Jan. 9, 1934. J. J. O'REILLY 1,943,036

CONCRETE, MASONRY, AND STEEL CONSTRUCTION

Filed Nov. 19, 1929 3 Sheets-Sheet 1

Fig. 1

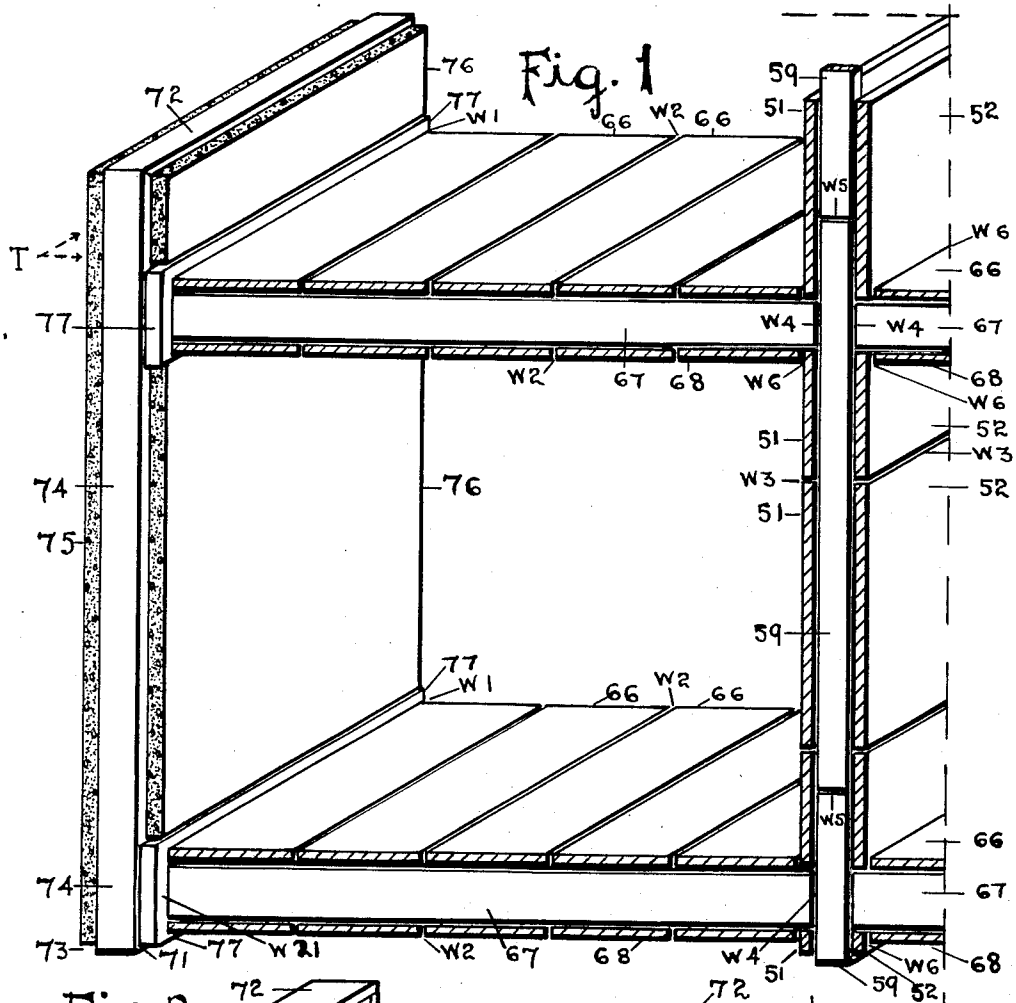


Fig. 2.

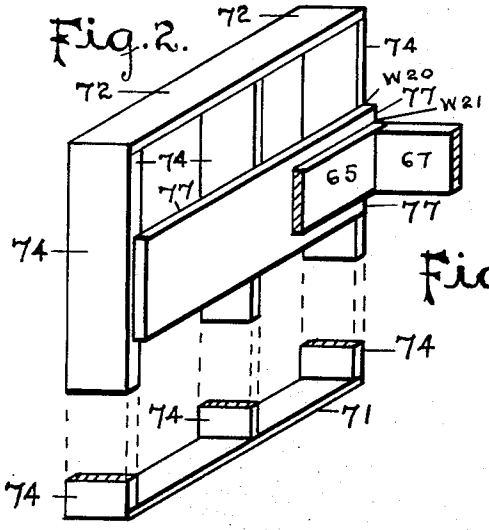
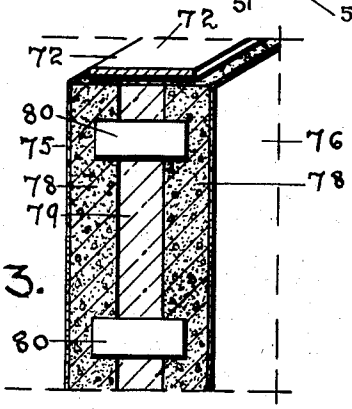


Fig. 3.



