April 20, 1954 J. LOEWENSTEIN **2,675,895**

FRAMEWORK FOR MULTISTORY STRUCTURES

Filed Dec. 15, 1951 4 Sheets-Sheet 1

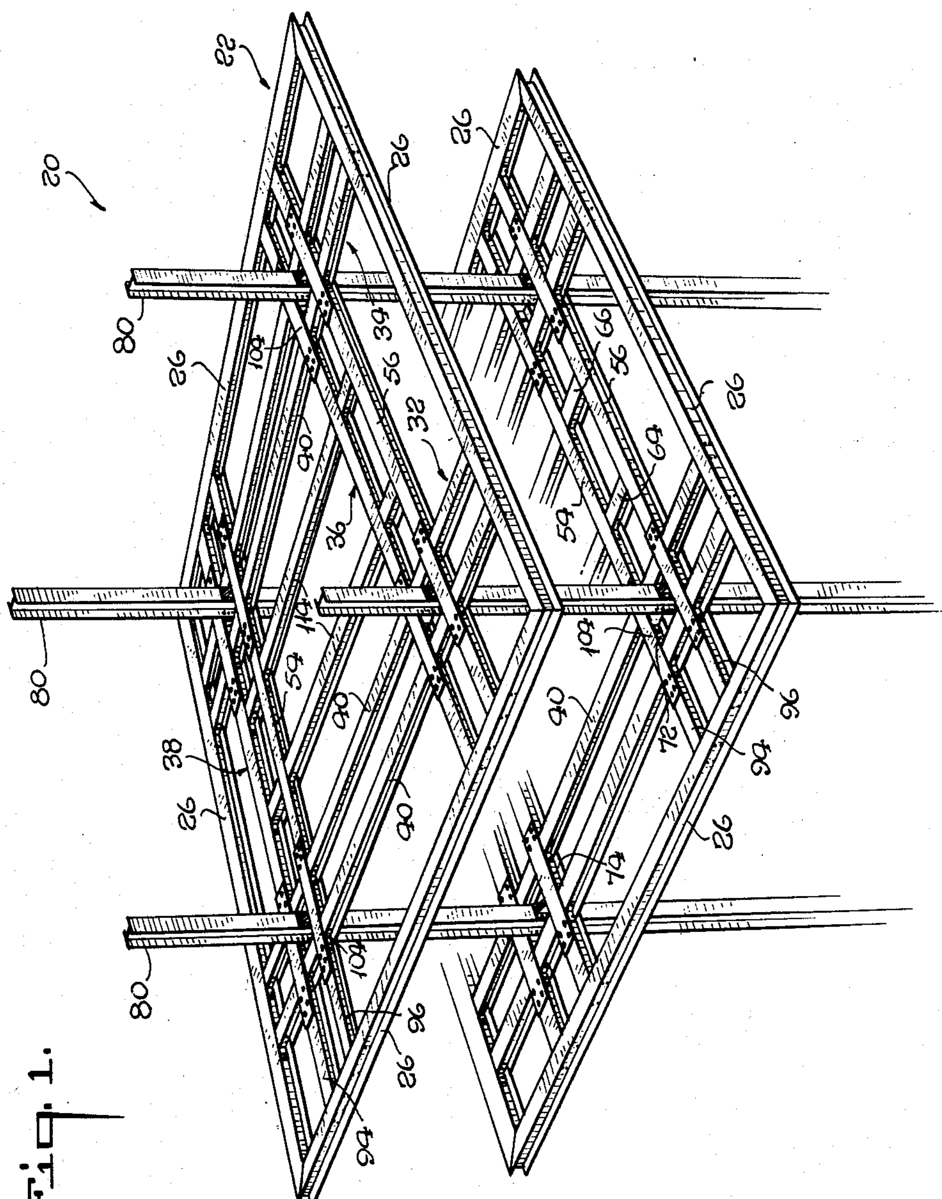

Fig. 1.

