

July 16, 1963

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3,097,730

CONNECTION OF STRUCTURAL ELEMENTS IN THE ART OF BUILDING

Filed Nov. 14, 1960

FIG. 1

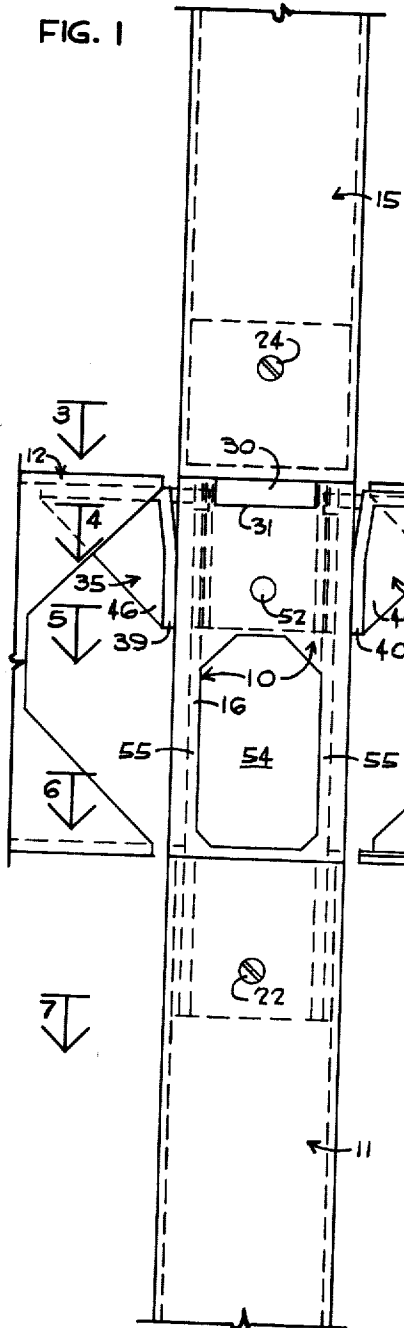
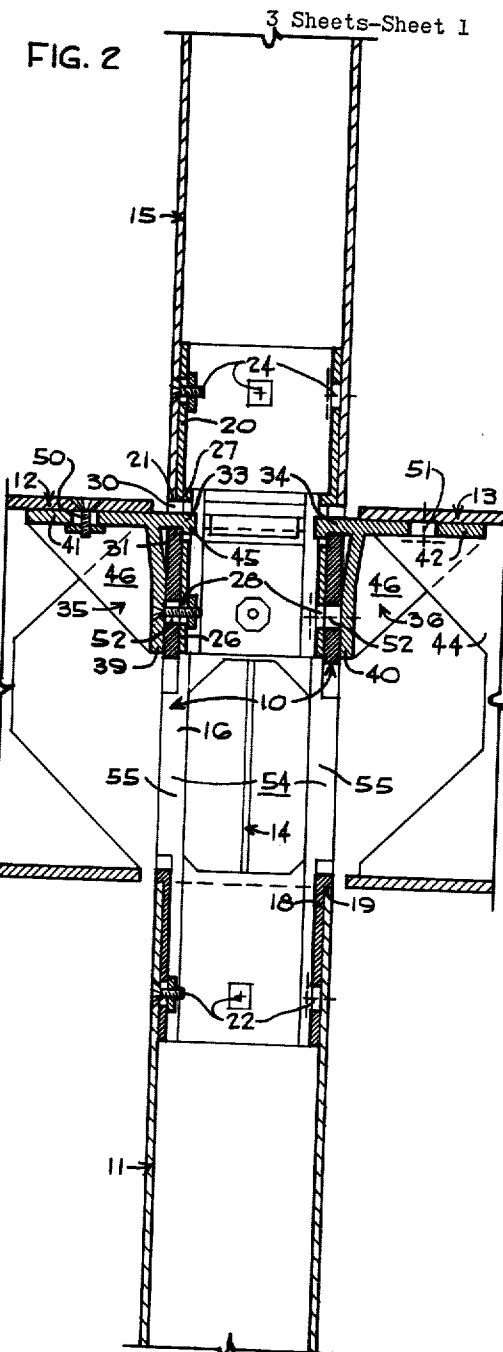


FIG. 2



3 Sheets-Sheet 1

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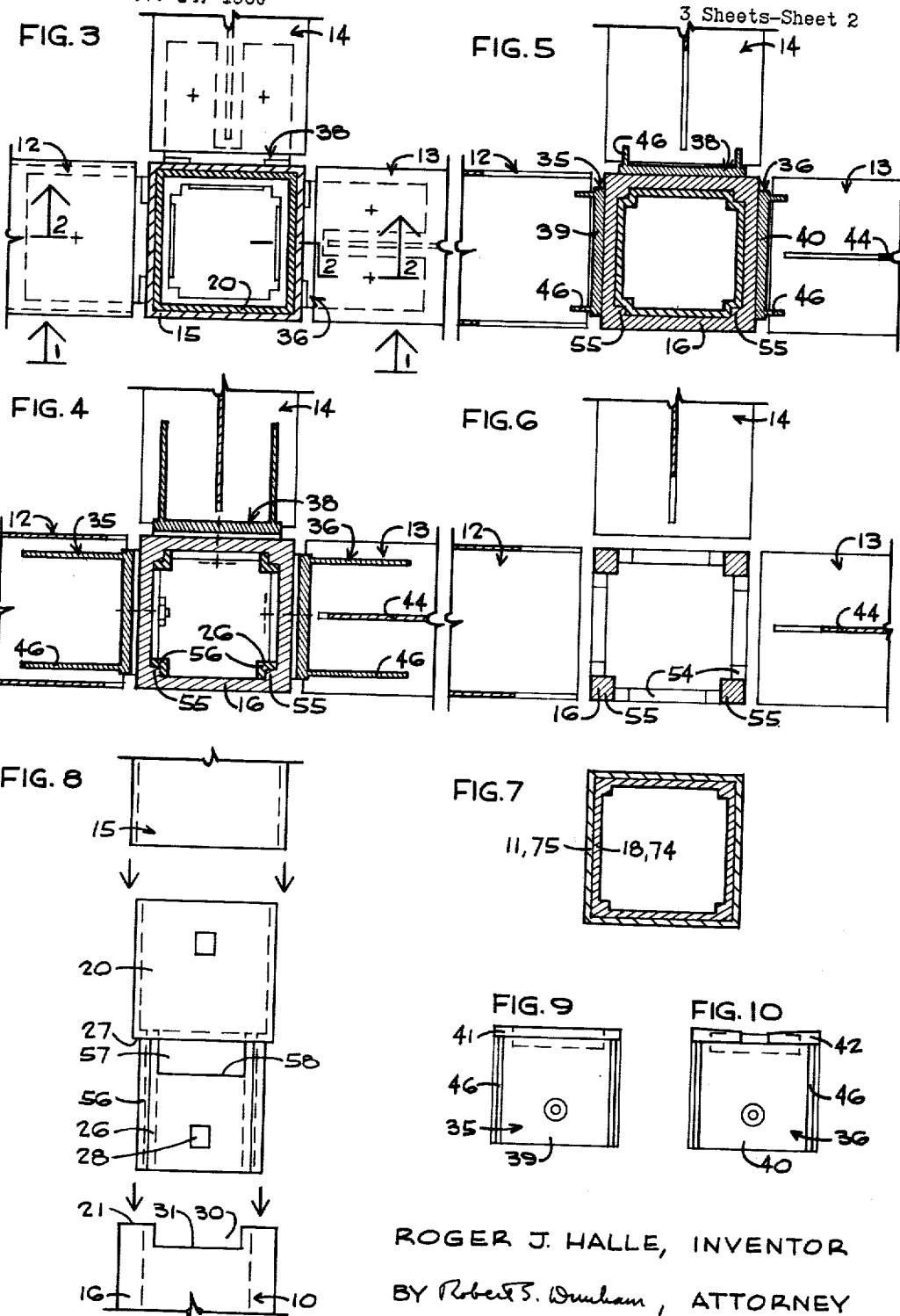
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3 Sheets-Sheet 3