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CONCRETE, MASONRY, AND STEEL CONSTRUCTION

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Fig. 4

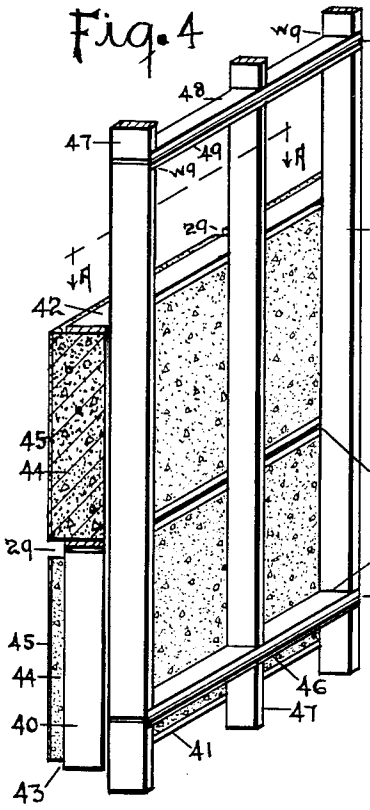


Fig. 5

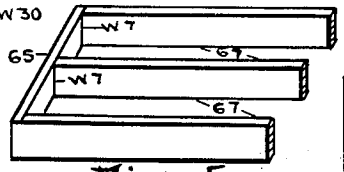


Fig. 6

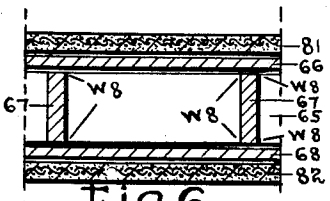


Fig. 7

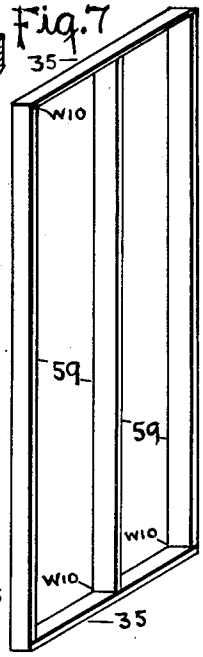


Fig. 9

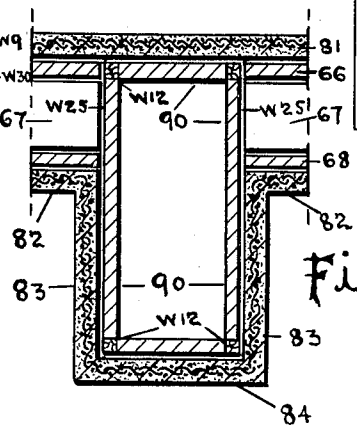
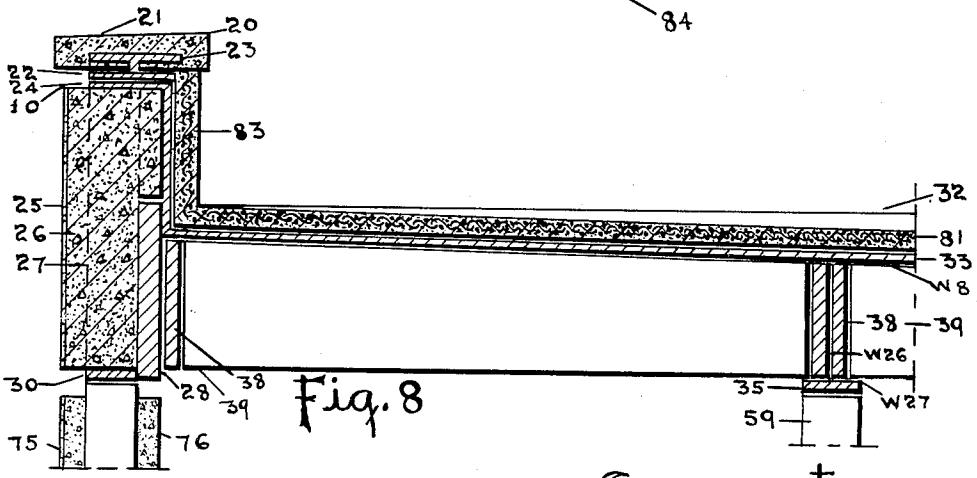


Fig. 8



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CONCRETE, MASONRY, AND STEEL CONSTRUCTION

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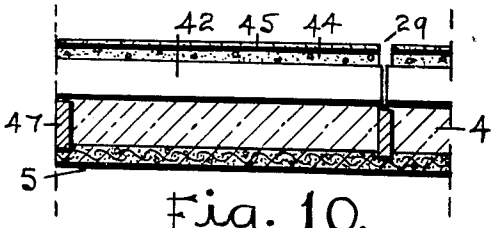


Fig. 10.

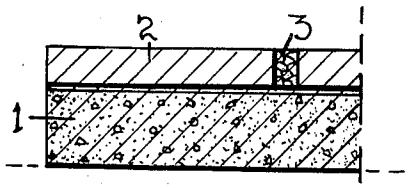


Fig. 11.

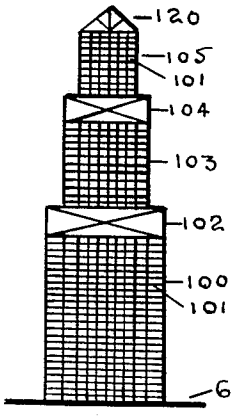


Fig. 12.

