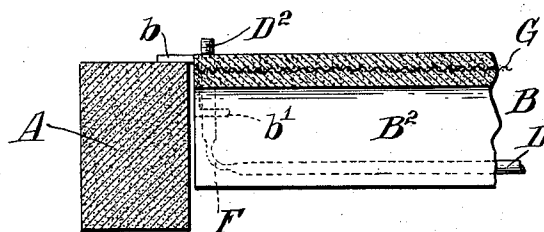
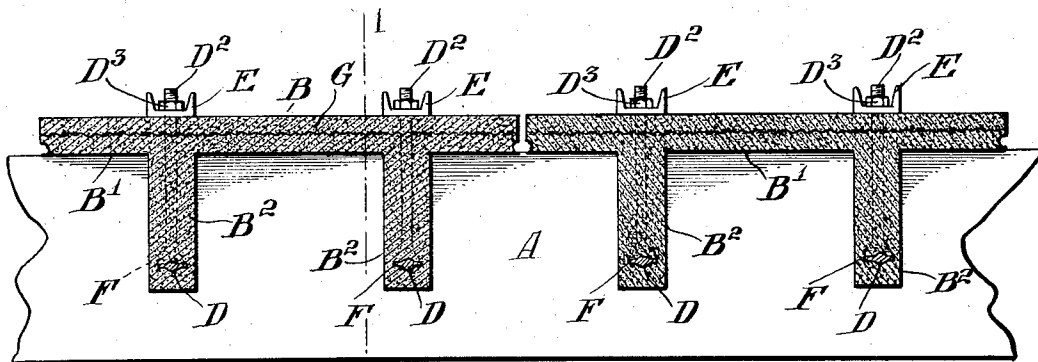
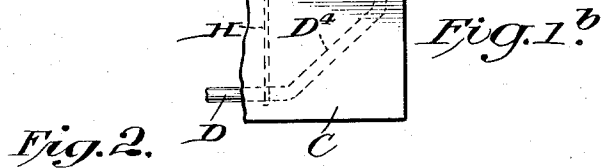
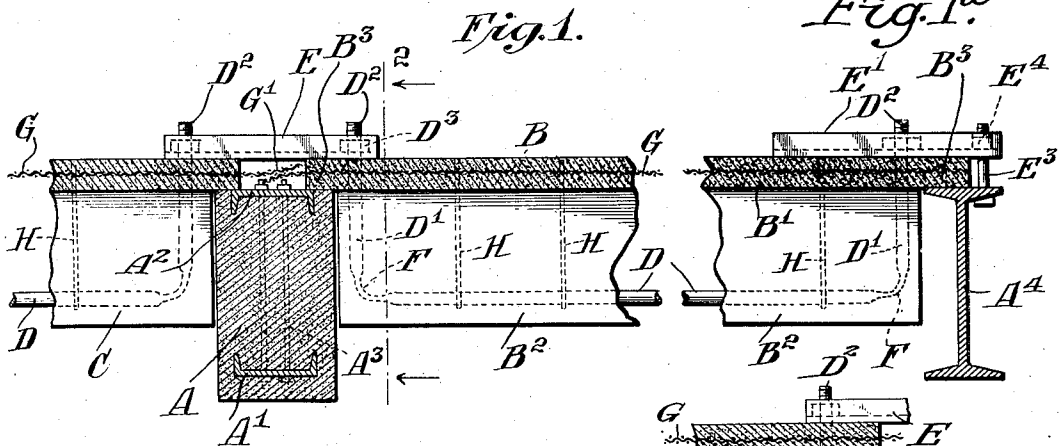


C. B. GRADY.
CONCRETE STRUCTURE.
APPLICATION FILED FEB. 19, 1910.

1,049,702.

Patented Jan. 7, 1913.

2 SHEETS—SHEET 1.



Attest:
Elizabeth B. King

Inventor:
Charles Benedict Grady
by
Donald Campbell, his Atty.

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2 SHEETS—SHEET 2.