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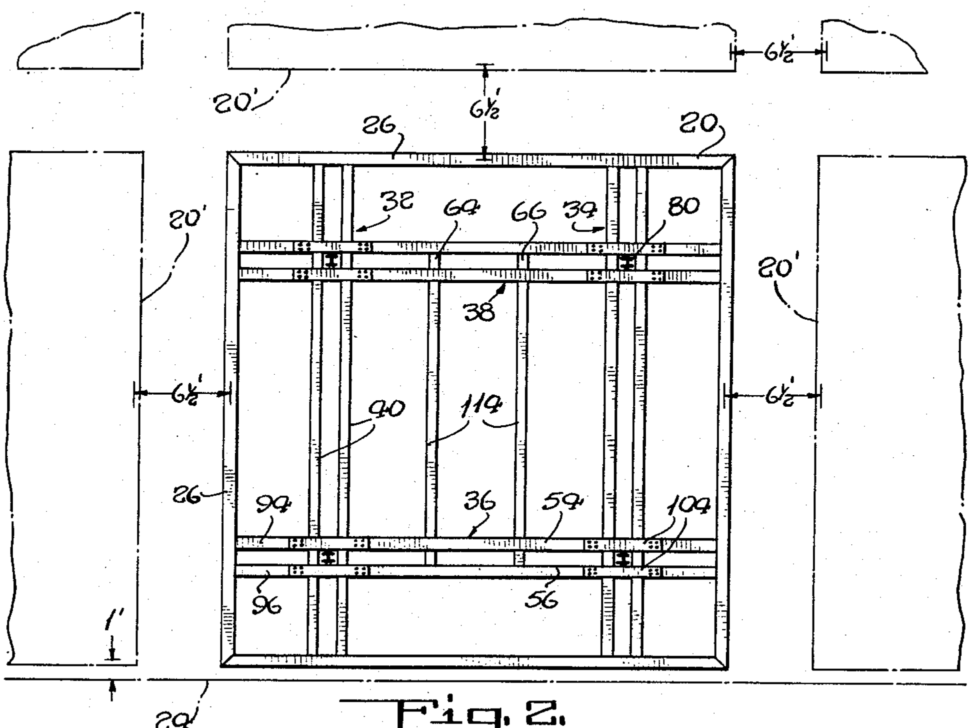

Fig. 2.

Fig. 3.

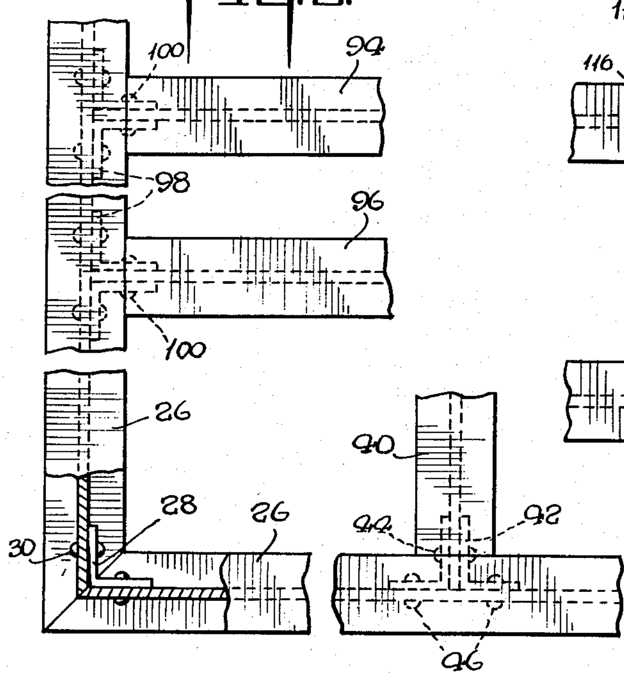

Fig. 4.

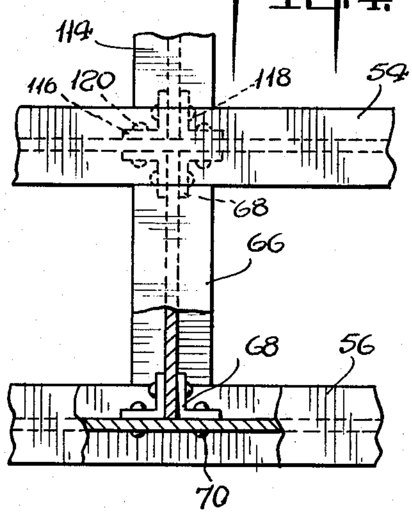

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Fig. 5.

