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Dobbie et al.

[11] **3,863,771**

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[54] **GANTRY CRANES**

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[52] **U.S. Cl.** **212/14,** 14/23, 29/429, 29/431, 52/745, 52/749, 404/73

[51] **Int. Cl.** **B66c 19/00**

[58] **Field of Search** 212/10, 11, 12, 13, 14, 212/15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27; 52/745, 749; 29/429, 431; 404/73; 14/23

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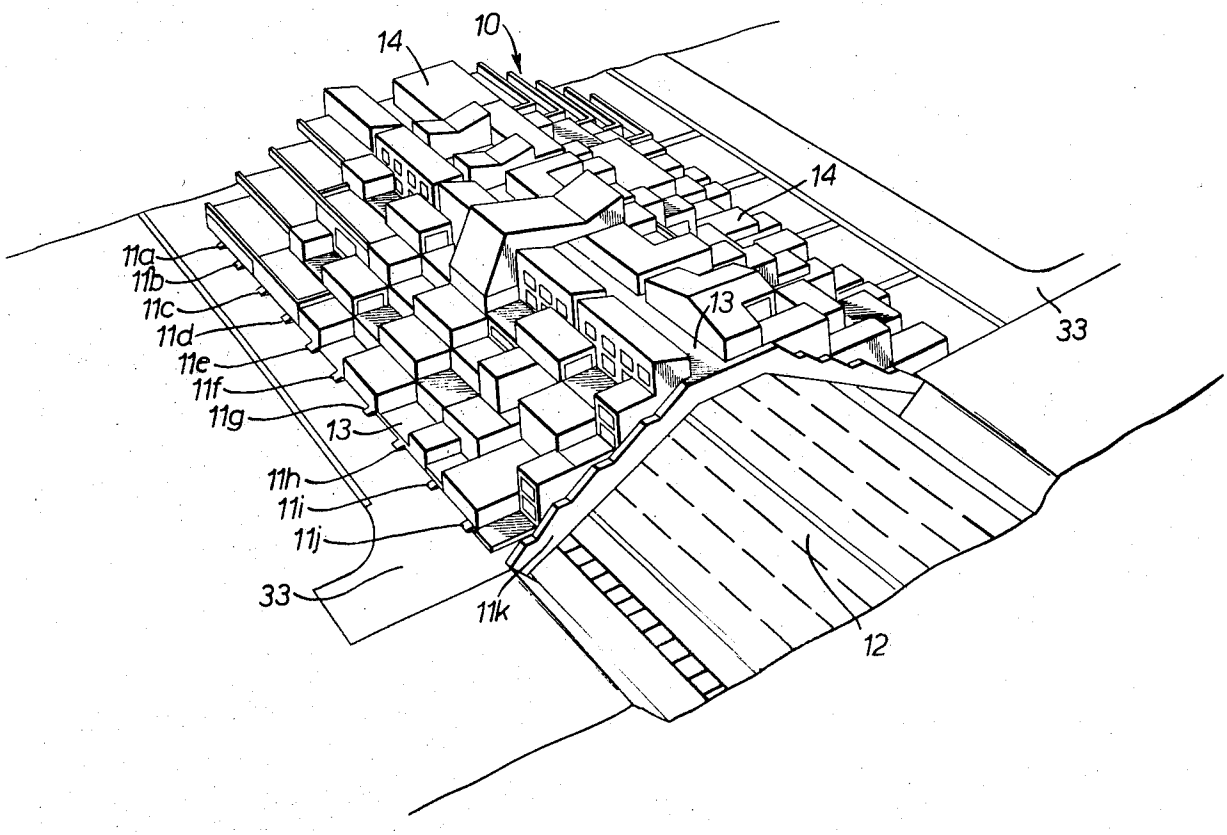
Assistant Examiner—L. J. Oresky
Attorney, Agent, or Firm—Oblon, Fisher, Spivak, McClelland & Maier

[57] **ABSTRACT**

A movable gantry crane for erecting a wide span structure comprising several bridge-like sub-structures arranged side by side in spaced relationship, which crane comprises: a horizontal girder long enough to span the structure and supported at each side of the structure by movable support columns; a platform suspended from the girder from hangers so as to lie beneath a sub-structure to be erected and enable work to be carried on without interference with the area spanned by the structure; there being at least one set of hangers in front of this sub-structure, and at least one other set of hangers behind it and which can be displaced to permit the crane and the platform to be moved forward when the sub-structure has attained a stable condition; and a lifting device movable along the girder between the sets of hangers.

