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BUILDING CONSTRUCTION

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Fig. 1.

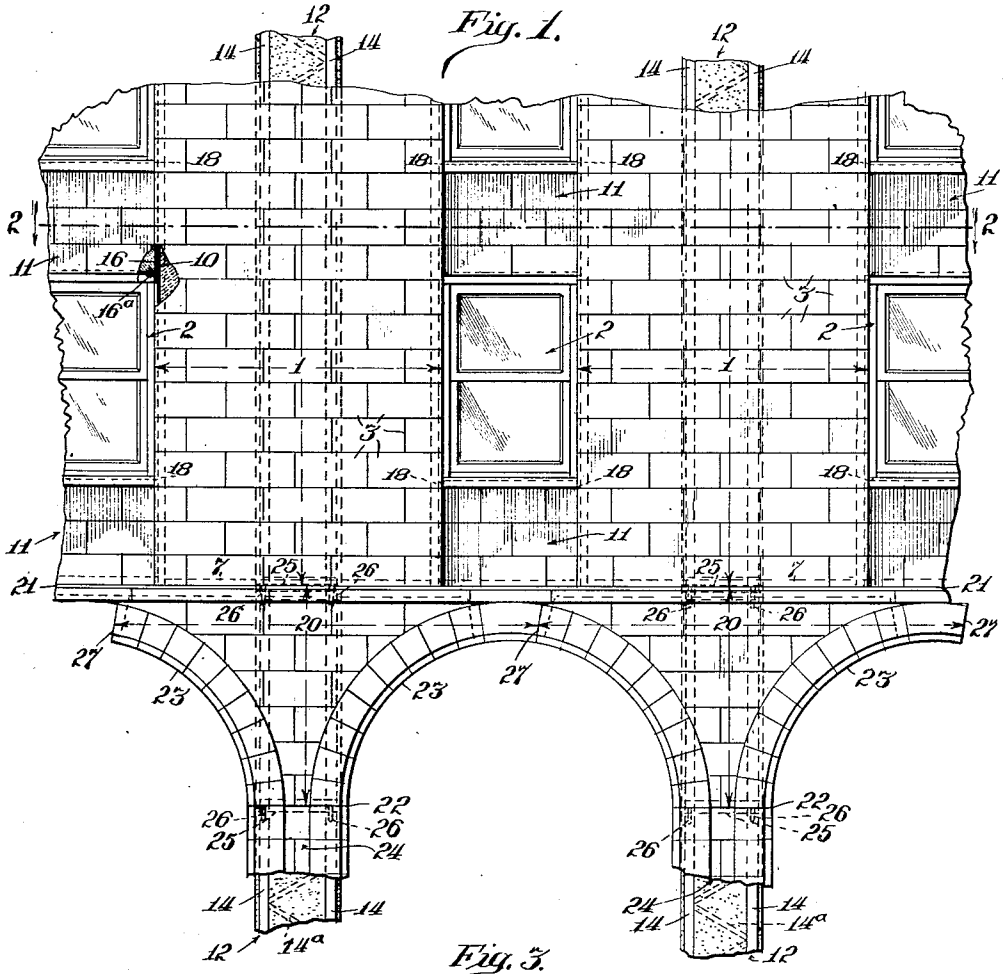


Fig. 3.

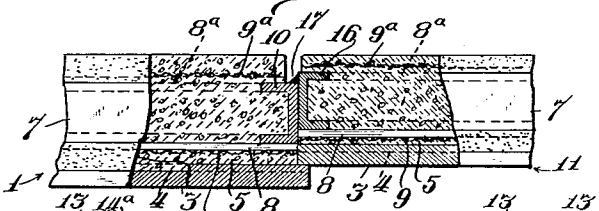
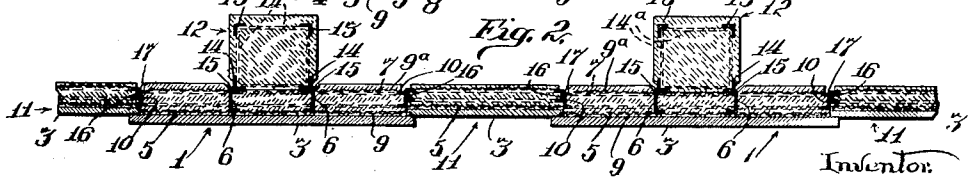


Fig. 2.



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BUILDING CONSTRUCTION

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Fig. 4.

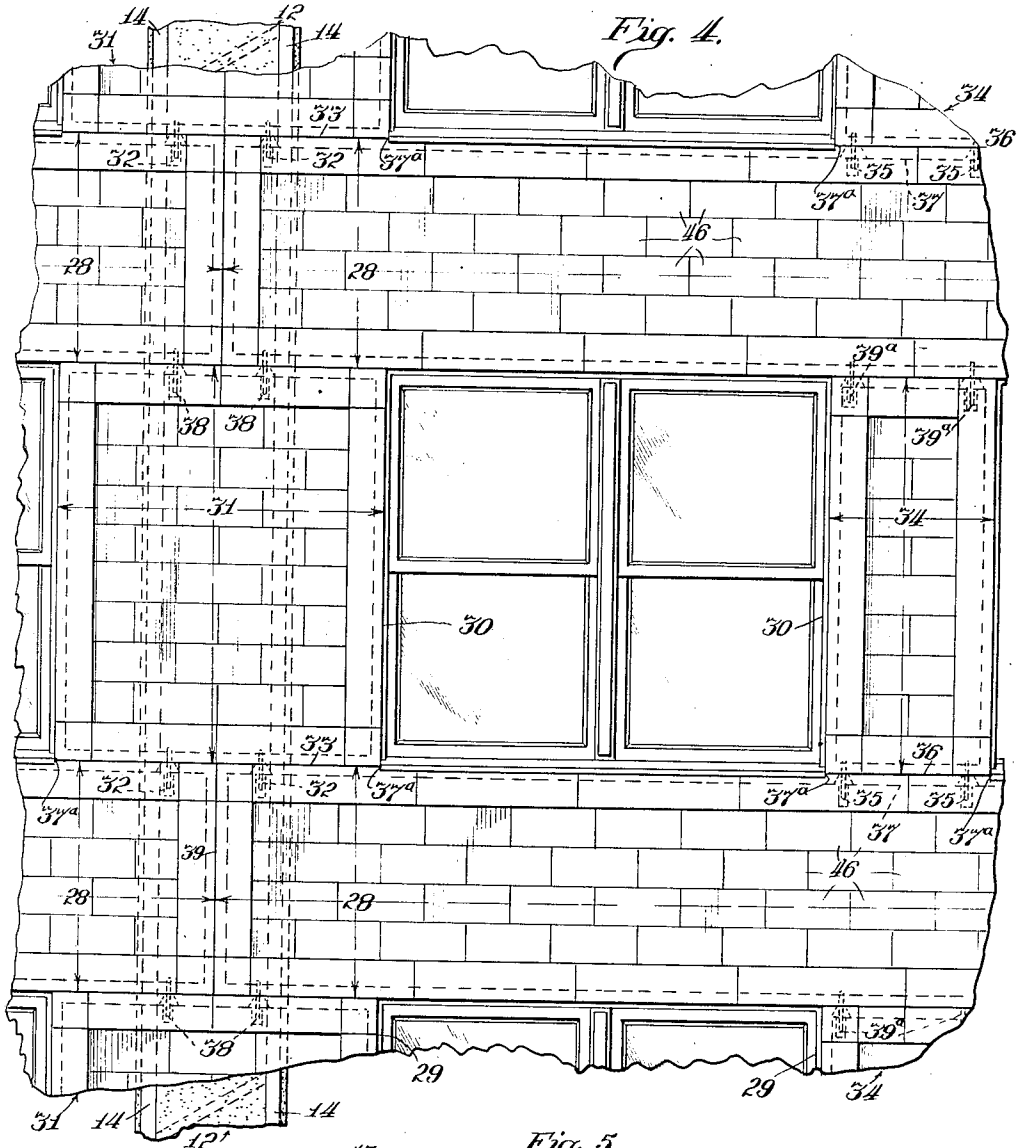
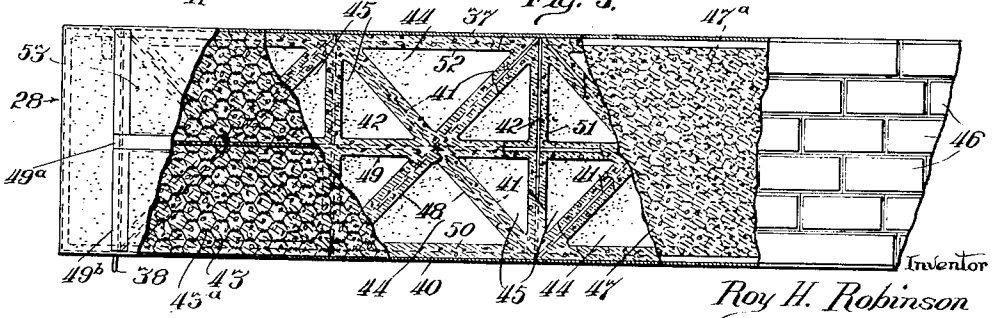


Fig. 5.



Inventor

Roy H. Robinson

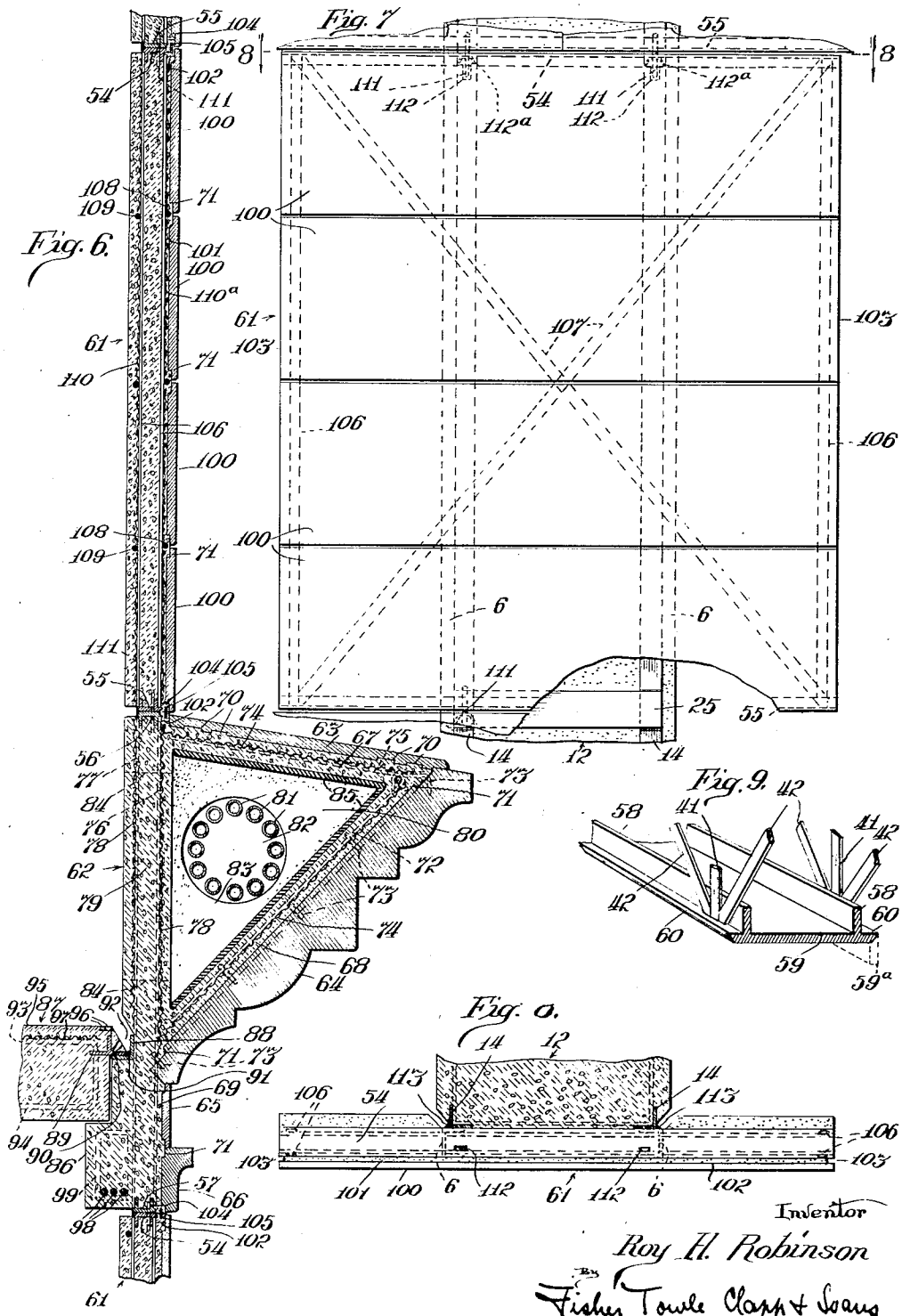
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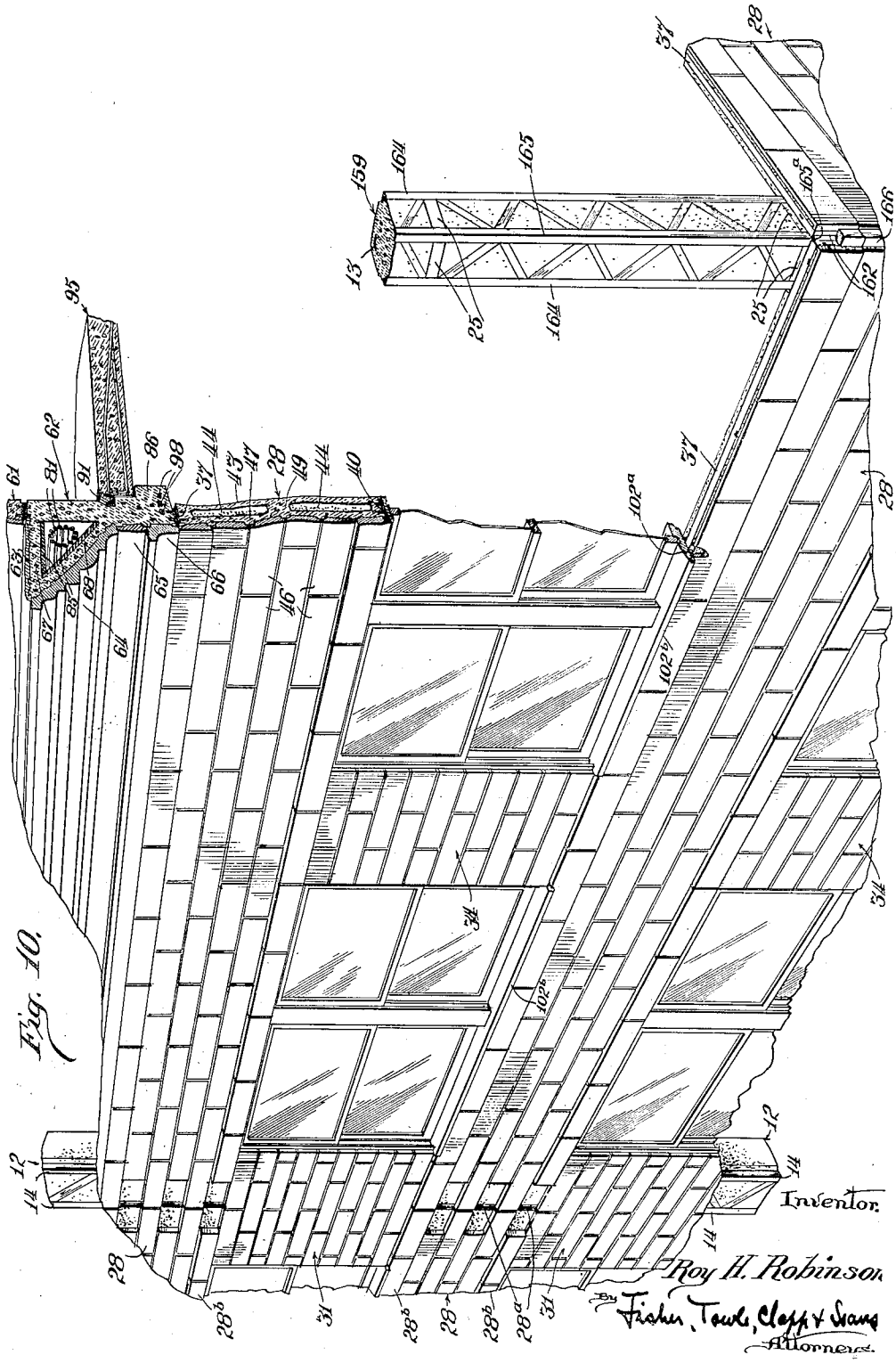


Fig. 10.