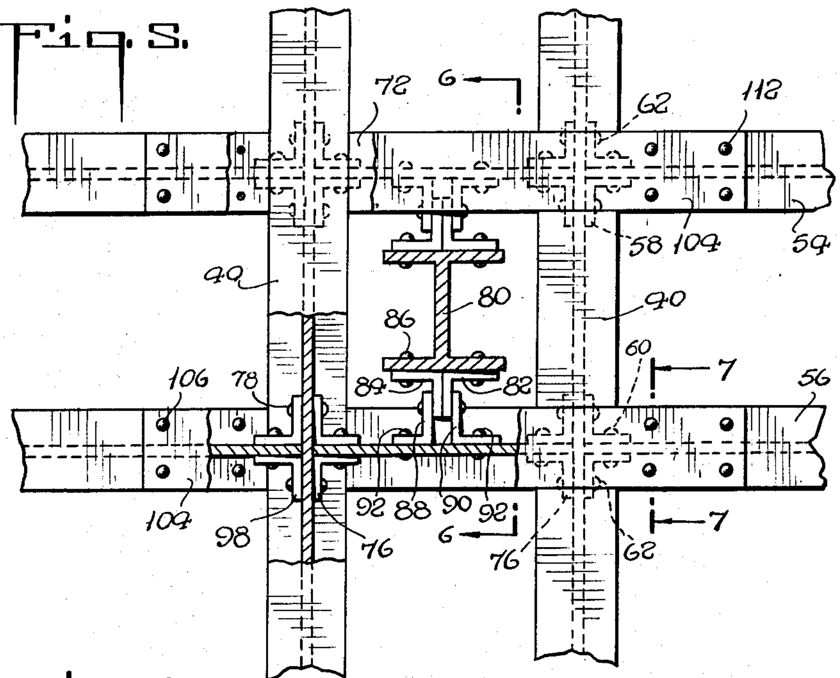
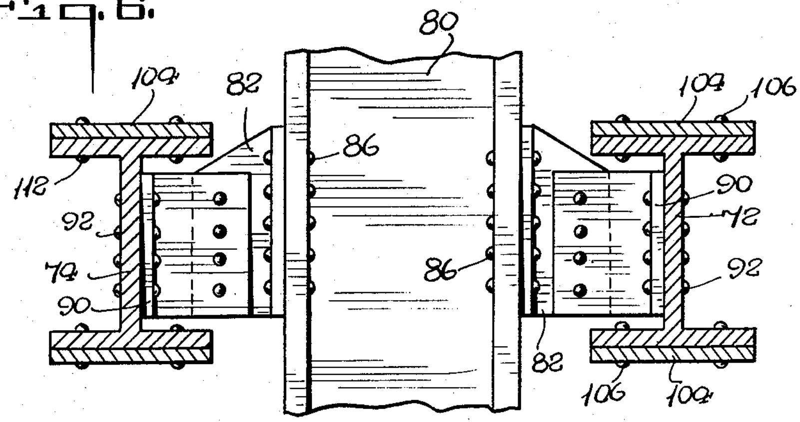


Fig. 6.



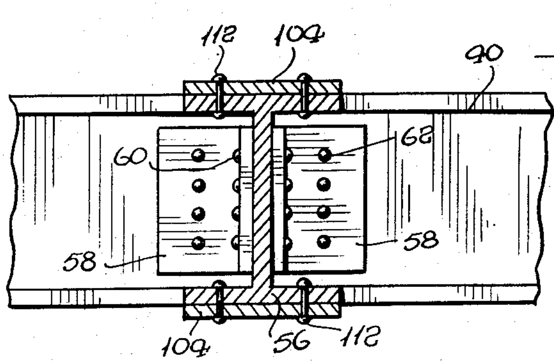


Fig. 7.

