F. P. KAFKA.

SYSTEM OR METHOD OF CONCRETE FIREPROOFING OF STRUCTURAL STEEL.

APPLICATION FILED MAY 25, 1918.

1,306,700.

Patented June 17, 1919.

5 SHEETS—SHEET 1.

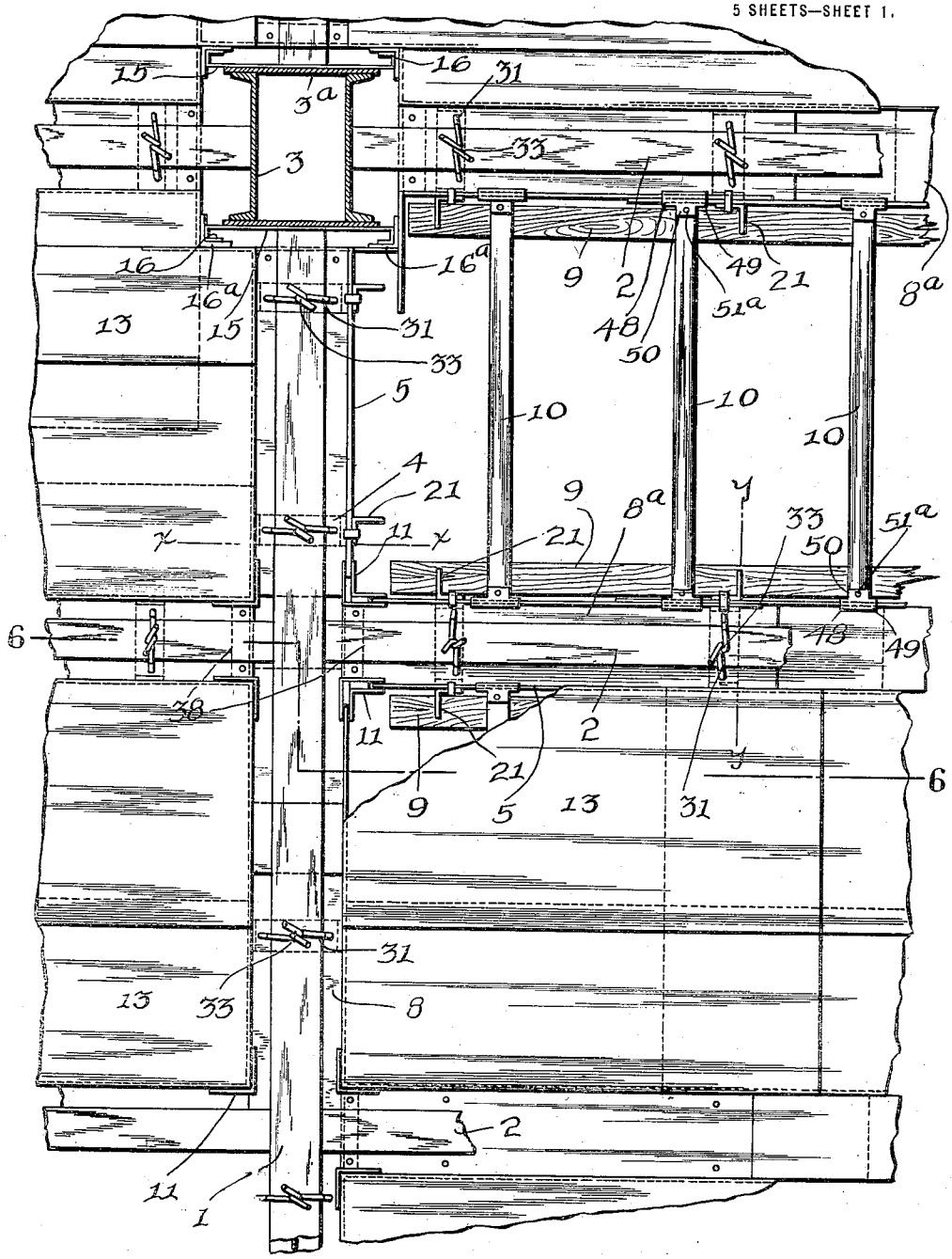


Fig. 1.

INVENTOR
Frederick P. Kafka
BY
Stewart & Perry
his ATTORNEYS

F. P. KAFKA.

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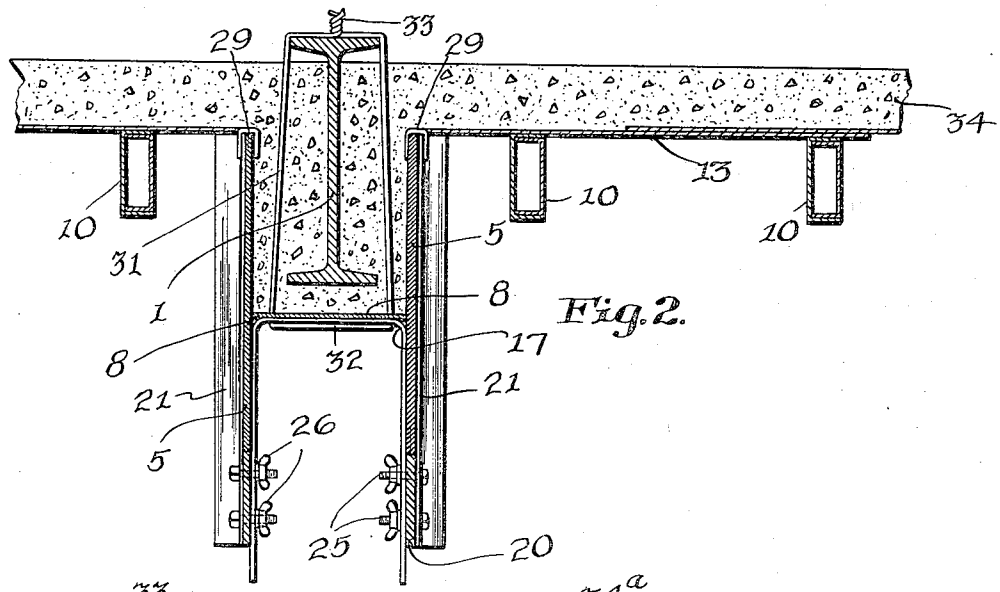


Fig. 2.