FIG. 11

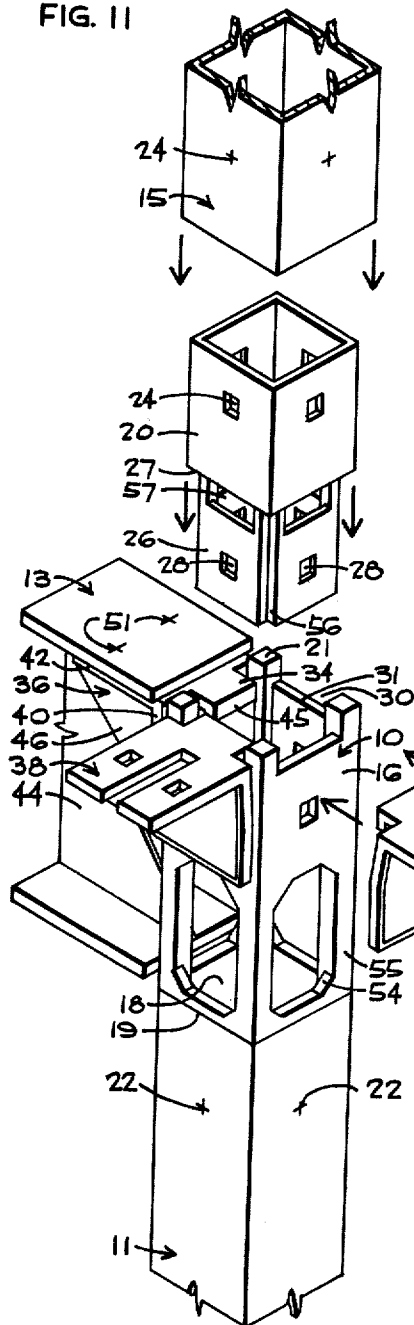
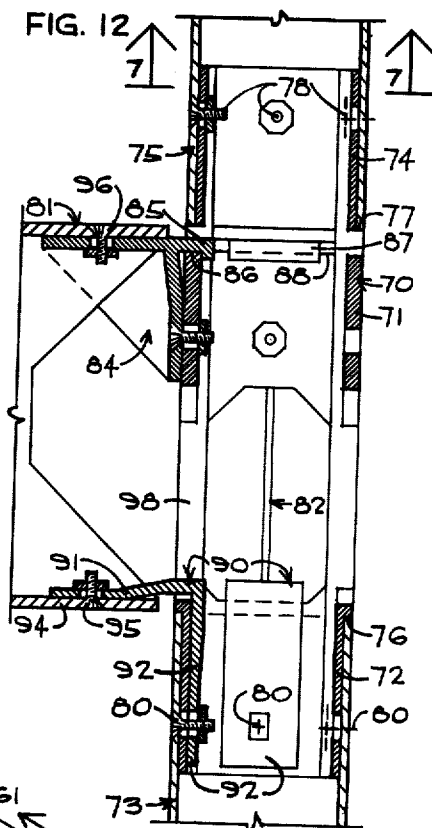


FIG. 12



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CONNECTION OF STRUCTURAL ELEMENTS IN THE ART OF BUILDING

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23 Claims. (Cl. 189-36)

This invention relates to means for connecting and supporting frame or structural elements in the art of building, and to assemblies of structural elements with such means. The present patent application is a continuation-in-part of my copending patent applications Serial No. 363,021, filed June 22, 1953, for Art of Building, and Serial No. 425,279, filed April 23, 1954, for Connecting Means for Structural Elements, both of which have been abandoned. Said application Serial No. 363,021 was a continuation-in-part of my patent application Serial No. 100,387, filed June 21, 1949 for Methods of Building, now abandoned, with which said application Serial No. 363,021 was copending.

A major aim of the invention is to achieve economy and flexibility in building through standardization and minimization of parts. In furtherance of this and other ends, an important object of the invention is to provide a universal and practical basis for joining structural elements in various frameworks, for example in the construction of complete buildings.

Problems of such connections include that of economical load support and transfer of normal stresses. A feature of this solution of such problems is that loads can be transferred as much as possible in bearing, rather than in shear.

Another feature is that provision is made for the adequate tolerances needed in practical building operations, i.e. account is taken of reasonable dimensional variations in manufacture and erection of the building structure, and also by reason of expansion and contraction.

An additional feature is that the structural elements are arranged and designed so that they are capable of providing a load-carrying frame upon which enclosure parts, i.e. wall panels, doors, windows, floors, ceilings and roofs can be attached and supported, thus providing a complete building.

In essence, the invention embraces a novel connecting device, which is here called a nucleus connector, and novel combinations of structural elements in a building, particularly assemblies of columns and beams joined by such connecting means.

The connecting device embodies a new principle, in which there is a separate structural element between beams and columns. In preferred forms it comprises a body portion which in contour and dimensions is substantially an extension of an envelopment of the beams and columns to be connected to it.

The body portion of the connector includes structure, preferably at each of four sides, such that a hanger or equivalent device may be supported, for supporting in turn, a horizontal element such as a beam. Most advantageously, all the beams would have substantially uniform cross-section, and the columns would likewise be substantially uniform in cross-section, although a single one of the devices can be used to connect differing beams or columns if desired.

