

Feb. 21, 1933.

J. JONES ET AL

1,898,668

FLOOR CONSTRUCTION OR THE LIKE

Filed June 25, 1931

3 Sheets-Sheet 1

Fig. 1.

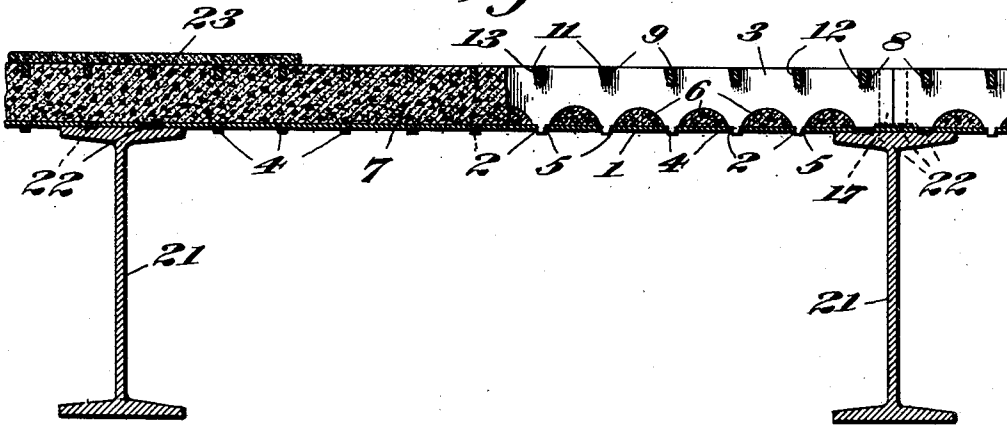
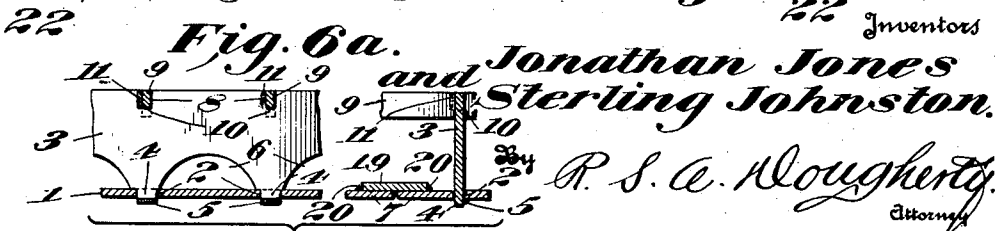
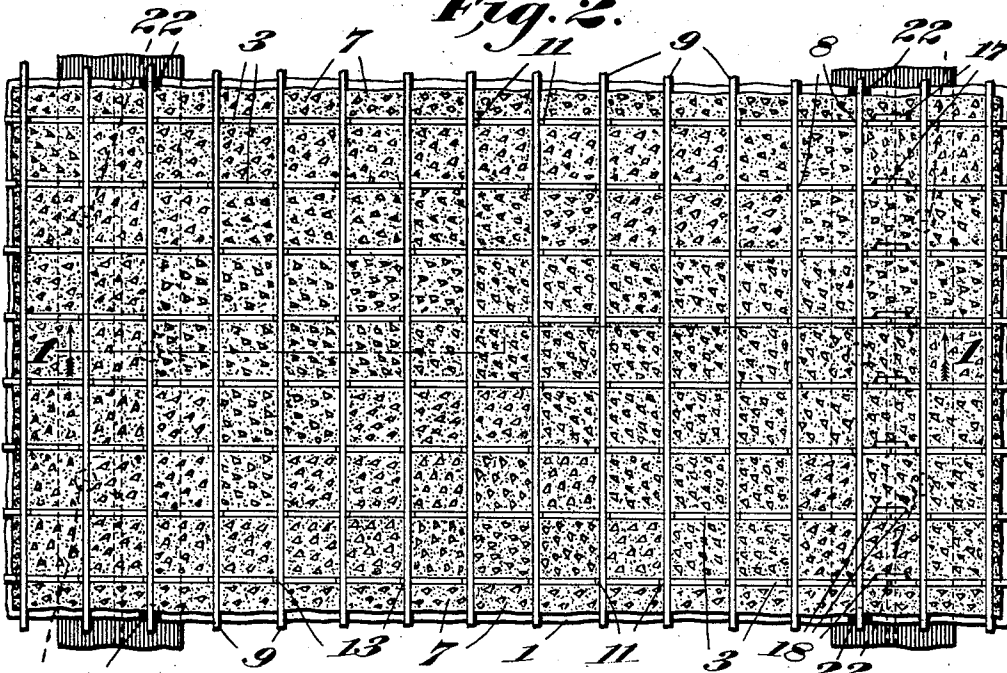