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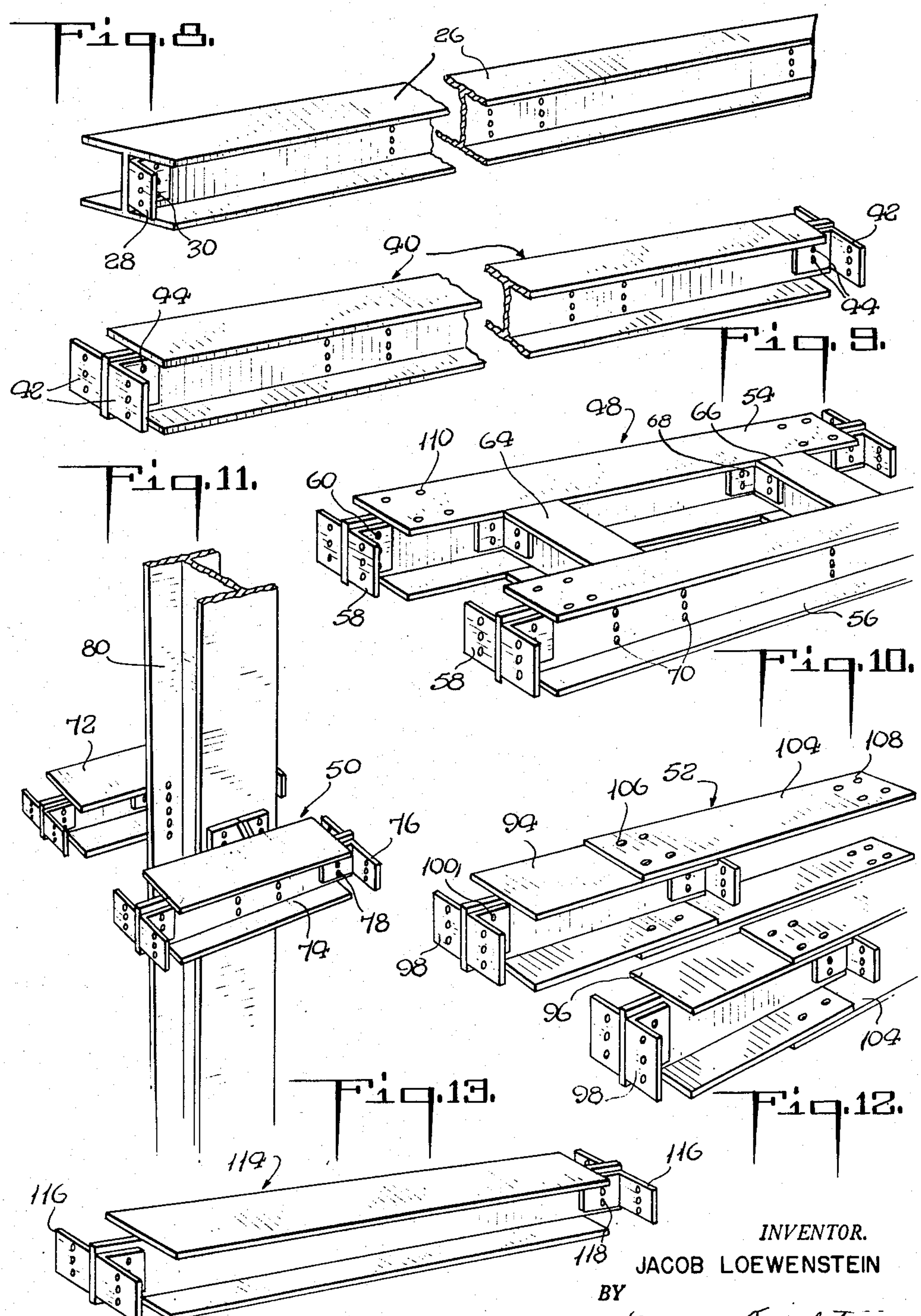

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UNITED STATES PATENT OFFICE

2,675,895

FRAMEWORK FOR MULTISTORY STRUCTURES

Jacob Loewenstein, Manhattan, N. Y.

Application December 15, 1951, Serial No. 261,861

8 Claims. (Cl. 189—1)

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This invention relates to frameworks for multi-story structures such, for example, as office buildings, hotels and apartment houses.