Fig. 4.

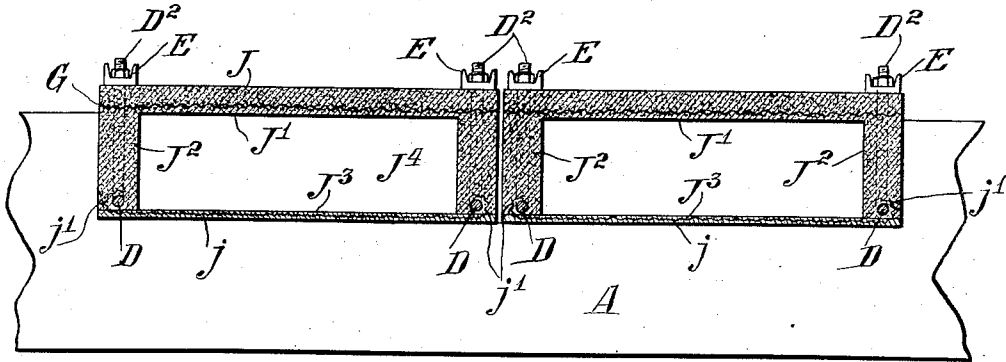


Fig. 5.

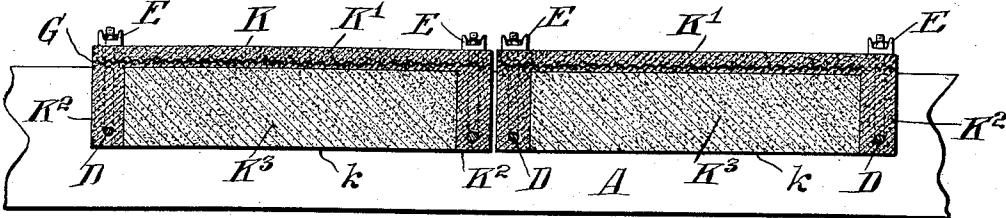
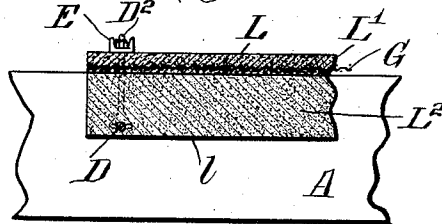


Fig. 6.



Attest:
E. M. M. M.
Elizabeth B. King.

Inventor:
Charles Benedict Grady
by
Donald Campbell, his Atty.

UNITED STATES PATENT OFFICE.

CHARLES BENEDICT GRADY, OF WEST ORANGE, NEW JERSEY.

CONCRETE STRUCTURE.

1,049,702.

Specification of Letters Patent.

Patented Jan. 7, 1913.

Application filed February 19, 1910. Serial No. 544,728.

To all whom it may concern:

Be it known that I, CHARLES BENEDICT GRADY, a citizen of the United States, residing in West Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Concrete Structures, of which the following is a specification.

My invention relates to concrete structures and more especially to a floor construction for buildings and the like.

Among the objects of the present invention are to cheapen and simplify the erection of a building having concrete flooring, and more especially with relation to such when of a light construction not intended for carrying excessive floor-loads.

In carrying out the above objects I have invented a novel concrete flooring which, as shown, is to be made up of girders or the like, together with floor-slabs, the latter being preformed, that is previously made in the shop or elsewhere before being set into place.

I will first describe one form of concrete structure embodying my improvements and will then point out the novel features in the claims.

In the accompanying drawings, Figure 1 shows partly in section and partly in elevation, a couple of girders and floor-slabs embodying my improvements, the section being taken on the plane 1—1 of Fig. 2. Fig. 1^a represents substantially a continuation of the structure shown in Fig. 1, illustrating the opposite end of the slab and containing certain modifications and details. Fig. 2 is a section taken upon the plane 2—2 of Fig. 1. Fig. 3 is a detail sectional view of a part of the construction shown in Fig. 1, but illustrating a modification thereof. Fig. 4 represents a modification, said view being a section upon the same vertical plane as Fig. 2. Fig. 5 represents, by means of a similar sectional view, a still further modification. Fig. 6 represents in a similar sectional view a still further modification.