7 Claims, 5 Drawing Figures



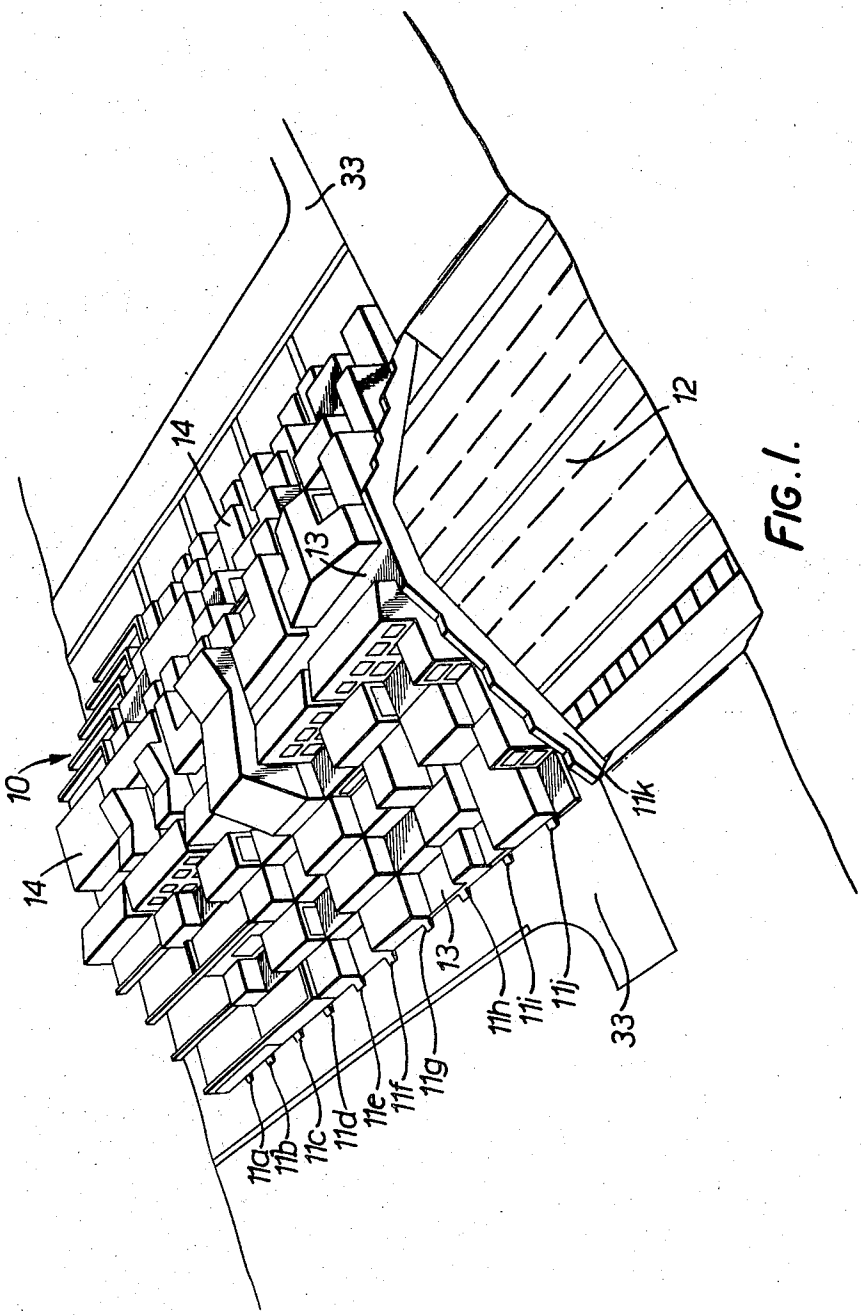


FIG. 1.