It presently is the custom for the steel framework of a multi-story structure to be designed by an architect who takes into account such controlling factors as the local building code, engineering considerations, external appearance, floor layouts, and the size and shape of the building lot. Invariably, due to the custom fitting of the framework to these factors, the architect specifies a large variety of lengths and sizes of steel beams. For sundry reasons, such as to lower labor costs and increase output and efficiency of machinery, a steel mill conventionally makes but one or a very few types of beams at a time and, barring unusual circumstances, does not repeat a run on any particular size for many months. As a result there usually is a shortage of many sizes of beams so that when the builder submits the steel framework specification to a mill, he is resigned to being told that certain beams are in stock and other beams are out of stock and may not be made for many months. The builder has the option of waiting until the beams are made, or he can redesign the framework to use currently available beams or beams which will be fabricated in the near future. But no matter what he does, it will be apparent that the cost of the framework will be more than estimated either due to delay in building or to the cost of re-engineering the framework, or to the use of too many or too heavy beams employed as substitutes in the original design.

It is an object of my invention to provide a novel framework of the character described which overcomes all of these disadvantages.

More particularly, it is an object of my invention to provide a framework of the character described which can do away with the necessity for employing an architect to design the framework, will enable the builder and steel mill to deal directly with one another in selecting the type of framework desired for a multi-story structure, will standardize and substantially reduce the variety of lengths and transverse dimensions of beams in the framework, will materially reduce the number of field connections, will simplify and standardize the erection of frameworks, and yet, withal, will lend itself to an almost unlimited variation of building stylings and floor arrangements.

It is another object of my invention to provide a framework of the character described which requires less steel than a conventional present-

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day framework, is simpler to erect and does not require as much shoring of adjacent properties.

It is another object of my invention to provide a framework of the character described which has comparatively few and identical columns and hence large expanses of unbroken floor space.

It is another object of my invention to provide a framework of the character described wherein the outer walls are uncluttered with columns so that a wide variety of architectural treatments may be employed for the facade and other walls of the building.

It is another object of my invention to provide a framework of the character described in which the utilities, such as heat, water, drains, electricity, air-conditioning and gas may be localized in a few channels thereby simplifying installation and permitting great flexibility in the layouts of different floors so that, for example, identical rooms need not be stacked in an apartment house.

It is another object of my invention to provide a framework of the character described which is particularly adaptable for use in cities such as New York, having a great number of rectangular land sites consisting of one or a plurality of modular building plots.

In this latter connection, it is a more specific object of my invention to provide a framework unit of the character described which is uniquely capable of being used in connection with the erection of multi-story structures on land sites consisting of one or a plurality of fifty by fifty foot modular building plots, that is to say, building lots which, for example, consist of a fifty foot square or a hundred foot square or a fifty by one hundred foot rectangle, etc.

Other objects of my invention will in part be obvious and in part will be pointed out hereinafter.

My invention accordingly consists in the features of construction, combinations of elements and arrangements of parts which will be exemplified in the device hereinafter described and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which is shown one of the various possible embodiments of my invention,

Fig. 1 is a perspective view of two stories of a framework unit constructed in accordance with my invention;

Fig. 2 is a plan view showing one framework unit in detail and fragments of adjoining framework units;

Fig. 3 is an enlarged fragmentary, partially broken away, plan view of a corner of the framework unit;

Fig. 4 is an enlarged, partially broken away, plan view of one of the intermediate sections in the vicinity of a diaphragm connector;

Fig. 5 is an enlarged, partially broken away, plan view of two of the long girders at a cross connection;

Figs. 6 and 7 are enlarged sectional views taken substantially along the lines 6—6 and 7—7, respectively, of Fig. 5;

Fig. 8 is a fragmentary perspective view of a fascia girder which constitutes one of the standard parts of the framework unit.

Fig. 9 is a fragmentary perspective view of a long continuous beam which is an element of one of the continuous double beam girders and constitutes a second of the standard parts of the framework unit;

Fig. 10 is a perspective view of an intermediate section which is an element of one of the spliced double beam girders and constitutes a third of the standard parts of the framework unit;

Fig. 11 is a fragmentary perspective view of a column and associated bridging section, the same constituting a fourth of the standard parts of the framework unit;

Fig. 12 is a perspective view of a cantilever end section, constituting a pair of beams, which is an element of one of the spliced double beam girders and constitutes a fifth of the standard parts of the framework unit; and

Fig. 13 is a perspective view of an intermediate girder which constitutes a sixth of the standard parts of the framework unit.