At the lower end or at both ends of the body portion, the nucleus connecting device includes means, such as a projecting sleeve, interfitted with a column, so that the device may be secured respectively to a column below or between vertically aligned columns. As part of such sleeve relationships, the preferred device also includes horizontal shoulder or equivalent surfaces at vertical ex-

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tremities of the body portion, so that it rests in bearing on the column below, and so that an upper column may similarly rest in bearing on the body portion. Such sleeves may be integral with the body portion or capable of interfitted with it.

The present device may be employed for connecting one or two columns with any number of beams from one to four, and may also be employed for connecting columns in vertical series without beam connection. In all such cases, the structural elements are effectively guided and aligned, with appropriate provision for necessary dimensional tolerances.

The connector can be adapted, for example by use of conforming hangers, for the attachment of various types of beams, such as I-beams and beams of so-called box section; and likewise can be adapted, for example by use of conforming sleeve sections, for use with H-columns, round (i.e. cylindrical) columns, rectangular columns and others, although box-section columns of square contour are presently preferred. For instance, although the accompanying drawings show a connector with arrangements for seating end portions of the upper flanges of I-beams or box beams, it will be understood that accommodation can be made for receiving corresponding seating portions of different kinds of beams or variants, such as conventional "open web" or "bar" joists.

While a particularly effective embodiment of the connector is in a separate device and such arrangement is therefore an important part of the invention, it is contemplated that some advantages may at times be realized when the connector constitutes an extension (but still occupying the same locality of interconnection) of one of the structural elements, for example the column below.

The connectors and other frame elements may be composed of various materials, chosen for strength, durability and economy, such as steel, aluminum, or other metals, although other materials such as reinforced, laminated or other plastics may be used.

By way of specific example, certain embodiments of the invention are illustrated in the accompanying drawings, in which:

FIG. 1 is an elevational view of a nucleus connector and portions of beams and columns assembled therewith;

FIG. 2 is essentially a central vertical section, taken on planes parallel to FIG. 1, of the assembly;

FIGS. 3, 4, 5, 6 and 7 are horizontal sections respectively on lines 3-3, 4-4, 5-5, 6-6 and 7-7 of FIG. 1, FIG. 12 also serving to represent a section on line 7-7 of FIG. 12;

FIG. 8 is an exploded elevational view showing the relation, during assembly, of the upper column with the connector, including an intermediate, removable attachment sleeve;

FIGS. 9 and 10 represent end elevational views of hangers respectively employed for attaching a box-beam and an I-beam to the nucleus connector body;

FIG. 11 is a perspective view of the connector and associated elements, including columns and beams, with the assembly in partly exploded form, to illustrate the relation of the parts in combination; and

FIG. 12 is essentially a central vertical section, similar to FIG. 2, but showing another form of the connector, having an integral upper sleeve, with lower and upper columns and a single attached beam.

In reference first to FIGS. 1 to 10 of the drawings, and likewise to FIG. 11 where the same basic parts occur (with only a variation in orientation and nature of certain beams), there is shown a connector device 10 seated at the head of a hollow, square-section column 11 and arranged for support of a plurality of beams 12, 13 and 14. The connector is adapted to support any number of

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beams from one to four, respectively at its four vertical faces, and likewise to be attached to a single column below or two vertically successive columns. For variety and convenience of illustration, three such beams are shown, including box-section beam 12 and I-beams 13 and 14. There is similarly shown an upper column 15, for example identical in cross-sectional configuration to the lower column 11, and seated at the upper end of the connector 10.

The connector 10 includes a central body portion 16, conveniently hollow and having a square outer contour conforming with the exterior of the columns 11, 15 and also conforming with the enveloping boundaries of the beams 12, 13 and 14. The basic configuration of the connector body portion is essentially a dimensional continuation of an envelopment of standard beams which may be attachable columns. While such dimensional continuity of the connector and the attached elements may not always be necessary, it can be of special advantage in the subsequent integration of enclosure elements for a building, in that it facilitates continuity of wall surfaces.

The connector has a square sleeve projection 18 dimensioned to fit within the column 11 in conforming relation on downward insertion therein, so that the body 16 of the connector seats directly in bearing on the upper edge of the column 11 at shoulder 19, for direct transfer of load to the column. The connector also has a similar upper sleeve projection 20 similarly fitting in conforming relation within the upper column 15, which seats directly in bearing on an upper edge portion 21 of the connector, for direct transfer of load. For permanence and rigidity the sleeves 18 and 20 may be attached to the respective columns 11 and 15 by suitable means such as bolts at the localities 22, 24.

Either or both of the sleeve projections may be constructed integrally with the body 16 of the connector, or either or both may be separate or removable in nature. The preferred device illustrated in FIGS. 1 to 11, has its lower sleeve 18 integral with the body 16, while the upper sleeve 20 is separate and has a downwardly extending sleeve-like portion 26 which fits the interior of the hollow connector body 16 in conforming relation therewith upon insertion therein.

Thus, the connector, in combination with the separable upper sleeve device 20, can be employed in practically all situations of a building frame, e.g. where beams are to be connected to columns or column-like elements both above and below, or where beams are to be connected only to a column below, while the upper end of the connector is to remain substantially flush with the upper beam surfaces. In the first type of situation, the upper sleeve device 20-26 is inserted and secured in place in the connector, while in the second type of situation, this supplemental assembly is omitted or removed.

The upper sleeve assembly 20-26 has a shoulder portion 27 which seats on the upper edge 21 of the connector body, inside the region abutted by the end of the column 15. For permanence and rigidity the lower sleeve portion 26 of the upper sleeve assembly may be attached to the connector body 16 by suitable means such as bolts; while these may be separate attaching bolts (not shown) that only serve the sleeve portion 26, use may quite conveniently be made of certain bolts for hanger attachment (or of bolts at hanger-attaching localities, in the absence of one or more hangers), as explained below. Bolt-receiving openings, for this purpose, are shown at localities 28 of the sleeve portion 26. The mutual relation of the connector body 16, the upper sleeve device 20-26 and the upper column 15 are clearly shown in FIG. 8, where these parts are illustrated as in course of assembly. Similar illustration appears in FIG. 11.

For attachment and support of the beams, the body 16 of the connector has, in each of its four vertical, plane faces, a horizontal aperture 30 having a heavy bearing edge 31 upon which may be seated suitable portions of

appropriate horizontal, beam-receiving structural elements, for example the flanges 33 and 34 of, respectively, hanger devices 35 and 36, similar arrangement being made for other, like beam-receiving hangers such as indicated at 38 in FIGS. 3 and 4. In the illustrated device of FIGS. 1 to 11, each of the apertures 30 is a recess, the upper column-seating edge 21 of the connector body being provided at its corners (FIGS. 8 and 11), where the body is preferably reinforced as described below.