Similar letters of reference designate corresponding parts in the several figures of the drawings.

Generally speaking a floor embodying the present improvements is one which consists of girders extending from column to column, and floor-slabs extending from girder to girder, there being preferably a series of par-

allel slabs set between each pair of opposite girders so as to cover the entire floor area; and between each of those girders and the succeeding girders other similar series of floor-slabs.

In a general way my present improvements relate to the subject matter set forth in my prior Patent No. 902,651, issued Nov. 3, 1908. By a "floor-slab" I mean a floor member which has substantially the following characteristics, namely, that its top surface is to be a portion of the floor, and that it is to have a substantial width as compared with its length in contradistinction to the proportions of an ordinary floor beam. The above definition, however, does not preclude the frequently used expedient of a supplementary layer of concrete or other material which is superimposed above the floor-slabs after the latter have had laid on top of them piping, wiring or tiling as may be desired.

The present invention is shown embodied in floor-slabs which are of such a character as to extend from girder to girder, one slab spanning the entire distance and having also such depth and strengthening means that the use of floor beams is unnecessary.

Referring to the drawings hereof A represents a girder which may be of any variety, but is shown as a composite member built up of concrete with embedded metal parts. As shown the girders are preferably rectangular in shape and the embedded structure comprises a tension portion A', a compression portion A² and bolts A³ connecting said tension and compression portions. The compression portion should be less in cross-sectional area than the tension portion since the concrete above the neutral axis of the girder will resist a part of the compressive strain. In Fig. 1^a is shown a simple I-beam A⁴ for a girder.

B represents one of the floor-slabs embodying my present invention, and C represents another one on the opposite side of the girder and used for convenience to illustrate a simple modification of structure. Referring now to the floor-slab B, it is a preformed floor-slab which may be made in the shop in its work-wise position, that is with the same side up as shown in the drawings; and said slab extends from one to the other of two oppositely disposed girders. Said slab B consists of a mass of hardened concrete having embedded therein at least

one metallic structure having the characteristics hereinafter to be described. In its general form the slab has a body portion, which is the flat upper portion B' and as shown at least one depending concrete rib B^2 , each of said ribs designed to embed one of the interior metallic structures. Referring to Fig. 2 it will be seen that beneath the body portion B' are arranged two of such ribs B^2 in parallelism. The body portion may have a greater length than that of the ribs so that as shown in Fig. 1 it will extend beyond the ribs at B^2 , this extending portion forming a projection which may rest directly upon the top of the girder A . The bearing thus obtained will be sufficient to hold the slab in place during the process of erection, but as will hereinafter appear, I have provided additional support for the slab. In addition to resting upon the girder's top, as just explained, the slab may otherwise engage the girder, for instance the lower corner of each rib may be engaged in a recess or seat formed in or projecting from the side of the girder.

Coming now to the metal interior of the slab this comprises, as already stated, at least one metallic structure, which structure extends longitudinally for substantially the entire length of the slab. In detail the structure comprises principally a tension portion D , which is shown as a horizontal bar of round cross-section embedded in the concrete and located substantially below the neutral axis of the slab; together with an upwardly extending portion D' which is, also embedded in the concrete and is located near the end of the slab or of the ribs thereof, and said upwardly extending portion emerges and projects from the concrete at or near the end of the slab. There of course will be a similar upwardly extending portion at each end of the slab. The projecting portion D^2 of the metallic structure is intended to be connected to a similar projecting portion of an oppositely disposed slab, said connection being made by a metallic tie which extends across and above the girder, there being means for attaching the tie at one or both ends so as to permanently connect the said projecting portions D^2 .

E represents a tie which extends across and above the girder, it being perforated at proper points so as to permit it being attached to the projecting portions D^2 of a pair of opposite slabs. For convenience the connecting tie E is made in the form of a channel bar with the flanges thereof projecting upwardly.