In many large cities such, for example, as New York city, land sites are rectangular and constitute one or integral multiples of a standard unit, i. e. a modular building plot. In New York city such modular plot is fifty by fifty feet.

In general, in carrying out the present invention, I take advantage of this modular plot by providing a steel framework unit having a square floor outline the size of which is such that but a single independent unit is placed on each modular plot and if there are a plurality of such plots, there will be a like number of independent units.

Referring now in detail to the drawings, the reference numeral **20** denotes a single framework unit constructed in accordance with my invention and adapted to be placed on a single modular plot. Each floor **22** of the framework is in the shape of a square which is about forty-five feet to a side. If, for example, the building is one hundred by one hundred feet, four independent framework units will be employed and each unit will be placed on a different one of the modular plots with the outer edges of the units about one foot from the edges of the building site and with the inner edges of the units about eight feet from one another. If the building is one hundred fifty by one hundred fifty feet, nine independent framework units will be used with the edges of the outer units placed about one foot from the edges of the building site and with the units spaced about six and a half feet from one another. In the case of a two hundred foot square building, sixteen independent units will be used with the edges of the outer units spaced about one foot from the edges of the building site and the units spaced about six feet from one another. In Fig. 2, by way of example, I have shown a portion of a building **24** constituting one hundred and fifty feet square, the unit **20** being about six and one half feet from the adjacent units **20'** and about one foot from the boundary of the building site.

Each floor of the unit comprises a square outer frame made up of four forty-five foot single beam fascia girders **26**. The beams constituting said girders, like the rest of the beams hereinafter described, are I-beams whose depth and weight will depend upon the floor and wall loading for which the building is designed but whose sizes for any given tier are the same. The fascia girders meet at right angles at the four corners of the floor and the ends of said girders are suitably shaped in any manner well known to the art to effect such connection. For example, the ends of the girders may be mitered, as best shown in Figs. 1, 2, 3 and 8. In addition, the girders are provided with suitable means for making the corner connections. This means may comprise angle brackets **28**.

The fascia girders are connected to the ends of four long double I-beam girders **32**, **34**, **36**, **38** which are arranged in a criss-cross. Each of these double I-girders is forty-five feet long so as to span the space between opposite sides of the square defined by the fascia girders.

Two of the long double I-beam girders are continuous, these being the girders **32**, **34**. That is to say, each of these girders consists of two unbroken I-beams **40** (see Fig. 9). The ends of these beams **40** may be suitably shaped and provided with connecting means to effect a joint with the fascia girders. For example, the upper and lower flanges at each end of the beams **40** are cut back to expose the web for a distance almost equal to the overhang of the flanges in the fascia girders. This permits the webs of the I-beams to be inserted between the flanges of the fascia girders, as shown for example in Fig. 3. Each stripped web end is provided with a pair of angle brackets **42** connected to the beam **40**, as by rivets **44**. Said brackets are connected to the fascia girders by rivets **46**.

The spacing between the I-beams in each girder **32**, **34** is about two and a half feet. The space from the outermost beam **40** in each said girder to the nearest parallel fascia girder is about eight feet, and the space between the innermost beams of the said girders is about twenty-four feet. This accounts for the total width of a floor unit; that is to say, the total width of the floor unit is equal to two eight foot spans, two two-and-one-half foot spans and one twenty-four foot span—in other words forty-five feet.

Each of the other two long double I-beam girders **36**, **38** which criss-cross the girders **32**, **34** are spliced, being formed in three sections, to wit, an intermediate section **48**, a bridging section **50** and a cantilever end section **52**, this arrangement being employed due to the criss-crossing of the girders, to the fact that double I-beam girders are used, and to the fact that all of the girders are arranged to lie in the same plane so as to conserve building space.