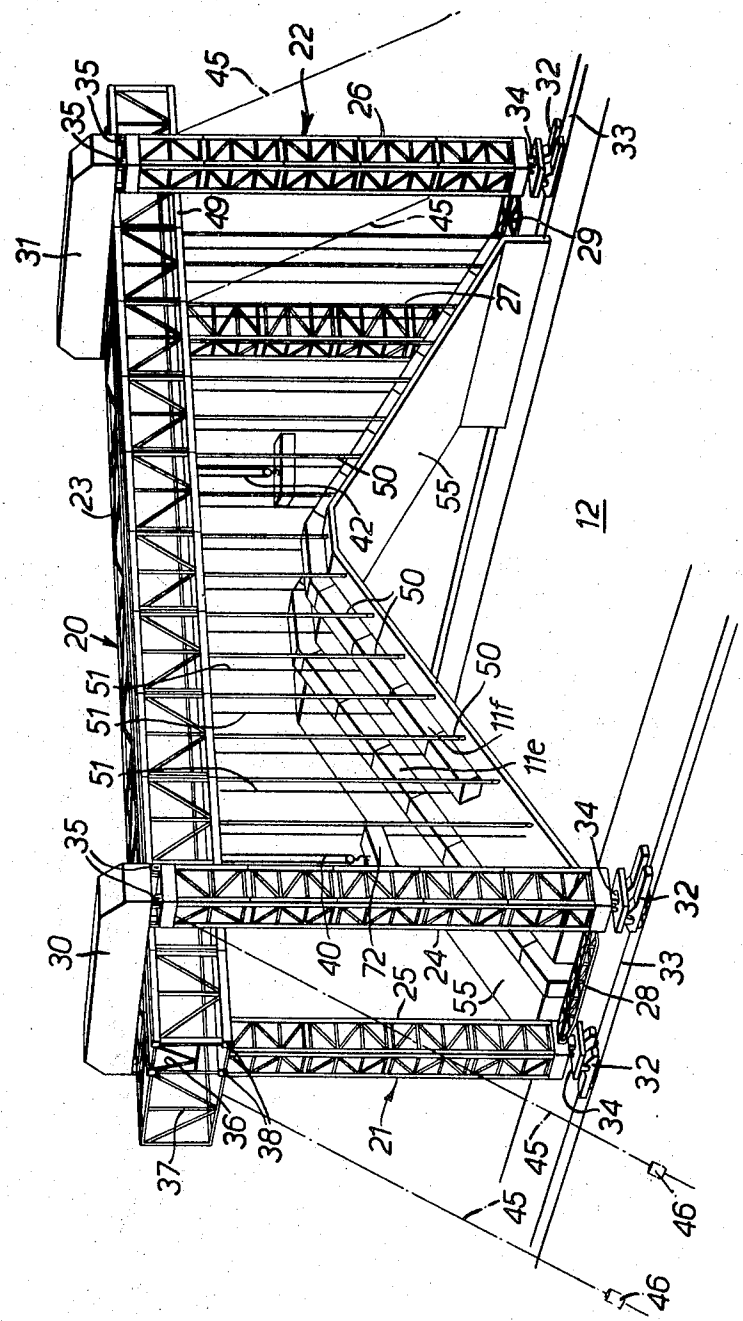

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FIG. 2.