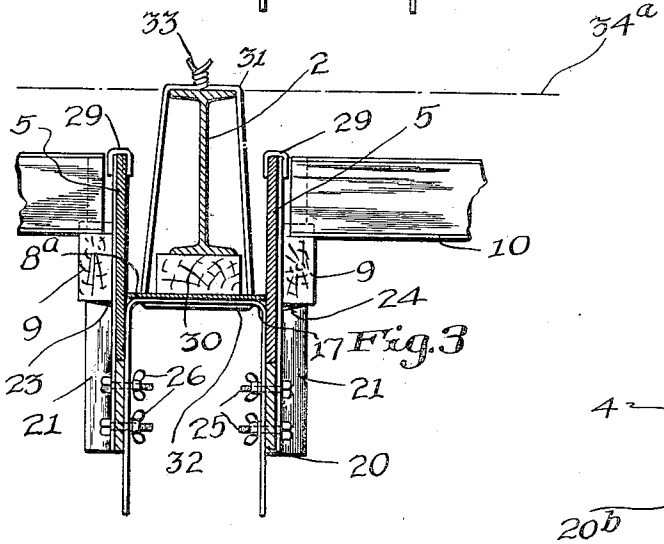


Fig. 3

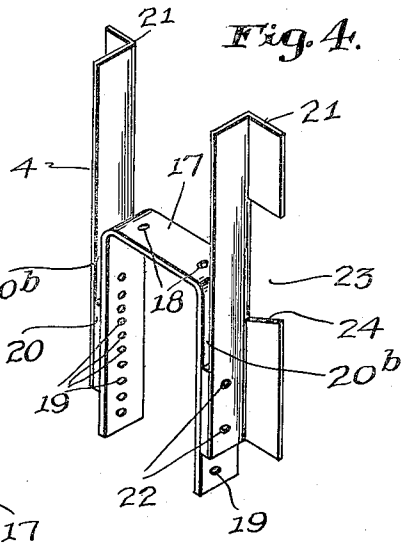


Fig. 4.

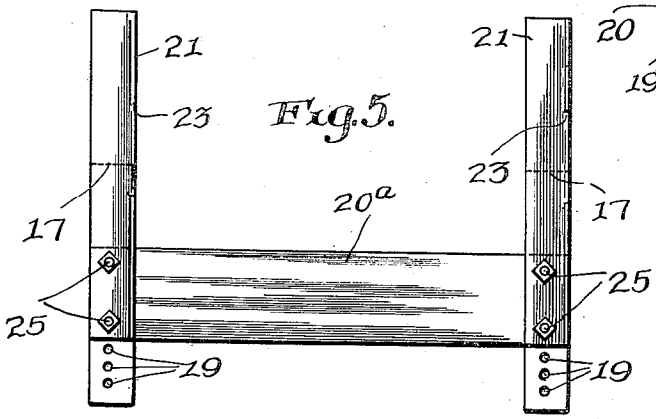


Fig. 5.

INVENTOR
Frederick P. Kafka
BY
Stewart & Perry
his ATTORNEYS

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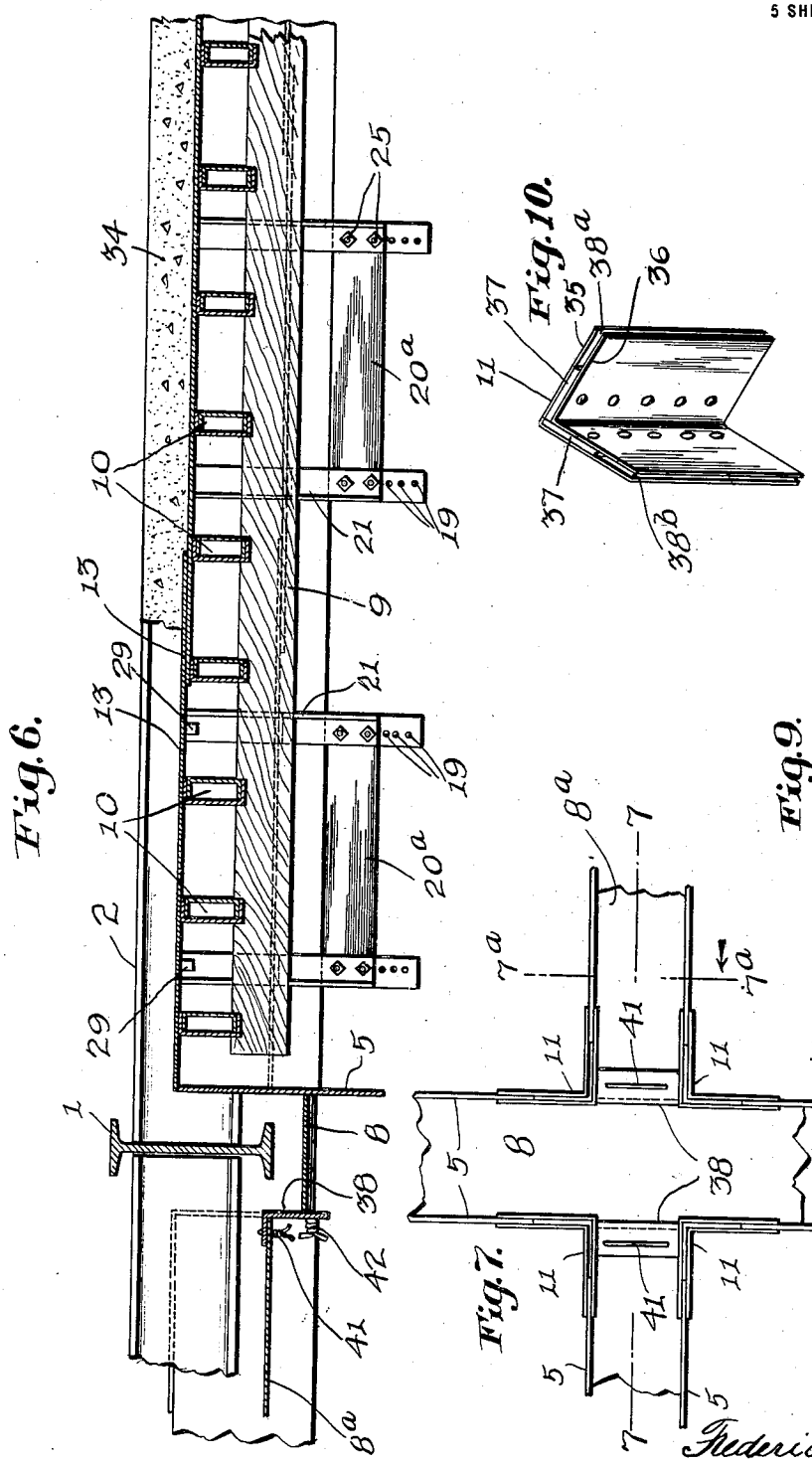


Fig. 6.

Fig. 10.

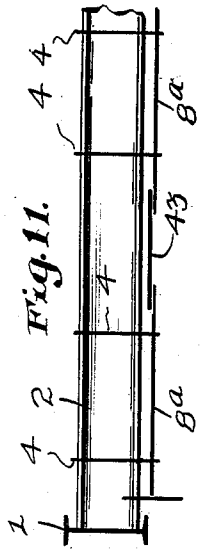


Fig. 11.