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Fig. 11.

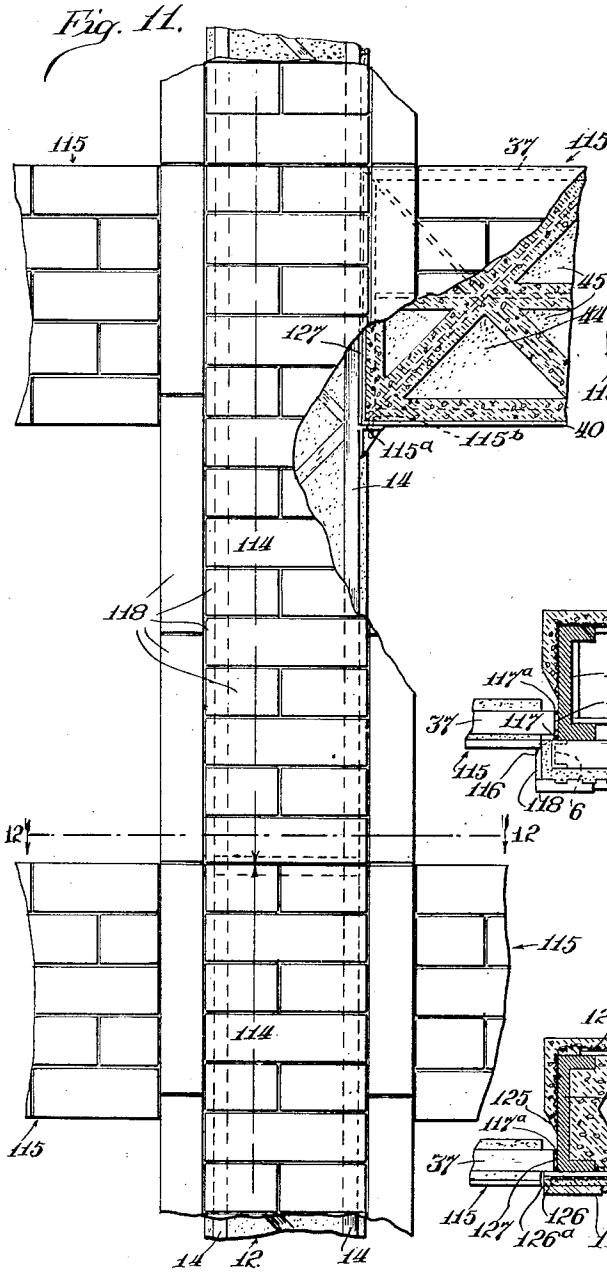


Fig. 12

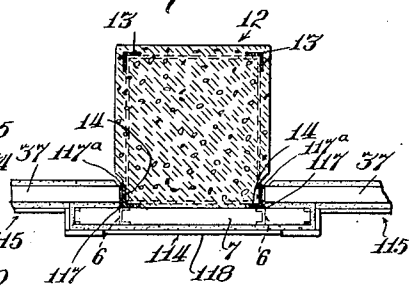


Fig. 13.

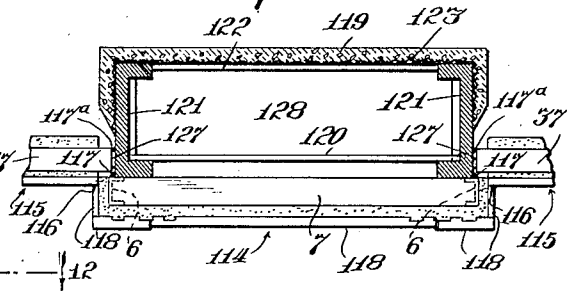
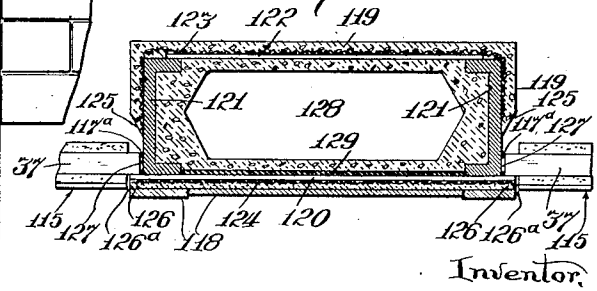


Fig. 14.



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Fig. 18.

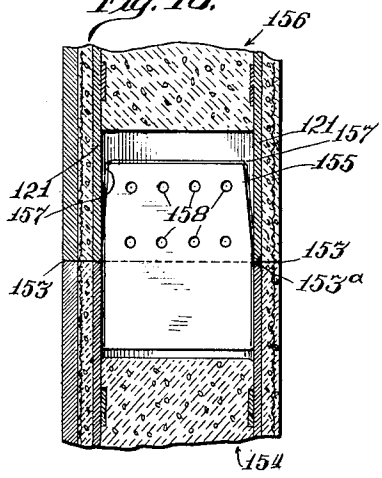


Fig. 20.

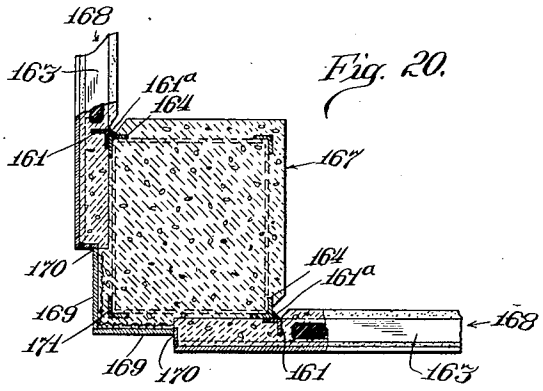


Fig. 19.

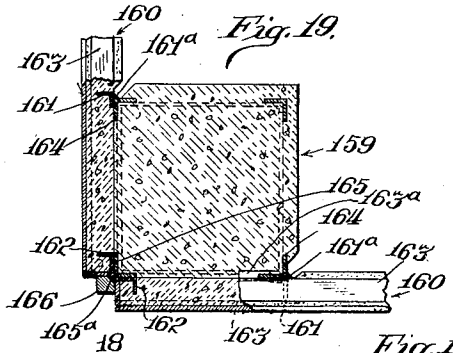


Fig. 21.

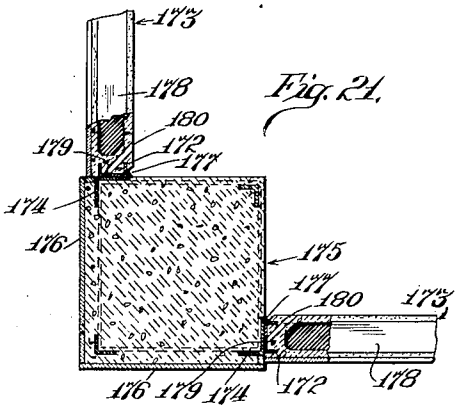


Fig. 15.

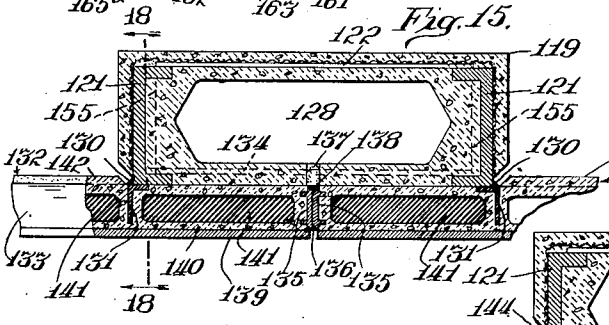


Fig. 16.

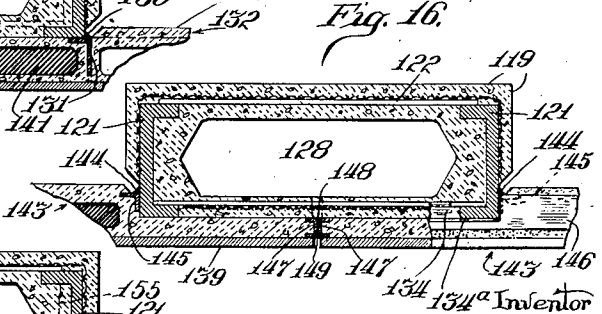
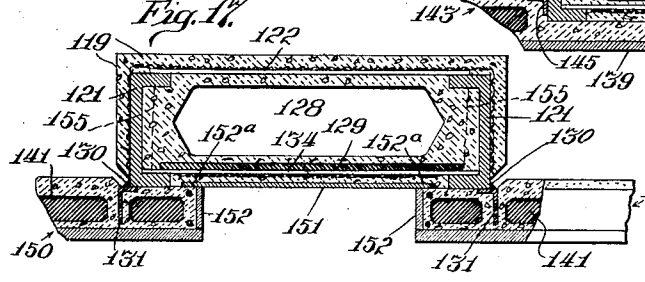


Fig. 17.



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Fig. 22.

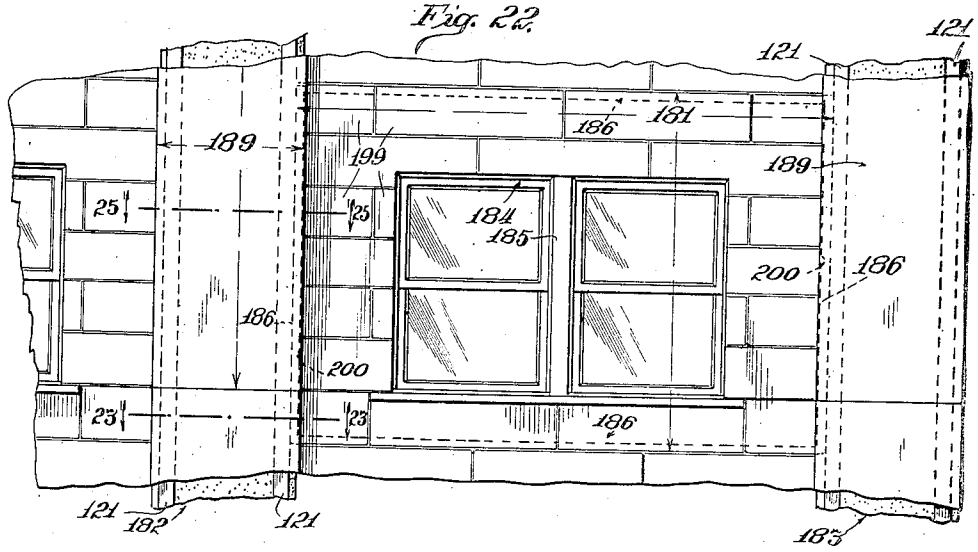


Fig. 23.

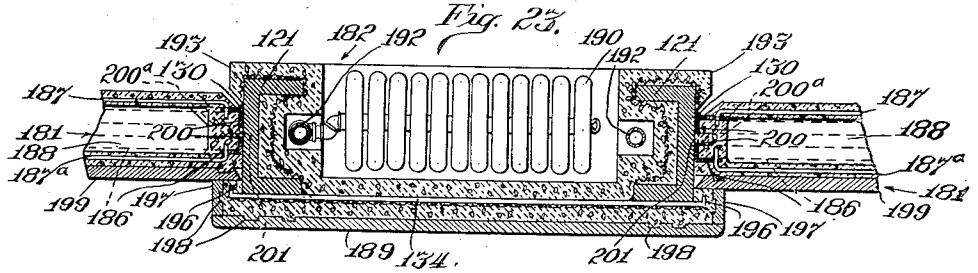


Fig. 24.

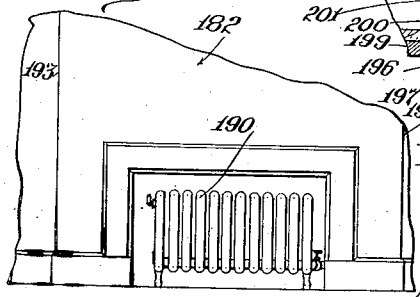


Fig. 25.

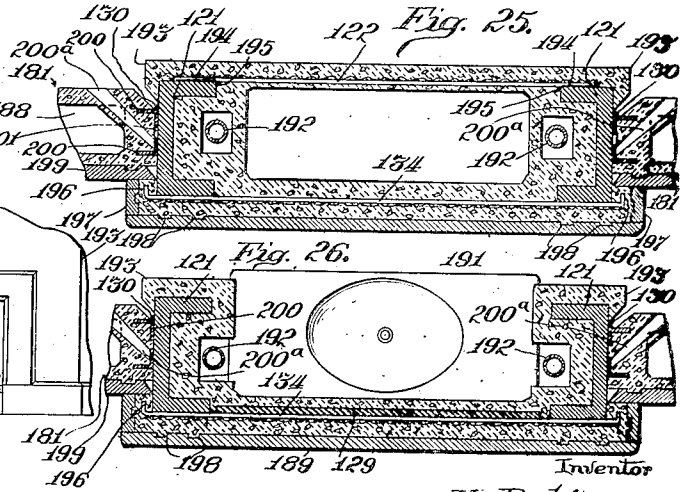


Fig. 26.

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Fig. 27

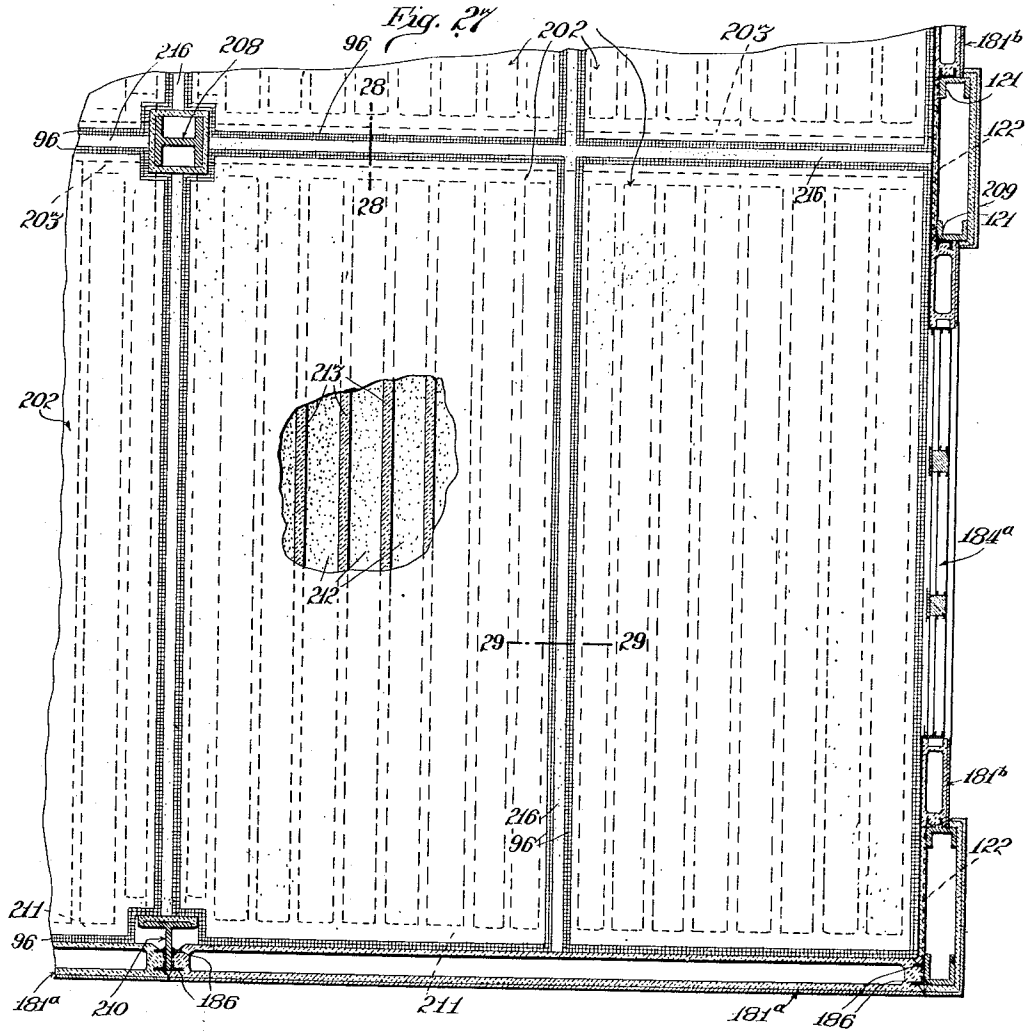


Fig. 29

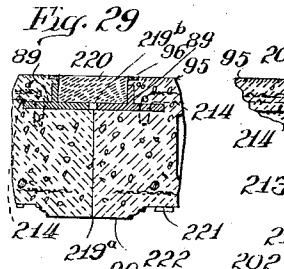


Fig. 30

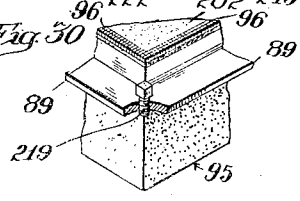
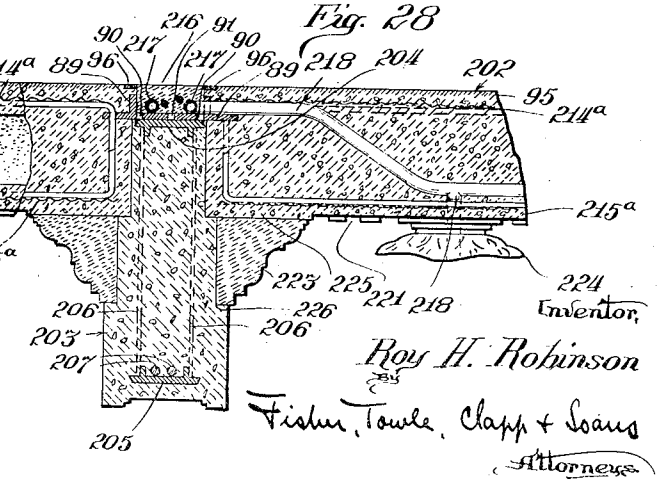