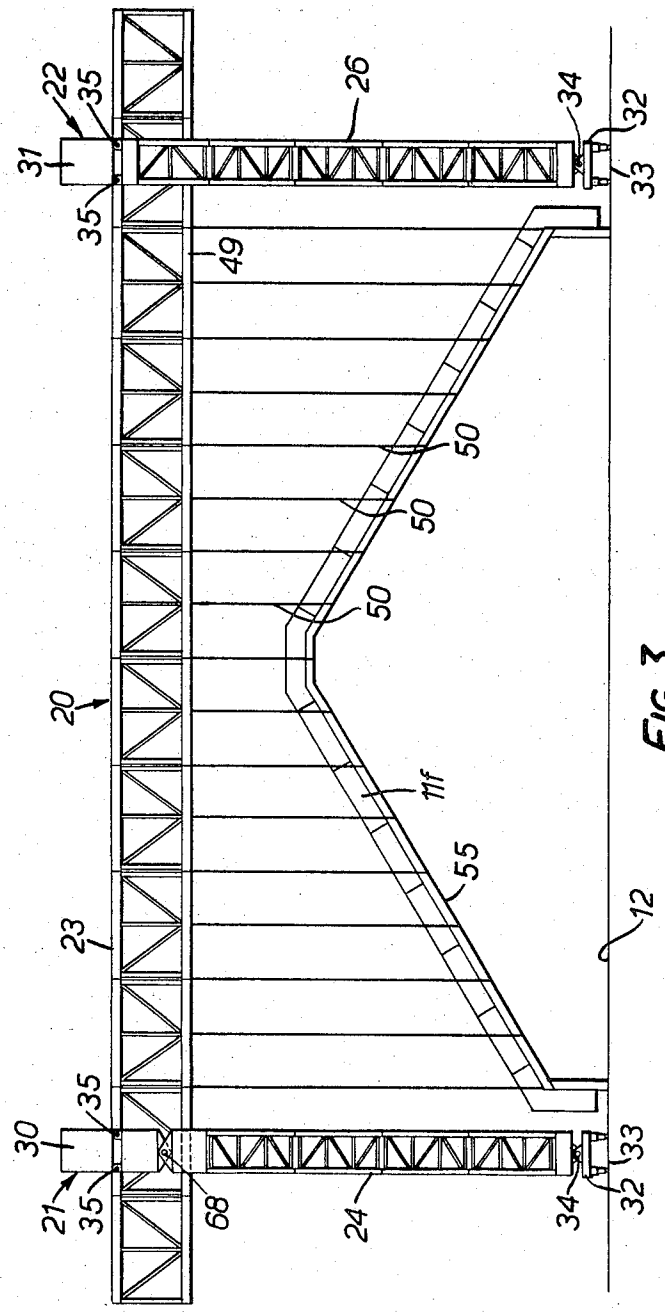
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FIG. 3.