The metallic projecting portions D^2 are shown as provided with screw threads adapted to receive nuts so that the perforated tie-bar E when engaged over two of the projecting rods D^2 , can be there securely attached by screwing the nuts D^3

firmly down into contact with the bottom of the channel bar. In this position the tie-bar has beneath it the concrete portions B^3 at the ends of the slab body, and these latter rest directly upon the top of the girder so that support for the tie-bar is obtained from the girder. The tie-bar in turn through the connections already described affords a strong support for the metallic structures embedded in the slabs, which support will be ample for any ordinary strain.

Beneath the tie-bar E is seen to exist a space bounded by the top of the girder and the ends of two opposite slabs. This space can be filled in with concrete or grout after the slabs have been duly connected in their final resting place. As already indicated, piping or other articles may be laid above the slabs and the same filled or covered with further concrete or other material to any desired depth.

The metallic structure heretofore referred to may be made of various shapes, the preferable one being that shown in the right hand slab of Fig. 1, in which the upwardly extending portion D' is substantially vertical; although said portion may be given an inclined position as shown at D^4 in the left hand slab of Fig. 1. I find it economical and desirable to have the structure consist of a simple bar of round cross-section, although I do not limit myself in this respect. When integral throughout its length the bar will be bent at its ends so as to change its direction from the horizontal to the vertical, and by substantially flattening the metal at the point F , where the bend occurs, this affords a broad bearing surface which precludes the metal cutting into the concrete and thereby adds to the durability and resisting powers of the slab. In a case where the metal was not integral throughout its length, the same effect would be obtained by equivalent means, namely by having the metal flat where the tension portion and the upwardly extending portion of the interior structure meet each other.

In Fig. 1^a is shown a variation which may be employed where a girder A^4 is at the outside of a building, and there is therefore no opposite slab. In this case the tie-bar will be used, but being differently constructed is designated E' . At its right end instead of connecting with the metallic projecting portion D^2 of a slab, it connects with a special screw threaded bolt E^3 passed through the flange of the girder or other convenient point, the nut E^4 at the upper end of the bolt serving to engage the top of the tie-bar as before, thus simulating as far as possible the conditions existing at the left hand of Fig. 1.

In addition to the parts above described, other devices of various kinds may be added, as for example supplementary strengthen-

ing means may be embedded in the concrete. Thus a large meshed wire cloth G may be arranged horizontally in the body portions of the several slabs and I prefer to have such wire cloth extend beyond the ends of the slab, as shown at G', so that when the supplementary filling of concrete or grout is poured in beneath the tie-bars E, the same will harden about and embed the projecting portions G' of the wire cloth. In addition thereto reinforcing rods or stirrups may be employed, as for example the stirrups H, indicated in Fig. 1, which pass down through the concrete around the tension member D and upwardly, thus helping to strengthen and render more rigid the assembled parts.

With respect to the action of the tie-bars E, not only do they serve to transmit, as already explained, a portion of the re-action from each slab to the girder, but they also serve to tie together two opposite slabs and at the same time to tie said slabs to the girder, thus preventing relative horizontal movement between any two of them.

A modification may be adopted with respect to the seating of the slabs B upon the girder A, as shown in Fig. 3. By this modification the slab is enabled to be dropped so that its upper surface is substantially flush with the upper surface of the girder; and this is accomplished by employing a metallic seat b which is to be used in lieu of the concrete projection B³ of Fig. 1. Said seat b is partly embedded in the concrete at b' of each of the ribs B² of the floor slab, and at its upper end extends horizontally above so as to rest or seat upon the upper surface of the girder, thereby holding the slab in place during erection.

Referring now to Figs. 4, 5 and 6, showing three different variations from the main form of the invention as shown in Figs. 1 and 2, it should be stated that the tie-bar E and the other devices connected or cooperating therewith, may be employed in all of the modifications. In fact the views of Figs. 4, 5 and 6 may be practically considered as substitutes for Fig. 2, although Fig. 1 would of course have to be modified in an obvious way to suit the changes contained in the views of Figs. 4, 5 and 6.