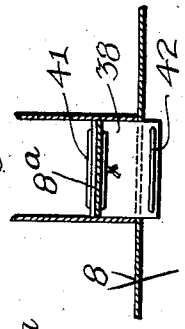


Fig. 9.

Fig. 7.

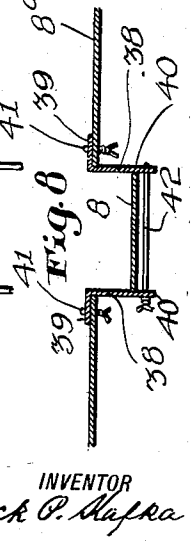


Fig. 8

INVENTOR

Frederick P. Kafka

BY

Stewart & Perry

his ATTORNEYS

F. P. KAFKA.

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5 SHEETS—SHEET 4.

Fig. 12.

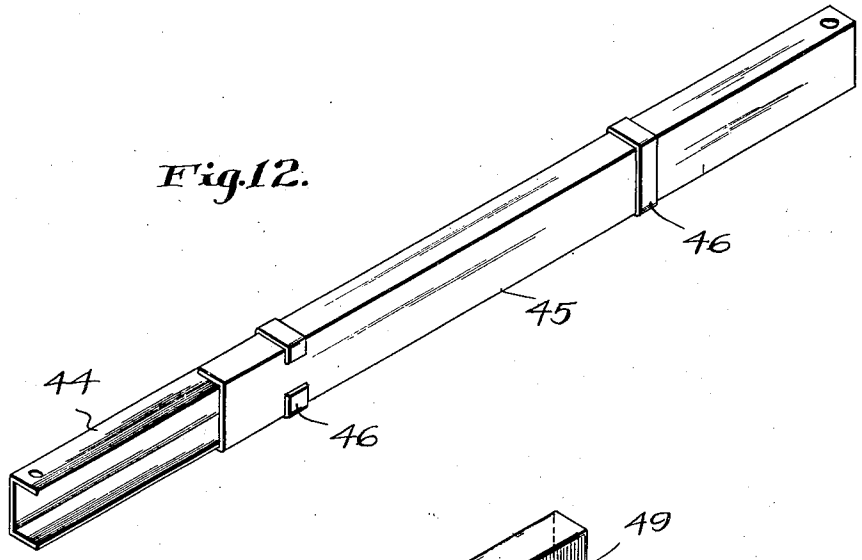


Fig. 14.

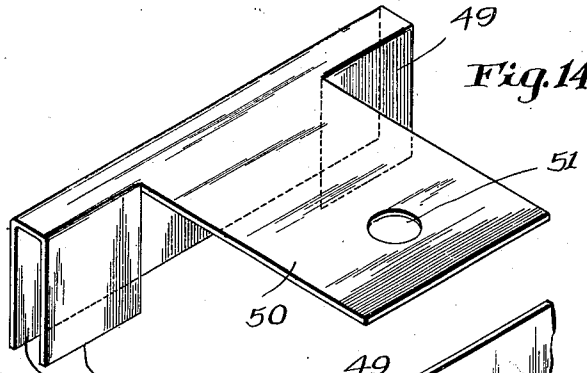


Fig. 13.

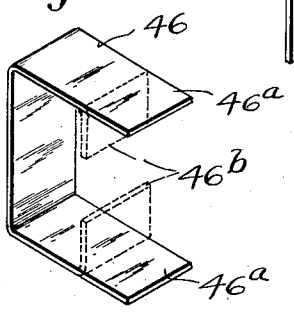


Fig. 15.

INVENTOR
Frederick P. Kafka
BY
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his ATTORNEYS

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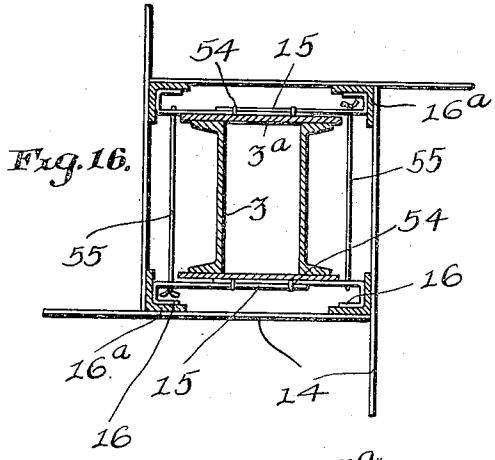


Fig. 16.

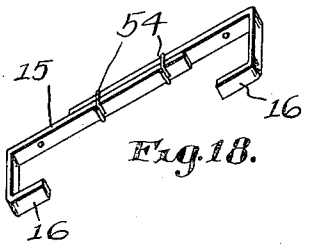


Fig. 18.

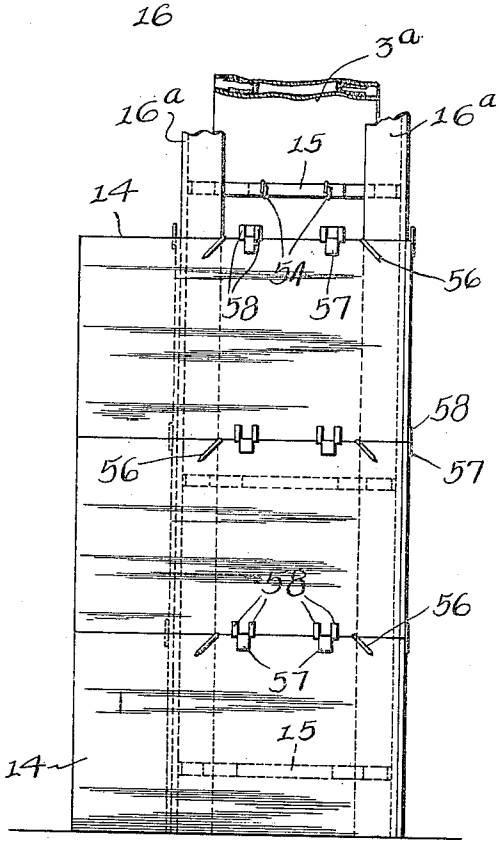


Fig. 17.

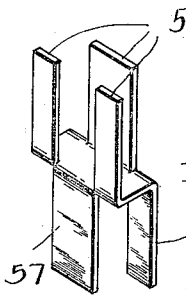


Fig. 19.

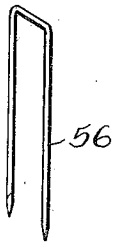


Fig. 20.

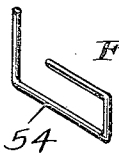


Fig. 21.

INVENTOR

Frederick P. Kafka

BY

Stewart & Perry

his ATTORNEYS

UNITED STATES PATENT OFFICE.

FREDERICK P. KAFKA, OF NEW ROCHELLE, NEW YORK.

SYSTEM OR METHOD OF CONCRETE FIREPROOFING OF STRUCTURAL STEEL.