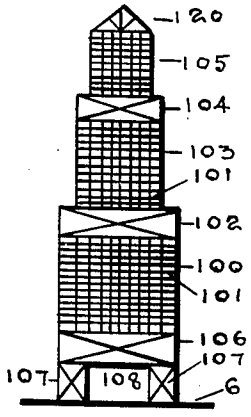


Fig. 13

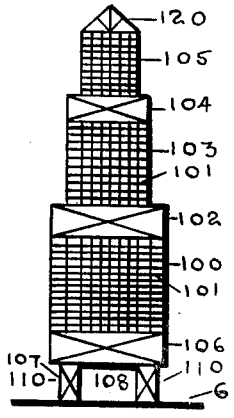


Fig. 14.

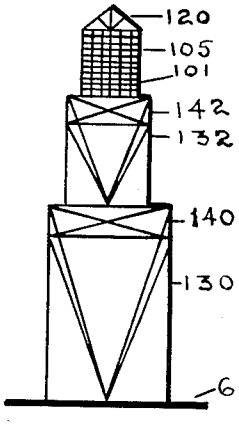


Fig. 15.

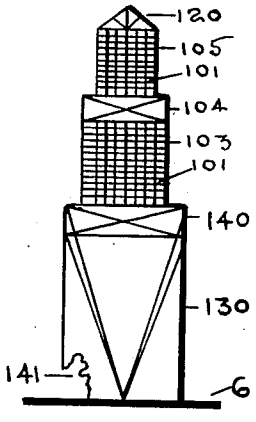


Fig. 16.

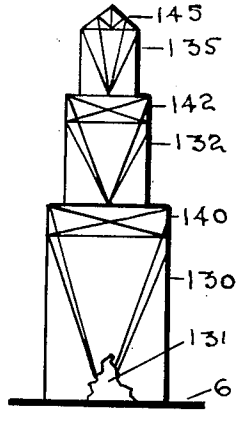


Fig. 17.

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UNITED STATES PATENT OFFICE

1,943,036

CONCRETE, MASONRY, AND STEEL CONSTRUCTION

John J. O'Reilly, Woodside, N. Y.

Application November 19, 1929
Serial No. 408,265

7 Claims. (Cl. 72—1)

This invention relates to improved structures and structural methods and has for its primary object to provide greater flexibility with structural safety for the design and construction of steel framed buildings, through the combined use of electrically welded steel plate framing and arc welded stones.

It is a more particular object of my invention to provide materials and methods whereby a structure of any practicable size, or height, may be constructed of welded steel plate framing and welded stones with greater ease, architectural and engineering flexibility, structural safety, and economy in time, money and usable space with lower maintenance costs than has ever been possible with other materials and methods.

My invention also contemplates providing materials and methods whereby it will be possible to construct the type of buildings commonly known as skyscrapers in a fraction of the time formerly required, while providing at the same time, a completely welded structure offering virtual immunity to fire, tornado, earthquake, exterior explosion, the elements in general, and, also, to rust, rot and vermin, with other incidental advantages, such as the conservation of heat through the use of more effective insulation, as will be explained more fully hereinafter.

A still further object of my invention is to provide structures of very wide or nearly universal architectural scope which may be quickly and safely erected on virtually any soil or on a float water foundation.

With the above and other objects in view the invention consists in the now newly disclosed structures and structural materials and methods, and in the form, assembly, construction and relative arrangements, and in the processes involved, and in the relative arrangements and construction of the several parts, as will be hereinafter more fully described and distinguished, illustrated in the accompanying drawings and subsequently incorporated in the subjoined claims.

In the drawings in which I have shown several practical embodiments of my invention:

Figure #1 is an isometric view of part of an outer wall stone and a fragmentary isometric and sectional view in elevation of the interior partition and combination floor and ceiling plate framing in welded alignment with the said outer wall stone.

Figure #2 is a fragmentary isometric showing more clearly, by the omission of the fireproof and other parts of the outer wall stone, the field assembly and ultimate structural relation of the wall and floor framing.

Figure #3 is a fragmentary isometric view showing a section in elevation taken through the upper part of the outer wall stone (as indicated by the symbol T and broken lines in Figure #1) between studs or vertical supports and along the face of the bricks bonding the two separate layers of cementitious materials through the intervening insulating blanket.

Figure #4 is a fragmentary view partly isometric and partly sectional in elevation of an embodiment of the outer wall stone in the form of a separate veneer and an inner separate arrangement of outer wall supporting elements. The view being sectional through the top stone of the veneer and an elevation along the end face of the bottom stone.

Figure #5 is a fragmentary isometric showing several steel plates welded together to form part of a floor joist assembly unit.

Figure #6 is a fragmentary view of a section in elevation taken through the finished floor construction—a fragmentary view of a section in plan taken through the finished partition construction would be very similar.

Figure #7 is a fragmentary isometric showing several steel plates welded together in the shop to form a partition stud assembly unit.

Figure #8 is a fragmentary sectional view taken in elevation through the finished roof and roof parapet wall—the ceiling below being unfinished.

Figure #9 is a fragmentary view of a section in elevation showing the connection in the field of steel plate floor framing to a hollow steel girder—the girder would in turn be fastened to a hollow column of steel (not shown in the view) by exterior welding—and similar units would be welded together to form the complete frame for a building.

Figure #10 is a fragmentary section taken in plan where indicated by the broken line A—A in Figure #4 and shows the finished construction left incomplete in Figure #4.

Figure #11 is a fragmentary view of a section taken in elevation through the upper left hand corner of a foundation—the construction would ordinarily extend to the right and downward.

Figure #12 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building of a new type.

Figure #13 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building forming a natural arch over a ground floor auditorium.