Fig. 2.



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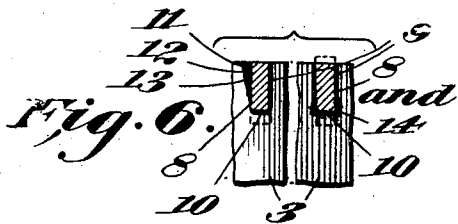
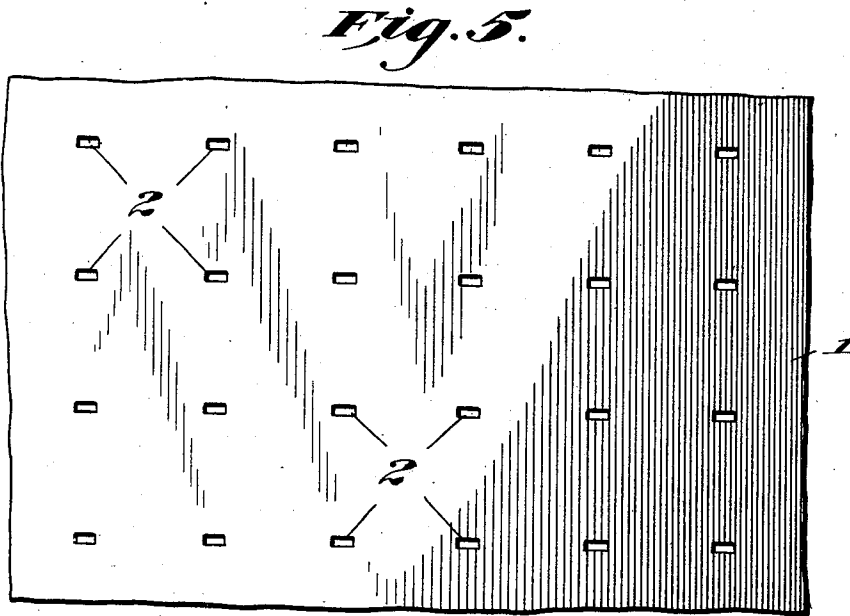
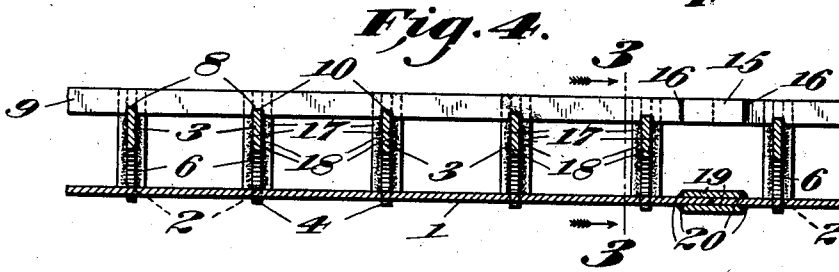
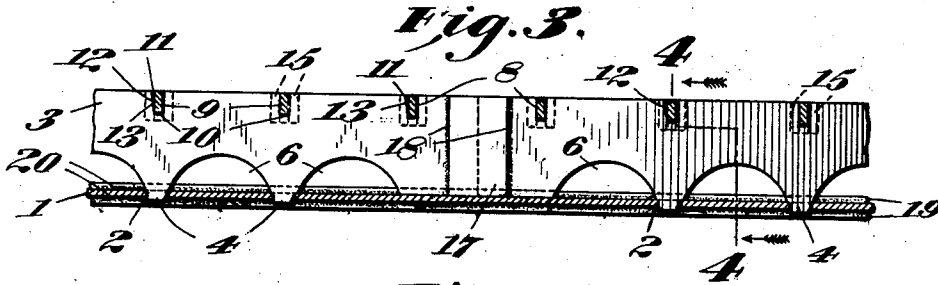
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3 Sheets-Sheet 2