Fig. 28



Inventor,

Roy H. Robinson

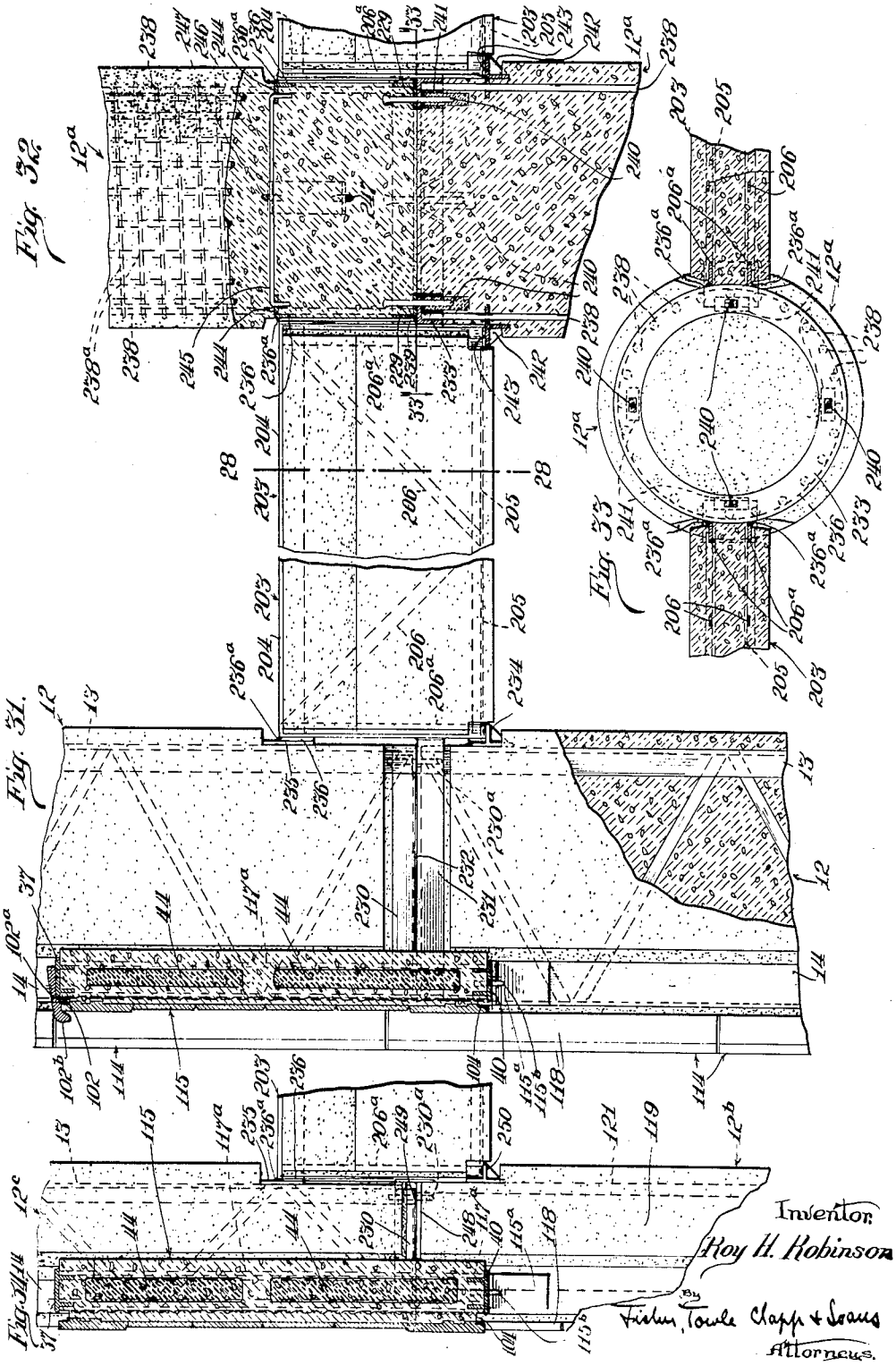
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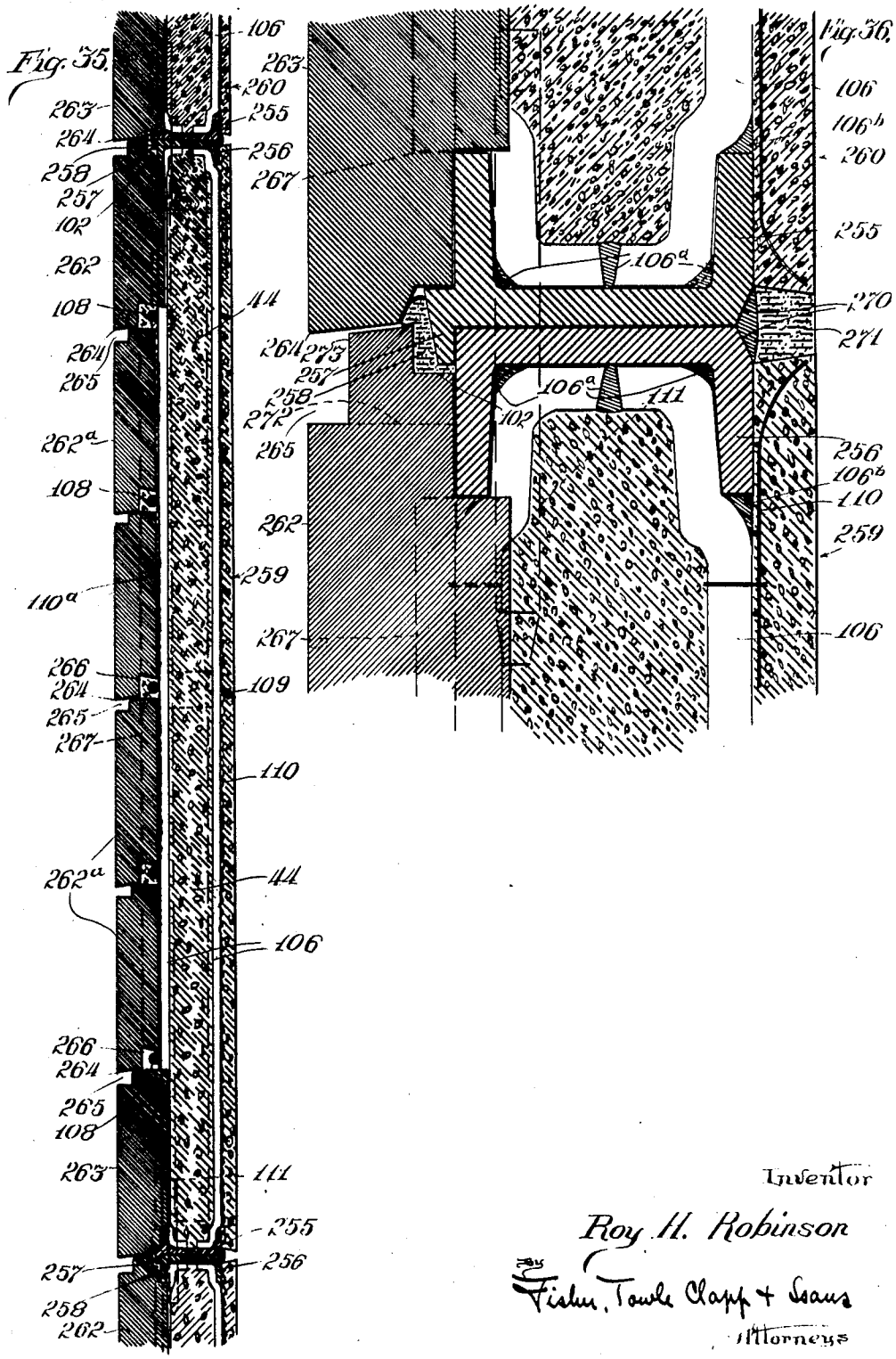


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March 10, 1931. R. H. ROBINSON 1,796,048

BUILDING CONSTRUCTION

Original Filed May 18, 1921 10 Sheets-Sheet 10



Inventor

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Attorneys

Patented Mar. 10, 1931 1,796,048

UNITED STATES PATENT OFFICE

ROY H. ROBINSON, OF CHICAGO, ILLINOIS

BUILDING CONSTRUCTION

Application filed May 18, 1921, Serial No. 470,669. Renewed June 10, 1927.

My invention relates to improvements in the design and construction of building structures particularly as applied to the modern skeleton type of building and in special relation to stone, marble and masonry work, together with important methods of manufacturing, assembling, and erecting the structural and ornamental parts of which the building structures are composed.

Among the principal objects of the present invention are to reduce the cost of building construction by eliminating a large and unnecessary wastage of both material and labor consumed by present methods of design and erection; to initiate new methods of building masonry work, whereby small quantities of costly stone and other masonry materials accomplish the same purpose as the relatively heavy constructions now employed; to reduce the quantity and thus the cost of transportation of ornamental materials generally shipped from distant points of production; to increase the available floor space in a building structure of the same external dimension; to change present masonry dead loads, which now uselessly weigh down the building frame work, into structural supporting elements; to reduce the imposed dead loads of the building structure and in consequence the size of the foundations and the supporting structural frame work; to eliminate the extensive fabrication of steel work now required in the structural framing; to very materially reduce the quantity of steel now employed; to substitute cheaper materials for the masonry backing now used, and at the same time, materially reduce the quantity thereof; to greatly increase the speed of erection of large building structures; to cheapen, facilitate and safeguard the erection of buildings in winter and in inclement weather; to permit the use of reinforced concrete columns in high buildings where the loads and consequently required column sizes do not now successfully permit of such; to make possible the use of concrete structural elements of improved strength and quality and of smaller size; and, finally, to reduce the process of building construction from a slow, expensive, field operation to a highly economical, rapid and standardized continuous process of shop manufacture so as, in summary, to produce buildings of greater strength, lighter weight, and greater capacity in shorter time, with a greatly reduced consumption of the now high prices of labor and material so as to insure at one and the same time profitable investment and returns in building enterprises for capital and favorable rentals for tenants, both of which are now made impossible by the revolutionized condition of the building industry.

My invention, while producing in exterior appearance a masonry façade, similar to that now used, introduces a quick, economical and novel means of attaining these same results with many distinct advantages. I assemble, preferably at the factory, the small individual units of stone, marble, terra cotta, brick or whatever ornamental material may be selected, in groups in union with a thin embedding matrix of steel reinforced concrete enclosed in a metallic reinforcing and welding frame, or, in lieu thereof, containing in any case embedded metallic welding or connecting members. In doing this, I am able to greatly lighten and reduce the thickness of the masonry units. I then erect and unite these several groups of pre-assembled masonry elements in the building structure, forming the wall façade preferably by metallically uniting their metal members. Metal is stronger than mortar, and similarly my wall structure composed of masonry or concrete elements united by metal instead of mortar or cementitious adhesion, is of increased strength and lightness, and a very substantial economy in materials is provided.

By thus metallically uniting the various units, I am able to set up and hold in position thin masonry and concrete panels which under the present method of masonry setting or securing with mortar or concrete could not be safely placed or sustained in position. At the same time, I utilize this material to develop structural frame bracing and supporting members which supplant the customary wind bracing and sustaining frame work of the present structures.

This new means of uniting masonry and

preformed concrete elements is widely applicable for all structural formations. It not only permits of uniting thin masonry and concrete elements rigidly together which hitherto has not been feasible, but particularly provides for uniting of two or more elements in what would ordinarily be difficultly connected positions and assures a rigid and dependable connection not secured by other means heretofore employed. It also secures a union in restricted positions without cumbersome space consuming connections and permits of readily concealing the connection and avoids both consumption of valuable space and interference with ornamental or architectural arrangements. Still further, it provides a leeway of adjustment in the field and freedom from troublesome exact register which otherwise makes fabrication and interfitting assemblage costly, slow and most uncertain.

A very notable advantage in the solidity of the building structure is secured by my construction as compared with the present practice of wall construction in buildings employing reinforced concrete framing.

My invention makes it possible to use thin slabs of these materials which are easily obtained and are relatively inexpensive in such thicknesses, while the exterior effect procured is quite the same as that obtained in the present heavy masonry construction.

With my light masonry elements assembled in extended lengths on an interior reinforced concrete core within a metallic welding frame, I am able to build a light skeleton structure with hollow chambers, eliminating the weight of material and saving the expense of a further quantity of masonry backing now required with these heavy stone exteriors as well as using only a thin veneer of the costly marble or other masonry elements. The hoisting and setting of these sections is obviously rapid and highly economical.

In addition to the difficulty and expense of obtaining in large sizes, many of the most desirable stones and particularly the highly decorative marbles are found to be structurally unsound, owing to the presence of seams and cracks of one kind or another. Some of these defects are invisible to the naked eye and it is impossible to work the material in large sizes without destroying it or making it unfit and unsafe to erect in the building structure.

My method of construction removes these difficulties however, first because it is comparatively easy to secure thin slabs of material of sound quality, and second, because the presence of structural unsoundness no longer impairs the solidity or safety of the structure, as the material when employed in my preformed masonry units is primarily an ornamental covering and is supported on and bonded with the strong reinforced concrete backing, instead of the stone itself being the element depended upon for strength and support.

Similarly, in these stones and particularly the most desirable marbles, it is most difficult to get stones of large dimension free from discoloration and objectionable natural markings and æsthetic defects. This is particularly true where two or more faces are to be exposed to view. In my thin slabs, however, which are sawed from the mill blocks, these difficulties and defects can be almost entirely avoided and with small waste of stock.

My method of construction also makes possible an innovation in the method of cutting these large stones, such as heavy cornices, etc., in the mill or stone-yard. I build up my cornices and other similarly projecting relief work out of thin veneers in one or several pieces which, because of their thinness, can be secured in long slabs. It is possible to form all the architectural members on these long slabs at small cost by grinding or planing in a machine. Under the present methods the stones because of their great thicknesses, size and weight, must be in short lengths and so this machine work cannot be readily done or with anything like the same facility and economy.

In building up these pre-assembled masonry cornices and similar units, the separate stone pieces are preferably set up in the factory, the uniting edges being either dry or buttered with mortar and, if desired, the veneer stones are further secured inwardly or outwardly with spots of quick setting plaster of Paris. This setting up, preparatory to concreting, can be done in various positions, light, temporary gauge and rack framework and supports being properly located to receive and hold the stones in accurate and secure alignment for concreting. In the case of cornices, one of the most desired methods is to set erect in vertical position the steel border and welding frame which is preferably used. The stone veneer elements are then set up on longitudinal gauges in their proper position, projecting out in front of the metal welding frame. Reinforcing bars are previously securely attached to the metal welding frame, certain of these projecting outwardly into the body of the cornice in proper relation to the stone members, and particularly so that certain of them lie as reinforcement in the countersunk or rabbeted joints with which the stone members are provided and which, when filled with concrete, form a permanent key bond between the stone veneer and the concrete core. These metallic reinforcements may be anchored directly in holes in the stones, or further anchors in the stones can attach or tie to or around the reinforcing bars.