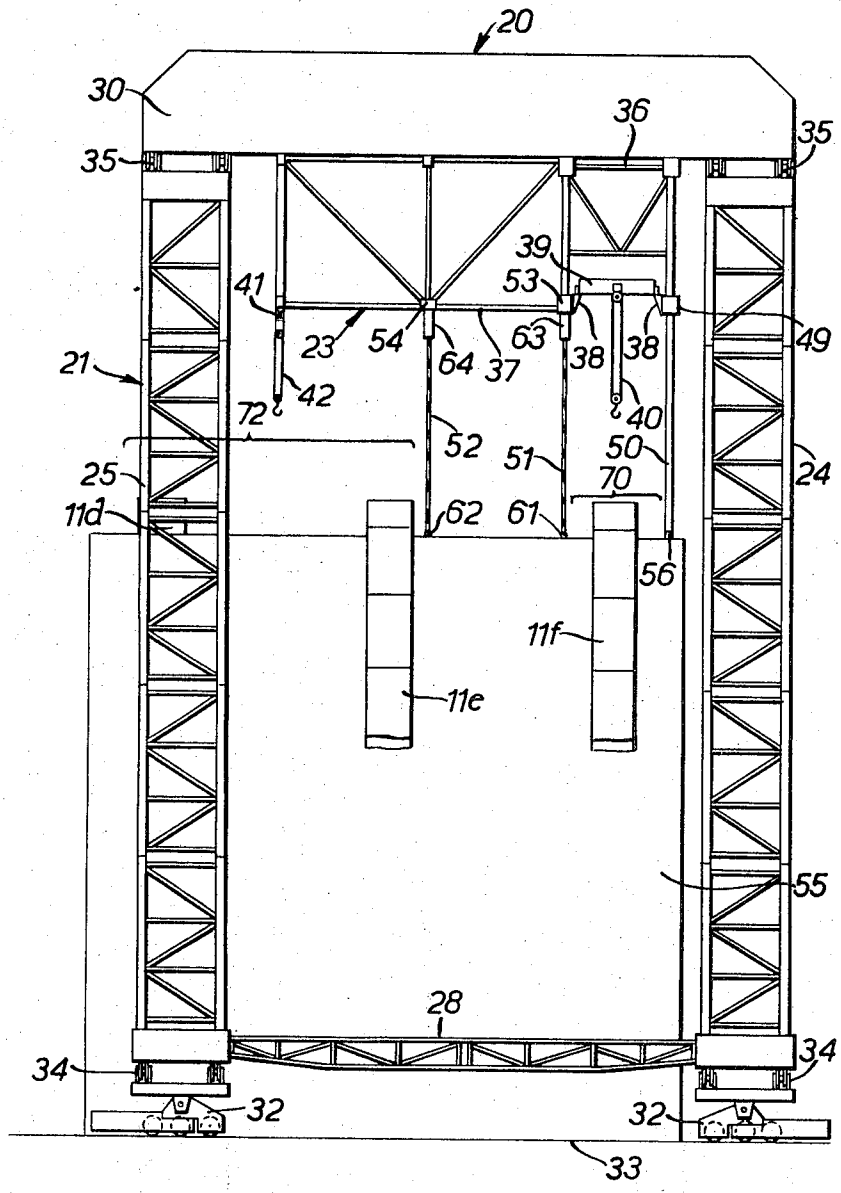
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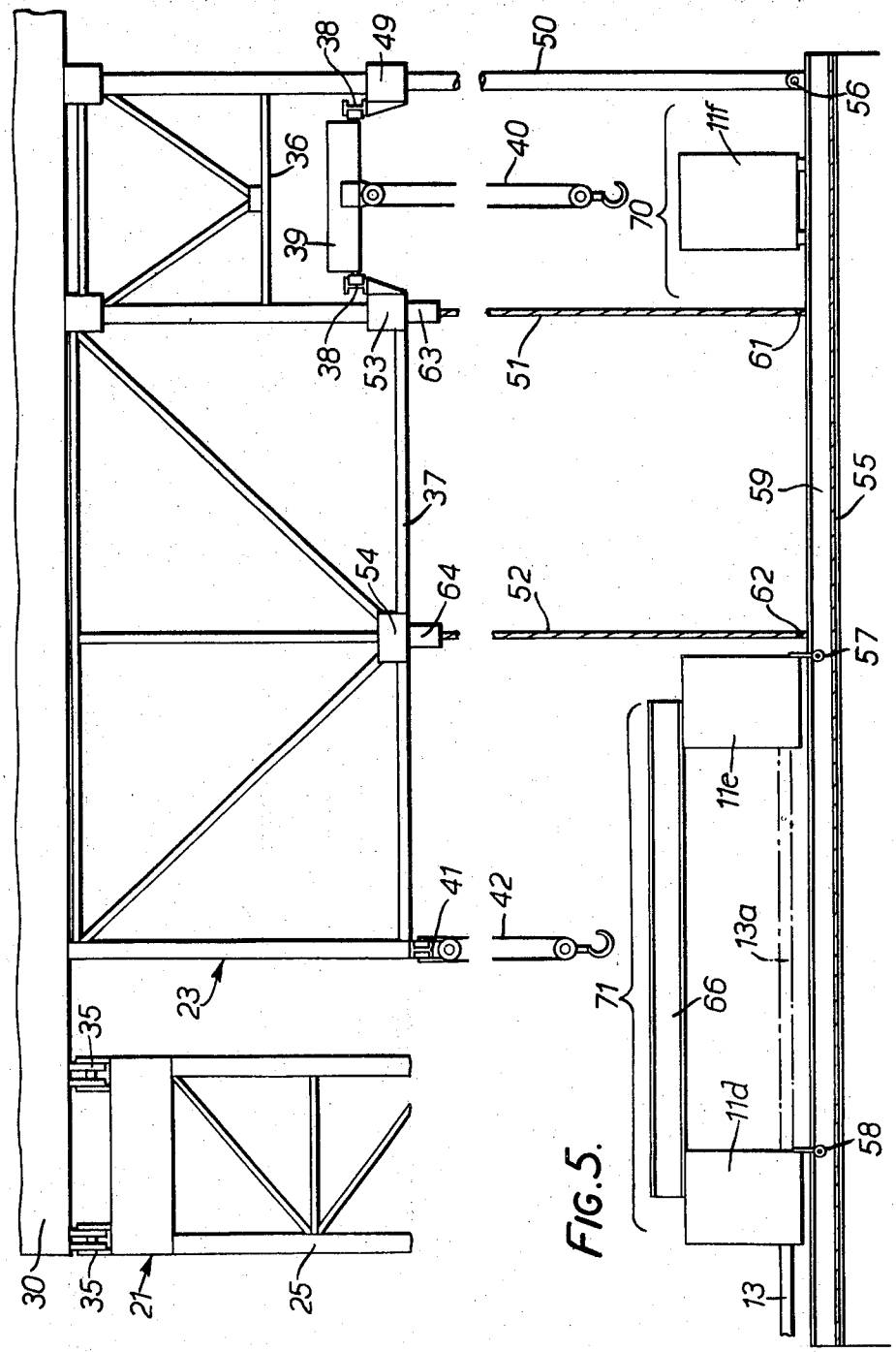
FIG. 4.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11e
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13a
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11d
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FIG. 5.