The hangers 35, 36 are in the form of brackets, having vertical arms 39, 40 respectively (FIGS. 9 and 10) to abut the adjoining faces of the connector body 16, and horizontal arms 41, 42 to receive and support, respectively, the upper flanges of the corresponding box-beam 12 and I-beam 13. The hanger 35 is disposed so that its upper arm 41 lies within the beam 12 and the hanger 36 is similarly dimensioned to lie within the boundaries of the beam 13, the upper arm 42 of the hanger 36 being centrally notched (FIGS. 10 and 11) to accommodate the vertical web 44 of the I-beam 13.

For security and convenience in attaching each hanger the projecting flange 33 or 34 may have a downwardly turned portion 45 which hooks over the supporting edge 31 in the connector. Stiffening and strengthening of each hanger device may be provided by means such as bracing webs 46 between the vertical arm and the beam-receiving horizontal arm of each.

For security of attachment (as distinguished from transfer of load), the upper flanges of the beams 12, 13 may be secured to the horizontal arms 41, 42 of the hanger devices by suitable means such as bolts at the localities 50, 51, and for similar purpose the vertical arms of the hangers can be secured to the faces of the connector body 16 by means such as bolts at the localities 52. Slotted arrangements for receiving these bolts, and to prevent load being transferred through them, may be provided, for example with slots as the holes for the bolts in one or both of the connected parts in each instance. Thus slots are shown in the horizontal arms 41, 42 of the hangers at the bolt-receiving localities 50, 51 respectively, and in the vertical walls of the connector body at the localities 52 for the bolts attaching the vertical arms 39, 40 of the hangers. As indicated above, the bolts through the hanger arms at localities 52 may also serve to secure the lower sleeve portion 26 of the separable column-receiving sleeve 20-26. Thus the holes at the localities 28 of the sleeve portion, conveniently also in the form of slots, for the avoidance of vertical load through the bolts, are disposed in registration with the localities 52, where a single bolt then attaches both the hanger arm and the sleeve portion to the connector body. At any face of the connector where no hanger is used, a corresponding bolt, at locality 52, can be used simply to secure the inner sleeve portion 26 to the connector wall.

A hanger device of the described sort is provided for each of the beams that is to be connected to the nucleus connector; where there is no requirement to support a beam at a given face of the body 16 (e.g. as at the face appearing lowermost in FIGS. 3 to 6, or at the rear in FIG. 11), no hanger need be attached.

The entire vertical load of each beam is transferred to the associated hanger in direct bearing, thence transmitted by the hanger in correspondingly direct bearing to the edge 31 of the hanger-receiving recess, and further transmitted by the connector body, in direct bearing, to the column below. Similar transfer of load of the upper column 15 in direct bearing on the connector body is effected as explained above, so that the entire load of the connector, beams and upper column, is supported in bearing by the lower column 11. To the extent that the weight of the supported beam on the hanger also creates a downward moment of the hanger about its region of support on the edge 31, such stress on the hanger is transmitted in compression by the vertical arm 39 or 40 to

and against the corresponding face of the connector body 16.

Because of the slotted arrangements, the bolts or other fastening means at the various localities of attachment between vertical faces of various parts carry essentially no load, and the entire support of all parts of the assembly is transmitted in bearing or compression, as explained above.

By virtue of the arrangement and slotted fastening of the beams and hanger devices, ample horizontal dimensional tolerances are achieved, i.e. with respect to the relation of the length of each beam to the horizontal distance between the columns (and connectors). As is readily apparent in the drawings, there can be ample space for tolerance adjustments between the end of each beam and the adjacent connector face.

In addition to the cut-out regions 30 to accommodate beam hangers, the connector body may have substantial cut-out regions in each face as indicated at 54, for access, passage of utility conduits (or other pipes or ducts) to and through the beams, columns, and the like. In compensation, the connector can be reinforced for greater strength, as by heavy column-like portions 55 along its vertical corners. To accommodate these last-mentioned portions, the lower sleeve-like portion 26 of the upper, removable sleeve assembly may be recessed at its corners 56 as shown in FIGS. 4, 5, 8 and 11.

For purposes of accommodation of the hanger arms 33, 34, each of the four faces of the sleeve portion 26 has a wide aperture 57 at its upper end, disposed to correspond with the openings 30 and being somewhat larger in vertical dimension so that when the sleeve assembly 20-26 is inserted in the connector, the lower edge 58 of each opening 57 will be located to clear the hook-like flange 45 of the inserted hanger (FIGS. 2 and 8). Various bolt-receiving openings, as at localities 22 and 24 in the sleeve parts or portions 18 and 20, may be slotted for avoidance of load transfer.

As stated, FIG. 11 further exemplifies the relation of the nucleus connector in a structure having vertically aligned columns and beams to be supported by them. Although in this figure the hanger devices 36 and 38 are shown engaged with the nucleus connector 10 while the upper sleeve device 20-26 is shown as if in course of being seated, this mode of illustration is adopted simply for clarity; it will be understood that in practice the upper sleeve assembly 20-26, if used, must be mounted in the upper part of the connector body 16 before the short horizontal arm (e.g. flange 34) of any hanger is inserted.

FIG. 11 shows one I-beam 13 supported in place on the hanger 36 at one side of the connector 10, and also shows inserted hanger 38 at an adjoining face of the connector, ready for seating of another I-beam, such as the beam 14 of FIGS. 1 to 6. Instead of a box-section beam at a further side of the connector (as at 12 in the preceding views), FIG. 11 depicts, in exploded form, another I-beam 60 and an appropriate hanger 61, to be carried at the face of connector 10 opposite the beam 13, the beam 60 and hanger 61 being thus identical with the beam 13 and hanger 36.

FIG. 12 illustrates another form of the invention, in which the upper as well as the lower column-securing sleeves are permanently part of the connector body. Such structure, which thus differs for the arrangement of FIGS. 1 to 11 in that the upper projecting sleeve is integral with the connector in the same fashion as the lower sleeve, is usable for all situations where the device is to be employed between vertically successive columns or equivalent column-like members, and thus for such situations may represent a somewhat simplified alternative to the device of the preceding views where the upper column-receiving assembly is separable.