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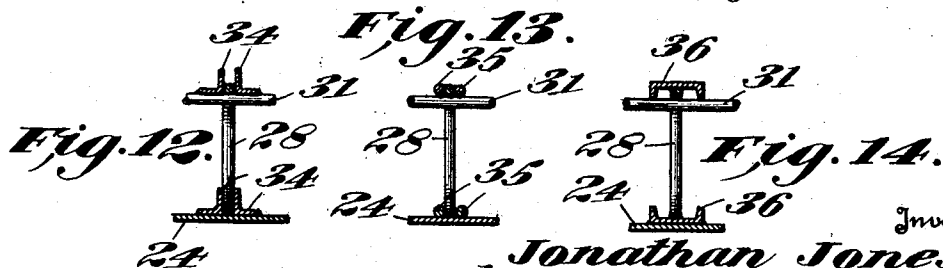
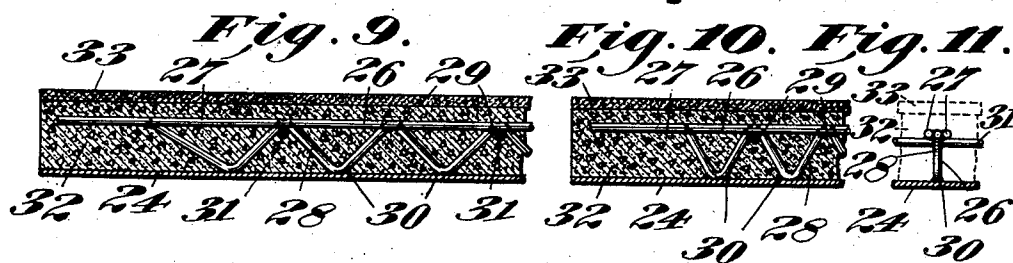
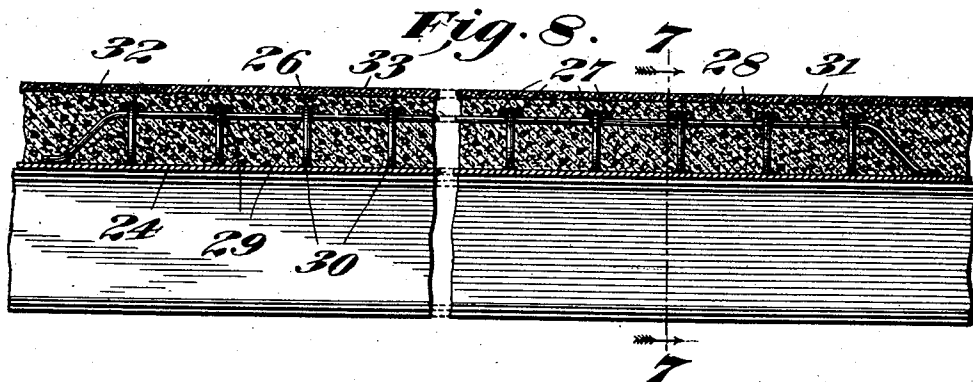
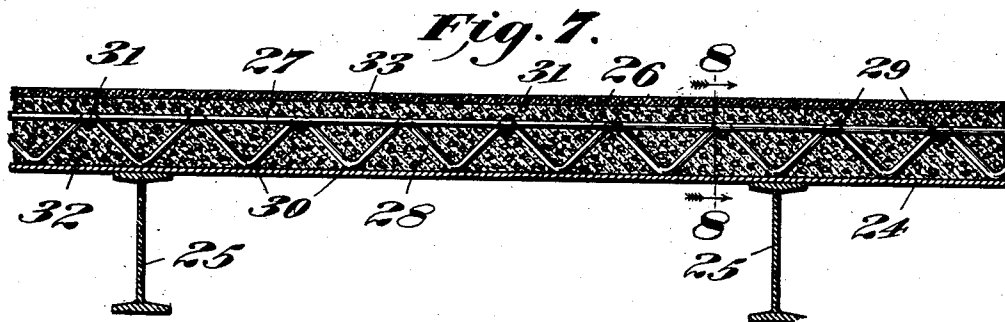
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FLOOR CONSTRUCTION OR THE LIKE