After this is done, hollow forms are set up in proper relation to the steel reinforcement

so as to produce structural ribs within the cornice structure and greatly reduce its weight, as well as the consumption of concrete material employed. In this way, a light, strong cornice is economically obtained. These hollow members can run transversely or longitudinally in the concrete, or with a combination of both.

In assembling these masonry elements in factory-built wall groups, I do away with the laborious and expensive vertical field work of stone setting or brick laying, and instead, assemble the masonry veneers by quick process on trued surfaces and patterns in horizontal position in the factory with great ease and rapidity. In casting the binding and sustaining matrix for these to form the structural panel, my aim is to secure a strong thin wall, in order to avoid waste of material and consumption of the valuable floor space occasioned in present time construction and still produce a wall which has equal or better insulating qualities despite its relative thinness.

In the manner described, large pre-assembled masonry arches forming substantial or complete portions of story heights may be built up with a thickness of six inches or less. These with their reinforcement and rib structure furthermore form in themselves complete structural panel beams for wind bracing the columns and sustaining all loads required in the wall façade and framework, and also for supporting floor arches. These masonry groups or panels I combine with each other and with the column framework of the structure to form the wall façades. I also preferably secure them in connection with the floor arches so as to provide a still further stiffening of the several members.

In one of my preferred masonry panel arrangements, particularly suitable for the high office building type of structure, I first erect the vertical columns made in one story or two story lengths and apply to the face of these, vertical pre-assembled masonry panels, the welding faces of which are welded to the metallic faces or connections of the columns. These vertical panel sections preferably come in alignment at their top with the top of the window openings or the spring of the arches for same, and when attached to the columns form a bearing upon which the horizontal panels, which form the wall and lintels between the story window levels, are swung into place and set by the derricks.

On the lower edge of these horizontal panels which are preferably designed to span from column to column metal pintles may be provided to register in slotted holes in the top metallic edges of the vertical pier panels. These receiving holes for the pintles are preferably partially filled with cement, grout or mortar just before setting the horizontal panels in place so that when the pintles sink into them they become permanently secured as an additional tie between these adjacent elements. These pintles, which preferably are anchored in and pass through the metal frames of the panels, serve a triple purpose; first, to determine the correct location of the panels, second, to hold the panel in position prior to the welding operation, and third, to provide a further stiffening tie between the wall members.

After the horizontal story panels are so erected in place, they are preferably welded to the metallic connections of the columns and to the temporarily sustaining vertical panels and also preferably to each other at their abutting ends. With these horizontal story panels in place, the structure is then ready to receive another tier of the vertical column covering panels, which also preferably have depending pintles on their bottom edge registering in receiving slots in the top of the horizontal panels. Where there are window openings between columns separated by masonry piers or mullions, vertical panels similar to those covering the columns are set with pintles registered on the horizontal panels at the required points. All these vertical panels should be properly plumbed preferably by thin metal wedges inserted from the rear and driven between the metal framing edges of the horizontal and the vertical panels. It is advisable in preforming the panels to slightly cant the bottom metal frame or face so that when temporarily set in place the panel tips inwardly slightly. The wedges driven in from the inside will then bring this into plumb, while the pintles prevent it from falling over in either direction, the pintles being preferably so fitted as to permit a slight plumbing movement of this kind. In this way, the panels are quickly brought into plumb. Their permanent position is then secured by the setting of the mortar about the pintles and the welding of the adjacent metal edges of the panels together. The metal setting wedges may then be knocked out.

In this manner, story after story is quickly set into position by derricks. Similarly constructed preformed floor panels may be set by the derricks at the same time, and these preferably have exposed metallic welding faces on the sides, as do the adjoining horizontal story panels. By this means, the wall panels and the floor panels may be welded together at the desired reinforcing points, stiffening both structures and making the complete metallic union between the several structural elements, walls, floor and framing.

Where the masonry panels are formed in the cornice construction already described, I preferably have an interior counterbalancing mass of concrete at the bottom of the plate to offset the thrust of the overhanging cornice members at the upper part of the plate. This counterbalancing concrete I further

form to receive the preformed floor panels which rest on this and bear against the cornice panel at a point generally in alignment with the lower portion of the cornice belt. This floor arch is preferably welded metallically to a welding face on the interior of the cornice panel at this point. In this way, the floor arch serves to counterbalance the thrust of the exterior cornice projection and firmly secures the cornice panel which at its ends is welded to the column members.

In other instances, I modify the arrangement of façade panels so that the vertical panels forming the column facings extend continuously in abutting vertical sections without interception by the horizontal panels. In this arrangement, the vertical panels have their metallic faces welded to the metallic faces of the columns and to each other at their abutting ends, while the horizontal panels connect with the side of the columns and weld to metallic connections on the column, and also preferably to metallic connections on the vertical panels.

Where the vertical panels are exceptionally wide, the horizontal panels may be made in lengths equivalent to the space between the wide vertical panels and set in place on supporting lugs or insets formed on the side edges of the vertical panels and then united by welded connection to the edges, or to both the edges and a face of the vertical panels.

The horizontal panels may be formed with rabbeted ends in conjunction with their connection to the supporting vertical columns and the terminals provided with metal facings so that they bear against and can be welded to both the outer face and the side of the column, forming a strong supporting brace for the column.

It will be readily evident that the steel work as well as the concrete and masonry material of my wall panels, on account of the metallic union with the structural column members, may be given full credit as a portion of the load sustaining material of the columns and the columns correspondingly reduced thereby.

For the initial support of the horizontal panels subsequently supplemented by metallic connection, the columns may be either provided with outwardly projecting lugs or brackets or inwardly projecting inset openings on the face or side of same and upon which, in each case, the horizontal panel rests when set in position.

In the union of panels to each other there are several important features which my invention provides. The welded connections are preferably disposed so that the welding can be done from inside the building instead of exteriorly, in order to avoid the expense and annoyance of scaffolding. On the inner face of the panels the concrete covering the welding elements is preferably margined back sufficiently on one or both of the panels to provide a welding recess for the access of the electrode. This will generally be at points relatively near the inner faces of the panel. Further stability against rocking movements may be obtained not only by further weldings extending across the metallic edges of the panels where they abut one another, but also by interlocking engagement occurring nearer the outer edge. Several details provide for this further interlocking engagement. The pintles are preferably located at points nearer the outer edge to offset the welding engagement near the inner edge. In addition to this, I also preferably provide near the outer face of the panels and along their upper edge, a sunken slot which is filled with mortar or other suitable adhesive before the setting of a superimposed panel. The superimposed panel in this case has a depending tongue or tenon, preferably of stiff sheet metal, which embeds itself in this mortar filled groove and thereafter serves to prevent the entrance of moisture and the erosion of the metal while at the same time lending additional stability to the united elements. This union also obviates any necessity for pointing the exterior joints from the outside with mortar to exclude moisture and weather.

Furthermore, the two contact metal faces of adjacent panels may be built with special steel shapes for this marginal framing, providing within themselves the registering metallic interlocks. Under ordinary conditions, however, this will be unnecessary.

Where conditions require a more strongly reinforced connection, the panels may have their metallic edges or welding elements also welded on the inside and outside of the panel. In such cases the masonry elements, or the ornamental finish of the exterior faces of the panel, are preferably sufficiently margined back, in the form of suitable architectural joints, to provide access for the welding electrodes applied at these marginal edges. After this metallic connection is effected the joint is then pointed with mortar, closing and protecting the weld and architecturally concealing the sectional panel joints which become indistinguishable from the general plan of masonry jointing.

It will be readily appreciated that in most of the preassembled masonry panels provided with a metallic welding frame, the masonry members are sufficiently margined back at the edges of the panel to give the width of the conventional masonry joint adopted in the architectural design when two panels are brought edge to edge with their metallic faces in bearing ready for welding.

In types of heavy masonry building, as distinct from the modern skeleton structure, and particularly in monumental public buildings of stone exterior, my construction in part may also be effectively employed. This

is done by preassembling several pieces of the stone work in one unit secured with bonding members and metallic elements on a reinforced concrete core, preferably containing hollow chambers or cells. By this means, the stones may be used in thin slabs, as already described, except on the returns or quoins where greater thicknesses to produce any desired head are combined with the thin intermediate slabs. One course or several courses of the wall may be pre-combined in this manner. Single stones cut thin may be filled out by the same method. Aside from the saving of the expensive stone stock and the employment of the cheap concrete material, not only as a substitute for the stone but also for the likewise more expensive brick backing, considerable labor and time are saved in the setting, as several stones are thus set in one operation of the derrick. These preassembled units may be made to lay up with mortar bed to bed, the same as the masonry they replace or, if desired, they may be formed with embedding welding elements and welded together, as already described. Particularly extensive savings will be effected in the cost of the heavy cornices employed in this type of architecture.

A very material saving will also occur in the construction of the lintels or arches for door and window openings where these are formed of numerous arch stones. In flat arches, under present conditions, these have to be supported by an expensive steel lintel. In my construction I not only eliminate the steel lintel entirely but make it possible to use a skeletonized stone structure of thin stones preassembled and secured by the reinforced concrete backing which forms the supporting lintel as well as the wall masonry and enables the arch to be set in the wall in one piece.

In carrying out the general purpose of my invention, I also preferably employ a new column shape, distributing the metal framing of the column so that the column is only the thickness of the wall or, at most, much thinner the wall depth way, and in the opposite direction very wide and much wider than columns heretofore generally employed. In both steel and reinforced concrete work, as at present used, the columns jut deeply into the room space behind the wall. By this means, I save a very considerable amount of floor space. At the same time, I secure the same bearing and compression area in the column to sustain the imposed loads. In the case of my structural steel columns, I embody a still further saving by concentrating the metal on the two sides furthest apart and forming a continuous open shaft within the column structure. In this shaft may be carried the heating risers and various piping required for the plumbing and mechanical equipment. In each story I preferably provide open panels depressed into the column shaft in which are installed the steam or other heating coils which connect onto the steam risers at the side. In this way the floor space customarily taken up by radiators is saved and the unsightly heating apparatus concealed. Where lavatories are required the wash-bowls and the lavatory slabs may be set within these column recesses and connected directly to the supply and waste pipe lines carried within the columns. The lavatory thus formed may be closed by a cabinet door.

A still further salient feature of my column construction lies in the combination of structural steel and reinforced concrete columns made possible by the methods devised for metallically connecting my preformed sections. Reinforced concrete columns because of their necessary cross sectional area are undesirable for buildings of extended height.

Where it is desired to secure the greater economy of the reinforced concrete column in skeleton structures of the greater heights, I employ my structural steel columns for the lower stories where the excessive loads are to be met. In the upper stories where reinforced concrete columns can be used with diminished size, I cap the structural steel columns with a steel plate support and on this metal support I superimpose my preformed reinforced concrete column with its metal faced base which rests on the steel column. This is then welded to it by welding the edges of this metal angle iron base to the metal top of the structural steel column. By this means, the tensile strains are safely transmitted and thoroughly substantial and safe interconnection between the two types of columns secured and safeguarded.

The floor beams or girders which span between columns to support the floor arches and which weld to the columns may be of either structural steel with preferably a precast coat of concrete fireproofing applied at the factory, or they may be a reinforced concrete beam. I preferably make the reinforced concrete beam by forming a metal framework, leaving exposed metal ends to which attach the customary reinforcing bars for stirruped or trussed construction. These rigidly attach or anchor into the metal terminals and the framework is then concreted to form the beam in the factory, the metal being exposed for welding at the ends. The metal frame face or anchored plates are preferably exposed on the top or sides of the beam for receiving preformed floor arches and welding to the metal connections in the latter.

After the beams are set in place and a filler plate has been inserted at the ends between beam and column, the beam is then rigidly and metallically united to the column by

welding it at the top and bottom and also, if desired, on the sides to the exposed metallic faces or connections on the column. Preformed floor arches are then swung into position by the derricks and set in position on these beams and, thereafter, the metal connection of the floor arch and the beam, and in certain instances also the column, are secured together by welding the contact faces at the desired points. This in turn makes the reinforcement from one floor panel to another continuous and transmits the stresses from panel to panel. This is a very important feature.

Where it is desired in some cases to reduce the number of wall panels and to embody more area in the same, the construction may be simplified by erecting the vertical supporting wall columns and uniting them by intermediate connecting masonry units, a single masonry panel spanning between two columns and being one or two stories in height. These large masonry groups are preferably precast in cellular formation within a metallic frame and have exposed embedded metallic welding or connection members at the desired points on the sides or edges. In casting these large panels, the window frames are preferably set in horizontal position properly located within the metal frame of the panel, the masonry elements being laid out beneath the frame and filling out the panel in proper design. The reinforcing bars and wire mesh backing for the masonry are attached to the metal frame, and generally to the window frames also. The concrete matrix is then poured, spread and screeded over the masonry elements to the proper thickness, generally about an inch and a half, embedding both matrix and metal work. Cellular forms are then placed in the proper location on the freshly screeded layer of concrete matrix and the concreting is then continued, embedding the cells and so forming the interior concrete ribs of the panel and embedding the metal frame or welding elements and metal reinforcements. I preferably make these forms of heavy waterproof paper with light metallic stiffening reinforcement attached to the same, or of insulating fibre, and shape to form troughs or prism-like cells. The concrete is brought to the proper finished lines on top, preferably reinforced with wire mesh, and screeded or troweled off to side gauges ready to receive a skim coat of finished plaster at the building after erection. The window frames are preferably anchored to the reinforcement or metallic framework of the panel and cast in place in their position in the panel so that the story section for the wall is complete with both window frame and masonry elements incorporated and all in a single complete masonry unit. These masonry units tie the columns together and thus eliminate the necessity for the customary beam and girder framing. These units likewise support themselves along their sides in connection with the columns instead of resting as a load on a supporting framework.

Where a large amount of relief work occurs in the masonry elements of a preassembled group, it will probably be found to be advantageous to lay these elements face up rather than by the face down method described. In such cases, the concrete is cast around the metal reinforcing work and the insulating members laid in place with a bed of non-staining or other concrete matrix mortar which embeds the reinforcing mesh across the top of the metal frame and bonds with the fresh Portland cement concrete which is preferably brought up to a level just below this reinforcement. The masonry elements are readily laid in horizontal position to their proper lines and levels in this matrix bed, the lines being preferably laid out and determined by side gauges and templets temporarily attached to the sides or metal frame of the panel, or by the metal framework itself. The rabbeted masonry elements are laid in horizontal courses, preferably with shoved joints and the bed mortar may be pushed up in this way to form mortar joints between the elements or their edges may be kept hard, stone to stone, the outer exposed edges of the joints being preferably beveled or grooved to form a rustic or nail head joint effect between the stones. This will relieve their outer edge from pressure and conceal any slight inequality in the masonry members, particularly between the masonry of abutting panel groups.

As the structural work of beams, columns and wall panels is erected at the building, the floor panels are preferably set at the same time. In this way, the danger involved in running up an open unfloored structure, as in the present steel skyscraper, is avoided. The floor panels are preferably set with their marginal metal connection members in metallic contact with or adjacent to exposed metallic surfaces on the supporting beams on which they are laid. I preferably provide the metallic border framework of these panels with holes at the corners of the panels, accessible for engagement and lifting by derrick hooks, lewises or other suitable devices.

I also preferably provide temporary screw lifts in these corner holes in the floor panel framework. Set screws are placed in these for leveling the panels after they are set in place on the steel bearing surfaces of the supporting beams. By this means, the panels can be readily brought to exact finishing levels and finally secured by welding their exposed welding members to the exposed metal surfaces on the beams, or, in certain instances, to each other where the panels are in contact or close position. After this is done, and

after any conduits have been laid in the sunken groove formed between the adjacent ceramic borders of respective panels, this groove is filled with concrete with the proper finish of cement, terrazzo, ceramic or whatever material may be desired. This filling is trued to the surface of the enclosing refractory borders. When this is done, a complete floor of ornamental finish, with no evidence of structural joints, is presented. As this work is practically all done at the factory, it will be seen that the construction of the finished floor at the building consumes but a small fraction of the customary time.

Where the precast floor panels abut the precast wall panels, both are preferably provided with metallic contacts at suitable and adjacent points and, after erection, the floor and wall panels are then welded rigidly together at this point, tying the structure and strengthening both members. On the wall façades where the panel load is carried by the wall panel at one end, the wall panel is preferably built with an offset providing a concrete shoulder with an exposed metallic member embedded in the wall panel to form a bearing on which the floor arch rests and to which it is welded.