The basic structure of the nucleus connector and other parts in FIG. 12 is otherwise identical with the construction in FIGS. 1 to 11. Specifically, the connector 70 in

FIG. 12 has a body portion 71, with an integral, downwardly projecting, square sleeve or tubular part 72 that is removably telescoped into a square lower column 73. The device also has a like integral, upwardly projecting square sleeve or tubular part 74, similarly fitting within a square upper column 75. An inward shoulder 76 at the bottom of the connector body 71, where the sleeve 72 projects, seats in bearing on the upper edge of the lower column 73, while the bottom edge of the upper column 75 seats on an upwardly facing shoulder 77 of the connector body, corresponding to the upper edge portions 21 of FIGS. 1 to 11. For security, the upper column 75, fitted over the sleeve piece 74, may be attached to the latter as by bolts at the localities 78, with a slotted arrangement. This arrangement is repeated by the bolts at localities 80, attaching the lower sleeve 72 within the lower column 73, the attachments of both the upper and lower sleeve portions being similar to the fastening of portions 18 and 20 in columns 11 and 15 respectively of FIGS. 1 to 11.

FIG. 12 shows two I-beams 81, 82 (the latter being indicated by its web) supported at adjacent sides of the connector body and carried respectively by a hanger 84 having its short flange or tongue 85 seated over the horizontal edge 86 of the connector, and a similar hanger represented by its corresponding short arm or tongue 87 resting on the like edge 88 of the connector. These hanger devices, as well as the means for receiving them in the connector body, and their relation to the latter and to the supported beams are identical with like devices in FIGS. 1 to 11.

In some cases, particularly with heavy beams, additional means may be desired so as to brace against the effect of torsional stresses that may occur in or around the longitudinal axis of the beam. For this purpose, the assembly in FIG. 12 includes supplemental bracket devices 90 (which may also be used, of course, in the structure of FIGS. 1 to 11), each constituting essentially a simple bracket of right-angle configuration having a horizontal arm 91 resting on the upper face of the lower flange of a supported beam (for example, the beam 81), and a vertical arm 92 seating against the inner surface of the adjacent wall of the lower sleeve 72. These supplemental brackets may be secured (with slotted tolerance) to the sleeve portion 72 by the same bolts at the localities 80 that serve to fasten the sleeve in the column 73. The horizontal arm 91 of each bracket 90 can be secured to the lower flange of the associated beam, such as the lower flange 94 of beam 81, by appropriate bolt or bolts (with slotted tolerance) at localities 95, similar to the bolts at 96 for securing the upper beam flange to the hanger, or to the bolts at 51 in FIGS. 1 to 11. For use with an I-beam the horizontal arm 91 of the bracket 90 has an appropriate slot (not shown), similar to the slot in the long horizontal arm of each hanger (FIG. 11), for admitting the web of the beam.

While these supplemental brackets are by no means necessary in all cases, they serve to brace the beams or stiffen their connections, for example against longitudinal stresses or eccentric loads.

Referring now to all of the devices illustrated, it is noted that for tolerance and easy fitting, certain parts may be shaped with special clearances. For instance, as appears in various views, the upper part of the vertical arm, e.g. arm 39 or 40, of the hanger device is fashioned to bend slightly away from the face of the connector. Likewise the upper arm 91 of the bracket 90 is shaped to bend slightly upward at a region adjacent the connector wall, for ample clearance where the arm traverses the side opening 98 of the connector.

It may also be noted that the term "column" is generally employed herein to designate a vertical frame element which carries or is adapted to carry a load. Likewise the term "beam" is employed to mean a horizontal frame element that is more or less elongated in character and is designed to transmit, or at least to present,

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a load for support by a column. The term "beam" thus includes beam-like members whether specifically designated as beams, girders, joists, or otherwise.

As has been indicated above, the nucleus connecting devices of the invention, and the corresponding assemblies of such devices with associated hanger elements, beams and columns, afford many practical advantages in building construction. They permit both simplification and standardization of building frame elements, yet achieve a strong and effective frame structure while affording unusual ease of erection with little or no fitting or shaping on the job. They are suitable for a wide variety of buildings, for example, residences, factories, office buildings, garages, warehouses, and other industrial and commercial buildings, as well as schools, other public edifices, and the like.

As also explained, a further advantage of the assemblies and systems of the invention is their ready adaptability, especially in modularly designed construction, to the use and attachment of standardized enclosure units, such as panels for walls, floors, ceilings and roofs, as well as window and door assemblies and the like. For such purposes a particularly important feature of the preferred structures herein described is that there is essentially nothing which projects outside the envelopes of the beams, columns and nucleus connectors, and into the rectangular vertical and horizontal areas that they define. As a result, there are no projections to interfere with the attachment of enclosure elements, or, in the final result, with smooth, uninterrupted wall surfaces. Stated alternately, all the structure, including the connector and hanger devices, lies within the enveloping longitudinal boundaries of the beams and columns, or projections of them, thereby providing full, uninterrupted rectangular spaces for the reception of both vertical and horizontal enclosure elements, so that the latter may, if desired, be in the form of unitary panels having simple flanges to overlie the faces of the structural elements which define the spaces.

Building systems utilizing this invention lend themselves to modular design, as by the use of column and beam elements having standardized lengths representative of multiples of a selected module; as one example, a horizontal module in the range of 3 to 5 feet is suitable for many business and residential buildings. In such a system, the nucleus connectors, hangers, and removable attaching sleeves (if any) can also be standardized throughout the assembly.

By way of summary, the preferred, special shape relation of the nucleus connector to the column upon which it rests and to at least one beam supported by it, is such that the connector body occupies essentially the space within the intersection of extensions of the longitudinal boundary planes of the beam and column. As such it is essentially or in principle a separate structural element at the confluence of beams and columns. Neither the beam nor the column itself extends into this space, at least other than for mutual attachment and load transfer means. At the same time, the nucleus connector device does not itself extend substantially outside the described space, except for mutual attachment and load transfer means. Furthermore, the assembly of the nucleus connector with the column below it or with columns aligned below and above it, and also with one or more supported beams, is preferably such that all structure, including attachment and load transfer means, is located essentially within a region defined by the longitudinal boundary planes of the beam or beams and column or columns and by the longitudinal extension of such beam boundary planes and column boundary planes.

It is to be understood that the invention is not limited to the embodiments herein shown and described but may be carried out in other ways without departure from its spirit.

I claim:

1. Connecting means for connecting beams to a column at a region of intersection having a predetermined vertical dimension, comprising a vertically extending body having top and bottom regions separated by said dimension, and having a cross-section not substantially larger than the column and having a plurality of beam-receiving vertical sides, said body having means adapted to interfit with the column and including horizontal surface structure engageable with horizontal surface structure of the column for transmission of vertical load in bearing between the body and the column, and said body having horizontal edge means permanently incorporated at each of its beam-receiving sides, within its said cross-section, and spaced below its top region and comprising an upwardly-facing edge disposed for removably receiving a beam-carrying hanger thereon, for supporting said hanger in bearing to transmit load from said hanger to said body, said upwardly-facing edge being disposed at an upper part of the side of the body, and said last-mentioned side of the body having vertically extending surface structure below the upwardly facing edge, adapted to be abutted by structure of the hanger for receiving horizontally transmitted stress therefrom.