Each intermediate section **48** (Fig. 10) includes a pair of twenty-four foot I-beams **54**, **56**. For assembly purposes the flanges of said beams may be stripped at the ends to expose the webs for reception between the flanges of the inner I-beams **40**. The exposed web ends may have angle brackets **58** secured thereto by rivets **60**. Said brackets may be attached to the beams **40** with rivets **62**. In a completed floor the beams **54**, **56** are spaced from one another about two and a half feet. The inner beams of the girders **36**, **38** are spaced about twenty-four feet apart and the outer beams of said girders are spaced about eight feet from the nearest parallel fascia girders so that the depth of the building consists of one twenty-four foot span, two eight foot spans and two, two and a half foot spans, or forty-five feet. Optionally, the two beams 54, 56 are interconnected, as with a pair of diaphragm connectors 64, 66. These connectors are two and a half feet long and are of I-shaped configuration. For assembly purposes the upper and lower flanges of the connectors may be stripped from the webs at the ends to permit insertion between the flanges of the beams 54, 56. The diaphragm connectors may be secured to the outer beam 56 by angle brackets 68 and rivets 70.

The bridging section 50 consists of a pair of short I-beams 72, 74 each two and a half feet long. For assembly purposes the flanges of said beams may be stripped from the webs at their ends to permit insertion between the flanges of the beams 40. The ends of the bridging section are arranged to be connected to the beams 40 as by angle brackets 76 that are secured to said sections by rivets 78. The inner angle brackets 76 are adapted to be registered with the brackets 58 and fastened to the beams 40 by the rivets 62 hereinabove referred to.

The bridging sections preferably are not shipped as individual pieces but are connected in pairs at the mill to columns 80. These columns may be of any appropriate length, for example long enough for two or three stories, in which case each column will have the appropriate number of pairs of suitably spaced bridge sections 50 fastened thereto at the mill as by rivets or welding. It is pointed out that the columns are interchangeable. A suitable manner of connecting each beam of a bridging section to a column is illustrated in Figs. 5, 6, 7 and 11. Said connection comprises a pair of angle brackets 82, 84 secured, as with rivets 86, to a flange of the column. The projecting legs of the brackets are juxtaposed, and are sandwiched between and connected to spaced projecting legs of a second pair of angle brackets 88, 90 secured, as with rivets 92, to the web of a short I-beam 72, 74. The columns 80 are centered in the small two and one-half foot square defined by the bridge sections and the included portions of the continuous I-beams 40.

Each column with its connected bridging sections may be shipped as a single unit from the mill.

The cantilever end section 52 comprises a pair of I-beams 94, 96 about eight feet long. For assembly purposes the flanges at the ends of the webs may be stripped away and provided with suitable connectors, such as angle brackets 98, secured thereto with rivets 100. One end of each beam is adapted to be received between the flanges of a fascia girder and the other between the flanges of a continuous I-beam 40. A cover plate 104 is attached, as by rivets 106, to the outer faces of the top and bottom flanges of the beams 94, 96 so as to protrude beyond the ends of said beams which are connected to the continuous beams 40. The protruding ends of the cover plates are formed with rivet holes 108 adapted to register with rivet holes 110 at the ends of the intermediate beams 54, 56, whereby rivets 112 or the like can be inserted through said holes and thereby aid in joining together the parts of the spliced long double I-beam girders 36, 38.

In further pursuance of my invention I provide a pair of intermediate girders 114. For assembly purposes the flanges at the ends of said girders may be stripped from the webs and the latter provided with suitable means to effect a connection to another beam, as for example, pairs of angle brackets 116 connected to the webs by rivets 118. The intermediate girders are spaced apart about eight feet, and run between the inner beams 54 of the intermediate sections 48. The ends of the intermediate girders are connected to said beams 54, as with rivets 120. Desirably, the intermediate beam girders are aligned with the diaphragm connectors 64 so that the same rivets 120 can be used to secure an end of an intermediate girder 114 and of a diaphragm connector 64 to the inner beam 54 of the intermediate section.

In erecting a framework unit 20, the columns 80 are away from lot lines making for economical foundations and avoiding the usual problems of shoring adjoining buildings.

The various parts of the floors are brought into place and riveted or otherwise suitably joined in a manner well known to the art. If desired the fascia girders of adjacent framework units can be interconnected by struts (not shown).

It will be observed that the framework unit 20 has its girders so laid out that the floor and wall loading give identical sizes of beams and all columns on the same tier will be identical.