1,306,700. Specification of Letters Patent. Patented June 17, 1919.

Application filed May 25, 1918. Serial No. 236,445.

To all whom it may concern:

Be it known that I, FREDERICK P. KAFKA, a citizen of the United States of America, and resident of New Rochelle, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Systems or Methods of Concrete Fireproofing of Structural Steel, of which the following is a specification.

My invention relates to a method, or system of means, by which structural steel work is incased in concrete, reinforced or otherwise, for the purpose of fire protection and such additional stability as may be derived from the inherent characteristics of the means employed, and, particularly, relates to the method, or system of means, by which the horizontal girders and beams of fabricated structures are reinforced, strengthened and fireproofed, including means for supporting forms or molds between the girders and beams, so as to enable the production about and between the girders and beams of a homogeneous structure of great strength, durability and many other desirable characteristics; and also to a combination of means by which columns, pillars, and other verticals or uprights are, or may be, combined with girders, beams, and similar supports in a ceiling or floor structure.

I am aware that concrete fireproofing and reinforced floor structures have been made by suspending box forms beneath the girders and beams, and by supporting suitable forms between the girders and beams to accomplish all that I accomplish by the employment of the system and the apparatus hereinafter described. I therefore do not intend to claim broadly the system as a system for accomplishing the result, but only in so far as I have improved the system by the apparatus employed by me in the various steps or stages by which I build up the forms which accomplish the result.

Under the present system of concrete fireproofing and reinforced floor construction, it is the practice to construct boxes from planks of approximately an inch in thickness and suspend these boxes below the beams. A temporary flooring is then constructed between the beams and girders and usually supported by wire hangers embracing the ends of temporary beams. The construction of these forms requires a considerable degree of carpentry skill, and each section must be individually supervised and carefully inspected before the concrete cast is made. This work requires a high degree of skill and is expensive in its construction. When the concrete is set the forms must be broken up and separated from the concrete resulting in a high percentage of loss in the lumber employed. It has been found impractical to remove the forms intact and use them repeatedly in duplicate branches of the same work. It has also been found that the lumber deteriorates so rapidly in the construction and wrecking of the forms that the same boards can only be used approximately three times, resulting in a higher percentage of cost.

My purpose in this invention is to standardize a system and method by which the work may be accomplished with greater expedition and economy than has been heretofore possible, and with the result that the work when completed will be more accurately disposed and of a better finish than is possible with the use of rough lumber in the manner previously described.

I have constructed frames which are adapted to be suspended from beams and girders and to carry between them not only the boards suitable for the girder form structure but also carry the temporary beams adapted to support the floor section formed between the beams and girders. I have discovered that a very thin fiber board can be used in carrying out my system in combination with my frames and that great efficiency and economy can be attained by the use of these fiber boards. In practice I cut these boards of pre-determined dimensions. In the case of the beam forms I prepare sections which are long enough to span a pre-determined distance between the frames as suspended from the girders and other sections which are of a length suitable to span any intervening gaps between the girder sections. So with the floor sections, I prepare these sheets in sizes of predetermined dimensions suitable to overlie the supporting floor boards, and in practice I prefer to tack said boards by temporary

means to the floor boards during the process of molding, but such tacks are not of a quality to tear or destroy the boards in the process of dismembering the form.

My system is adapted for the purpose intended largely because of the fact that I am able to standardize both the frames and the sizes of the sheets of fiber board employed. These may all be manufactured and brought to the building in completed form, and set up to accomplish the result by unskilled labor and with expedition. No carpentry work incident to cutting and fitting is required. The forms are adjustable to meet the requirements of different sizes of girders, but such adjustment is accomplished by means of bolts and nuts and may all be adjusted before the frames are sent to the work, or may be adjusted on the work at any time that occasion may require with very little skill according to a definite formula, prescribing the necessary adjustment of the frames to meet the various requirements incident to the various sizes of beams and girders.

The whole structure after the cast is made may be readily dismembered without destroying any of the fiber boards or frames. In the case of the beam forms the supporting means is the only element that remains embedded in the concrete, whereas in the column form the only structure remaining embedded in the concrete are the initial form bars.

As regards the question of transport, the frames are light and easily packed. In like manner, the fiber boards which are but one eighth of an inch in thickness, are so tough and durable as to permit even rough handling. I may, of course, use sheets of thin metal in place of the boards referred to, but I have found the boards so satisfactory that I recommend them for the purpose.

I have illustrated my invention in the accompanying drawings, designating the parts by numerals and referring to like parts by like numerals.

Figure 1 is a plan view showing the layout partly in section showing a girder and one vertical pillar or column and a plurality of beams mounted at right angles to the girder, together with the forms and supporting structures employed by me in the system of concrete fire protection above referred to. The subsequent drawings and description will give the details embodied in the layout exhibited in this drawing.

Fig. 2 is a vertical section taken on the line x—x of Fig. 1. It would be the same if taken on a similar line through any one of the supporting elements lying along the line of the girder 1 as will be hereinafter more fully described. In this instance I have shown the concrete 34 as set in the form.

Fig. 3 is a vertical section taken on the line y—y of Fig. 1, and the same section would be found wherever a supporting member similar thereto is supported by a beam as the beam 2, Fig. 1. In this instance I have omitted the concrete in order to show the spacing block 30, which as hereinafter will be explained is removed before the concrete is introduced.

Fig. 4 is a perspective view of one of the elements employed in my construction which I characterize as a frame.

Fig. 5 is a side view of two frames of the type illustrated in Fig. 4, said frames being braced together by a supporting member 20^a, thus forming one unit in the train of supporting members hereinafter described.

Fig. 6 is a vertical section taken on the irregular section line 6—6 of Fig. 1. It presents a side view of the structure as seen by looking upward from the bottom of the drawing Fig. 1.

Fig. 7 is a plan view of the forms as the same appear at the juncture of the beams and girder. In this drawing both the beams and girder are omitted.

Fib. 8 is a vertical section of Fig. 7 on the line 7—7, while Fig. 9 is a vertical section of Fig. 7 on the line 7^a—7^a looking in the direction of arrow.

Fig. 10 is a perspective view of a corner piece adapted to receive the vertical walls of the forms.

Fig. 11 is a diagrammatic view intended to illustrate the manner in which the floor boards of the form are caused to overlap.

Fig. 12 is a perspective view of one of the floor supporting beams formed of two channel irons adapted to telescope to form any length of beam required. The parts are united by a clip 46 illustrated in perspective in Fig. 13.

Fig. 14 is a perspective view of a clip adapted to embrace one of the vertical walls of the form and to be secured to a floor supporting beam as illustrated in the perspective drawing Fig. 15.

Fig. 16 is a horizontal section of the column or structural pillar together with the means employed by me to build up a concrete form about the column or pillar.

Fig. 17 is a side elevation of one of the forms referred to in the last figure.