Filed June 25, 1931

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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FLOOR CONSTRUCTION OR THE LIKE

Application filed June 25, 1931. Serial No. 546,692.

Our invention relates to reinforced concrete slabs or plates and is more particularly adapted for use in constructing floors for bridges and buildings or for ceilings and like purposes which shall be light in weight, simple of application, durable, and a permanent addition to the general stiffness of the structure which supports it.

Various types of light-weight floors have been proposed or manufactured, in which parallel carrying elements of steel such as angles, or T-bar sections with stems erect, or similar reinforcing members, are placed in approximate contact and filled with concrete or other material. These types have the defect that the bottom elements thereof possess little or no continuous tensile strength in a direction at right angles to the length of the carrying elements, and they do not therefore develop the full supporting power or strength that can be attained in a slab possessing both tensile and compressive values in all horizontal directions.

This defect is not present in our invention, because an integral part thereof is a steel plate bottom which has approximately equal tensile values in all horizontal directions.

One of the objects of our invention is to secure a slab or floor structure of maximum strength combined with a minimum weight at as reasonable a cost as possible, the reinforcing elements of which can be fabricated in a structural shop from standard structural material which can be assembled in the shop or in the field as desired.

Another object of our invention is to form the slab with a continuous base plate to which reinforcing elements are attached which serves the double purpose of a form for pouring the concrete as well as a bottom for the finished slab. The continuity of this plate, taken in conjunction with the interlocking of the same with the joists gives a design of maximum distribution of strength and permits wide spacing of the floor stringers or supports.

Another object of our invention relates to extending the joists the full depth of the

slab and securing the joists to the base plate in such a manner as to carry the major portion of the shear between the stringers.

Another object of our invention relates to the manner of holding the joists in proper alignment in spaced relation to each other.

Other objects of our invention will appear from the following description taken in connection with the annexed three sheets of drawings forming part of this specification and in which like characters of reference indicate like parts.

Figure 1 is a vertical section through a portion of a floor structure taken on the line 1—1 of Fig. 2;

Fig. 2 is a top plan view of a portion of the floor structure as shown in Fig. 1;

Fig. 3 is a detail vertical section of the reinforcing elements before the concrete is poured upon the base plate between the joists and tie-bars, drawn on a larger scale than those shown in Figs. 1 and 2. The section being taken on the line 3—3 of Fig. 4;

Fig. 4 is a section taken on the line 4—4 of Fig. 3;

Fig. 5 is a top plan view of a portion of the base plate;

Fig. 6 illustrates two different ways of welding the tie-bars to the joists;

Fig. 6a illustrates another manner of welding the tie-bars to the joists and the tenons to the base plate;

Fig. 7 is a vertical section of a modified form of floor structure taken on the line 7—7 of Fig. 8;

Fig. 8 is a vertical section taken at right angles to the section shown in Fig. 7 and taken on the line 8—8 of Fig. 7;

Figs. 9 and 10 illustrate two ways of forming the ends of the joist members shown in Figs. 7 and 8, the web member of the joists being bent at a different angle;

Fig. 11 is an end elevation of one of the joists illustrated in Figs. 7 to 10; and

Figs. 12, 13 and 14 show other modified forms of joists we may use with the construction shown in Figs. 7 to 11.