Figure #14 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building forming an arch over an auditorium and a cantilever over an arcade on the same ground floor.

Figure #15 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building of another type.

Figure #16 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building and showing external damage.

Figure #17 is a diagrammatic sketch in sectional elevation indicating the framing design for a terraced building and showing internal damage.

Referring in detail to the drawings and more particularly to Figure #1 the symbols 75 and 76 indicate the outer and inner facings respectively of a factory finished outer wall stone. Other and similar stones would be welded to the one shown to form a complete outer wall for a building. This would be accomplished by placing the stones together, in the usual manner for masonry, to form an open joint for welding purposes. One half of this open joint is indicated in Figure #1 by the symbol 73. No mortar is used in the setting of these stones as they rest on natural metal to metal beds and are fitted together metal to metal in the butt joints. 72 indicates a metal top plate in the factory finished stone. 71 indicates a metal bottom plate in the same stone. 74 indicates a vertical stud of metal in the same stone—three or more of these vertical studs usually occur in each outer wall stone. 77 indicates a metal girt built-in the outer wall stone, in the factory, for the purpose of lateral bracing and readily fastening the floor joist assembly unit in the field. 66 indicates a floor plate binding the floor joists together laterally and forming a watertight surface to receive the wire lath and cementitious finishing materials. 67 is a floor joist. 68 is a ceiling plate binding the floor joists together laterally and forming a watertight surface to receive the wire lath and plastic finishing materials.

The symbol 59 indicates a wall stud or vertical supporting element. 51 and 52 indicate wall plate surfaces on opposite sides of the partition or wall stud 59. 51 and 52 serve to bind the wall or partition studs together laterally and form a watertight surface to receive the wire lath and other finishing materials. W1 indicates the field welding of the floor plates to the built-in wall girt 77. This welding would be continuous or intermittent as desired and the ceiling plates would be similarly welded to the girt 77. W2 indicates the field welding of the floor and ceiling plates to the floor joist assembly units and to each other. W3 indicates the field welding of the wall plates to the partition stud assembly units and to each other. W4 indicates the field welding of the floor joist assembly units and the partition stud assembly units. W5 indicates the field welding of the partition stud assembly units to each other. W6 indicates the welding of the wall plates to the floor plates. It should be understood that all metal in predetermined shop or field contact is welded preferably by arc welding wherever possible and this applies throughout the drawings.

In Figure #2 the symbol 77 again indicates the built-in girt which extends above and below the header plate of the floor joist assembly unit 65 to form a ready field welding surface. 74 the steel stud built into the factory finished stone and 67 the steel floor joist are shown aligned. The partition stud 59 would likewise be aligned with 74 and 67 at the opposite end of the joist. W20 indicates the shop welding of the built-in girt to the outer wall stone studs. W21 indicates the field welding of the floor joist assembly unit to the built-in girt 77. These symbols merely indicate that the parts are welded but do not attempt to show the extent of the welding which would in every case depend upon the size of the parts and the stresses, etc. It should be noted that 71, 72 and 74 together form a welding band around the outer wall stone for field welding purposes when in structural relation with other similar stones.

In Figure #3 75 indicates the exterior surface of the factory finished stone and 76 indicates the interior surface. Both of these surfaces are finished in the shop or factory. 79 indicates an insulating layer, between the two separate layers of concrete backing 78, and in this case is granulated cork.

The symbol 80 indicates an ordinary brick used header fashion to bind the two separate layers of concrete backing 78, on opposite sides of the insulating blanket or core 79, to each other.

In Figure #4 the symbol 44 indicates the concrete backing and 45 indicates the outer factory finished facing of a stone veneer, the back of which 46 finishes flush with the back edge of the built-in studs 40. The three vertical studs 47 and the top and bottom plates (49 and 48 respectively) when welded together as indicated by W9 and as shown in the view form an exterior wall stud assembly unit. The stone veneer is continued with similar factory finished stones to form a complete outer wall surface, and each stone is welded to adjacent stones through the open vertical and horizontal joints 29 and to the exterior wall stud assembly unit, as indicated by W11, wherever exposed metal is in predetermined field contact. W9 indicates shop welding. W30 indicates the field welding of one outer wall stud assembly unit to another. The wall stud assembly units and the stone veneer are continued to form a complete outer wall—both being mitred at the corners of the building to form a return—and are aligned with and welded to the floor joist assembly units. 42 indicates the top metal plate of the stone veneer and 41 indicates the bottom plate of same. 43 indicates an open half joint.

In Figure #5 the symbol 65 as before indicates the header plate which occurs at both ends of the floor joist assembly unit. 67 indicates a metal floor joist, a plurality of which are shown welded in the shop as indicated by W7 to form half of the unit. The whole unit would be almost identical with Figure #7 except that the floor joist assembly units and the partition stud assembly units are generally composed of members having a different depth and thickness. This depth and thickness being dependent entirely upon the engineering and cost factors involved in each case.

In Figure #6 the symbol 81 indicates wire lath welded to the floor plate 66 and cementitious or like finishes. 82 indicates wire lath welded to the ceiling plates 68 and plastic or like materials applied to the lath in the usual manner. W8 indicates the field welding of the joists 67 to the floor and ceiling plates 66 and 68.

In Figure #7 the symbol W10 indicates the shop welding of the two header (or top and

bottom) plates 35 and the three vertical studs 59.