Fig. 18 is a detail in perspective of the member employed in connection with the building up of the form.

Fig. 19 is a detail in perspective of a clip employed to unite the side walls of the form.

Fig. 20 is a perspective view of a clip adapted to hold the form to the vertical members.

Fig. 21 is a perspective view of a clip adapted to coöperate with the member illustrated in Fig. 18.

1 is a girder supported between two columns, one of said columns or pillars being designated as 3. These girders are usually of greater depth and weight than the beams, and it is customary in applying the concrete as hereinafter more fully described to leave the head or top section of the girders protruding out of the concrete as illustrated in Fig. 2. When the fireproofing construction is completed it is usual to lay a second coating of ash concrete or other substance on top of the fireproofing concrete so as to cover the top of the girder and form a bedding for the finished flooring. 2 is one of a plurality of beams secured at right angles to the girder last referred to. In such concrete construction it is required that the fireproofing concrete should embrace both the girder and beams and that such concrete should be homogeneous in such a way that it envelops both the beams and girders except as to the head or top section of the girder as heretofore stated. 4 indicates generally the whole construction that goes to make up the frame such as that illustrated in Figs. 2 to 5 inclusive.

Still referring to Fig. 1, 5 indicates the side walls of the form, while 8 indicates the base boards of the girder form. 9 are sill beams supporting the floor supporting beams and 10 are the floor supporting beams. 11 are corner pieces adapted to receive the side walls of the forms, while 31 indicates a wire employed to support the frames illustrated in Fig. 4. 13 are floor boards adapted to rest on the cross beams 10. 14 are form boards embracing the column. 15 are forms employed in connection with building up the column form, 16^a are angle pieces adapted to form the corners of the column forms.

Referring to Figs. 2 to 5 inclusive, and particularly to Fig. 4, 17 is a bifurcated member having a flat top pierced with two holes as 18—18, and two depending members as 19—19. 19^a represents a series of holes in these side members adapted to receive bolts. 20 is a spacing block and 21—21 are angle pieces provided with bolt holes 22, while 23 is a slot cut in one wing of the angle pieces 21, such cut having one bevel surface as 24. 25 are bolts and 26 are winged nuts, the function of the latter being to hold the bifurcated member 17 and angle pieces 21 together, the spacing block 20 being interposed. In the structure shown in Fig. 5, I unite two of the forms shown in Fig. 4 and connect the same by a plate as 20^a, which operates to perform the function and take the place of the spacing block 20 as illustrated in Fig. 4. As previously stated, 8 represents the base board of the girder form, while 5—5 represent the side walls. 29 is a bifurcated clip adapted to hold together the side walls 5 of the form and one wing of the angle piece 21 when the same are assembled. 30 is a spacing block employed to space apart the base-board of the form and the base of the beam or girder. This block, as previously stated, is removed after the parts are assembled and adjusted and before the concrete is introduced. 31 is a form supporting wire. It is adapted to pass through holes in the base-board of the form and corresponding holes 18 of the bifurcated member 17. It is shown at 32 below the said bifurcated member, and tied in a knot or loop at 33 on the top of the beam. 34 indicates the concrete as introduced into the form. 35 and 36 are two angle pieces, while 37 is a spacing block interposed between them. They are secured together by rivets or otherwise and form the corner pieces 11 into which the side walls 5 of the form enter and are supported. This structure is illustrated in Figs. 1, 7 and 10.

Referring to Fig. 8, 38 is an angle piece adapted to fill in the gap between the elevation of the base of the form employed in connection with the girder and the form employed in connection with the beams. One wing of the said angle piece as 39 is secured by the wire as at 41 to the floor board of the beam as 8^a, and the other dependent member 40 extends below the base-board of the girder as 8; and is pierced with holes through which is run the wire as 42 to secure said dependent members together against the edges of the base-board 8.

In the diagrammatic view in Fig. 11, the supporting forms are indicated as 4, while the floor boards of the form are indicated as 8^a. It is my practice to suspend one of said boards 8^a between two of the forms 4 and to encompass the gap between them by a separate board as 43 supported by the ends of the boards 8^a.

Referring to Fig. 12, the floor supporting beams illustrated are formed by two channel pieces as 44 and 45, one being of slightly less depth than the other, thus permitting said members to telescope to any desired length whereupon they may be locked together by the clip as 46. This clip is illustrated in Fig. 13, where the original position of the flanges or wings 46^a are illustrated in solid lines, while their position when clamped about the beams is illustrated in dotted lines as 46^b. This combined structure I have designated as 10.

Referring to Figs. 14 and 15, the clip therein illustrated comprises two bifurcated members as 48 and 49 adapted to fit over the side wall of a form as 5. This clip is also provided with the extension 50 having the hole 51 therein. In Fig. 15 is shown a

mortise as 9^a in the sill beam 9 to receive the floor supporting beam 44. When in position the bifurcated members 48 and 49 embrace the vertical walls of the form as 5 and are secured to the beam 44 by a bolt as 51^a.

Referring to Figs. 16 to 21 inclusive, 15 is an angle piece formed with a right angular end as 16. Two of these are illustrated in Fig. 18 as secured together by the clips 54, the latter being shown open in Fig. 21. A column is designated in Fig. 16 as 3, and two of these forms such as illustrated in Fig. 18 are secured together by the wires 55 as indicated in Fig. 16. 16^a are angle pieces cooperating with said forms 15, and 14 are wall members of the column form. 56 is a clip adapted to unite the wall members 14 and the angle pieces 16^a, while the clip illustrated in Fig. 19 is adapted to support and hold in alinement the wall members 14 of the column form as indicated. This latter clip has two oppositely disposed sets of parallel members, one set of three members being designated as 58 and the other set of two members as 57. Referring now to Fig. 1, it will be seen that a pillar or column, the members of which are indicated by 3, is suitably juxtaposed to provide a hollow column having its ends closed by plate members 3^a. The members of the column are held together by the frame member of Fig. 18, or its equivalent, in the manner shown in Fig. 16, the wires or binders 55, however, being omitted in Fig. 1. Such a column in a building structure, for example, is surrounded by the girders 1 and floor beams 2, as clearly shown, each having the form structures surrounding and applied to them, as shown in Figs. 2 and 3, preparatory to having the plastic cement or concrete poured thereinto. The girders abut against opposite sides of the column, while the beams abut against the other opposite sides of the column, thus solidly combining the girders, beams and columns firmly together when the cement or concrete filling is solidified. As shown in Fig. 1, the forms for the girders and beams, and the forms for the columns, are so adjusted and juxtaposed as to cooperate with one another so that the concrete filling surrounding the girders and beams will become a homogeneous mass with the concrete filling surrounding the columns.