Where electric lights are to be furnished in the ceiling panels, I preferably insert the electric conduit and outlets before casting the panel. The conduits terminate in exposed position at the edge of the panel where they will be accessible after the panels are set in place. In the slot or groove formed between the panels, the floor conduits are run below the level of the finished floor and are connected to the cast-in conduit sections already embedded in the panels. These conduits are then concealed when the slot is filled with concrete and covered with the floor finish along the panel joints.

After the floor panels are finished at the factory, they are preferably covered with a protective coating, such as whitewash or adhesive paper, so that materials at the building will not become permanently attached to the finished surfaces. In this way the floors will be kept in good condition and can be readily cleaned off on the completion of the interior work in the building.

Where wood floor finish is desired, I follow the same procedure of panel casting, with the exception of incorporating in the final topping surface sawdust or similar ingredients to produce a nailing concrete. The several panels are then trued by adjustment of the corner screws, and the finished flooring nailed directly to the precast floor panels. This produces a great saving of labor and materials.

A further feature of my floor construction lies in the fact that in welding together the metallic connection elements of adjacent floor panels either directly or indirectly through the connecting metal of the supporting beam members, I secure the extra strength of continuous reinforcement notwithstanding the fact that the floor panels are of separate precast formation. Similarly, by placing my reinforcement in both directions, lengthwise and crosswise, within the metallic framework of the panel, I secure a two-way reinforcement of the floor arch and continuous reinforcement from panel to panel in both directions after the welding of the panel on all four sides.

In the panel and beam construction described, it should be noted that my panels eliminate the necessity for tie beams between columns and girders so that the beams or girders between columns need run in one direction only, with a corresponding saving of steel or reinforced concrete. My construction, however, is not confined to the beam and panel type of floor alone, but is equally applicable to the formation of a new type of floor in the form of a precast flat slab or beamless floor system, corresponding to the present monolithically field built flat slab floors. This is made possible through the continuous tying of the reinforcement of the flat panels by the welded metallic connections between the precast members, which permits of a flat slab or paneled ceiling without beam obstruction where the same is desired for factory buildings, etc.

The many other features and advantages of my invention will be better understood by reference to the following specification when considered in connection with the accompanying drawings illustrating certain selected embodiments thereof, in which:—

Fig. 1 is a front elevation of a section of a masonry wall constructed in accordance with my invention.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view of the connection between masonry wall panels of Fig. 2.

Fig. 4 is a front elevation of a typical section of wall façade, indicating one form of masonry panel arrangement.

Fig. 5 is a front elevation of one of the wall panels of Fig. 4, portions being broken away to illustrate the interior and rear construction thereof.

Fig. 6 is a vertical sectional view of a wall showing masonry wall panels in combination with a masonry cornice panel and floor arch.

Fig. 7 is a front elevation of the vertical masonry panel shown in Fig. 6.

Fig. 8 is a section on line 8—8 of Fig. 7.

Fig. 9 is a perspective view of a portion of a preferred form of steel shape employed in the framing of the wall panels.

Fig. 10 is a perspective view partially in

section of one arrangement of masonry panels and cornice construction.

Fig. 11 is a front elevation partially in section of a portion of the vertical masonry wall.

Fig. 12 is a horizontal section of a reinforced concrete type of column and adjacent panels, showing the horizontal panels connected to the side of the columns and the vertical panels to the front of the column to produce exterior architectural pilasters.

Fig. 13 is a horizontal section of a special structural steel column and the adjacent masonry wall panels, showing the horizontal panels connected to the side of the column and the vertical panels to the front of the column to produce exterior architectural pilasters.

Fig. 14 is a horizontal section of a structural steel column and adjacent masonry wall panels in which the column has the masonry exterior in preformed combination therewith to form exteriorly either a pilaster or a flush wall surface with the horizontal masonry wall panels attached to the sides of said column.

Fig. 15 is a horizontal section of a structural steel column and adjacent wall panels in which the masonry wall panels extend across and are attached to the face of the steel column.

Fig. 16 is a horizontal section of an arrangement of column and panels in which the masonry wall panels extend across the face of the column and attach to both the side and the face of the column.

Fig. 17 is a horizontal section of an arrangement of column and panels with the masonry wall panels attaching to the face of the structural steel column but not extending entirely across same.

Fig. 18 is a vertical section of a structural steel column indicating the manner in which the column lengths are spliced and welded together.

Fig. 19 is a horizontal section of an arrangement for the corner wall column and the masonry wall façade where the masonry wall panels extend across the face of the column, welding to the same.

Fig. 20 is a horizontal section of another arrangement of the corner wall construction where the masonry panels extend partly across the face of the column, welding to the same, while the column itself provides the masonry finish of the remaining exposed corner.

Fig. 21 is a horizontal section of a further corner arrangement wherein the horizontal wall columns attach to the interior sides instead of the external faces of the corner column, and the column has in preformed union a masonry exterior on its external exposed portions.

Fig. 22 is a front elevation of a portion of a wall façade wherein the preformed masonry wall panels are in large story sections containing within themselves the window openings.

Fig. 23 is a section on line 23—23 of Fig. 22, showing the connection of preformed masonry panels to structural steel column and the special type of column embracing the risers, pipes and heating coils.

Fig. 24 is an interior elevation of a portion of the column shown in Fig. 23, illustrating the recess in the column for the heating coils.

Fig. 25 is a sectional view on line 25—25 of Fig. 22.

Fig. 26 is a sectional view of a special column arrangement similar to Fig. 23, illustrating the method of embracing within same a lavatory and the necessary pipes connected therewith.

Fig. 27 is a horizontal section of the building structure above the floor level, illustrating the wall and panel arrangement of the type shown in Fig. 22, together with preformed floor panel, beam and column construction.

Fig. 28 is a vertical section on the line 28—28 of Fig. 27 or Fig. 32.

Fig. 29 is a vertical section on the line 29—29 of Fig. 27.

Fig. 30 is a perspective view of the corner of one of the floor panels as shown in Fig. 27.

Fig. 31 is an elevation and partial vertical section of the union of precast reinforced concrete column, beam members and masonry wall panels.

Fig. 32 is an elevation partially broken away to show the union of interior columns and beams.

Fig. 33 is a horizontal sectional view of column and beam on the line 33—33 of Fig. 32.

Fig. 34 is an elevation and partial vertical section of the union of a structural steel column and a reinforced concrete column together with the masonry wall panel.

Fig. 35 is a vertical section of the wall panels showing the method of embracing the preassembled masonry elements within the metal panel frame.

Fig. 36 is an enlarged detail sectional view of the joint between panels shown in Fig. 35.

Referring to Figs. 1, 2 and 3 of the drawings: 1 designates the typical vertical preassembled and preformed masonry panels employed in this general type of wall. These panels are preferably two stories in height, and have a width corresponding to the distance between adjacent window openings 2, and so form the masonry pier or pilaster effects. The masonry of these panel groups is formed in any stone desired, the ashlar 3 being formed of thin masonry slabs preferably about an inch thick or varying from three-quarters to one and one-half inches thick so

as to reduce the quantity of material, the cost of same, and the weight of the structure. These pieces of stone may be run under a carborundum planer so as to provide channelled grooves or rabbets on their backs 4, to engage with the concrete matrix 5, uniting the masonry in preassembled groups.

Embedded in the concrete matrix of the panels 1, are vertical metallic reinforcements 6, either channel irons as shown, or any standard or special steel shape desired. These engage within the top and bottom horizontal metallic frame members 7, and have welded or otherwise firmly attached to their outer edges the reinforced bars 8, and similarly the reinforced bars 8a weld to the other side of the frame members 10 and 16 or to other reinforcement of the metallic frame which is used in the exterior portion of the panel to reinforce the concrete matrix 5 in close proximity to the backs of the masonry elements. The masonry elements where conditions demand can directly anchor to the steel reinforcement 8 or to the outer steel frame itself by metallic hooks or wires which insert into holes drilled in the back of masonry elements 3. In the preferred practice a wire mesh 9 is tied on the outer side of these reinforced bars 8, (and similarly 9a to the bars 8a), the mesh 9 serving to further reinforce the matrix backing 5 directly behind the bonding backs of the masonry elements 3.

At the side edges of the panels 1 are further steel reinforced members 10 of suitable shape and size to properly stiffen the panel framework and provide a welding connection for carrying the intermediate wall panels 11 which span between and on the masonry panels 1 when same are erected to form the wall façade. In the manufacture of the masonry units several metallic members, as 6, 7, 8, 9 and 10 forming the panel framework, are fabricated and united into a unit. After the masonry elements 3 and the panels 1 are laid in proper architectural relation, edge to edge, face down upon the molding floor, the metallic frame unit is then set over the back of same properly spaced away and the concrete matrix 5 is then poured over the masonry and steel work to form the preformed masonry panel as already described.

Prior to the erection of the panels the wall columns 12, which can be either of structural steel or of reinforced concrete as shown in Figs. 1 and 3, are erected in place. In the reinforced concrete design, the preferred form employs angle irons 13 and 14 or other structural steel shapes as the corner reinforcement tied together by light bars 14a, bent back and forth to form a lattice, laid inside the angle irons 13 and 14, and preferably welded to the legs of same. The concrete of the columns properly covers and fireproofs the inner angles 13, but the outer angles 14 are left with exposed surface, as noted, for metallic contact with members 6 and 7 of panel 1, forming a welding joint 15, and on the sides of the column the concrete is properly margined back at the approach to these welding points to properly admit the welding electrodes, rigidly securing the panel 1 to the column 12 by welds 15. These can run either continuously along the metallic offset formed between the metallic faces 6 and 14 or they may be located merely at major stress points in tack welds, allowing the necessary number of inches of welding required to secure the solidity of the structure. It will be particularly noted that by this union the panel 1 becomes a homogeneous and structural part of the column 12, the materials of the panel being thus made available to assist in sustaining the load which the column has to bear, and a large T column is secured in cross section noted. This is of particular value in resisting the wind stress, and in itself becomes the wind-bracing of the column and façade. By this means, instead of the masonry being a mere load upon the wall frame as in present construction, it becomes, as is clearly seen, an important load sustaining factor as a monolithical part of the wall frame. The intermediate horizontal panels 11 which are carried on the vertical panels 1 have metallic border members 16 of a suitable shape and shown as channels in this instance. These meet to form a welding slot or offset on the inner side, in which the connecting weld 17 is made after the panels are set in place supported on brackets 16a which are welded or riveted on the outer face of the channels 10 to sustain same in erection as well as subsequently in addition to the welding connections. In addition to and in conjunction with the vertical weld 17 which can be tack, or continuous, I preferably weld the joints across the width of the face of the steel members 10 and 17 at point 18 on the top of panel 11, where same is exposed to form the window opening. This provides welding in more than one plane to prevent any rocking movement between the two panels.

A salient feature of my invention is further shown in the formation of panel 20 of Fig. 1. These more fully exemplify the cantilever construction also presented by panel 1. These panels, as will be noted, have their lateral joints 27 located and concealed in the arch masonry at or near the keystone. This feature is of particular value in avoiding interference with the inter-bonding joints of masonry which generally occur in the wall masonry at other points between arches. In conjunction with the metal framing of the panel, the metal framework provides a particularly strong cantilever construction, having a channel iron or steel shape 21 extending along the upper joint line at that point, forming a cantilever tension member in the

most desirable position. The panel is provided with vertical steel welding and bracing members the same as 6 of panel 1, which correspondingly weld at 15 to the angles 14 of the column and has the upper and lower steel frame members at joints 21 and 22 corresponding to 7. There may be also a marginal metal reinforcement either exposed or slightly submerged below the face of the concrete matrix on the curved arch soffits 23 of the panel.

The panel 24 forming a pilaster on the front of column 12 is of similar construction to panel 1 and welds to the vertical column angle irons 14 in the same manner. The upper metallic frame member of the panel 24 welds both to a horizontal plate 25 attached to the angle irons 14 and the bottom steel edge 22 of panel 20 welds to this at accessible points where the same extend on either side of the column. Similarly the metal reinforcement and welding elements 7 of panel 1 and 21 of panel 20 weld to each other along their marginal edges on either side of column 12, and the element 21 is welded to the exposed face of the steel cross strap 25 on the column before panel 1 is superimposed on panel 20 in the wall.

The vertical panels, such as 1 and 20, preferably have depending steel pintles 26 anchored in their bottom metallic frame member which set and engage in holes in the panel below, passing through the upper metallic members of those panels and preferably near their outer edge. These holes in the metallic framework are so located as to secure the panel exactly and automatically in erection in proper relation to bring their exterior faces flush, as already noted, but the holes are preferably slotted sideways so as to permit some adjustment in moving the panel sideways in small degree for suitable adjustment and dividing up of possible vertical joint discrepancies.

Where desired in special instances, the arch cantilever panels 20, instead of meeting at points 27, can have a separate keystone panel which will insert between and be carried by panels 20 on either side to which the intermediate keystone section will weld.

The panels 11 will be of any length required by the span between panels 1, thus in some instances in meeting architectural requirements, they will be long masonry panels carrying upon them groups of windows with vertical masonry mullions between the windows, seating on and welding to the panels 11 in a manner to be subsequently described and further illustrated in other figures.

Fig. 4 discloses another desirable arrangement of my wall masonry units particularly suitable for modern architectural wall structures. As a salient feature of this construction the masonry of the wall is formed in long horizontal panels 28, forming the wall structure between the windows 29 and 30 of adjacent stories. These horizontal panels which form the lintel arch for the windows 29 and the sills for the windows 30 of the next adjacent upper story are attached to the face of the wall columns 12 to which they are welded. These panels may be attached to both the face and the side of the wall column. Instead of spanning between the vertical panels 1, as noted in the arrangement of horizontal panels of Fig. 1, the vertical masonry covering the columns between these horizontal panels 28 of Fig. 4 is preassembled to form the vertical panels 31 which extend from the sill line to the arch line of the window openings, greatly facilitating both the preassembling and the erection of the masonry units. These vertical panels have pintles 32, which insert in the receiving holes passing through the upper metallic frame members of the panels 28, the same as the pintle arrangement already described. After being so set in place the panel 31 welds to panels 28 on the inside along the joint line 33 where same is accessible on either side of the column 12, while vertical metallic members similar to 6 of Fig. 3 embedded in the irons with exposed face weld to the angle irons 14 of column 12. It is understood that the metallic framing of the masonry panels 31 is similar to that of panels 1 of Fig. 1 with the exception that the channel side members 10 are not necessarily required and reinforcing bars embedded in the concrete and welded to the upper and lower steel framing members of the panel are sufficient to provide the necessary lateral reinforcement.

Panels 28 are particularly designed for long span construction. Masonry mullions are provided by further preassembled masonry panels 34 which set upon the panels 28 secured by pintles 35 and have welding members along the joint line 36 which weld to the top frame member 37 of panels 28.

The metal and welding member is preferably tilted at a very slight angle in the fabrication and concreting of the units, so that when these units are erected in their vertical position on 28, they tilt slightly inward at the top and out of plumb. This enables the exact plumbing of the panels by the workmen from inside the building after their being set in place by driving steel wedges between the bottom face of the vertical panel and the top metal face 37 of the horizontal panels. After being so plumbed and before the cement grout, if used, has set up in the pintle holes of 28, receiving the pintles 32 and 35, the panels are then permanently secured by welding at their inner edge to the metal frame 37 of panel 28 and also across the face of 37 where same is exposed to form the window openings, as for example 37a. This welds the panels in more than one plane.

In erecting and completing the uniting of

the preassembled masonry units of a story, the masonry units 28 having been welded in place, the vertical masonry units 31 and 34 of whatever number required are set in place and secured on the units 28 by the pintles 32 and 35. These having been properly secured in alignment, plumbed and welded in place, the horizontal units 28 of the next story are then set in place upon these vertical units to which they are temporarily secured at the lower edge by depending pintles 38 and 39[a] which enter receiving holes previously provided in the upper metallic frame members of the vertical units 31 and 34. It will be seen that by this simple means the stories are carried upwards in rapid succession, and a strongly braced yet light wall façade is secured.

It should also be noted that in accordance with modern construction methods these stories may be started on any and several points of the wall façade, the vertical supporting columns having been first erected. In the architectural arrangement of masonry in Fig. 4, it is to be noted that units 28 meet on the columns in abutting joints 39 in such manner that the joint 39 becomes a suitable architectural masonry joint in the general architectural effect without disclosing the nature of the construction or the exact location of the joints between the masonry panel groups.

