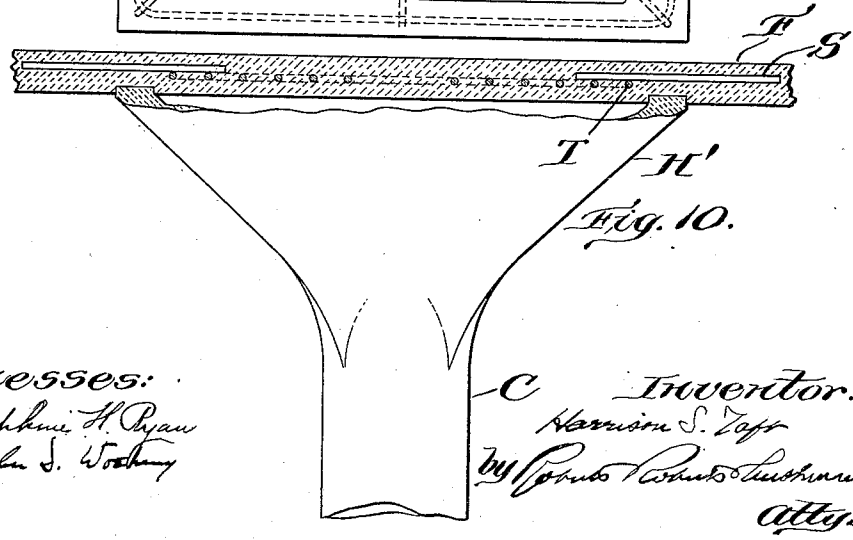


Fig. 10.

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UNITED STATES PATENT OFFICE.

HARRISON S. TAFT, OF SEATTLE, WASHINGTON.

REINFORCED-CONCRETE COLUMN CONSTRUCTION.

1,111,194. Specification of Letters Patent. Patented Sept. 22, 1914.

Application filed May 22, 1913. Serial No. 769,216.

To all whom it may concern:

Be it known that I, HARRISON S. TAFT, a citizen of the United States, and resident of Seattle, in the county of King and State of Washington, have invented new and useful Improvements in Reinforced-Concrete Column Construction, of which the following is a specification.

My invention relates to reinforced concrete construction, and consists in certain improvements by which columnar supports for decks or floors are endowed with an improved and superior capacity for carrying superimposed loads.

Reinforced concrete columns which embody my improvements do not depend, for their effective operation, upon attachment to the covering floor or slab by means of internal steel reinforcement, although the reinforcement of the column head may, for convenience in supporting the reinforcing metal during construction be carried into or incorporated with the reinforcement of a concrete floor slab. In connection with this improved column, simplifications and improvements of floor slab reinforcement are made possible.

In the drawings hereto annexed which illustrate my inventions,—Figure 1 is a vertical section of the head of a reinforced concrete column; Fig. 2 is a plan view showing the mode in which the reinforcing steel is arranged in and near the head of the column; Fig. 3 is a vertical section on the broken line 3—3, Fig. 4, of a modified form of column and head; Fig. 4 is a plan view on a reduced scale of the column head shown in Fig. 3; Fig. 5 is a vertical section at the line 5—5 of Fig. 4; Fig. 6 is a diagram illustrating the method of reinforcing floor slab to be used in connection with my improved reinforced concrete column; Fig. 7 is a diagram illustrating another mode of floor slab reinforcement; Fig. 8 is an elevation, partly broken away and in section, of a column surmounted by a rectangular expanding head; Fig. 9 is a plan view of the column head of Fig. 8; and Fig. 10 is an elevation, partly broken away and partly in section, of a column with rectangular head and a reinforced concrete floor slab superimposed thereon.

Referring to Figs. 1 and 2, a reinforced concrete column C which may be constructed in the manner described in an application for United States Letters Patent filed by me concurrently herewith, Serial No. 769,212, is surmounted by an integrally formed hollow conical head H. The steel reinforcement for the conical head is anchored in and extends upward from the body of the column C and consists of radial steel members R, R^2 and R^3, the members R being anchored in the body of the column C and extending upward toward the geometrical base of the inverted cone which constitutes the head H, the radial members R^2 and R^3 being shorter than the members R, and arranged in such manner as to supply a substantially uniform quantity of reinforcing material per square foot of surface in the conical head H at all parts of the same. If desired, the ends of this radial reinforcing material may be extended upward out of the conical head H, as shown in dotted lines at R′, so as to be available for incorporation with a reinforced concrete floor slab, although such extension of reinforcement of the conical head into the floor slab is not necessary in the system of construction which is characterized by the hollow expanding-headed columns herein described. The radial members R, R^2 and R^3 of the reinforcement are supplemented by circumferentially disposed members which may be arranged in effect to constitute a continuous spiral extending from the spirally arranged reinforcement B in the top of the column C to the similar reinforcement B′ in the hollow conical head H. The helical or spiral form of circumferential reinforcement has the effect of a series of reinforcing rings of successively increasing diameters in conformity with the upward enlargement of the head H. The circumferential reinforcements B, B′ embrace the radial reinforcements R, R^2 and R^3 so as to afford the necessary resistance to stresses which tend to expand or burst the head H.