2. Connecting means as defined in claim 1, wherein said body includes a pair of means each adapted to interfit with a column and disposed respectively at upper and lower parts of the body for receiving columns respectively above and below the connecting means, said body having horizontal surface structure, as aforesaid, at each of its upper and lower parts, respectively engageable with horizontal surface structure of the upper and lower columns, for transfer of vertical load in bearing from the upper column to the body and from the body to the lower column.

3. A nucleus connecting device for connection between one or more beam and a column, comprising a vertically extending body structure having a basically rectangular cross-section substantially congruent with the cross-section of the enveloping horizontal boundary of the column and having means engageable with a column below the body for transmitting load in bearing from the body to the column, said body having four vertical sides at right angles to each other, and each of said sides being apertured to provide horizontally extending upwardly facing surface means for receiving and supporting a horizontal beam carrying element in bearing, said surface means being disposed near the top of each side, so that the load of a beam is carried at a locality which is uppermost relative to the vertical dimension of the beam, and said body having vertical surface structure at each side remotely below said surface means for receiving horizontal stress of a beam-carrying element having means at a lower locality for engaging said surface structure, and in combination with said body structure, at least one beam-carrying element consisting of a hanger comprising: a portion extending toward said body structure at one of the vertical sides and supported in bearing on the aforesaid surface means of said side, an outwardly projecting portion having an upwardly facing surface disposed to carry a downwardly facing surface at the upper part of a beam, so that the beam can be supported with tolerance endwise relative to the body structure, and vertical means extending below the aforesaid portions and arranged to engage the aforesaid vertical surface structure of the body of the connecting device, to transmit horizontal thrust caused by weight on said hanger.

4. A nucleus connecting device for connecting one or more beams to a column, comprising a vertically extending body member having a basically rectangular cross-section and four vertical, substantially plane sides at right angles to each other, said body comprising means adapted for telescopically interfitting with a column below the body, and including means engageable with horizontal surface

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structure of the column in bearing, and at least one of said sides being shaped to provide means within the cross-section of the body, comprising upwardly facing surface means in an upper part of said body, for receiving and supporting a beam-supporting element, to transmit load to the body, and a beam-supporting element having means to carry an upper flange of a beam thereon in bearing and having means to rest on said upwardly facing surface means of said body member, said body member having an outwardly facing vertical surface remotely below said surface means and said supporting element having structure below its flange-carrying means, abutting said vertical surface to transmit horizontal stress thereto.

5. A nucleus connecting device, comprising a vertically extending body having a basically square cross-section and four plane vertical sides, means at a lower part of said body telescopically engageable with a column and including horizontally extending edge means at the lower localities of a plurality of said sides to rest in bearing upon horizontal edge structure of the column, said body having upwardly facing edge structure extending horizontally crosswise of each of its sides, for receiving and supporting horizontal hanger elements in bearing on said edge structure, said body being hollow and having openings at its lower end and at its sides respectively providing communication between the body portion and associated cavity-containing column and beams, for passage of building utility means among the column and beam, said edge structure being disposed near the top of each side and said openings at the sides being disposed at localities below the edge structures, said body having vertical surface structure disposed below the edge structure at each of its four sides and arranged to be abutted by a downward extending portion of said horizontal hanger element to receive stress transmitted horizontally by said hanger element.

6. A nucleus connecting device as defined in claim 5, having means at an upper part of said body telescopically engageable with an upper column and including horizontally extending edge means at the upper localities of a plurality of the aforesaid sides to support in bearing horizontal edge structure of said upper column.

7. A nucleus connecting device for connecting one or more beams to vertically successive column elements, comprising a vertically extending body having a cross-section not substantially larger than the column elements, means at each end of the body for telescopically engaging a column, said means including horizontal surface structure engageable with horizontal structure of the column for transmission of load in bearing, and said body having a plurality of vertical sides and means at each of a plurality of said sides, approximately within the lateral boundaries of the body, for receiving and supporting horizontal means to be carried by the body, said receiving and supporting means at each side comprising upwardly facing surface structure at an upper part of the side, and at least one beam-supporting element disposed at one side and having load-transmitting arm means resting in bearing on said surface structure, the aforesaid body having a vertical surface remotely below said surface structure and said beam-supporting element having means below said arm means, engaging said vertical surface to transmit horizontal stress thereto, said beam-supporting element also having a portion projecting outwardly from the body and providing an upwardly facing surface at the upper part of said element, to carry a downwardly facing surface of a beam, with tolerance endwise of the beam relative to the aforesaid body.

8. Connecting means for connecting a column to one or more beams each having a horizontal flange, comprising a vertically extending body having a cross-section not substantially larger than the column, said body including means interfitting with the column disposed below the body and including structure adapted to rest on up-

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wardly facing structure of the column for transmission of load in bearing to the column, said body having four beam-receiving sides facing in respectively different directions, each of said sides being constructed for supporting attachment of a separate hanger device having beam-receiving horizontal shelf structure, and at least one hanger device attached to and supported by one side of said body, said hanger device having a horizontal shelf structure projecting from the body for receiving the flange of a beam resting in bearing on said shelf, and a beam having a flange resting on said shelf for support of the beam, said hanger device being dimensioned and disposed substantially within the upper and lower enveloping boundaries of the beam, and having arm means resting on a part of the adjacent side of the aforesaid body to transmit vertical load and means vertically remote from said last-mentioned means engaging a vertical surface of the body to transmit horizontal stress, said body having structure at said last-mentioned side to support said arm means and having a vertical surface vertically remote from said last-mentioned structure for engagement by said engaging means.

9. In a building structure, a column and beam assembly comprising a column, a connecting device having a body portion with horizontal cross-section substantially congruent with the enveloping horizontal boundary of the column, said body portion having means interfitting with the column and including edge structure engageable in bearing with the column for transfer of vertical load, said body portion having four vertical sides each constructed to receive a separate connecting element, a connecting element mounted on and supported by at least one of said sides, said connecting element including a plate-like structure projecting horizontally from said side, and a beam having a longitudinally extending face resting on a horizontal face of said plate-like structure in lapping relation for support of said beam by said connecting element, said body portion having an edge structure in each side, said connecting element having means resting on said edge structure and also having a pair of means at localities mutually remote from each other in a vertical direction and respectively engaging the body portion for transmitting stress thereto in mutually opposite horizontal directions to prevent downward rotation of the connecting element about said edge structure under the load of the beam.