Where a different arrangement of the masonry elements in the group units of panels 28 is required which will not permit of straight joints at the point 39 where the panels 28 abut on the columns, and instead toothed interbonding of the masonry elements is required, alternate stones or other masonry elements are omitted in the manufacture of these panels as will be noted in Fig. 10, and these inter-bonding masonry elements are set in place after the main panels 28 are erected in place. Under this novel arrangement the stone bond in broken joints is maintained continuously and the unit panel joints and connections entirely concealed from without.

In Fig. 4 the joints between masonry units as at 39, 33 and 36 are ordinarily secured by welding from the inside of the building only, in addition to the pintles 32, 38, 35 and 39[a] which are preferably located toward the outer edge of the panels. Where desired, however, the panels can be welded both from inside and out at joints, as 33, 36 and 39, which in such case are made wide enough to permit of reaching the metal frame of the panels from the outside with the electrode so that they can be welded in these sunken slots when the panels are brought together and thereafter the sunken slots are filled and pointed with mortar, making the exterior masonry joints indistinguishable from the other architectural joints of the preassembled masonry elements which are made of a width to suitably correspond with the main panel welding joints.

Fig. 5 shows a rear or inside view of the panel 28 with fragmentary section disclosing its interior construction. The metal frame member 37 along the upper side of the same is connected to the metal frame member 40 along the lower side by the truss tie bars 41 and 42 which weld, hook into, or otherwise firmly attach to these outer frame members forming a steel truss framework which becomes embedded in the panel forming its structural reinforcement. These steel members are embedded in structural concrete which also forms the inner face 43 of the panel as well as the outer matrix 47, embedding the exterior masonry members as 46. Between these inner and outer layers of structural concrete 43 and 47, both of which are preferably reinforced with wire mesh 43[a] and 47[a] attached to the metal reinforcement of the panel, are insulating interior sections 44 and 45 which are formed of insulating material, serving a triple purpose. 1st: to lighten the weight of the structure. 2d: to form an insulation to prevent conduction through the thin panel, and 3d: to shape or form the ribs about the metallic members as 37, 40, 41, 49[a] and 49[b], with which the structural concrete is bonded, providing an interior reinforced concrete beam work within the panel. It will be noted in the above connection that the masonry panel in this way develops a great strength by the use of a small quantity of material. The inner concrete wall 43 and the outer concrete wall 47 in union with the masonry elements 46 form large compression members connected by the structural rib webs of reinforced concrete as 48, 49, 50, 51 and 52.

The insulating sections as 44 and 45 can be either precast of cork and cement or other insulating ingredients which are laid on the waterproof concrete matrix 47 before the remaining structural concrete of the ribs and the inner face 43 are added; or, if desired, both the structural and insulating concrete can be placed at the same time. As already noted, 44 and 45 may be similarly formed of built-up layers of manufactured insulating material, and these spaces may be left cellular with a shell of insulating material to form them within the concrete.

After the panel 28 is erected in place in conjunction with the other units, the inner face of the wall requires only a skim finishing coat of plaster 53, saving the expense of the customary brown or foundation coats required with all ordinary masonry wall construction.

It is understood that the interior construction of the other panels 31 and 34 is similar to that of 28, having reinforced and welded

members located at the desired stress and welding points with insulating sections interposing to form a structural rib formation about the metal and a heavily insulated wall in union with the preassembled masonry.

In Fig. 5 a salient feature of my invention will be noted in the exposed metal face 49ª which is embedded in the concrete rib 49 and preferably attaches by welding or other secure means to the metal frame members 49ᵇ near the end of panels 28. Other metal reinforcement of the panel, such as 41 and 42 of the inner side of the panel, preferably pass through slots in 49ª and may be welded to the same.

The purpose of the metal member 49ª is to provide a metallic welding connection for welding the panel 28 to the preformed floor arches which are set against the same and united by welding, as will be further illustrated elsewhere. By this means, the preassembled masonry unit 28 becomes a structural portion of the floor panel at right angles to the same, and its strength and rigidity greatly enhanced as is also that of the floor arch panel. The metal members 49ᵇ of panels 28 are preferably channel irons or angles for welding these panels to the metal angles 14 of column 12, with which they come in contact in the same manner as the members 6 of panels 1 of Figs. 1 and 2.

The cornice is preferably made of cellular interior construction having one or more hollow cells 80, as shown in Fig. 6. By this means much weight and material are saved while the wall is further insulated by these air chambers. In addition, this space may form a receptacle for heating coils or other purposes. In this instance the heating coils 81 are shown passing through the aperture 82 in the cross walls 83, which are formed in the panel in casting to give it the proper strength. Apertures 84 may be provided in the wall 79. These are disposed between the frame members 56 and 57, the cross structural ribs tying the same together in a manner similar to the rib formation 48, 49, 50 and 51 of the masonry panels 28 of Fig. 5. Insulating material 85, such as cork, wood fibre or other manufactured insulating sheets of low cost, may be used for a double purpose in making the form work for the casting of the concrete to form chambers 80, this being permanently united with the concrete 67 and 68 so as to insulate against outside conduction.

It is to be noted that this overhanging masonry cornice 62 has a counterbalancing reinforcing concrete member 86, which also serves in conjunction with the wall of the structure 62 to form a supporting beam for the preformed floor arches 87, bearing on and supported by same. A metal shape, in this instance an angle iron 88, which is welded to the metal frame member 77 corresponding to the metal member 49ª of Fig. 5, forms a metal seat for the marginal metallic member 89 of the preformed floor arches 87. The member 89 has slots 90 punched at intervals in its outwardly projecting flange. After the arches 87 are set in place on 62, they are rigidly connected with the latter by welds in the slots 90, and along the edge 91 where a welding slot between 88 and 89 is formed and made accessible at 92 by the margining back of the concrete of 87 and 62. Slot 92 so formed serves for receiving conduits for electric wires or other horizontal piping, and after the same are placed the slot is concreted in and concealed by the customary floor base attached to the wall 62. The holes 90, where occurring at intervals, are similarly made accessible by openings in the concrete embedding 89 at such points. The preformed floor arches 87 are reinforced with suitable reinforcing bars 93 and 94 which rigidly attach to the metallic framework 89 of the floor panels 87, 93 either welding to or preferably hooking through holes in 89, and 94 being hooked in the concrete at its ends, which preferably tie or weld to the ends of 93.

A salient feature of the construction of the panels 87 is seen in the floor finish 95 formed as a structural part of the arches 87 with the border edges and joints of the same protected and concealed by the border ceramic 96. The wire mesh 97 is attached to the upper reinforcing bars 93 to properly reinforce the same. At the bottom of 62, the counterbalancing projecting member 86 is reinforced with steel bars 98 which lie in reinforcing stirrup bars 99 and which weld or rigidly attach to the frame members 77. In the preassembling of the group units 62 the masonry elements 64, 65 and 66 are laid together on supporting templets in the factory, the abutting joints being preferably buttered with mortar. The fabricated metal frame consisting of the reinforcement attached to the major frame members 56 and 57 is then set in proper relation to the masonry elements and the concrete is poured in place, the matrix portion 67, 68 and 69 being preferably formed of non-staining cement concrete where stone susceptible to staining is used, the balance being formed of ordinary Portland cement concrete. These preassembled units 62 are designed to span from column to column, welding to the same similarly to the panels 28 of Figs. 4 and 5, or they may be of cantilever design carried on the column, welding to the same similarly to the panels 20 of Fig. 1.

In 61, shown in Figs. 6 and 7, the thin masonry ashlars 100 are shown with their backs rabbeted at 71. The ends may also be rabbeted and channel grooves similar to 70 of 63 may be cut on the backs either vertically or horizontally to give the necessary

interbond with the concrete matrix 101. A salient feature of my construction is shown in the sunken slots formed in the margin of my masonry panels, as 102 of panels 61 and 62. This groove is formed along the side of the panel and preferably between the steel marginal frame and the masonry elements. On the sides of the panel at 103 this provides a receptacle for a tenon or projecting interbonding member of the window frames which is cemented in, in this groove, completely concealing the opening and also protecting the metal marginal members of the panel from exposure and erosion where the same would be otherwise exposed to the weather. Similarly along the bottom side of the panels a groove 104 has concreted into it, prior to erection, a depending metal tenon 105. In erecting the panels in the wall this tenon 105 registers in the groove 102, which is filled with cement or mortar just prior to the setting of the superimposed panel. By this means the joints between the panels are outwardly sealed against moisture and the weather, and the metal frame members, as 54, 55, 56 and 57, are protected from erosion from such outward source. Where the steel framing shape is provided with a projecting lower flange as 59[a] of Fig. 9, this can displace the cemented metal tongue 105 and the steel flange of the frame itself will then set in the freshly filled cement groove 110, sealing the joint.

It will be seen in Figs. 7 and 8 that the top and bottom metallic marginal members 54 and 55 of the panel 61 are tied together near the ends by bars 106 and welded or anchored to the same by the cross bars 107, the latter tying in the outer matrix portion of the plate and preferably welding to the vertical channels 6 where crossing the same and to the metal framing members 54 and 55. In addition to this reinforcement, horizontal bars 108 are run across the panel in the outer matrix, preferably near the joints between the masonry elements 100 and welded or tied to 106 and 107, this entire framework having a wire mesh 110[a] tied to it to further reinforce the matrix behind the masonry elements. On the other side of the panel similarly horizontal reinforcing bars 109 are attached to the bars 106 and the vertical steel shapes 6 and the inner wire mesh 110 attached to this for reinforcing the inner concrete face of the panel.

As already described, the panels 61 and 62 have depending pintels 111 projecting through the metal frame at their lower edge which engage in receiving holes 112 in the upper metallic face and concrete of each panel. These pintle holes 112 are preferably formed with a lewis chamber 112[a] in their upper portion and the panels are lifted by the customary stone lewis, which, in this instance, engages through the pintle holes in the upper metallic framework and so prevents the concrete breaking out and the lewis being released by any such accident.

It is understood that the panel 61 welds to the angle irons 14 of the column 12 at 113 through the welding holes formed by the concrete margined back at these points on the column and panel and subsequently filled with cement or plaster so as to protect and thoroughly fireproof the welds. The panel 62 similarly welds to the angle irons 14 in the same manner as panels 28 of Figs. 4 and 5. In addition to these vertical welds, the cross plates 25 of the columns which tie the angle irons 14 together are so placed as to afford a welding surface for the horizontal metal frames of the panels as 54 and 56 to weld horizontally along their marginal edge, the weld being formed in a sunken groove formed by the beveled corner of the metal frame as 54 or 56 so as not to interfere with the smooth bearing of the metal face of the superimposed panel.

In Fig. 9 is shown a special steel shape for the framing of my masonry units and structural beam members, the steel shape 59 being rolled with the outer projecting flanges 60 so as to form an outside seat to give a firm bearing for the bar members as 41 and 42 which are welded to both the projecting flange 60 and the upper projecting flanges 58. The outer projecting flanges 60 are beveled as noted, forming an inset fillet joint when two of these are brought together as in the assembling of the masonry panels. These shapes are also particularly desirable for making structural steel trusses or skeletonized box girders either with or without a combination of concrete.

In Fig. 10 a corner of a building structure showing the wall façades shows a wall structure of the type shown in Figs. 4 and 6. It will be noted in this instance that the masonry of the horizontal panel units 28 which span from column to column and form the wall structure between tiers of story windows have their masonry elements toothed at their ends exposing the abutting metal frames so as to permit of exterior welding at these points, 28[a]. After this metal connection, the toothed surface openings in the ashlar at 28[a] are bedded or plastered with mortar and filled in with ashlar stones which thus protect and cover the metal and welds and conceal the panel joints by making continuous the broken masonry joints.

It will be noted that panels 28 in this structure span between the columns 12 and 159, welding to the exposed metal 14, 164 and 165 and reinforcement on the face of the column, while the masonary pier units 31 covering the columns seat on 28 and also weld to the face of the column. The intermediate pier members 34 between the columns seat and weld on 28.

In this figure is also shown a salient feature of my preassembled masonry units in the belt courses 28^b projecting along the edges. By providing my masonry panel units with such a projecting course at either the top or bottom or both, extremely exact register of the superimposing masonry panel is not required and a slight variance in or out of the masonry of the superimposed pier resting on the lower panels is not discernible to the eye because of the line being broken by these projecting members 28^b.

Referring to Figs. 11, 12, 13 and 14, vertical masonry panels 114 attaching to the face of the column 12, extend end to end continuously up the face of the wall columns 12. The horizontal panels 115 under this arrangement attach to the sides of the columns 12, the vertical panels 114 being preferably projected out to form a pilaster, as indicated in Figs. 12 and 13. This construction is particularly desirable for buildings of the modern industrial type, as well as the office building type, and readily conceals the joints between the vertical and horizontal masonry units with little or no field work. The horizontal masonry units 115 are constructed in a similar manner to panels 28 of Figs. 4 and 5 and the vertical masonry units 114 are of similar construction to the vertical panels already described. The masonry face of the panel 115 extends slightly beyond the overlapping of the pilaster edge at 116 of the masonry of 114, so that slight discrepancies in the field are concealed by the overlapping masonry and exact register of the masonry in the spacing of columns is not required. These joints at 116 are preferably pointed after the masonry units are set in place.

In Fig. 13 a special wide and shallow structural steel column is used in lieu of reinforced concrete and the arrangement shown, the frame of the vertical panels 114 in this instance is formed so that the vertical metallic welding members 6 form the marginal vertical frame of the wall panel, this channel frame 6 being connected at the ends horizontally by the channel 7 at the top and bottom of the wall panels. The steel shapes 6 weld to the column faces at 117, this being done before the horizontal panels 115 are set in place. The panels 115 are swung into position and are supported on side brackets welded or riveted to the side of the steel column or, in the case of a reinforced concrete column, to the angle irons 14 as in Fig. 12.

It will be noted that in making the vertical masonry units 114 where the pilaster design of Figs. 12 and 13 is employed, the masonry elements 118 are disposed to cover both the face and sides of the preformed unit. Where my structural steel columns are used, as in Fig. 13, the concrete fireproofing 119 can be either precast on the steel column in the shop or applied after the erection of the building. In the column shown in Fig. 14, however, where the masonry 118 is united with a structural steel column as a preformed unit, the fireproofing concrete 119 is preferably poured with the column as a structural monolithical unit with the structural masonry 118. In this column reinforcing bars 120 are welded to the outer flanges of the heavy steel column shapes 121 and bars or plates 122 are also welded on the inner side of the shapes 121, completing the steel framework of the column. Wire mesh 123 and 124 is tied to this steel reinforcement and in the outer matrix forms a strong backing for the masonry elements 118 which are rabbeted or grooved to bond with this matrix in accordance with my general practice. The concrete fireproofing on the sides of the steel shapes 121 is preferably so margined back at 125 as to permit of swinging the horizontal panels 115 sideways into place against the projecting reinforced concrete and masonry shoulder at 126.

It will be noticed in each instance that the horizontal panels 115 are of a slightly shorter length than the distance between columns, so that the steel ends give a slight clearance for easy placing and adjustment against the exposed steel welding face of the columns on 121. After the horizontal panels 115 are rested in place on the column brackets 115^a, this end clearance is taken up by a steel wedge filler 127, which is driven in between the metal of the panel and the column and is of such size as to form a grooved welding slot, as noted, between the two steel frames which are then welded together in this slot so formed. The exterior vertical joints 126^a formed between masonry units 114 and 115 are grouted or pointed with cement after the erection so as to protect and conceal the same architecturally.

A salient feature shown in Fig. 14 of the preassembled panel of masonry composing within itself a structural column of the wall can have as the column member either the structural steel type, preferably as illustrated in Fig. 14, or a reinforced concrete column, the construction in either case being the same with only minor modifications in the structure of the column already illustrated and described. As the interior chamber 128 of my steel column in Fig. 14 is preferably used as a receptacle for heat coils, pipe risers, or heating and ventilating air circulating flues or stacks, as already outlined, I insert in the casting of this masonry and column an insulating member 129 of suitable thickness, back of the masonry matrix of the outer face of the column so as to thoroughly insulate the interior of the column, notwithstanding the relative thinness of the masonry exterior. In Fig. 13 where the heavier vertical panel 114 is welded to the column, this

insulating member 129 is not required to protect the column chamber 128, particularly if the panel 114 is cast with the insulating interior members within it as already described for panels 28 of Figs. 4 and 5, which indicate the typical insulating arrangement and interior rib forming construction which I employ preferably in all of my masonry wall units both vertical and horizontal.