Referring now to the drawings in detail, and first to Figs. 1 to 6a, the numeral 1 in-

dicates a steel base plate which may be of any size convenient for manufacturing and handling into place having aligned perforations formed therein as at 2 which are preferably rectangular in outline. A plurality of web plates or joists 3 are mounted on the base plate 1 having tenons 4 along their bottom edges in spaced relation to each other which are adapted to extend into the perforations 2 and welded to the base plate 1 as at 5. The lower portions of the joists between the tenons 4 are cut out as at 6 to form arch shaped holes in the bottom of the joists to lighten the construction and also permit the distribution of concrete 7 between the webs of the joists while pouring and assist in locking the concrete in place after it has set. These joists 3 having their tenons interlocked and welded to the base plate 1 reinforce the slab and carry the major portion of the shear between the stringers. It will be noted that these joists extend the full depth of the slab, thereby contributing the maximum shear values of the web members and also take the direct impact from the traffic.

Kerfs 8 are formed at spaced intervals in the upper edges of the webs of the joists. The kerfs 8 in one joist being in transverse alignment with the kerfs formed in the adjoining joists and are adapted to receive tie-bars 9 having notches 10 formed therein to interlock with the same and welded thereto at their intersections as at 11. These tie-bars 9 serve the triple purpose of holding the upper edges of the joists against buckling, act as reinforcing bars for transverse distribution and as wearing bars for traffic. The concrete fill carries its part of the shear, compressive stresses and further acts as a bond to hold the structural parts in alignment.

In Fig. 6 I have shown two ways of welding the tie-bars 9 to the joists in which one of the kerfs is formed with an inclined side face 12 which is filled with additional material as at 13 by means of arc-welding which is the preferred manner of securing the tie-bars 9 to the joists, and this same manner may also be used in welding the tenons 4 to the base plate 1. In the other form of welding the tie-bars to the joists, the kerfs in the joist are formed with dove-tailed lower portions and the tie-bars are inserted therein in a loose manner and pressure welded to the dove-tailed portion of the kerf as at 14.

In Fig. 6a we have illustrated another manner of welding the parts together in which the welds 11 between the tie-bars 9 and the joists 3 are formed at one of the corner intersections between the two members, and the welds 5, for securing the tenons 4 to the base plate 1 are disposed at one of the lower side edges of said tenons.

As the width of the floor or the like structure may be of considerable area it will in some cases be necessary to splice the members of which the reinforcing structure is formed which may be accomplished in any approved manner, one way being indicated in Figs. 3 and 4 of the drawings in which a pair of plates are used for connecting together the abutting ends of each member. As indicated in these two figures, the abutting ends of the tie-bars 9 are spliced together by means of a pair of plates 15 which are welded thereto as at 16, the webs of the joist being connected together by a pair of plates 17 and welded as at 18 while the base plates 1 are similarly connected together by means of a pair of plates 19 and welded thereto along their edges as at 20.

In some cases however it is desirable to use a single splice plate for securing the different members of the reinforcing structure together as indicated in Figs. 1, 2 and 6a of the drawings.

Floor sills 21 preferably of I-beam construction support the floor, the base plate being welded to the top flanges of the sills as at 22.

The monolithic floor thus formed is adapted for heavy duty and is prearmored, the floors may be made in units, shipped precast or arranged for field assembling and pouring whichever method may be most desirable.

The road or slab may in some cases be covered with a layer of sheet asphalt, blocks or other wearing surface as indicated at 23 in Fig. 1.

Referring now to the modification shown in Figs. 7 to 11 inclusive, in which a somewhat lighter metal reinforcing structure is illustrated than that shown in Figs. 1 to 6 inclusive.