As previously stated, the object of this invention is to provide means by which forms may be so assembled as to provide a mold wherein may be cast a plastic substance such as concrete for the fireproofing and reinforcing of girders and beams and the forming of reinforced concrete floors lying between the beams and girders. While I have shown in Fig. 1 a column and the form structure and auxiliaries therefor, the method, or system of means, by which the same is produced forms no part of my present invention, the same being made the subject of a divisional application filed.

I have characterized the invention as a system or method of accomplishing the results stated for the reason that the result is attained by the performance of certain steps or stages. It is necessary, of course, that I employ certain types of mechanisms in the accomplishment of the result. I will now describe these mechanisms and the steps or stages referred to.

The fundamental mechanism essential to the performance of the system other than the column forms is that structure which I characterize as a frame which is illustrated in perspective in Fig. 4. It is also shown in Figs. 2, 3 and 5. This structure comprises two members, a bifurcated element as 17 having holes 18—18 in the top and holes 19 in the sides, and two angle iron members such as 21—21 having holes in the side for the reception of bolts and a slot 23 in one of the flanges. I interpose between these elments the spacing blocks 20 or the spacing plate 20^a. In carrying out my system I employ a plurality of these frames which may be used alone as in Fig. 4 or in pairs as in Fig. 5. It will be noted that between the arms of the member 17 and the walls of the members 21 a space as 20^b is provided. This space or way is intended to receive the vertical side walls of the form. The relation between the members 17 and 21—21 may be adjusted by the bolts 25 and thumb screws 26, so that the way 20^b may be made shallow or deep as the occasion may require dependent upon the width of the board employed as a side board of the form or dependent upon the depth which it is desired that the form shall assume.

When I desire to construct a form beneath a girder I first take a base board as 8 perforated with holes corresponding to 18 and lay the same within the frame so that said holes register with the said holes 18 in the frame. I then run a wire 31 through these holes, the same appearing on the underside of the bifurcated member 17 as indicated at 32. I then interpose a block 30 between the bottom flange of the girder 1 and the base board 8 and with the wire 31 I draw up the frame as far as the spacing block will permit and tie the wire on top of the beam as at 33. I can then remove the block 30 and the forms are then in position to be built up in the manner which I will now describe.

The walls 5—5 are introduced into the spaces 20^b and held to the members 21—21 by the clips 29. As previously stated the bolts 25 coöperating with the holes 19 permit of an adjustment so that the side walls of the frame may be made of any desired height. The girder form referred to is now

established between the base-board 8 and the side walls 5.

Referring to Figs. 3 and 11, it will be noted that similar frames 4 are suspended on the beam 2 at pre-determined intervals, preferably somewhat as indicated, and the intervening space between the floor-boards 8^a is filled by the connecting board 43. In building up the side walls I follow a similar procedure by placing the side-walls between two of the frames in the slot 20^b and where the side boards are not sufficiently long I span the intervening space by a board not indicated in the drawing but which corresponds with the board 43 Fig. 11.

I prefer to have the boards forming the base and side walls of the form cut to uniform sizes, but it is obvious that the frame shown in Fig. 4 is capable of adjustment both vertically and horizontally to meet the conditions of any height or width of form. The horizontal adjustment can be accomplished by the thickness of the spacing block 20, the vertical adjustment, as previously stated, by the bolts and bolt holes 25 and 19.

In building my construction I suspend these frames beneath the beams and girders and place the base and side boards in position as indicated and these units may be multiplied to any extent.

As previously stated, the girders are heavier and deeper than the beams, consequently when the forms are put in position there is a space intervening between the floor board of the beam forms and the base board of the girder forms. In order to fill this space I provide the angle piece 38 having one wing of the angle 39 tied to the floor board 8^a of the beam by the bolts or wire 41. The other wing 38 of the angle piece is dependent sufficiently to extend below the base board 8 of the girder form. The two ends of said wings 40 are bound together by the wire as 42 thus closing the aperture which would otherwise exist between the girder and beam forms. I have illustrated the foregoing in Figs. 7, 8 and 9.

It is also necessary to provide means by which the side walls of the girder and beam forms may be united in such a way as to be tied against leakage. This I accomplish by the corner pieces 11 illustrated in Fig. 10. These are formed of two angle members as 35 and 36, the spacing block as 37 interposed between them, thus leaving a space 38^a and 38^b of a width approximately to receive the side boards of the forms, said side boards being secured therein by suitable bifurcated clips or by any other means that may be appropriate.

The foregoing is all that is necessary to accomplish the building up of the forms suitable to incase the beams and girders.

I will now describe the means for building up a form for the floor section lying between the beams and girders. It will be understood that it is desirable that the floor section concrete and the beam and girder concrete should be homogeneous when set.

Assuming that a rectangular structure is to be provided with a floor and that the frames, as Fig. 4, are in place as indicated above, the next step is to place beam supporting sill beams on either side of the rectangular structure as indicated in Fig. 1, or these sill beams may be made to encompass the entire rectangular form lying between the beams and girders. The sill beams referred to are indicated as 9, and they are placed in the slot 23 of the frames, Fig. 4. Said slot has an inclined lower surface as 24 which has a tendency to hold said beams in position. I prefer that these beams should be mortised as indicated in Fig. 15, 9^a to receive the cross beams about to be described. The cross beams 10 shown in Fig. 1 and indicated in detail in Figs. 12 and 15 are formed of two channel iron sections adapted to fit one within the other, and to telescope to any desired length so as to fill the span between the adjacent sill beams 9. When a proper length is attained the clips illustrated in Fig. 13 are bent over so as to clasp and brace two sections of the beam, thus giving the rigidity and strength necessary for the purpose of sustaining the weight of the floor. The clip illustrated in Figs. 14 and 15 is then applied, the bifurcated ends thereof embracing the side board of the form and the free end thereof 50 being secured to the cross beam 44 by the bolt 51^a. Boards as 13 cut to approximately appropriate sizes are then laid on the beams 10. They may be permitted to overlap, and they may be secured to said beams 10 by any appropriate means, but it will be noted that said floor boards 13 overlap the side walls of the forms to a slight extent so as to make a complete union between the beam forms and the floor forms.

When all of these forms are in position as indicated concrete in plastic condition is poured into the forms as indicated at 34 in Fig. 2. It will be noted that the level of the floor in that case is slightly below the top flange of the girder 1, whereas in Fig. 3 the dotted line 34^a indicates the floor surface in that figure. This will also be the floor surface of the floor between the beams and girders. However these levels can be varied to suit any requirements.

When the concrete has set, the forms may be removed as follows. The wire 31 can be cut at the point 32. This will release the whole system of girder beam and floor forms, the wire 31 remaining embedded in the concrete. It will then be possible to remove the cross beams 10, sill beams 9 and slip out frame 4, thus releasing the base

board and side boards of the girder forms as well as the boards 13 of the floor beams.

My experience is that all of these elements can be removed without damage to any of the parts and that the same frames, beams and boards may be used over and over again for the same purpose.