While, for many purposes, a hollow expanding or upwardly flaring head, such as shown in Fig. 1, will suffice, the further reinforced and strengthened form shown in Figs. 3, 4 and 5, is, I believe, to be preferred. In these figures the upwardly flaring head H surmounting the column C, is provided with vertical transverse webs which at their intersection form the central post P. In addition to the radial and circumferential reinforcements R, B and B′, there is provided transverse reinforcement D comprising steel rods which extend dia-

metrically across the column head and are incorporated in the webs W. The diametrical reinforcements D are preferably hooked or otherwise tied to the circumferential reinforcement B′ as at D′. Vertical reinforcing material P′ may, if desired, be introduced to increase the rigidity of the central post P, and constitute it, in effect, a continuation of the column C.

If a reinforced concrete floor is to be supported by a group of columns such as hereinabove described, the reinforcement of such floor may be and preferably is, wholly independent of the reinforcement of the columns and heads themselves in so far as resistance to stresses is concerned; as illustrated in Fig. 10 a reinforced concrete floor slab F may be molded on top of the column heads, or, for that matter, might be formed separately and independently and then laid as a completed slab upon the columns. Obviously, however, it will better serve the economies of construction to construct such floor slabs *in situ* upon the columns.

Referring to Fig. 6, the head H of an expanding-head column, such as above described, is shown in dotted lines, the full lines representing a mode of reinforcement of the floor slab to be laid upon and supported by the column head H. Rings T of reinforcing steel are laid concentrically in the slab and radially extending reinforcing pieces S are incorporated in the slab so as to coöperate with the outer rings T and to extend beyond the periphery of the column head H. When the number of columns with upwardly flaring heads H are arranged radially in longitudinal and transverse rows, annular and radiating slab reinforcements, such as shown in Fig. 6, will operate effectively to resist bending moments developed in the floor slabs.

In Fig. 7 there is illustrated another mode of reinforcing a concrete floor laid upon a group of columns, the reinforcement in this case consisting of longitudinal parallel reinforcement rods F, transverse rods G, and diagonal rods M and N. The columns are preferably so grouped that a diagonal reinforcement rod, such as N′, which is just tangent to the outer periphery of one of the column heads, will pass within or very close to the periphery of the next column head so that each diagonal rod in the system will receive direct support from the column heads at points which are distant from each other less than the distance from center to center diagonally between any two column heads. Practically every diagonal rod therefore will pass over and be supported by each of the column heads in two adjacent diagonal rows.

For some purposes it may be desirable to employ expanding or upwardly flaring conical column heads which, instead of being geometrically conical, may be pyramidal in form. Such forms are illustrated in Figs. 8, 9 and 10 in which the heads H′ are rectangular in horizontal section and are reinforced like the conical head H by radial reinforcement R and peripheral reinforcement B′. Preferably, also, column heads of this character will be further strengthened by webs which may extend both diametrically and diagonally across the interior of the hollow head. Such webs are shown at V and V′ in Fig. 9, and the transverse, that is to say, diametrical and diagonal reinforcement for such webs is indicated at *d* and *d′*, the peripheral reinforcement being shown in dotted lines at B′.

Referring to the construction shown in Figs. 3, 4, 5, 8, 9 and 10, which illustrate the preferred form of internally webbed hollow expanding column head, the hollow expanding head and its webs form a system of supports around the center core of the head (the post P as in Figs. 3, 4 and 5), which core is in reality an upward extension of the column itself into the head, and upon this system of supports the floor slab itself rests. It is not essential that the column head or its reinforcement shall act as a carrying support for the reinforcement of the slab itself, as has been the case with concrete column and floor construction hereto employed. The reinforcement of the column heads consists of the radial and circumferential rods, while the reinforcement of the webs consists of the diametrically or diagonally arranged horizontal rods which furthermore tie the rings or spirals of the circumferential reinforcement diametrically. The ends R′ (Figs. 1, 2 and 5) may be bent or tied over the steel rods of the floor slab in such a way as to tie the slab steel to the head steel; but even in this case the radial head-reinforcement will not act as a reinforcement of the slab itself.