In Figure #8 the symbol 25 indicates the outer factory finished facing, 26 the concrete backing and 27 the vertical studs of a parapet stone which is not insulated. 24 indicates the top plate and 30 the bottom plate of the same stone. 28 is the built-in girt of the parapet stone. The roof joists 39 are cut with one side out of parallel as clearly shown in the view to form a draining surface. They are welded to each other W26 over the partition stud assembly units (and to the latter as indicated by W27) to form an unbroken watertight roof surface when the roof plates 33 and the wire lath and cement finish 81 have been applied in the same general manner as explained in Figure #6. The roof plates 33 are carried up the parapet and welded to the top plate 24 of the factory finished stone to form a watertight flashing all around the roof parapet. The coping 20 is set in the same manner as the other stones and welded to the parapet stones thorugh the open joint formed when the bottom plate 22 of the coping is placing over the top plate 24 of the parapet stone. 10 indicates the outer line of the mortar filling of this open joint after the stones have been arc welded together. On the roof side of the parapet the wire lath and cement finish 83 are carried up to the underside of the coping. 21 indicates the pitch of the top of the coping and 23 the built-in anchors holding the coping to the bottom plate 22. These anchors are small pieces of metal welded to the plate 22 before the stone is cast over same in the shop. 32 indicates the level line from which the roof is pitched toward a drain not shown in the view.

In Figure #9 the symbol 90 indicates a hollow steel girder supported from steel columns at each end. These columns are not shown in the view as they represent no substantial departure from the prior art. The floor joists 67 are welded directly to the girder 90 as indicated by W25. The floor plates 66 finish flush with the top of the girder and are finished with wire lath and cementitious materials 81. 82, 83 and 84 indicate wire lath and plastic or cementitious materials which are fastened to and carried under the floor plates 68 and the lower part of the girder. W12 indicates the exterior shop welding of the four steel plates shown to form the hollow girder 90.

In Figure #10 the symbol 29 is the open vertical joint formed by bringing together two pieces of stone veneer. 45 indicates the outer facing, 44 the concrete backing and 42 the top plate, as before, of the stone veneer. 4 indicates the plastic insulation preferably of gypsum applied in the field. 5 indicates the wire lath welded to the studs 47 and plastic or cementitious materials applied to the lath in the usual manner.

In Figure #11 the symbol 1 indicates an ordinary concrete foundation which would be reinforced with steel re-inforcement in the usual manner whenever necessary or advisable. 2 indicates a foundation plate of metal and 3 a foundation plate welded joint.

In Figure #12 the symbols 100, 103 and 105 indicate each an array of steel columns carried through various floor levels indicated by 101. 102, 104 and 120 indicate trussed areas formed by welding the outer walls, floor framing, partition framing, and possibly the columns, girders and beams together. In Figure #13 the symbol 106 indicates a trussed area similar to 102 spanning the open space or auditorium 108 between the buttressed walls 107. 6 indicates a foundation constructed in the manner indicated in Figure #11 and carried continuously through the base of a building. In Figure #14 the buttressed walls have been set in slightly from the face of the building and the truss 106 spans the open space 108 and cantilevers out over the arcade 110. The open area 108 and the arcade 110 have no structural supports other than the buttressed walls 107.

In Figures #15, 16 and 17 the symbols 130, 132 and 135 indicate a trussed area carried continuously through the structure from grade to roof or from one setback roof to another. 140, 142 and 145 indicate an area having a different working stress from the lower part of the same truss.

Similar symbols refer to similar parts throughout the drawings.

Whether shown in the views or not all metal in predetermined contact with other metal is welded either in the shop or field as noted herein.

The material which I refer to as factory finished stone has been described in detail in pending patent application #322,285 filed November 27th, 1928. It is essentially an assembly of metal plates welded together to form a frame and partly encased in artificial stone.

More properly each frame generally embraces two separate layers of cementitious materials, each having a factory finished face exposed, with a layer of insulating materials or an open air space between.

The stones are set in the field by means of a hoisting apparatus. Suitable means for accomplishing this have been previously proposed. Due to the elimination of the mortar bed, and the use of steel to steel bearings with welded connections, the setting of these stones is a very simple matter.

It will be noted that the studs 74 built-in the stones are aligned in the field with the floor joists 67 which in turn are aligned in the field with the studs 59. This is possible because the outer wall studs are located in the factory finished stones in an exact predetermined position. This is accomplished by laying out the frames on the ground and pouring or precasting a complete facade, or a large part of same, as one huge flat slab of (easily separable) factory finished stones.

Figure #3 shows that the two separate layers of concrete 78 either side of the insulating blanket 79 are tied together by means of the header bricks 80. The concrete slabs 78 may be re-inforced in any practical manner if required or if desired this re-inforcement may be omitted altogether. If re-inforcement must be used I prefer to weld the necessary re-inforcement to the studs 74 and the plates 72 and 71 before the precasting, or else to mix a sufficient quantity of small pieces of free unfastened wire in the concrete during the precasting process.

Complete window and door openings, factory finished, are included in the factory finished stones as necessary.

The outer wall stud assembly units (if used), the floor joist assembly units, the partition stud assembly units and the roof joist assembly units for a complete building would be made in the shop generally as shown in Figure #7, and would consist of three or more studs or joists framed into and welded to a header plate at each end of each unit. These assembly units would likewise be framed out to include door, window, stair, elevator, skylight and other openings as they occur in the building. Electric arc welding is pre-

ferred for the shop fabrication and field erection of these assembly frames.