I will now describe the assemblage of the pillar or column forms as illustrated in Figs. 16 to 21 inclusive. The structural column is usually of a form indicated in Fig. 16, having two channel pieces as 3 and two side walls as 3^a. I employ a plurality of members such as that indicated in Fig. 18 as a foundation for the form. These members may be joined together by a clip as 54 or they may be made in one piece with the two angle ends 16. I place two of these oppositely disposed members on either of the flat sides 3^a of the column and secure the same together by appropriate means as the wires 55. A plurality of these pairs inclose the column to the desired height as indicated in Fig. 17. I then employ four corner pieces which are angle irons as 16^a of sufficient height to inclose the column and bind these angle irons 16^a to the forms 15 by wires or any other suitable means. The form is now in position to receive the first layer of boards as 14. Four of these are placed on the four sides of the square. I prefer to secure them to the angle irons by clips such as that illustrated in Fig. 20, where the bifurcation is caused to embrace the top of the board and the edge of the angle iron. The second tier of the form is built up as follows. The clips illustrated in Fig. 19 are placed with the lower bifurcations embracing the upper edge of the first tier of boards and the second tier of boards is placed between the arms of the upper bifurcations and secured to the angle irons 16^a by the clips 56 as stated above.

In practice I prefer that these boards should be of uniform size suitable for the purpose but a large latitude in the sizes is possible as indicated by the overlapping of the boards in the illustration.

To disassemble this form I first knock out the clips 56 and remove the boards. When they are all removed the angle irons are separated from the concrete. The member, as shown in Fig. 18, however, remains embedded in the concrete and is lost in each operation.

As previously stated I prefer in the practice of my system to employ a fiber board. This board is made very thin and has a remarkable degree of strength. It may be cut to any desired sizes suitable for the work or within the limitations of the adjustable capacity of the frames, but of course it will be understood that I may use sheets of metal. A desirable feature however is that the sheets, whether of fiber or metal, should be cut of uniform sizes suitable for the purpose indicated.

It is within the scope of my invention to adjust these forms on the ground and elevate the same to a position adjacent the beams and girders, but I find that it is a more convenient practice to suspend the frames and build up the forms as indicated.

What I claim is:

1. In a system for concrete fireproof construction, a frame adapted to support a form to mold concrete about a beam or girder, a plurality of said frames being employed for the purpose, said frame having a platform to support the base board of the form and two slots one on each side of said platform and at right angles thereto, said slots adapted to receive and support the side boards of the form at right angles to the base board of the form, and means to suspend said frame beneath the beam or girder.

2. In a system for concrete fireproof construction a frame adapted to support a form to mold concrete about a beam or girder, a plurality of said frames being employed for the purpose, said frame having a platform parallel with the base of the beam to support the base board of the form and two vertical slots parallel with the axis of the beam adapted to receive and support the side walls of the form, with means interposed in said slots to fix the depth to which said side boards may enter the same, thus where the width of the side boards is constant determining the depth of the form, with means to suspend said frame beneath the beam.

3. In a system for concrete fireproof construction a frame adapted to support a form to mold concrete about a beam or girder, a plurality of said frames being employed for the purpose, said frame having a platform parallel with the base of the beam to support the base board of the form and two vertical slots parallel with the axis of the beam adapted to receive and support the side walls of the form, a slot on each side of said frame to receive and support a temporary sill beam which in turn operates to support one side of a floor section form, with means to suspend said frame beneath the beam.

4. In a system of concrete fireproof construction a frame adapted to support a form to mold concrete about a girder or beam as well as to form a floor section, a plurality of said frames being employed for the purpose, said frame comprising a bifurcated member with a central section parallel with the base of the beam and approximately of the width of the beam form, with two legs one dependent from each end of said central section, said legs pierced with bolt holes, two angle irons of right angular cross

section, one wing thereof of each provided with bolt holes corresponding with those in said legs and the other wing provided with a slot adapted to receive a sill beam to support one side of the floor section form, a spacing block interposed between said angle irons and said legs with bolts and nuts to secure the legs and angle irons together and to adjust their relative position, with means to suspend said frame beneath the beam.

5. In a system for concrete fireproof construction a frame adapted to support forms to mold concrete to envelop the beams and girders and to form a reinforced floor section intermediate said beams and girders, a plurality of said frames being employed in practising the system, said frames comprising a platform parallel with the base of the beam adapted to support the base-board of the beam form, and two vertical slots parallel with the axis of the beam adapted to receive and support the side wall of the beam form, slots on either side of the forms to receive and support temporary frame supporting sill beams with means to suspend the forms beneath the beams and girders, in a right angular section formed between two girders and two beams, four temporary beams thus supported and temporary base plates of the floor section laid thereon.

6. In a system for concrete fireproof construction, a frame adapted to support forms to mold concrete to envelop the beams and girders and to form a reinforced floor section intermediate said beams and girders, a plurality of said frames being employed in practising the system, said frames comprising a platform adapted to support the base board of the beam form, and having two inner slots adapted to receive and support side boards of the beam form, and also having outer slots on either side of the forms to receive and support temporary sill beams; means to suspend the forms beneath the beams and girders; temporary sill beams supported in said outer slots; temporary cross-beams supported thereby; boards of uniform length and width laid as floor boards upon the cross-beams between said forms with sections of board of like width but not so long spanning the gaps intervening; side boards supported in said inner slots and corresponding in length to the floor boards; base-boards supported upon said frame-platform; and means for making a union between adjacent ends of the several boards to retain the concrete when placed in the form in a plastic state, all being removable when the concrete is set, except the frame supporting means which remains embedded in the concrete.

7. A form member for employment in a system of means for producing concrete construction, the same comprising a bifurcated member, the arms of which are each provided with a series of apertures; and angle-members secured to said arms in spaced apart relation thereto; each angle-member being provided with a slot adapted to receive a sill beam.

8. In a system for concrete fireproof construction a frame adapted to support a form to mold concrete about a beam or girder, a plurality of said frames being employed for the purpose, said frame having a platform parallel with the base of the beam to support the base board of the form and two vertical slots parallel with the axis of the beam adapted to receive and support the side walls of the form, with means to suspend said frame beneath the beam, sheets of fiber board of pre-determined dimensions adapted to fit into said frame to produce a form substantially as described.

9. In a system for concrete fireproof construction a frame adapted to support a form to mold concrete about a beam or girder, a plurality of said frames being employed for the purpose, said frame having a platform parallel with the base of the beam to support the base board of the form and two vertical slots parallel with the axis of the beam adapted to receive and support the side walls of the form, with means interposed in said slots to fix the depth to which said side boards may enter the same, thus where the width of the side boards is constant determining the depth of the form, with means to suspend said frame beneath the beam, sheets of fiber board of pre-determined dimensions adapted to fit into said frame to produce a form substantially as described.