It will be seen that by having the columns disposed inwardly of the periphery of the framework, the sides of the building are clear of upright members so that a framework unit embodying my invention lends itself to an infinite variety of architectural treatments. Also, since the columns are within the building proper, all the utilities can be grouped around the columns and on each floor utilities can be run from the columns and between the criss-crossed double beams in any manner the architect desires so that the floor planning is not limited by the necessity of having certain utilities in preselected spots. In this manner the architect can arrange each floor in accordance with the desires of the tenants and it will not be necessary, for example, to have all the bathrooms located in the same vertical line.

By standardizing the units, ordering, supply and delivery of steel is greatly simplified and it is not necessary to employ an architect to design the individual units. Furthermore, by placing the columns in the positions indicated, the negative and positive moments of the building are made identical, thus attaining maximum economy in the use of steel.

Setbacks and courts (not shown) can be provided by eliminating the cantilever ends of the spliced double I girders 36, 38, and further by eliminating the intermediate sections and one pair of columns.

It thus will be seen that I have provided a structural element which achieves all the objects of my invention and is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein described, or shown in the accompanying drawings, is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. A framework for a multi-story building, said framework comprising a plurality of adjacent

identical framework units spaced from one another, each of said units having a plurality of stacked square floors and including four columns only, the columns in each unit being set at the same distance inwardly from the periphery of the floors and being located on the diagonals of the square floors, the spacing between the columns on different diagonals of a given unit being the same as the spacing between adjacent columns of juxtaposed units, and columns of all the units being aligned, each said floor including two pairs of double beam girders, the beams of each double beam girder straddling a different pair of columns and extending equal distances beyond the columns, each double beam girder being parallel to the other double beam girder of the same pair and being perpendicular to and intersecting both double beam girders of the other pair, means connecting the girders to each other and to the columns at the points of intersection, four fascia girders at the ends of the double beam girders, said fascia girders defining a square whose corners are on the diagonals of the floor, said fascia girders constituting the periphery of the floor, and means connecting the ends of the double beam girders to the fascia girders.

2. A framework as set forth in claim 1 wherein an intermediate girder is provided between and parallel to the girders of one pair of double beam girders and perpendicular to the other pair of double beam girders, and wherein means is provided connecting the ends of said intermediate girder to said other pair of double beam girders.

3. A framework as set forth in claim 1 wherein one pair of double beam girders is joined by means of a splice at the columns and wherein all of the girders for each floor lie in the same plane.

4. A framework as set forth in claim 1 wherein each of the double beam girders is about forty-five feet long and the spacing between the beams thereof is about two and a half feet, wherein each double beam girder extends about eight feet beyond the columns, and wherein the length of each of the fascia girders is about forty-five feet.

5. A framework for a multi-story building, said framework including on any given floor of several floors a plurality of adjacent identical square framework floor units spaced from one another, each of said floor units being supported by four columns only, the columns of each floor unit being set at the same distance inwardly from the periphery of the floor unit and being located on the diagonals of the square floor unit, and the spacing between the columns on different diagonals of a given floor unit being the same as the spacing between adjacent columns of juxtaposed floor units, and columns of all the floor units being aligned, each floor unit including two pairs of double beam girders, the beams of each double beam girder straddling a different pair of columns and extending equal distances beyond the columns, each double beam girder being parallel to the other double beam girder of the same pair and being perpendicular to and intersecting both double beam girders of the other pair, means connecting the girders to each other and to the columns at the points of intersection, four fascia girders at the ends of the double beam girders, said fascia girders defining a square whose corners are on the diagonals of the floor units, said fascia girders constituting the periphery of the floor unit, and means connecting the ends of the double beam girders to the fascia girders.

6. A framework as set forth in claim 5 wherein an intermediate girder is provided between and parallel to the girders of one pair of double beam girders, and perpendicular to the other pair of double beam girders, and wherein means is provided connecting the ends of said intermediate girder to said other pair of double beam girders.

7. A framework as set forth in claim 5 wherein one pair of double beam girders is joined by means of a splice at the columns and wherein all of the girders for each floor unit lie in the same plane.

8. A framework as set forth in claim 5 wherein each of the double beam girders is about forty-five feet long and the spacing between the beams thereof is about two and a half feet, wherein each double beam girder extends about eight feet beyond the columns, and wherein the length of each of the fascia girders is about forty-five feet.

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