The built-in girt 77 is imbedded as part of each factory finished stone that occurs at a floor level, and it is made to finish flush with the interior face of the stone. Plates or built-in girts 77 are welded continuously to each other all around the inside face of the outer walls of the building. They are made a little deeper than the connecting header plate 65 in the floor joist assembly unit to enable ready field welding. The ceiling lath and plaster 82 when applied in the field would ordinarily be continued in the form of a cove or a cornice to cover the bottom of plate 77—Figure #1. The wire lath and floor finish 81 would likewise cover and fireproof the top of the plate 77—Figure #1.

Figure #1 shows only a fragment of the typical floor construction. Ordinarily this floor construction would continue, unbroken except for legitimate floor openings, to the four walls of the structure. The partitions likewise would extend with the outer walls from grade to roof.

Figure #4 indicates the method used for assembling the vertical supports or stud assembly units in the field. They are placed one above another and alongside of each other and electrically arc welded together on both sides of the stud assembly units wherever exposed metal is in predetermined field contact with other metal.

At the roof level the roof joist assembly units take the place of the floor joist assembly units to complete the roof framing. They are welded in the field to the built-in girt of the parapet stone 28 at one end and/or to each other W26 over the interior partitions of the floor below. They are also welded to the partition stud assembly units, as indicated by W27, in the field.

Figure #11 shows the type of foundation I prefer to use, the chief characteristic of which is continuity. In the past foundations have been placed in most cases under bearing walls or columns and the entire weight of the building was consequently brought to bear upon only a small part of the building plot. The intermittent type of foundation has many advantages and disadvantages but the one chief point of interest is that it served to prevent the erection of very tall buildings on anything but a solid rock foundation except at very great expense. The type of foundation I prefer consists of a bottom of re-inforced concrete covering the entire area of the building plot, and more if possible, and a top layer of welded steel plates placed continuously over the re-inforced concrete.

Above these plates watertight compartments are constructed and filled with concrete with a view to distributing the weight of an entire building evenly over the re-inforced concrete—symbol 1—Figure #11. These compartments would be very similar to the floor construction shown in Figure# 1 except that the joists 67 would run in both directions and at various angles depending entirely upon the method used for distributing the load.

In a similar manner compartments could be constructed in a shop or factory and launched with a view to supporting a large group of tall buildings over water.

When the foundation has been completed the outer wall is built up all around to a point just above the first floor next above the foundation. After the outer wall stones have been set and welded together through the open joints the latter are filled up with mortar or the like to fireproof the weld and complete the exposed surfaces of the wall. The factory finished stones thus form a complete wall one story high or more faced and finished on both the exterior and interior sides and thoroughly insulated against heat and cold. The interior partition stud assembly units are next built up to the same height as the outer wall stones to form the framework of all the partitions required. Then the floor joist assembly units are placed into position and welded to the outer wall stones and the partition stud assembly units to complete the framing of the lowest floor. The floor, ceiling and partition plates are then welded into position on the studs as shown in Figure #1 or the joists as the case may be. Wire lath is then welded to the plates in a rigid position just clear of the plates to enable the finishing materials to clinch in around the wire strands of the lath. This is accomplished by building up small welding deposits on the plates back of the lath. The plastic finishing materials are then applied whenever the condition of the work warrants same. Plumbing, heating and electrical piping, etc., which it is desired to conceal, is placed in position in the usual manner before the interfering plates have been welded into position to avoid cutting. The work proceeds floor by floor in a like manner. The parapet walls are carried above the roof as shown in Figure #8. This figure also indicates the method of ending a partition not wanted on the floor next above.

Whenever the embodiment shown in Figures #4 and #10 is used the outer wall stud assembly units are first placed into position all around the walls, and to the same height as explained hereinbefore, and they are then welded together. Then the stone veneer is placed into position and welded to the outer wall stud assembly units and together wherever exposed metal comes into predetermined field contact. The stones of the veneer are welded to each other through the open joints such as 29 in Figure #10 and through the horizontal joints such as 29 Figure #4. The insulation 4 is then applied in the field. For this purpose I prefer to use plastic gypsum or a mixture of one part of Portland cement to about four parts of granulated cork, with a sufficient quantity of short lengths of free wire mixed in the cement, the proportion of wire being between two and five pounds of fine wire for each bag of cement. After the partition and floor framing has been erected and welded to the outer wall stud assembly units wire lath is welded to the back of same and finishing materials of a cementitious or plastic nature then applied in the usual manner whenever the condition of the work warrants same—symbol 5 Figure #10.

Thus a building of any practical size or height may be readily constructed with exterior walls of welded stones in conjunction with interior metal plate framing, or of interior metal plate framing and welded stone veneer. The partitions, floors, roof and parapet would be constructed in the manner previously outlined in either case.

Formerly buildings of the skyscraper type were built of nearly independent columns, girders and beams piled tier upon tier. Each column was designed as a separate shaft resting on its own foundation. Steel loses its structural value quickly when heated, corrodes easily in most cases and is always susceptible to shock. Should a single column in an old fashioned skeleton steel framed building fail near its lower extremity

from fire, defective foundation, earthquake, overload, corrosion, shock or other cause, its failure might cause the collapse of an entire building. This is especially possible in the case of a very tall building and even more so if it is built on a relatively narrow base. On the other hand the failure of a single heavy girder near the top of such a building might carry a large part of the structure with it as it snow-balled into the cellar.