In this construction a base plate 24 is used which is mounted on the floor sills 25 and welded thereto in a similar manner to the construction described for Figs. 1 to 6. On the base plate 24 is mounted a plurality of joists 26 arranged vertically in parallel relation to each other or otherwise. These joists each comprise a top chord member formed of a pair of bars or rods 27 to which is attached a web member 28 which may be continuous throughout the length of the top chord member or partially continuous, or discontinuous; in the illustration however the web member is formed of a continuous bar or rod bent in a zigzag manner one set of the bends or apices being welded or otherwise secured to top chord member as at 29 in such a manner to prevent slippage, and to insure that shearing stresses carried by the web member 28 may be transformed into increments of longitudinal stresses in the top chord member.

The joists 26 are arranged in a vertical

position upon the base plate 24 in parallel rows as shown in the illustrations or in such other arrangement as may be appropriate to the conditions, the opposite set of bends or apices of the web member 28 are secured to the base plate 24 as at 30 to prevent slippage, and to ensure that shearing stresses carried by the web members 28 may be transformed into increments of longitudinal stresses in base plate 24.

A stay-bar or rod 31 is secured within a plurality of the bends or apices attached to the top chord 27 and secured to the top chord and apices of the web member; the outer ends of the stay-bars or rods being bent down and secured to the top of the base plate 24. As indicated in Figs. 7, 8 and 9 the stay-bars or rod 31 are welded to the top chord and web member in every other bend of that portion of the web member attached to the top chord but a greater or less number may be used if desired.

With this construction the reinforcing members may be assembled in the field or the completed reinforcing elements may be assembled in sections and can be taken and installed upon the supporting structure or sills etc. in the shop and the joints between the adjacent sections secured together by means of splice bars or splice plates uniting them, thus providing such continuity across the joints as may be desired and add greatly to the general stiffness thereof by means of positive attachments, and will largely or wholly preclude the necessity of lateral bracing or other customary means of resisting wind, traction and vibrational forces.

After the reinforcing elements thus positioned have been attached together, the structure is filled to, or over the tops of the joists and tie-bars with cement concrete, or asphaltic concrete, or other suitable material 32.

It will be noted that with our construction wooden or other forms will not be required to contain the concrete or other filler, as the base plate 24 entirely replaces the wooden forms which are required for most types of concrete floors.

Assuming that the filling material be cement concrete, this material will bond with the base plate 24 and with the joists 26 and will be locked against the base plates 24 by the cage formed by the joists 26 and stay-bars 31. Therefore, under the action of the dead weight of the construction, and also under the external or live loads as may be applied, the entire construction will operate as a doubly-reinforced concrete slab, with tensile values in all horizontal directions, provided near the top by the top chord members 27 and stay bars 31 and at the bottom by the base plate 24, with compressive values in all horizontal directions provided throughout by the concrete filling

32 and by the base plates 24 and with vertical shear values provided by the concrete filling 32 and by the web members 28 of the joists 26.

After the concrete filling 32 or other suitable material has been poured upon the base plate 24 around and over the tops of the joists 26 and stay-bars 31, it may if desired be covered with a layer of sheet asphalt, blocks or other wearing surface as indicated at 33.

In Fig. 12 we have illustrated in cross section a modified form of joist in which the top and bottom chord members are used formed of angles 34, in Fig. 13 another form of joist is shown in which the top and bottom chord members are formed of a pair of rods 35, and in Fig. 14 the top and bottom chord members are each shown formed of a channel member 36 disposed with their flanges extending inwardly towards each other.

Although we have shown and described our invention in considerable detail, we do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or equivalents thereof, as are embraced within the scope of our invention or as pointed out in the claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. A metal structure adapted to serve as a reinforcement in concrete floor slabs or the like, comprising spaced joists, tie-bars rigidly connecting one of the edges of the joists together at spaced intervals, and means secured to and extending over the opposite edges of the joists to those engaged by the tie-bars and adapted to continuously connect the joists together.