In Fig. 4, the floor-slab is designated J, it consisting of the body portion J' and the depending ribs J². There should be at least two of such ribs, and as shown the width of the body portion J' is substantially the same or no greater than the distance between the two ribs J², J², so that said ribs come at the extreme side edges of the slab instead of at intermediate points, as seen in Fig. 2. Among the advantages of this construction is the following, namely, that when making the slab in the shop, the same can be provided with a bottom surface extending from rib to rib; the result being

that when the slabs are put in place, said bottom surfaces will substantially constitute a ceiling and obviate the very great expense that is usually incurred in constructing and setting in place the ceiling which is to be made to depend from floor beams or ribs previously set up in the construction. In Fig. 4 the bottom surface of slab J is indicated at J³ and is shown as a thin, composite ceiling-slab, this giving the result that the article as a whole is hollow, having the form of a square box.

Embedded in the ceiling portion J³ is a metal strengthening means in the form of a large meshed wire cloth j, which in the process of manufacturing the floor-slab, is caused to be engaged or wound around the tension portion D, as shown at j' Fig. 4. In this way the different portions J', J² and J³ of the floor-slabs are made substantially integral or unitary. By forming the ceiling portion J³ separately in point of time from the rest of the floor-slab, I am enabled to constitute said portion J³ of a cheaper grade of material, for example, a concrete made from cinders instead of stone, this being not only less expensive but lighter in weight, and at the same time adequate for its purposes, as little strain is to be borne by such part.

The slab just described may be manufactured as follows. The bottom portion J³ is first cast on a flat shop floor. A collapsible form is then placed above it and the ribs J² and body J' are then cast preferably before the bottom portion has set. The form is then withdrawn through one of the open ends (which can be done in the shop where it would be impossible if the floor were manufactured at the building site in the usual manner); the concrete is allowed to harden sufficiently to be handled and then the slab is ready to be shipped to the building. The bottom portion or ceiling-slab J³ is preferably composed of a concrete lighter in weight than the body and ribs, as previously stated. For instance the body and ribs might be of stone or gravel concrete and the portion J³ of cinder concrete. With a floor composed of such slabs, no metal lath or furring rods are necessary and the ceiling will have much better fire-resisting qualities, besides which the dead weight of the floor will be very light as the metal reinforcement G for the slab body B' may be placed nearer the bottom than is the common practice. This is because the bottom slab will protect the body from fire.

With such a flooring, the work at the building is greatly simplified, for one reason among others that after setting the girders and floor-slabs in place, we have not only a solid floor capable of carrying heavy loads, but also a flat ceiling ready for plastering. Furthermore, there is a broad

structural difference between the above described flooring and a flooring which is composed of girders, floor beams set between the girders, and small hollow tiles or blocks set between said floor beams, this latter construction being more complicated and expensive, partly because necessitating special floor beams which are dispensed with in my invention. The fact that the floor-slabs embodying the modification of my invention shown in Fig. 4, are of the preformed species, is a very important one, for as already intimated a floor of this particular construction could not be built *in situ*, since it would be impossible to remove the knock-down structure or forms that can be used in the shop or factory; the girders and other parts of the building being in the way.

A floor constructed with floor-slabs such as that of Fig. 4 above described, wherein the ceiling portions are embodied in the preformed slabs, is very much superior in point of convenience and labor as compared with a flooring of a form like that of Fig. 2, following the erection of which costly and elaborate ceiling supporting means may have to be employed, as well as the need of labor in a place inconvenient and more or less dangerous to the workmen.