Re-inforced walls have often been proposed, and in many forms both cast in place and precast, for skyscraper construction, but they are seldom if ever used. They all lacked something which prevented them from obtaining widespread support. They were not universal in application under all circumstances, and/or flexible enough architecturally with complete safety and sufficient economy in first cost and maintenance to give pause to investors by promising to make all other types obsolete and overcome the speculative advantages of a solid rock foundation.

Existing skyscrapers depend entirely upon inertia, or nothing happening, for their safety. In congested areas they present a continual menace to the life, wealth and industrial well-being of the nation in peace, and they would prove to be a great national weakness in the event of war.

Great economy is now possible solely through the designing of an all welded skyscraper of the type now proposed, or other large structures, as a welded whole, instead of as a series of nearly independent columns, girders and beams. Engineers formerly used the stiffeg factor of safety design for structural steel in skyscraper construction. For example—steel is capable of sustaining about 80,000# per square inch of metal in either tension or compression. The New York city code which may be taken as a criterion for the rest of the country allows about 16,000# per square inch and in columns for compression where the length divided by the least radius of gyration equals 120 only 7600# per square inch is allowed. Since steel columns in skyscraper construction were designed individually and to rest on individual foundations, as a general rule, no credit could be taken for overhead support in tension since none existed. In the wire wheel theory of structural steel design, which is now applicable to the all welded buildings described herein, the vertical supports receive reciprocable support from the foundation and from overhead, and the horizontal supports likewise receive reciprocal support from more than one direction. This is based on the obvious fact that a steel wall or partition, as described herein, will form a natural arch over an area of internal damage, or a natural cantilever over an area of external damage. The floor, ceiling and partition plates, etc., also give reciprocating push and pull support to joists and studs.

In the case of a very tall building on a relatively narrow base we now visualize a natural overhead truss near the roof. It has no physical properties beyond the fact that it represents an area of change in the allowable working stresses to compensate for lack of further overhead support. This means that in the lower limits above mentioned 7600# for compression plus 16,000# for tension, or 23,600 pounds per square inch, may be safely used as a working stress for certain metal below the truss. This new working stress, which is about 3.10 times the former allowance for the same amount of steel section, may safely be used for all the metal in the structure, excepting the vertical supports in the overhead truss area, the floor joists, and certain other minor parts. Thus, all of this steel could be figured with a much higher working stress or it may be visualized as presenting a tremendous additional factor of safety.

Figure #12 shows an example of a skyscraper with its walls, floors, partitions, roofs, girders and columns welded together with a change in the working stresses at each roof or set-back. Girders, of course, are figured the same way as joists.

Figure #13 shows the same type of building with the entire load of the building transferred to the buttressed walls 107 to obtain an open space 108 free of columns for a theatre or auditorium.

Figure #14 is the same as Figure #13 except that the buttressed walls have been set in to provide an arcade free of columns outside of the auditorium. There is no disclosure in regard to the construction of these buttressed walls because they are similar to the rest of the walls but thicker and stronger.

Figure #15 indicates a building in which the columns and girders have been eliminated in the lower parts and the construction in these lower parts is as shown in Figure #1. 140 and 142 indicate trussed areas with a change in the working stresses to compensate for lack of any further overhead support and to distribute the load of the towers above, or to take up any overload or weakness in the lower members.

Figure #16 shows a building similar in its lower parts to Figure #15 with the exception that it has a large area of external damage 141 and the building forms a natural cantilever over this area of destruction.

Figure #17 shows a building, all of which is constructed as shown in Figures #1, 8, etc., with an area of internal damage or destruction 131 which has been arched over naturally by the rest of the structure.

In some buildings of the skyscraper and similar types permanent partitions are undesirable, and Figures #12, 13 and 14 show how welded stones in conjunction with welded interior metal plate framing, as now disclosed, may be used in conjunction with welded columns and girders for this type of work. To effect economy with greater safety, the welded stone walls are used throughout the structure, likewise the metal plate floor framing as shown welded to the hollow girder in Figure #9. The columns and girders being first erected and welded together to form a frame similar to those now in use. I prefer, however, a hollow section like that shown for the girder in Figure #9 as a column section also.

Vertical plates similar to girt 77 are built into certain of the outer wall stones in the factory for the purpose of welding the columns and partitions to the outer walls. This method would be used also for fastening the partition (part of which is shown in Figure #1) to the outer wall where they intersect. The intersection and construction has not been shown in any of the views because it is similar to the floor construction connection shown in Figure #1, only vertical.

In forming an arcade or an auditorium temporary braces must be used, under the ceiling of same, until the construction has been advanced sufficiently to spread the load properly on the buttressed walls.

I prefer the use of plates throughout the construction, because, they are made easier and thinner usually than other shapes, pack better, there-

fore cost less in shipping and handling, are safer for erection, can be welded more readily, and their flexibility is an advantage for field fitting. In the stones they can be braced by the cast to prevent buckling.

It will be noted that hollow structural metal has been previously disclosed, but the prior erection of the assembly units clearly distinguishes the present invention, as likewise, does the present complete structures, and/or some combined parts thereof, and the use of reciprocal support in the present manner, and the complete combinations of the present invention.