Referring to Figs. 15, 16 and 17, some of the different combinations of masonry wall units and columns are shown in which the wall panels attach either to the face of the wall columns or to the face and side. In Fig. 15, using a structural steel column similar to that shown in Fig. 13, the steel shapes 131 of the horizontal wall panels 132, similar to the panel 28 of Fig. 4, are shown welding to the steel shapes 121 of the column at 130. The top metal frame member 133 can weld also along the top edge of each panel to the metal tie 134 which can be an angle iron, T iron, or steel plate connecting the special heavy column channels 121, and having an extending edge or portion flush or almost flush with the outward face of the shapes 121 so as to come in welding contact with the members 133. In addition to these welds, the panels 132 may have the steel marginal frame 133 carried down the vertical sides to form frame 135 which can be welded from the outside, if desired, at 136 and likewise an opening can be kept in the column at 137 so that the vertical panel frames 135 may also be welded along the inside at 138 from within the column between the cross plates 134. The panels 132 have the typical construction already described, the exterior masonry elements 139, the reinforced concrete matrix 140, the insulated interior 141, and the reinforced concrete back wall 142. It is understood that the interior exposed face of the wall 142, when it is not desired to merely finish the same with a skim coat of plaster, may also serve as a matrix having preassembled masonry or other finish for the interior the same as the exterior of the preformed units, and the wall column may also have preassembled masonry sides on the exposed interior faces bonded by the matrix 119.

In Fig. 16 the preformed masonry units or panels 143, while passing across the exterior face of the wall column and welding at 134a horizontally to 134 and to the outer face of the steel channel shapes 121, also weld to the sides of the column at 144. In this instance, the steel welding face 145, corresponding in its finish to 131 of Fig. 15, comes against the side of 121 instead of against the outer face, the purpose of this being to provide exceptionally strong windbracing and general stability by this bracing from column to column on both face and sides. The weld 144 may be effected either by the steel shape 145 being welded directly on the column side 121, or greater clearance space may be allowed for facility in setting, and a filter similar to 127 of Figs. 12, 13 and 14 driven in after the panels 143 are set in place, a welding groove being formed between 145 and 121, the same as in the previous instances. In the setting of the panels 143 the wall columns are first erected and have provided in their original fabrication steel bracket seats 115a, as in Fig. 11, welded or riveted to the outer faces of the steel shapes 121 at the levels at which the panels 143 rest. These brackets preferably have a pintle hole in them and a pintle, corresponding to 115b, (Fig. 11) in the bottom of 143 passes through this hole so as to hold the panel in setting prior to its welding to the columns at 144 and 134a.

The marginal horizontal frame 146 which is exposed along the top and bottom of the masonry units 143 for welding and framing purposes can also extend and frame about the ends at 147, as shown in this instance, and the abutting panels can weld both interiorly at 148 and exteriorly at 149. The exterior joint at 149 is filled with mortar so that the vertical joint between the masonry elements at the point becomes an indistinguishable part of the jointing of masonry 139 and alternate stones at the joint can be laid in over the connection 149 after the panels have been welded in the toothed openings left originally in the masonry panels for this purpose, as already described in connection with Fig. 10.

In the construction shown in Fig. 17, the masonry panel units 150 attach to the structural steel column with welds 130 between 121 and 131, but the panels merely overlap the portion of the face of the column instead of meeting and concealing the column as in Figs. 15 and 16. The column itself is provided in its preformed casting with a preassembled masonry group 151 which is overlapped and aligned architecturally with the masonry facing 152 of the panels 150. The construction permits of lateral movements of the panels 150 in erection so that slight discrepancies in masonry and the location of the wall columns will not interfere with the position or welding connection of the panels at 130 or the exterior masonry exposure which purposely overlaps with this idea in mind at points 152a. The column matrix preferably embeds an insulating member 134 in order to protect the interior chamber 128 from conduction through the thin masonry wall of the exterior column face.

Fig. 18 shows the manner of welding together the lengths of the structural steel columns shown in Figs. 13, 14, 15, 16, 17, 24 and 25. The ends of the heavy structural shapes 121 are milled to a square bearing so as to rest end to end at the joint line 153. On the lower column section 154 are attached interior connection plates 155 welded or otherwise united with the channels 121 shown in cross section in Figs. 15 and 17 the interior concrete at this

point being bared for the connection. The plates 155 are preferably battered part way down on the side of their projecting length so that the upper superimposed column section 156 is readily lowered onto the lower column section 154 on the outisde of the two side connections 155. A part of the sides of 155 are left straight with practically the full interior width between the flanges of the channels 121 to hold the column 156 in steady position when so set and the edges 157 of plates 155 are then welded to the channel 121 from the inside, giving a strong connection. If still further welding is desired, the joints between the upper and lower members 121 may be welded at the outside at their abutted ends which may be milled with a beveled welding bearing edge as shown at 153[a], and also holes 158 may be provided in the plates 155 and welds made in these holes to the inner face of the channel 121.

In Figs. 19, 20 and 21 are shown some of my preferred methods of effecting the connections at the corner of the building façades where the preformed masonry units form walls meeting at an angle in combination with a corner structural column. In Fig. 19 the corner wall column 159 of reinforced concrete construction has the preassembled and preformed masonry wall units 160 attached to the two outer corner sides of the column. In this instance the panels 160 are provided with vertical face welding and reinforcement shapes 161 and 162 which frame into the top and bottom steel border frames 163 of the panels. The shape 161 overlaps and welds to the exposed corner angle iron 164 at 161[a] of the column 159, and the angle irons 162 have their edges exposed so as to permit of a welding connection 165[a] with the outer corner column angle iron 165. The weld 165[a] preferably unites three metallic members by the one weld. After the corner weld is made, the weld is covered with mortar and protected and concealed with a small corner masonry filler 166 preferably laid as a rabbeted architectural inset on the corner of the building. In addition to the vertical welds at 161[a] and 165[a], the panels 160 can be welded along their upper edge to the angle irons 164 and 165 and also to a horizontal steel plate or shape 163[a], embedded in the column, connecting these column angle irons, and presenting an exposed metal face at these joint lines for welding.

In Fig. 20 a slightly different arrangement provides for a side face connection between the column 167 and the wall masonry panels 168. In this instance, the necessity of subsequently building up the masonry corner 166 of Fig. 19 is avoided, the column at the exterior corner having for a distance back on either side exposed preassembled masonry elements 169 formed in union with the column structure in its fabrication in the shop. The panels 168 abut against the elements 169 on the rabbeted edge of same and the joints so formed at 170 can be pointed with mortar after the erection of the panels. The steel shapes 161 of the panels are welded directly to the corner angle irons 164 of the column by the welds 161[a], as in Fig. 19. In addition to the vertical welds 161[a], the upper steel frame and welding members 163 of the panels 168 can weld along the upper edge horizontally to the angle irons 164 and to a horizontal connection plate embedded to connect between the angle irons 164 and 171 at the joint lines as described for the members 163 of Fig. 19.

Fig. 21 shows the side connection between columns and wall masonry units for corner construction. In this instance, the vertical and steel border frames 172 of the preassembled masonry panels 173 weld to the steel corner angle irons 174 of the column 175, the column itself having its exteriorly exposed sides 176 of preassembled masonry construction in union with a precast column backing of same. The steel border frame 172 welds along the interior in the sunken slots formed by the column and the panels at 177 and also along the top edge of the panels where the steel face of the upper horizontal frame 178 abuts the angle irons 174. These panels may be framed to make a space between the parts 172 and 174 for greater clearance in erection, and a filler plate similar to 127 in Figs. 12, 13 and 14 used to wedge the connection up and form a welding groove which may be welded from both inside and outside the building and the welding joint then pointed up with mortar.

Where the welding is done from the inside and it is desired to secure another weld approaching the outer face of the panel 173, as well as the inner weld 177, welding holes are punched in the shapes 172 at 179 before the assembling and complete fabrication of the panel frames. In casting the concrete matrix, welding openings 180 are then left in the concrete so as to give access for welding electrodes to reach these holes in the steel frame 172, and this frame 172 is then welded to the angle irons 174 in these weldings.

Referring to Figs. 22, 23, 24, 25 and 26, in Fig. 22, 181 is a larger type of panel than those described, and includes in one unit the entire masonry for the wall space between supporting wall columns 182 and 183. This panel composes a complete story height and preferably has embedded in the matrix of the preassembled masonry elements, the window frames occurring in the wall section embraced by this unit. In the setting-up of the masonry and precasting of the matrix for this preassembled panel, the window frames 184 and the mullion 185 are preferably set up in conjunction with the metallic framework 186 which reinforces the sides of the

panel as shown in Fig. 23 and preferably extends around the four sides of the panels. The window frame and mullion are preferably of sheet steel or other metal and the bars 187 and 187ª, which reinforce the inner and outer walls of the cellular panels 181, anchor directly into this metal frame at the points where the window openings occur. Where the preformed long span construction is used with columns spaced twenty-five or thirty feet apart, the panel 181 is preferably one story in height and spans from column to column. On the other hand, when the columns are on short spans, the unit 181 can be two stories in height. Because of the greater size of these units it is preferable that they should be of a cellular interior construction with the outer and inner walls reinforced with bars 187 and 187ª extending across the panels at regular intervals, welded or anchored rigidly to 186, and so disposed as to form the beam reinforcement for the concrete ribs 188 which extend horizontally across the panel at intervals.

The pilaster panels 189 between the wall panels 18 are preferably formed by precombination of preassembled masonry units with one of my special structural steel columns with the heavy side shapes 121, with the distinct feature of their wide spacing apart held together by occasional cross plates or bars 122 and 134 and the narrow depth, and enclosing within them the heating coils 190 or lavatories 191, with the pipes and risers 192 disposed at the sides within the pockets formed by the heavy channel irons. In especially high buildings, the columns in even the lowermost stories protrude but slightly into the floor space to form an interior pilaster break at 193 and in the stories coming above these constituting a large majority of the structure, the inner column face will come flush with the panels 181 so as to eliminate even the small break at 193 and such consumption of floor space. At the same time, the space ordinarily taken up by radiators, pipe and heating lines and lavatories is entirely saved, giving valuable floor space at the most important point of the room layout.

The heating coils 190 may be either of the customary floor radiator type shown in Fig. 24 or they may be located in sunken panels in the column at points higher above the floor and in any size and quantity desired, the inner cross plates 122 tying the channels 121 together, being so spaced apart and located in the fabrication of the column as not to interfere with these or with the recesses occupied by the lavatories 191. By welding the cross plates 122 and the bars 134 to the shapes 121 and using a welded splice connection 155, shown in Fig. 18, it is possible to do away with drilling and fabricating work on the heavy steel column shapes 121, thus saving a great deal of expensive labor and handling. The cross plates 122 may be welded at their ends 193 and along the top and bottom edges 194 and interiorly at 195. On the masonry side of the column the ties 134 welding to the shapes 121 are preferably reinforcing bars that should be allowed to extend beyond these shapes 121 and preferably hook as shown so as to reinforce the masonry return 196 to strengthen its bond with the column and resist the pressure of the panels 181 when the same are set against this from the inside. The constructon of the preassembled and interbonded masonry face of the column 198 is the same as already described.

It will be noted that owing to the thinness of the masonry material required in building this pilaster structure, it is possible to use long thin slabs of marble or other masonry material for the exterior of these pilasters 189, and these are preferably grooved on their backs, as already described, with bonding slots 198 which are cheaply and quickly made by passing the slabs under a grinding machine. These can be run either crosswise or lengthwise on the slabs but it is preferable, in order to avoid weakening of the panel and also for economy, to run these the long way of the stone and near the outer edges of the slabs as shown. The joint edges can also be similarly rabbeted for the purpose already described. The masonry elements 199 forming the masonry wall panels are similarly grooved and bonded with the matrix of the wall panels. They can also have metal hooks engaging with the reinforcement of the matrix and anchoring in holes in the masonry elements. In the construction of the large type of panel such as 181, it is preferable instead of using a single steel shape as a channel iron or the like for the marginal frame of the panels, to employ smaller shapes as, for example, the angle irons 200 which are spaced apart with welded strap connections 201 at intervals connecting these. These marginal frame members are welded at 130 to the steel shapes 121 as described, and the inner leg of the outer angle 200 may be also welded at intervals to the shapes 121 through the welding apertures 200ª and subsequently filled up with cement and wall finished.

It will be observed that no tie beams of structural steel or reinforced concrete for tying the wall columns together and supporting the walls are required in this construction, the preformed masonry units serving both purposes while supporting themselves along their vertical edges.

Referring to Figs. 27, 28, 29 and 30, the precast floor arches 202 formed as already described with the metal marginal frame members 89 framing around the four sides of the panel and having the reinforced bars 214 welded, hooked into or otherwise rigidly attached to the same and extending across the panel in both directions, to produce continu-

ous two-way reinforcement extending continuously from panel to panel in both directions after the panels are set in place and united to each other by welding their marginal members 89. The panels are supported at their one end by the precast beam 203, formed preferably of my typical metal framework consisting of the upper and lower frame and welding members 204 and 205, united by truss or stirrup bars 206. This framework is embedded to form the concrete beam at the factory, the upper space of the welding member 204 being left exposed as a bearing for the steel edges of the panels 202 which weld in the punched holes 90 to 204 and at their outer edge 91 to both 204 and to each other by similar welding. Additional reinforcing bars 207 can be located inside this framework at the lowest tension point and various tensile strains can be taken up in this way while using the same stock steel shape sizes for the welding member 205. The precast beams are seated on plates or brackets riveted or welded to the interior columns 208 and similarly at the wall to a bracket or bearing on the cross tie plate 122, uniting the steel shapes 121 of the wall column 209 similar in construction to those already described.

The columns 208 extending in a row across the building are tied together and to the wall columns, but these beams 203 extend in the one direction only. The precast floor columns span on these beams with their welded metal framing connections tying the columns in the opposite direction, making the customary tie beams in that direction unnecessary. Column 210 on the side wall of the building is united to the precast wall panels 181^a, of the type already described in Fig. 22. The metal frame 186 when welded to the outer edge of the column 210, which forms a tongue between the adjoining panels, completes the formation and fabrication of the steel column by uniting them with these additional members. The panel 181^a has near its bottom a beam formation 211 similar to the member 86 of Fig. 6. The panels 202 also bear from beam 203 to 211 and weld to 211 as described. They also weld as a stiffening element to a metallic face on the panel 181^b. Panel 181^b in this instance is shown in cross section of the type 181 already described, and containing formed within it a triple window 184^a.

The floor panels 202 are precast with deep cellular interior chambers 212 formed between the ribs 213, as already described, so that a floor arch of considerable depth, generally about twelve or fourteen inches, can be cast with a small amount of concrete but with strength sufficient for a long span system twenty or even thirty feet in length with a thin top 214 and bottom 215, forming the floor above and ceiling below, 214 having incorporated as a structural part the floor finish 95, as already described, saving three inches or more ordinarily allowed for the floor finish of the building, and at the same time making this a component structural portion of the floor slab. The ribs 213 may run in both directions across the panel or in any other desired formation, it being understood that the metal reinforcement of these hooks, welds or otherwise firmly attaches to the metal framing or welding members embedded at the sides of the panels. It will be particularly noted that when these finished panels 202 are laid in place, the ceramic or other hard ornamental border 96 forms a pleasing effect, and the space 216 between them permits of laying the conduits 217 in place in all directions about the floor. These conduits in turn unite with the precast conduit sections 218 formed in the panel 202 and united at 217 at points along their edge. After these conduits are properly laid and connected, the floor space is evened with Terrazzo or other finish brought to the level of the borders 96. By this means the joints of the floor section are entirely concealed by the architectural design so formed.

In order to have the floor finish an integral and structural part preformed with the floor arch, it is necessary to have means provided for bringing the adjacent floor panel 202, when set on the exposed beams 204 and 211, to a very exact level and for this purpose I preferably provide adjusting screws 219 in the metal frame as may be desired. These screws 219 bear on the metal face 204 of the supporting beam and by this means the panels can be quickly brought to their exact level after seating and prior to welding. The screws may be removed after the welding.

Along their side edges where the panels do not meet upon a beam, as at their ends, they are preferably shaped in cross section as shown in Fig. 29, the concrete meeting at the edges 219^a and the steel framing meeting to form the weld 219^b between the edges, the pocket 220, so formed, being filled and finished after the laying of the conduits as in 216. The soffets of the panels may be slightly recessed as shown at 221 with an ornamental border cast in the concrete. This will permit of applying a skim coat of plaster on the recess ceiling panels 221 in the factory where the work can be done much more economically with the panels having their ceiling surface upward and only requiring a skim coat of finish, saving the brown coating and the laborious overhead work and scaffolding in plastering ceilings under present practice. These panels being furthermore recessed the finish is preserved and the only finish further required is the finish coat on the concrete bearing edge 222, which protects the plaster finish prior to the setting of the panels.