2. A metal structure adapted to be embedded in concrete or the like, comprising spaced joists, tie-bars rigidly connecting one of the side edges of the joists together, and means secured to and extending over the other side edges of the joists adapted to continuously connect the joists together.

3. A metal structure adapted to serve as a reinforcement for concrete floors or the like, comprising spaced joists, tie-bars secured to the tops of the joists extending transversely thereof and connecting the joists together, and a plate secured to the bottom of the joists for continuously connecting the joists together.

4. A metal structure adapted to serve as a reinforcement for concrete floor slabs or the like, comprising spaced joists each having a serrated bottom surface, tie-bars secured to the tops of the joists and extending transversely thereof, means for holding the tops of the joists in spaced alignment, and a plate secured to the apices of the serrated

bottom edges of the joists adapted to continuously connect the joists together.

5. A reinforced concrete structure, comprising spaced joists each having a serrated bottom surface, tie-bars extending transversely of the joists and secured thereto, a plate secured to the apices of the serrated bottom of the joists adapted to continuously connect the joists together, and a filling of concrete or the like between the joists and continuously connected together through the openings formed by the serrations at the bottom of the joists.

6. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists, tie-bars interlocking with the spaced joists and secured thereto, serrations formed on one edge of the spaced joists, tenons extending from the apices of the serrated edges, a plate provided with perforations adapted to receive the tenons, means for securing the plate to the tenons to form a continuous connection between the spaced joists.

7. A metal structure adapted to be embedded in concrete or the like, comprising spaced joists, tie-bars interlocking with the spaced joists and secured thereto, serrations formed on one side of the spaced joists, and a continuous plate connection secured to the apices of the serrations formed in the joists.

8. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists, provided with kerfs formed in one of the edges of the joists, tie-bars provided with notches adapted to interlock with the kerfed edges in the joists, means for securing the tie-bars to the joists, serrations formed in the edges of the joists opposite the kerfs, tenons extending from the apices of the serrated edges of the joists, a plate provided with perforations adapted to receive the tenons, and means for securing the plate to the tenons to form a continuous connection between the spaced joists.

9. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged in parallel alignment with each other, provided with kerfs each having one of their side walls inclined and formed in spaced relation to each other in the top edges of the joists, tie-bars provided with spaced notches adapted to interlock within the kerfs in the joists, a welded connection between the inclined side walls of the kerfs and the tie-bars, arched shaped serrations formed at the bottom edges of the joists in staggered relation to the kerfs, tenons extending from the apices of the serrated edges of the joists, a plate provided with perforations adapted to receive the tenons, and means for securing the plate to the tenons to form a continuous connection between the spaced joists.

10. A metal structure, adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged in parallel alignment provided with kerfs each having one of their side walls inclined formed in spaced relation to each other in the top edges of the joists, tie-bars provided with spaced notches adapted to interlock within the kerfs formed in the joints, a welded connection between the inclined side walls of the kerfs and the tie-bars, arched shaped serrations formed in the bottom edges of the joists in staggered relation with the kerfs, tenons each having shoulders at their sides extending from the apices of the serrated edges of the joists, a plate provided with perforations adapted to receive the tenons, a welded connection between the plate and the tenons adapted to form a continuous connection between the spaced joists, supporting sills for the structure, means for splicing the joists, tie-bars and plate, and means for securing the plate to the supporting sills.

11. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists formed of flat plates arranged vertically in parallel relation to each other, each provided with kerfs formed in their top edges in spaced relation to each other, tie-bars interlocking with the spaced joists and secured thereto, serrations formed in the bottom of the spaced joists, and a plate adapted to form a continuous connection between the joists secured to the serrated portion of the joists.

12. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists formed of flat plates arranged vertically in parallel relation to each other provided with kerfs formed in the top edges of the spaced joists in spaced relation to each other, tie-bars having notches formed therein adapted to interlock with the spaced joists and secured thereto, serrations formed in the bottom of the spaced joists, tenons extending from the apices of the serrations, and a plate adapted to form a continuous connection between the joists secured to the tenons of the joists.

13. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists formed of flat plates, means for rigidly tying the tops of the joists together at spaced intervals, and means extending over the edges of the joists for continuously connecting the bottom of the joists together.

14. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists formed of flat plates arranged vertically in parallel relation to each other provided with kerfs each having an inclined side face formed in the tops of the joists in spaced relation to each other, serrations in the bottom of the

spaced joists, tenons extending from the apices of the serrations, a plate provided with perforations for receiving the tenons, means for securing the tenons to the plate, said plate adapted to form a continuous connection between the joists, tie-bars provided with notches adapted to interlock within the kerfs, and means for securing the ties-bars to the joists.

15. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists formed of flat plates arranged vertically in parallel relation to each other provided with kerfs each having an inclined side face formed in the tops of the joists in spaced relation to each other, serrations formed in the bottom of the spaced joists in staggered relation to the kerfs, tenons extending from the apices of the serrations, a plate provided with perforations for receiving the tenons, means for securing the tenons to the plate, said plate adapted to form a continuous connection between the joists, tie-bars provided with notches adapted to interlock within the kerfs, and means for securing the tie-bars to the joists.

16. A reinforced concrete floor slab or the like, comprising spaced joists formed of flat plates arranged vertically in parallel relation to each other, spaced tie-bars rigidly connecting one of the edges of the joists together at spaced intervals, a plate extending over the edges of the joists and secured thereto for continuously connecting the opposite edges of the joists to those connected by the tie-bars, and a concrete filling or the like between the joists.

17. A reinforced concrete floor-slab or the like, comprising spaced joists arranged vertically in parallel relation to each other each formed with a web having serrated bottom edges, tie-bars welded to the joists for connecting the top edges of the joists together at spaced intervals, a plate secured to the serrated bottom edges of the joists and adapted to form a continuous connection between the joists, a concrete filling or the like between the joists and continuously connected together in the spaces formed by the serrations, and a wearing surface extending over the structure.

18. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged in parallel relation to each other formed with top chord and web members, tie-bars extending transversely of the joists and rigidly secured thereto, and a plate welded to the bottom edges of the joists adapted to continuously connect the said joists together.

19. A metal structure, comprising spaced joists arranged in parallel relation to each other, a zigzag web member for each joist, a top chord for each joist attached to the

apices at the top of the web member, tie-bars extending transversely of the joists and rigidly secured to the apices at the top of the web member and to the top chord, and a plate extending over and secured to the apices at the bottom of the web member adapted to form a continuous connection between the joists.

20. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged vertically in parallel relation to each other, a continuous zigzag web for each joist, a top chord for each joist attached to the apices at the top of the web, a plate extending over and secured to the apices at the bottom of the web adapted to form a continuous connection between the joists, and tie-bars having their ends attached to the plate and extending transversely of the joists and rigidly secured to the apices at the top of the web and to the top chord for connecting the spaced joists together.

21. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged in parallel relation to each other each formed with a web and top and bottom chord, tie-bars extending transversely of the joists and rigidly secured thereto, and a plate adapted to extend over the edges of the joists and welded thereto adapted to continuously connect the joists together.

22. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists arranged in parallel relation to each other formed with a web and top and bottom chord members of flanged sections, a plate extending over one of the edges of each of the joists and adapted to form a continuous connection between the joists, and tie-bars extending transversely of the joists and rigidly secured thereto with their ends secured to the plate.

23. A metal structure adapted to form a reinforcement for concrete floors or the like, comprising spaced joists, means rigidly tying the tops of the joists together at spaced intervals, and means connecting the lower portions of the joists to constitute a bottom for such structure rigidly united to the joists and adapted to sustain the concrete in its soft condition.

In testimony whereof we hereunto affix our signatures.

JONATHAN JONES.
STERLING JOHNSTON.