Coming now to Fig. 5, this construction embodies some of the advantages of Fig. 4, namely in that it provides in the preformed construction a ceiling surface; but this is obtained in a different manner. In this form the floor-slab K has its body portion K' and the side ribs K², K² all formed of strong hard concrete and the ribs, as before, embedding metallic structures having tension portions and means for connecting across a girder to another floor-slab by means of a tie-bar E. The floor-slab of Fig. 5, however, is not of a hollow construction as in Fig. 4 but has the entire space between the ribs K² filled up with a species of concrete lighter in weight, for example, a concrete in which cinders take the place of stone. This interior portion is represented at K³, it being flush on the lower side at $\frac{1}{2}$ so as to practically constitute a ceiling. There will be sufficient adhesive power between the different concrete portions to effect the adherence thereof, but if desired any ordinary expedient could be adopted to assist therein, such for example as ridges or roughened places upon the ribs K².

In the modification of Fig. 6 the constructions previously described are simplified mainly by dispensing with the formation of the side concrete ribs K² of the same material and at the same time with the formation of the body portion K'. In the latter formation the slab L has its body portion L' and has the interior metal structures comprising the tension portions D, but in this

case said metal structure is embedded partly in the hard concrete L' and partly in the lighter species of concrete L² which extends from L' down to the ceiling surface $\frac{1}{2}$.

The different forms of slabs shown in Figs. 4, 5 and 6 above described, may be manufactured in any appropriate manner, but I prefer that they should be made in a work-wise position, that is with the same side up that the slabs will assume when in final position. In such case the cheaper or lighter form of concrete, namely that at J³, at K³ or at L² will be first poured into the form, followed subsequently by the application of the hard concrete constituting the more important portions of the floor-slab.

Referring further to the co-action of the girders and floor-slabs; the top metallic reinforcement A² of the girder A is less in area than the bottom member A' for the reason, that the concrete of the girder will take care of a portion of the compressive strains above the neutral axis as heretofore stated, and also for the reason that after the floor-slabs have been placed upon the girder and the spaces between the slabs have been filled with concrete or grout, the top portions of the slabs will co-act with the top portion of the girder and also take a portion of the above referred to compressive strains. The projecting ends of the bolts A³ and also the metallic ties E, serve to augment this co-action, and other means may be added.

Where in the claims it is stated that the metal of the reinforcement of the floor slabs emerges from the concrete substantially at the slab ends, it is intended to include an emerging thereof either immediately at or approximately near the slab ends.

What I claim as new and desire to secure by Letters Patent is:

1. In a concrete floor member, a reinforcing structure comprising a substantially horizontal tension portion and a bent up portion near the end of said floor member, the same being of round or thick construction for the greater part of its length but being thin or flattened in the vicinity of said bend.

2. In a building, a floor comprising oppositely disposed girders, in combination with a plurality of preformed floor-slabs, each of said floor-slabs set between and extending from girder to girder, and each floor-slab consisting of a mass of hardened concrete embedding a metal reinforcement, the metal of said reinforcement emerging from the concrete substantially at the ends of the slab to where the latter obtains support from the girder, and each slab comprising a reinforced body portion, at least two reinforced ribs depending therefrom, and a flat bottom portion connecting the bottoms of said ribs, said bottom portion being com-

posed of a different species of concrete, lighter in specific gravity than the concrete forming body portion and ribs.

3. In a building, a floor comprising oppositely disposed girders, in combination with a plurality of preformed floor-slabs, each of said floor-slabs set between and extending from girder to girder, and each floor-slab consisting of a mass of hardened concrete embedding a metal reinforcement, the metal of said reinforcement emerging from the concrete substantially at the ends of the slab to where the latter obtains support from the girder, and each slab comprising a rein-

forced body portion, at least two reinforced ribs depending therefrom, and a flat bottom portion connecting the bottoms of said ribs, said bottom portion being composed of a different species of concrete, lighter in specific gravity than the concrete forming body portion and ribs, and filling the entire space between ribs and body portion.

In witness whereof I have hereunto set my hand, this 18th day of February, 1910.

CHARLES BENEDICT GRADY.

Witnesses:

ELIZABETH B. KING,
DONALD CAMPBELL.