Pending patent application #322,285 filed by the present applicant on November 27th, 1928, discloses stones very similar to those now employed, but not the present built-in girts, or the use of bonding bricks, and being directed to a building material did not disclose the present structural and engineering features.

Pending patent application #331,308 filed by the present applicant on January 9th, 1929, discloses the use of stones and interior steel plate framing somewhat similar to that now employed. Being directed to a small dwelling, or the like, it did not disclose the present complete construction in conjunction with the built-in girts and bonding bricks and floor and ceiling finishes, or the use of a veneer with separate wall supporting frames, or skyscraper construction with the present structural and engineering features.

From the foregoing it may be readily seen that anyone familiar with building construction methods and engineering design could readily construct a building of welded factory finished stones and welded metal plate framing in the manner now disclosed. I have disclosed herein several practical embodiments of my invention. Nevertheless, it must be clearly understood that, because of the wide scope of architectural, engineering and structural requirements in building construction that the invention may also be exemplified in numerous other alternative constructions, and I, therefore, reserve all such legitimate changes as may be fairly embodied within the spirit and scope of the invention as claimed.

I claim:

1. A building structure comprising frames having a plurality of spaced metal supporting members welded to like cross framing members as described, said frames being welded together to form wall, floor, partition and roof framing substantially as described, lateral reciprocal bracing for the outer wall framing consisting of metal plates and reinforced stone sheathing or the like with a hollow space or blanket of insulating materials between the inner and outer layers of the said sheathing, lateral reciprocal bracing for the partitions, floor and roof framing consisting of metal plate sheathing as described faced with reinforced plastic or cementitious materials or the like, the aforesaid wall and partition framing being arranged in structural continuity from foundation to main roof or setback and having its individual members aligned in structural relation with the individual members of the floor and roof frames and reciprocal overhead tension and foundation support for the lower vertical supporting members of the structure.

2. A building structure comprising frames having a plurality of spaced metal supporting members welded to like cross framing members as described, said frames being welded together to form wall, floor, partition and roof framing substantially as described, lateral reciprocal bracing for the outer wall framing consisting of metal plates and reinforced stone sheathing or the like with a hollow space or a blanket of insulating materials between the inner and outer layers of the said sheathing, lateral reciprocal bracing for the partition, floor and roof framing consisting of metal plate sheathing as described faced with reinforced plastic or cementitious materials or the like, the aforesaid wall and partition framing being arranged in structural continuity from foundation to main roof or setback with its individual members aligned in structural relation with the individual members of the floor and roof frames and reciprocal overhead tension and foundation support for the lower vertical supporting members of the structure, and an array of structural vertical supporting members in the form of columns in welded continuity in the interior of the structure.

3. A building structure comprising frames having a plurality of spaced metal supporting members welded to like cross framing members as described, said frames being welded together to form wall, floor, and roof framing substantially as described, lateral reciprocal bracing for the outer wall framing consisting of metal plates and reinforced stone sheathing or the like with a hollow space or a blanket of insulating materials between the inner and outer layers of the said sheathing, lateral reciprocal bracing for the floor and roof framing consisting of metal plate sheathing as described faced with reinforced plastic or cementitious materials or the like, the aforesaid wall framing being arranged in structural continuity from foundation to main roof or setback with its individual members aligned in structural relation with the individual members of the floor and roof frames and reciprocal overhead tension and foundation support for the lower vertical supporting members of the structure, and an array of isolated interior supports in welded continuity throughout the structure.

4. A frame for building construction comprising insulated outer wall stones of duo-monolithic construction as described and hollow metal interior partitions, floor and roof construction substantially as described, said frame being welded in structural continuity substantially as described and having its individual supporting members aligned to provide reciprocal overhead tension and foundation support for the lower vertical supporting members of the structure.

5. In building construction the relative arrangement of metal construction in horizontal tiers each of the said tiers forming a combination floor and ceiling or a combination roof and ceiling substantially as disclosed herein, comprising individual frames each having a plurality of spaced metal supporting joists welded both ends to a cross framing member or header, said individual frames being welded together and to spaced vertical supports to provide the aforesaid horizontal tiers, lateral reciprocal bracing top and bottom to the individual joists of the said frames consisting of metal sheathing covered with plastic or cementitious materials or the like, and a precise alignment of the individual joists of the aforesaid frames with the individual supporting members or studs of the above mentioned spaced vertical supports for the purposes disclosed hereinbefore.

6. A building structure comprising insulated

outer wall stones of duo-monolithic construction as disclosed and hollow metal partition, floor and roof construction as disclosed welded together in rigid structural relation substantially as disclosed, said partition, floor and roof construction being covered with plastic or cementitious materials or the like, and the individual supporting members of the aforesaid insulated outer wall stones and hollow metal partition, floor and roof units being in carefully aligned structural relation as described to provide for reciprocal overhead tension and foundation support for the vertical supporting members of the lower part of the structure.

7. In building construction the relative arrangement of metal construction in horizontal tiers each of the said tiers forming a combination floor and ceiling or a combination roof and ceiling, comprising individual metal frames having a plurality of individual spaced metal supporting joists welded both ends to a cross framing member or header, said individual frames being welded together to form the horizontal tiers hereinbefore mentioned, and the said tiers being welded to spaced vertical supports with the individual supporting members or joists of the said tiers carefully aligned with the individual supporting members or studs of the spaced vertical supports.

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