10. A connecting structural device for building frames, adapted for joining at least one beam to a column below, said beam having a predetermined envelope of longitudinal boundary planes and having an uppermost flange and vertical web means extending longitudinally along and beneath said flange, and said column having a predetermined envelope of longitudinal boundary planes, said connecting device comprising a body portion which occupies essentially the space defined by the intersection of extensions of said longitudinal boundary planes of the beam and column when the beam is disposed endwise adjacent to, and the column is disposed immediately below, said body portion, and said body portion being shaped to lie essentially within said space, said body portion having lower horizontal surface means adapted to seat on upper horizontal surface means of the column for transmission of load in bearing thereto, means projecting below said body portion for interfitting with the column to secure the connecting device in seated relation on the column, and hanger means comprising a shelf-like arm having a broad horizontal upper surface and supported by the body portion at one side of said body portion, for receiving the aforesaid uppermost flange of the beam on said upper surface to support the beam, said shelf-like arm having a vertical thickness which is small relative to the vertical dimension of the beam and said connecting device being substantially free of beam supporting structure below said shelf-like arm, whereby

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the said beam flange may be seated on said arm with both longitudinal and transverse tolerance, said shelf-like arm being disposed near the upper boundary of the body portion so that the said beam flange lies approximately at the level of said upper boundary of the body portion, and all projecting structure at said side of the body portion, including said shelf-like arm, being dimensioned to lie within the aforesaid longitudinal boundary planes of the beam, said hanger means also including means extending below the shelf-like arm to an upright part of the aforesaid body portion, for transmitting horizontal thrust, caused by weight on the shelf-like arm, to said body portion.

11. A connecting device as defined in claim 10, wherein the beam and column to be connected each have a cavity extending throughout the length thereof and opening at the end thereof which is to be adjacent the connecting element, and wherein said body portion is hollow and has openings respectively at its aforesaid side and at its lower end to provide communication through the body portion between the cavities of the beam and column, for passage of building utility means, said opening in the aforesaid side of the body portion being disposed below the aforesaid shelf-like arm.

12. A connecting structural device for building frames, adapted for joining one or more beams to a column below, said beams all having a predetermined rectangular envelope of longitudinal boundary planes and having an uppermost flange and vertical web means extending longitudinally along and beneath said flange, and said column having a predetermined rectangular envelope of longitudinal boundary planes, said connecting device comprising an upright rectangular body portion which has four vertical faces and which has a vertical cross-section parallel with each face that is substantially congruent with the cross-section of the beam envelope, said body portion having a horizontal cross-section substantially congruent with the cross-section of the column envelope, said body portion being free of parts projecting appreciably outside the boundaries defined by its said cross-sections, said body portion having lower horizontal edge means adapted to seat on upper horizontal edge means of the column for transmission of load in bearing thereto, means projecting below said body portion for interfitting with the column to secure the connecting device in seated relation on the column, said body portion having in each of its four faces a cut-out area near the upper boundary of the face and a horizontal edge extending substantially across the face in the wall of the body portion, each said edge being the lower boundary of said cut-out area, each said edge and area being arranged to receive a broad arm of a beam-supporting hanger with said arm resting on the edge for transmitting load in bearing thereto, the major part of the vertical extent of each face being disposed below the said edge, and a beam-supporting hanger separably mounted on at least one of the faces of the body portion, said hanger comprising a broad arm as aforesaid, short relative to its broad dimension across the body face, and resting on the aforesaid edge in said face, a shelf-like arm projecting from said first arm in the direction outwardly from the connector body and having a broad horizontal upper surface for receiving the aforesaid uppermost flange of a beam thereon, and an arm extending vertically downward from the junction of the aforesaid arms and abutting the face of the connector body portion at a locality remote from the aforesaid edge, for transmitting stress from the hanger against the body portion, said first-mentioned arm having a vertically extending projection at its end within the body portion, and said body portion having an inner surface engageable by said projection to retain the hanger in place, and said hanger being dimensioned to lie wholly within the boundary planes, or extensions thereof, of the supported beam.

13. A connecting device as defined in claim 12, wherein each of the beams and column to be connected has a

cavity extending throughout its length and opening at the end thereof which is to be adjacent the connecting element, and wherein said body portion is hollow and has openings respectively at each vertical face below the aforesaid edge therein and its lower end, to provide communication through the body portion between the cavities of the beams and column, for passage of building utility means.

14. A nucleus connecting device for connection between one or more beams and a pair of columns respectively above and below the device, comprising a vertically extending body structure having a basically rectangular cross-section substantially congruent with the enveloping boundaries of the columns and having means at one end, engageable with a column for transmission of load in bearing between the body and the column, said body having four vertical sides at right angles to each other, each side comprising a face adapted to adjoin the end of a beam and having a periphery substantially coextensive with the vertical cross-section of such beam, each of said sides being apertured within its said face to provide horizontally extending upwardly facing surface means for receiving and supporting a horizontal structural element in bearing at each side, and means separably attached at the other end of the body structure for receiving the other column in seated relation of said other column on the body with the load transmitted in bearing, said last-mentioned means including structure telescopically interfitting with the body in attachment thereto, said structure having sides corresponding to sides of the body and being apertured at each of its sides in correspondence with the apertures of the body sides, for permitting full access of horizontal structural elements as aforesaid, when inserted through the apertures of the body sides.

15. In a building structure, a column and beam assembly comprising vertically extending column means including a vertical outer face, and upwardly facing edge means horizontally extending across said face, a hanger device having a short horizontal arm resting in bearing upon and across said edge means, a substantially vertical arm extending downward from the first arm and flatwise abutting said vertical face and another horizontal arm extending oppositely from the first horizontal arm and substantially at the same horizontal level, and a beam having flange structure overlying said second horizontal arm and resting in bearing thereon, said column means comprising connecting structure which includes said vertical face and the said upwardly facing edge means, and column structure extending below said connecting structure, said connecting structure having an upper end above said edge means and approximately at the horizontal locality of the uppermost portion of the aforesaid beam, and said assembly including column-receiving means separably attached to said connecting structure at said upper end thereof, for receiving and retaining a column element above said connecting structure.

16. Connecting means for connecting beams to a column, comprising a vertically extending body having a cross-section not larger than a cross-section approximately equal to that of the column if extended through the locality of said body, said body being bounded by four vertical sides, each side comprising a face adapted to adjoin the end of a beam and having a periphery substantially coextensive with the vertical cross-section of such beam, and column-engaging means at one end of the body, said column-engaging means comprising horizontal surface structure engageable with horizontal surface structure of the column for transmission of vertical load in bearing between the body and the column, said means also comprising an element separably attached to said body and having a portion projecting vertically from the body for interfitting with the column to hold said column in position with the aforesaid surface structures mutually engaged, and said body having means permanently incorporated at each of its sides, within its

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aforsaid side faces, and within its said cross-section, for removably receiving and supporting a horizontal structural element at each of said sides, so as to transmit load from said element to said body, said last-mentioned receiving means at each side comprising upwardly facing structure distributed over localities within the side, for supporting, at said localities of the side, the horizontal structural element which is to be carried at the side.