10. In a system for concrete fireproof construction a frame adapted to support forms to mold concrete to envelop the beams and girders and to form a reinforced floor section intermediate said beams and girders, a plurality of said frames being employed in practising the system, said frames comprising a platform parallel with the base of the beam adapted to support the base board of the beam form, and two vertical slots parallel with the axis of the beam adapted to receive and support the side wall of the beam form, slots on either side of the forms to receive and support temporary frame supporting sill beams with means to suspend the forms beneath the beams and girders, in a right angular section formed between two girders and two beams, four temporary beams thus supported and temporary base plates of the floor section laid thereon, sheets of fiber board of pre-determined dimensions to meet the requirements of the girder and beam forms and also the floor forms substantially as described.

11. In a system for concrete fireproof construction a frame adapted to support forms

to mold concrete to envelop the beams and girders and to form a reinforced floor section intermediate said beams and girders, a plurality of said frames being employed in practising said system, said frames suspended from said beams or girders and disposed along the same at pre-determined intervals apart, said frames comprising a platform parallel with the base of the beam adapted to support the base board of the beam form, and having two vertical slots parallel with the axis of the beam adapted to receive and support the side wall of the beam form, slots on either side of the forms to receive and support temporary frame supporting sill beams with means to suspend the forms beneath the beams and girders, at pre-determined intervals as stated, in a right angular section formed between two girders and two beams, four temporary sill beams adapted to be supported within said slots on either side of the frames and temporary base plates to form a floor section supported on said temporary beams, fiber boards of pre-determined dimensions adapted to form the base boards of the beam forms and to span the space between the frames, with similar boards of less length adapted to span the intervening space between the last mentioned boards, similar fiber boards of predetermined dimensions adapted to form the side walls of the beam and girder forms of a length to span the distance between the frames and similar boards of less length adapted to span any intervening gap between the side walls of the form, and means to secure said intervening boards to the adjacent side wall boards, fiber plates of predetermined dimensions adapted to be laid on the temporary base beams of the floor section to constitute the base of said floor section form, the beam forms and the floor forms making a union to retain the concrete when placed therein in a plastic state, all being removable when the concrete is set except the frame supporting means which remains embedded in the concrete.

12. A form member for employment in a system of means for producing concrete construction, the same comprising a bifurcated member, the arms of which are each provided with a series of apertures, in combination with angle-members; means interposed between the angle-members and the arms of the bifurcated members for spacing the several members from each other; and means for securing the angle-members, arms and spacing means adjustably together, whereby to produce board-receiving slots of variable depth between the angle-members and bifurcated member, substantially as described.

13. A system of means for producing concrete construction comprising a bifurcated member, the base of which is flattened and provided with an aperture, and the arms of which are provided with a plurality of apertures; angle-members adjustably secured to the said arms in spaced apart relation thereto, said angle-members projecting in parallel relation a considerable distance beyond the flattened base of the bifurcated member; wall boards set in said slots between the bifurcated member and angle-members; means for securing the wall boards to the angle-members; and means whereby the entire structure may be secured to a beam or girder.

14. A system of means for producing concrete construction comprising a bifurcated member, the base of which is flattened and provided with an aperture, and the arms of which are provided with a plurality of apertures; angle-members adjustably secured to the said arms in spaced apart relation thereto, said angle-members projecting in parallel relation a considerable distance beyond the flattened base of the bifurcated member; wall boards set in said slots between the bifurcated member and angle-members; means for securing the wall boards to the angle-members; base boards set upon the flattened base of the bifurcated member between the wall boards; and means whereby the entire structure may be secured to a beam or girder.

15. A system of means for producing concrete construction comprising a bifurcated member, the base of which is flattened and provided with an aperture, and the arms of which are provided with a plurality of apertures; angle-members adjustably secured to the said arms in spaced apart relation thereto, said angle-members projecting in parallel relation a considerable distance beyond the flattened base of the bifurcated member, each having in its outer side an elongated slot; wall boards set in the slots between the bifurcated member and angle-members; means for securing the wall boards to the angle-members; sill beams set in the slots of the angle-members; and means whereby the entire structure may be secured to a beam or girder.

16. A system of means for producing reinforced concrete construction embodying a plurality of girders and beams arranged at right-angles to each other; form frames mounted on the girders and beams; wall and base boards mounted upon the form frames; angle-pieces connecting the wall boards at the angle of the girders and beams; and angle-pieces connecting the base boards at the point of juncture of the girders and beams.

17. In a system of means for producing concrete construction, and in combination with a girder and a plurality of beams abutting against the girder at a right-angle to the latter; a plurality of form frames mounted

upon the beams and upon the girder; wall boards mounted upon the several form frames; and bifurcated angle-pieces into which the form boards of the girders and beams extend whereby to form a closing juncture between the form boards of the girders and beams at the angles where the beams abut the girder.

18. In a system of means for producing concrete construction, and in combination with a girder and a plurality of beams abutting against the girder at a right-angle to the latter; a plurality of form frames mounted upon the girder and beams; base boards mounted upon the form frames beneath the girder and beams; and angle-pieces forming a juncture between the base boards, which are arranged at an angle to each other substantially at the points of abutment of the beams against the girder.

19. In a system of means for producing concrete construction, a plurality of forms adapted to be suspended from girders and beams; wall boards mounted in said frames; sill beams also mounted in said frames parallel to the wall boards, said sill beams being mortised; floor board supporting beams supported upon the sill beams in the mortise thereof; and connecting means between the floor board supporting beams and wall boards.

20. In a system of means for producing concrete construction, a vertical column or pillar; form frames secured to said column in spaced apart relation; frame boards mounted upon the form frames so as to entirely inclose the column; in combination with girders abutting opposite sides of the column; and beams abutting opposite sides of the column at a right-angle to the girders; form frames mounted, respectively, upon the girders and beams; base boards mounted upon the form frames beneath the girders and beams; and wall boards mounted upon the form frames at opposite sides of the girders and beams and embracing the base boards.

21. In a system of means for producing concrete construction; a vertical column or pillar; form frames secured to said column in spaced apart relation; frame boards mounted upon the form frames so as to entirely inclose the column; in combination with girders abutting opposite sides of the column; and beams abutting opposite sides of the column at a right-angle to the girders; form frames mounted, respectively, upon the girders and beams; base boards mounted upon the form frames beneath the girders and beams; wall boards mounted upon the form frames at opposite sides of the girders and beams and embracing the base boards; sill beams mounted upon the form frames; floor board supporting beams mounted upon the sill beams; and floor boards mounted upon the supporting beams and arranged to overlap the wall boards of the girders and beams, whereby a plastic material supporting form is built about columns and girders and beams into which the plastic material may be poured.

Signed by me at New York city, N. Y., this 23rd day of May, 1918.

FREDERICK P. KAFKA.

Witnesses:
HARRY KRAUSS,
MARGARET VOGEL.