In the construction illustrated in Fig. 7 the extreme peripheries of the column heads in two adjacent diagonal rows are tangent to the same diagonal 45° line so that, in effect, every diagonal rod will pass over each head. Whatever the actual column spacing may be the head should be of such a size as to meet this requirement so that the slab reinforcement will obtain the advantage of the shortest possible unsupported span. The reinforcements, such as shown in Fig. 7, will preferably be in duplicate, consisting of two distinct similar sets of longitudinal, transverse and diagonal rods, one network of rods being located near the bottom of the slab or flooring, and the other set near the top. The bottom layer of rods will then take up all the tension stresses in the lower part of the slab or floor and the top rods all the negative bending stresses over the supporting slabs. Or, these negative

stresses can be taken care of by the individual "spider web" arrangement shown in Fig. 6, preferably in coöperation with the network arrangement shown in Fig. 7, employing the network of straight rods at or near the bottom of the floor slabs and the "spider web" reinforcements at the level near the top of the floor slab.

It will be noticed that where the system illustrated in Fig. 7 is used, at least two sets of reinforcing rods are present in the floor slab, as at the rectangular space located symmetrically between each group of four column heads. With this arrangement 7% of the floor slab has two such belts of rods, 39% has three belts, and 54% has four belts, assuming only one network system such as illustrated in Fig. 7 to be employed. A similar disposition of floor slab reinforcement may be used in coöperation with polygonal or rectangular column heads, in which case the cross and longitudinal reinforcement might be wholly or partly eliminated by reason of the shortening of the maximum span from head to head. It is recommended, however, that in all cases a proper measure of diagonal reinforcement be employed in the manner hereinabove suggested.

Among the advantages of the above described construction the following may be enumerated: The upwardly flaring reinforced concrete hollow heads of the columns are self supporting and amply capable of resisting the expansive stresses of superimposed load. The slab or floor reinforcement needs in no way to be tied to or incorporated with the column head reinforcement. Perfectly straight unbent reinforcing rods may be employed throughout the entire deck slab and not a single cantaliver reinforcing bar is required in any of the types of construction herein described. The spans without direct support from the column heads are short and the disposition of reinforcing material in the floor slabs in relation to the column heads is such that a minimum of unsupported span is insured. The stresses developed in the construction are simple. Irrespective of the type of head employed, not less than two sets of belts of reinforcing rods are found in every portion of the floor slab.

The column head hereinabove described is shown as a development at the top of a column, adapted to receive and support a superincumbent floor load. It is obvious that a column of essentially the same characteristics, with a similar head, may be inverted, the head constituting a lower head or base, adapted to rest upon a foundation, or on a raft or crib, substaining a reactive load from below. In using the term "head", I include thereby an inverted head or base of the character described.

I claim:

1. A column head, comprising a flaring hollow concrete body, transverse concrete webs integral with said body, and reinforcement arranged in flaring form in the body and transversely in said webs.

2. A column head, comprising a flaring hollow concrete body, transverse concrete webs integral with said body, reinforcement arranged in flaring form in the flaring body and transversely in the webs, said reinforcement consisting of radial members and circumferentially disposed members in the flaring body, and transverse members in said webs.

3. A column head, comprising a flaring concrete body, transverse concrete webs integral with said body, reinforcement arranged in flaring form in the flaring body and transversely in the webs, the body reinforcement comprising radial members and circumferentially disposed members which inclose the frame work formed by the radial members.

4. The combination of a concrete column, a column head comprising a flaring hollow concrete body, transverse concrete webs integral with said body, and reinforcement arranged in flaring form in the said concrete body and transversely in the said webs, part of the said reinforcement extending from the head into the column.

5. The combination of a concrete column, a column head comprising a flaring hollow concrete body, transverse concrete webs integral with said body, and reinforcement arranged in flaring from in the flaring body and transversely in the webs, said reinforcement consisting of radial members and circumferentially disposed members in the flaring body and transverse members in the webs, portions of said reinforcement extending from the head into the concrete column.

6. The combination of a concrete column, a column head comprising a flaring hollow body, transverse concrete webs integral with said body, reinforcement arranged in flaring form in the flaring body and transversely in the webs, said reinforcement comprising radial members and circumferentially disposed members which inclose the framework formed by the radial members, parts of said reinforcement extending from the head into the concrete column.

Signed by me at Seattle Washington this 12th day of May 1913.

HARRISON S. TAFT.

Witnesses:
EUGENE L. MCALLASTER,
CLIFFORD WILEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."