17. Connecting means for connecting beams to a column, comprising vertically extending structure having a cross-section approximately corresponding to the column in boundary shape and size and having four vertical sides, each side comprising a face adapted to adjoin the end of a beam and having a periphery substantially coextensive with the vertical cross-section of such beam, and means separably attached to said vertically extending structure at one end, for receiving the column in direct load-bearing relation, said last-mentioned means including a portion projecting from the said end of the aforsaid structure to engage the column and to retain it against lateral displacement, and said structure having upwardly facing horizontally extending edge means permanently embodied at each of its four sides, within its aforsaid side faces, and within its aforsaid cross-section, and adapted for removably receiving a horizontal structural element inserted upon said edge means at each of said sides, for supporting said element in bearing, each said edge means extending horizontally along the side in which it is embodied.

18. A nucleus connecting device for connecting one or more beams to vertically successive column elements, comprising a vertically extending body having a cross-section not larger than a cross-section approximately equal to that of the column below if extended through the locality of said body, means at the top and bottom ends of the body for telescopically engaging a column, said connecting device including horizontal surface structure at each end engageable with horizontal structure of the adjacent column for transmission of load in bearing, at least one of said column-engaging means which is disposed at an end of the body comprising a member which is separably attached to the body and which includes a portion removably engaging the said body and a projecting portion for telescopically engaging the associated column element, and said body having a plurality of vertical sides immediately adjoining each other, each side comprising a face adapted to adjoin the end of a beam and having a periphery substantially coextensive with the vertical cross-section of such beam, and means at each of said sides, within its aforsaid side faces, and within the aforsaid cross-section of the body, for receiving and supporting horizontal structural elements to be carried by the body at each of said sides, said last-mentioned receiving means at each side comprising upwardly facing structure distributed over localities within the side, for supporting, at said localities of the side, the horizontal structural element which is to be carried at the side.

19. A nucleus connecting element for beam and column joints in a building frame, said element being capable of joining, selectively from one to four beams to a column below the element and also joining a column above the element to and in line with the first-mentioned column, said element comprising a body portion and column-receiving means projecting downwardly from the body portion, said body portion having four vertical faces and means at each face for supporting a beam-receiving hanger at said face, said element having downwardly facing surface structure cooperating with the column-receiving means and adapted to seat in bearing upon upwardly facing surface structure of the column, and said body portion, including its said hanger-supporting means, having enveloping boundaries, in horizontal and vertical planes, approximately congruent with the respective enveloping boundaries of the cross-sections of the column and of the beams to be joined by said element, and col-

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umn-receiving means separably attached to the said body portion at the upper region thereof, said last-mentioned column-receiving means including a part projecting upwardly from the aforsaid body portion and another part removably engaged with the body portion, arranged to provide for transfer of load in bearing from a column received by said last-mentioned receiving means to the said body portion of the connecting element.

20. A nucleus connecting device, comprising a vertically extending hollow body having a basically square cross-section and four plane vertical sides, each side comprising a face adapted to adjoin the end of a beam and having a periphery substantially coextensive with the vertical cross-section of such beam, column-receiving means at a lower part of said body including projecting means telescopically engageable with a column below the body and including horizontally extending edge means at the lower localities of a plurality of said sides to rest in bearing upon horizontal end structure for the column, and means separably attached to the body for receiving a column above the body, said last-mentioned means including a portion removably fitted into the hollow body for attachment thereto and a vertically projecting portion telescopically engageable with the column above, said body having horizontally extending edge means at the upper localities of a plurality of said sides and said separably attached means being arranged in association with the body to receive the upper column in seated relation over said edge means for transmission of load in bearing at said edges means to the body, the aforsaid square cross-section of the body having its horizontal side dimension not larger than the greatest horizontal dimension of the column below, and said body having means, disposed within it aforsaid side faces, at each of a plurality of its sides immediately adjoining each other, for receiving and supporting horizontal structural elements, each of said receiving and supporting means being disposed approximately within the said square cross-section of the body.

21. An attachment device for a nucleus connecting element of the type having a hollow body portion with four side faces and means at each face for receiving and supporting horizontal structural elements, comprising a device separately attachable to said connecting element in vertically coaxial relation therewith at one end thereof for receiving a column, said device including a portion telescopically insertable into the connecting element and another portion projecting vertically from the connecting element for telescopically engaging said column, said device being arranged to provide, when attached to the connecting element, for the seating of the column endwise in such fashion as to transmit load in bearing between the column and the connecting element, said second portion of the attachment device being shaped for telescopic insertion into the column so that the end edge of the column can seat in bearing on an outer part of the end edge of the connecting element and said attachment device being also shaped, at a locality intermediate its said first and second portions, to provide a shoulder to seat in bearing on an inner part of the end edge of the connecting element.

22. Connecting means for connecting beams to a column, comprising a vertically extending body having a cross-section not substantially larger than the column, said body including means interfitted with the column disposed below the body and including structure adapted to rest on upwardly facing structure of the column for transmission of load in bearing to the column, and said body having a plurality of beam-receiving vertical sides, and at least one hanger projecting from and supported by one of said vertical sides of the body near the top thereof, said hanger having a width not greater than that of the vertical side supporting it, said hanger having an upwardly facing surface, adjacent the top of the body, which is adapted to carry a downwardly facing surface at the

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upper part of a beam, with tolerance endwise of the beam relative to the body, and said hanger having means for transmitting horizontal thrust, caused by weight on the hanger, to the body at a locality below said upwardly facing surface.

23. Connecting means for connecting beams to a column, comprising a vertically extending body having a cross-section not substantially larger than the column, said body including means interfitting with the column disposed below the body and including structure adapted to rest on upwardly facing structure of the column for transmission of load in bearing to the column, and said body having a plurality of beam-receiving vertical sides and having upwardly facing horizontally extending surface means in at least one of said sides within the cross-section of the body for receiving and supporting a horizontal portion of a hanger, and at least one hanger comprising: a horizontal portion extending inwardly of the said body and supported in bearing on said surface means

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of said one side, a projecting portion having an upwardly facing surface which is adapted to carry a downwardly facing surface of a beam, with tolerance endwise of the beam relative to the body, and a vertical portion arranged to transmit horizontal thrust, caused by weight on the hanger, to the body against a vertical surface thereof, said body having such vertical surface structure for each of its beam-receiving sides, to be abutted by the vertical portion of a hanger.

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