In Fig. 28 the panel 202 on the right-hand side is shown with the ornamental cast plas-

ter work for ornamental ceilings structurally incorporated in the casting of the floor arch at the factory as already described, the ornamental casting work, as the cornice 223 and the rosettes 224, etc., being set up in the forms prior to the concrete matrix 225 being poured over these in the formation of the floor arch. By leaving a concrete bearing edge 226 around the border of the panel for the same to rest on, this interiorly incorporated ornamental plaster work is protected and safeguarded from injury during handling and setting. After the panels are set it is necessary then to apply only a skim finish to the remaining exposed portion of the exposed girder 203. It is understood that the ornamental cornice member 223 can also be formed directly by the matrix 225 instead of casting plaster by providing suitable form in casting the floor arch 202.

Referring to Figs. 31, 32, 33 and 34, the reinforced concrete wall columns 12 and the interior beam supporting columns 12^a have at their abutting ends a steel cap preferably formed by angle irons 229, 230, 231 and 233. These form the seat to which the vertical reinforcement of the columns is rigidly and firmly attached, preferably by welding or by hooking, bolting or other suitable means. The wall columns 12, being rectangular, are preferably formed with corner angle irons 13 and 14 connected by steel lattice work. These corner angle irons set in the terminal angle irons 230 and 231. In order to present a desirable offset for a welding fillet, I preferably set the angle iron 230 at the base of the column on the inside of the vertical angle irons 13 and 14, while at the top the angle 231 is framed on the outside of the vertical angle irons, forming this offset. The upper and lower column sections of the column 12 are welded around their exposed edges and further united by pintles 230^a, one being preferably in each corner of the rectangle column embedded in the concrete, passing through the steel 230 and projecting into a receiving slot and hole in 231, the latter being filled with fresh cement grout just prior to setting. In addition to this, the concrete end of the column inside of the steel frame 231 can be slightly recessed and a bed of finish mortar leveled just slightly above the edge of the angle iron 231 put on the column just before setting the next column length on same. In this way, the precast concrete bed of the upper column finished level with the metal face of the angle iron 230 will bear hard and solid throughout on the mortar bed bringing the metal faces of the angle irons 230 and 231 into bearing for welding.

To provide for receiving the floor beams 203, which span from the columns for carrying the floor arches 202, the column 12 is framed with a supporting bracket 234 which is welded or riveted to the two inner angle irons 13 of the column and a cross plate 235 is similarly welded or riveted to the angle irons of the column at a point where the top of the beam meets the column so as to provide an exposed welding face. The beam is sufficiently short for the span to allow of clearance and a filler plate 236 at the end which is wedged in after the beam is set in place on the bracket 234 provides a welding groove between the cross plate 235 and the metal framework of the beam which is exposed at the ends and sides for welding connections 236^a. At the bottom the concrete of the precast beam is recessed to expose the edges of the bottom frame 205, which offsets on the bracket 234 for a welding fillet. The vertical strap irons 206^a which tie the welding members 204 and 205 together are also exposed on their edge to permit of a weld to the cross plate 235 and to the supporting bracket 234 at the top and bottom of the beam.

It will be particularly noted that the beam 203 spans the joints between the two column sections 12 so as to rigidly brace and metallically connect the union of the two column sections in addition to the weld of their own abutting ends. It will also be noted that the preassembled masonry unit which in this particular instance is shown as of the type 115 of Figs. 11 and 12 is also designed to weld to the column sections 12 at this point so as to brace this joint across the column sections at 230 and 231 and so fimly brace and unite them by the vertical welds 117^a along the angle irons 14. A small pintle 115^b seats in the bracket 115^a to stay and support the panel 115 before it is welded to the column. The slot 104 formed in the lower edge of the panel 114 can either have a depending tongue, as hitherto described, embedded in same for sealing the window frames which fill the opening between panels, or it can be left open as shown in this instance and a projecting tongue or tenon fitted around the window frame and projected into this and cemented so as to thoroughly seal the joints and likewise protect the metal frame of the panel from erosion. The corresponding groove 102 in the upper edge of the panel forms a receiving slot for a tongue 102^a of the cast iron window sill 102^b embedded in cement which seals the upper joint and protects the frame 37.

In Fig. 32 the interior precast reinforcing concrete columns 12^a are generally of the round type and formed with reinforcing bars 238 which seat and weld to the terminal angle irons 229 and 233 at the bottom and top of each column length. The columns can be cast in one or two story lengths and are provided with both metal faces and sustaining brackets for attaching the floor beams at story heights. Where the precast sections terminate and are united with superimposed beams, the joint is preferably so located as

to be spliced across by the welded connections of the abutting floor beams 203, as shown. The angle irons 229 and 233 are preferably slightly offset for welded connection 239 and otherwise connect and unite similarly to the wall columns 12 already described. The pintles 240 pass through the abutting metal frames. The receiving pintle holes are preferably formed with the lewis hole top 241 already described, so that the columns can be set with lewises inserted in holes at the top in the same manner as the wall masonry units.

In order to simplify and economize in metal so far as possible in the reinforcing and framing of these column sections, I form column seats 242 of a suitable heavy steel T shape which slips into the reinforcing bars 238 at the point where the beam bearing comes. This is concreted in the casting of the column and its upper exposed metal edge at 243 welds to the exposed metal ends of the beam framing 206 and 206^a, the same as on the wall column. Similarly for the top welding of the beam a short angle iron section 244 is slipped onto the bars 238 and embedded in place in casting the columns, the outer face being left exposed to weld to the steel frames 204 and 206^a at 236^a, and below this coming in a groove formed between the filler plate 236 where same is driven in place to take up any clearance space after the beam is seated. If the filler 236 is only used at one end of the beam, the other metallic end of the beam will weld directly to the exposed metal 244 of the column.

These two exposed angle irons 244 are tied rigidly together by the tie bars 245, hooking into or welding to them, and it will be particularly noted that through this medium and the welds 236^a, the tensile strains developed in the beams are transmitted from one beam to the other into the column by continuous steel reinforcement, increasing the strength of the beams in accordance with well-known engineering laws.

In Fig. 34 is shown the combination of one of my structural steel columns 12^b, similar to that of Fig. 14, united to a superimposed reinforced concrete column 12^c, preferably of a similar shallow and wide shape and corresponding to 12 of Fig. 31, and welded to 125 through its metal terminal formed of an angle iron base 230 similar to column 12. The heavy structural steel channel shapes 121 of column 12^b are preferably capped at the top by a steel plate 248 welded rigidly thereto. On this supporting plate is set the precast reinforcing column 12^c, the four projecting pintles 230^a being embedded in the corners of same and projecting into holes in the steel plate 248 so as to thoroughly stay the same. The concrete column is then united to the steel column by welds around the offset edge 249 on the exposed sides of the column. In this way the tensile strains developed in one section of the column are substantially transmitted to the lower section. Where the reinforced concrete column 12^c is of larger cross section than the steel column 12^b, the plate 248 is extended out with bracket supports so as to extend beyond the edge of the reinforced concrete column and similarly permit of the welded connection 249 along the sides. As already described in Fig. 31, the precast floor beam 203 and the preassembled wall masonry units 115 are located so as to splice across the joint of the column sections at 249 and weld to the upper and lower sections forming a strong bracing connection in addition to that of 249. The beam 203 rests on the steed T iron or angle iron 250 which ties the channel column shapes 121 together and the welds at this point and also to the face plate 235 on the angle irons 13 of the concrete column 12^c, uniting the beam to the upper section. In addition to this the steel member 206^a of the beam can be welded to the angle iron 230. On the other sides the exposed metallic edge of the metal end framing of the panel 115 which ties the upper and lower steel panel frames 37 and 40 together, welds to the exposed metallic face of the steel shape 121 at 117^a, and similarly to the angle iron 14 of the column 12^c.

Referring to Figs. 35 and 36, it will be noted that I employ special rolled steel shapes 255 and 256 for framing members of the panels 259 and 260, 255 being rolled with a projecting lip 257 which overlaps 256 and embeds itself when the panel is set in the fresh mortar 258. This mortar prior to the setting of the superimposed panel 260 on the panel 259 is filled into the trough 102 almost to its level. In setting the panel, the mortar 258 is then displaced sufficiently by the lip 257 to be pushed upward so as to fill the pocket between the stone ashlars 262 and 263 thereby sealing the horizontal joint between the two panels and protecting the metal.

It will be particularly noted that the steel frames of the panels 259 and 260 are set into the masonry elements 262 and 263 so that the latter are firmly embraced inside of the steel framework in the form of an arch and the entire preassembled masonry panels so firmly held in place directly within the metal border members of the panel and in the form of a contained arch. At the same time, the masonry elements of the two panels do not come directly in contact with each other at the panel joints as noted, but a slight open joint occurs between the edges of the masonry elements 262 and 263 so that no pressure is brought to bear on the fragile edges either in the course of setting or by reason of the expansion in the masonry façade when in the wall from changes of temperature. The same provision is made between the individual

masonry ashlars 262 and 262[a] in regard to their adjacent joints so that there is no danger, in the use of fragile stones, of having the edges spawl off from expansion pressures in the wall.

It will also be noted that the upper edges of these stones are slightly beveled and the bottom edge is undercut to give a drip at the bottom arrises 264 so as to properly exclude the water at the joints. The rustic jointing at 265, it will be particularly noted facilitates the concealment of the panel joints between adjacent frames and conceals from the eye any slight discrepancy in the face alignment of the superimposed panel which would be noticeable with flush joints. At the same time, this rabbeted joint avoids all possibility of the noticeable spawling of the outer arrises of the joints from pressure developed either within the masonry panels themselves or by the adjacent panels.

The inner edges of the masonry elements 262 and 262[a] are preferably rabbeted at their lower edge 265 and also at their vertical ends 267 to form concrete tongues for the embedding matrix to firmly secure the masonry elements and also to permit of reinforcing bars 108 for securing the same more securely within the matrix in addition to the backing wire reinforcement 110[a] which is tied to the reinforcing bars 106.

It will be noted that the shapes 255 and 256 have their outside corners beveled at 270 so that when the shapes are brought together they form an inset fillet for receiving the uniting weld. This is a distinctive feature which I preferably employ on all my steel shapes for their welded union. In this instance, I also arrange the bars 106 which span the framework so that they do not extend outside the outer flanges of the steel shapes but continue with them in alignment, having joggled ends and edges and being attached or welded at 106[a] and 106[b], as indicated, on the inner and outer sides of the steel shapes. The purpose of this is to reduce the thickness of fire-proofing required on the outside of the metal and give the steel shapes 255 and 256 the greatest possible width and bearing within the masonry panel. The weld at 270 uniting the frames is covered over with a concealing and protecting cement filler 271. In addition to the inside welds at 270, the panels are further united by the pintles 111 set in the upper frame 255 and passing through the lower frame 256 in the outer portion of the panels and further, when desired, by cross welds along the cross edges of the frames 255 and 256 at their ends.

If it is desired in addition to have a weld between the outer edges of the frames 255 and 256, I provide welding holes in the masonry elements 262 at 265 in such manner that the outer edges at their point of finish can be welded at suitable spots along the line of the panel joints, or if longer or continuous welded joints are desired, the masonry element 262 is formed with the upper edge within the rustic joint 265 at a lower point 272, exposing the welding edges and after welding from without this opening is closed with an insert piece of masonry 273, forming the same rustic joint effect with a stone insert or with cement mortar, the latter being preferably used at all points of sufficient distance above the ground to make the material of the inner face of the rustic joint indiscernible to the naked eye.

As already described, the inner portion of the wall panel between the concrete frame members formed around the steel work of the panels is filled as indicated with a light insulating concrete or other insulating material 44 between the inner concrete wall and the outer masonry matrix.

In welding or fusing the exposed portions of the steel or embedded metallic reinforcement members and the auxiliary metallic reinforcement members which extend into or through the preformed concrete sections or members, the heat of welding is diffused or distributed through the sections or slabs, the molecular union between the metal parts facilitating this and thus preventing the heat from being concentrated or localized at the points of welding, thus preventing disintegration, cracking, or exploding of the concrete material. In addition, this results in a desirable slow cooling of the welded joints which is particularly advantageous in welding technique. That is, the concrete will absorb the heat and hold it for a long time after the weld is completed, and the steel, part or much of which, is embedded in the concrete, has its temperature slowly reduced because of this concrete heating up with it and the embedding or connecting material tends to insulate it in the welding and helps to prevent it from being suddenly chilled or quickly cooled, the cooling of the metal, on the other hand, taking place rather slowly. Furthermore, by having one or more continuity members incorporated in a column or similar structural element such as a beam or floor slab and fused or welded to the beams, provision is made for resisting compression and tension stresses, strains and wind pressure in all directions, as well as to support the weight of the concrete or other similar structure which ordinarily forms a dead weight, according to the present method of building, whereas the concrete structure reinforced as described forms a part of the sustaining and supporting structure, as well as resisting stresses and wind pressure.

I am aware that many other changes may be made in the construction and arrangement of parts without departing from the spirit of my invention and I reserve the right to

make all such as fairly fall within the scope of the following claims.

I claim:

1. A building structure comprising masonry walls and structural framing manufactured in preformed sections, each including a plurality of arranged blocks of stone united by a binder and having metallic elements incorporated therein, the sections being assembled in juxtaposition with the structural framing of adjacent sections in mutual contact and welded together to form a united structure.

2. A building structure comprising vertical supporting columns having metallic members, and preformed masonry panels connecting said columns and having metallic reinforcements welded thereto, each of said panels comprising a plurality of arranged and fitted blocks of stone united by a binder and having marginal metallic elements incorporated therein.

3. In a building, a wall structure comprising groups of arranged blocks of stone preunited by an embedding composition in which are incorporated concealed metallic elements, and the composite groups assembled and united together by said elements, metallic elements of adjacent groups being in mutual contact and welded together.

4. In a building, a wall structure comprising groups of arranged and fitted blocks of stone preunited by an embedding composition metallically reinforced, and the composite groups assembled and united together by the connection of said reinforcing, reinforcing elements of adjacent groups being in mutual contact and connected together.

5. A building structure having exterior walls composed of vertical structural columns strutted apart by preassembled panels, each including a plurality of arranged blocks of stone and an embedding composition, said panels being rigidly attached to said columns and forming a wind bracing and floor load support.

6. In a building structure, supporting columns, and a preassembled self-sustaining masonry arch including a plurality of arranged blocks of stone embedded in a binding material erected as a unit and spanning between said columns.

7. In a building structure, a supporting column, and a preformed self-sustaining cantilever unit attached to said column, said unit including a plurality of arranged blocks of stone forming the face of the unit and being partially embedded in a binding material.

8. In a building structure, a wall façade composed of vertical supporting columns connected by preformed horizontal wall arches between window openings, each of said arches comprising a plurality of blocks of stone prearranged and united by a binding material and erected as a unit and the arch erected as a unit.

9. In a building structure, a façade comprising spaced vertical columns tied together by a plurality of preformed units, each comprising a plurality of arranged blocks of stone united by a binding material.

10. A building structure of the skeleton frame type comprising vertical columns tied together and wind braced by preformed panels, each comprising a plurality of arranged blocks of stone embedded in a binder and the panels attached to said columns.

11. A building structure of the skeleton frame type comprising vertical supporting columns tied together and wind braced by preassembled masonry units, each of said units comprising a plurality of arranged blocks of stone forming the face thereof, and a concrete backing.

12. A building structure of the skeleton frame type comprising wall columns tied together and wind braced by preassembled masonry units metallically united to said columns, each of said panels comprising a plurality of arranged blocks of stone, a binder for uniting said blocks, and marginal metallic elements.

13. In a building structure, a preformed structural unit comprising a concrete backing, metallic welding members embedded in said backing, masonry elements inlaid in rows on said backing with their front faces exposed, and a welding slot formed between rows of said elements to provide access to said members.

14. A building structure comprising masonry walls and structural metal framing in sections, the sections being assembled in juxtaposition and the adjacent frame sections being in contact and welded together to form, in effect, a one-piece frame, and auxiliary reinforcing metal members in the masonry wall material and welded to said framing.

15. A building structure comprising masonry walls and structural metal framing, the framing being formed of sections welded together to form an integral structural frame, and reinforcing metal members embedded in said walls, certain of said reinforcing members being welded directly to said framing, as and for the purposes described.

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