GANTRY CRANES

This invention relates to gantry cranes useful in the erection of structures which comprise several bridge-like sub-structures arranged side by side in spaced relationship. Such a structure may be required, for example, for covering a railway goods yard. In such a case the bridge-like sub-structures span the full width of the goods yard without intermediate supports and are disposed side by side along the length of the goods yard at a spacing appropriate for carrying load-supporting flooring or the like between them. Buildings or the like may be erected on the structure to afford an additional use for the goods yard site. Another example of such a structure is a bridge over a river or motorway.

The erection of the bridge-like sub-structures requires the emplacement of massive structural elements such as blocks or beams of pre-stressed concrete. This can be accomplished by means of a giant gantry crane which spans the structure, the supporting columns being disposed beyond the ends of the bridge-like sub-structures and these columns being themselves movable on rails or prepared tracks so that the whole crane can be moved forwards as the bridge-like sub-structures are progressively completed to a condition in which they are self-supporting and laterally stable.

According to the present invention a movable gantry crane useful in the erection of such a structure comprises a girder long enough to span the structure, supported by movable supporting columns, at least two sets of hangers which suspend a platform from the girder in a position to lie beneath a bridge-like sub-structure to be erected with the aid of the crane, at least one set being disposed to occupy a position in front of the said sub-structure and at least one other set being disposed to occupy a position to the rear of the said sub-structure, a lifting device movable along the girder between sets of hangers disposed to occupy positions respectively in front of and to the rear of the said sub-structure, and the hangers of the said other set or sets being removable or displaceable to permit the crane including the platform to be moved forwards when this sub-structure has been made self-supporting and laterally stable.

The provision of the platform beneath the sub-structure which is being erected with the aid of the crane enables the erection work to be carried on without risk of articles or material employed in the erection falling to the ground if accidentally dropped. Thus the movement of persons or vehicles at ground level can continue safely and without interruption throughout the construction of the whole structure, which may extend over a long period of time. Also, the platform enables the construction work to be carried on without the erection of temporary scaffolding from ground level. However, the presence of platform-supporting hangers behind the sub-structure being erected would prevent the crane from being moved forward, unless these hangers are removable or displaceable. By making these hangers capable of being removed or displaced, the crane can be moved forward together with the platform when a sub-structure has reached a self-supporting and laterally stable condition, so that the erection of the next sub-structure can be commenced. The hangers positioned in front of the sub-structure being erected need not be removable or displaceable because these hangers do not interfere with the forward movement of the crane. Of course, temporary supports

for the rear portion of the platform must be provided when the removable or displaceable hangers are removed or displaced. These temporary supports could be a further set of removable or displaceable hangers disposed further to the rear and which would remain in position until the crane had been moved forward and the removed or displaced set had been repositioned in front of the newly erected sub-structure. This further set would then be removed or displaced to permit further forward movement of the crane.

There may be another lifting device movable along the girder to the rear of the set or sets of removable or displaceable hangers.

Preferably the platform is long enough to encompass three sub-strctures. In this case the crane may have a forward working bay served by the first-mentioned lifting device for the erection of the foremost sub-structure and a rear working bay served by the said other lifting device for operations between the two previously erected sub-structures. Thus, while the forward sub-structure is being erected in the forward bay, further work may be carried out between the next two previously erected sub-structures in the rear bay.

The sequence of erection may be as follows: 1. The crane is moved forwards to a new position. 2. Construction units for the new sub-structure are brought to the site and hoisted into position, aligned and then jointed, in the forward bay of the crane. In the rear bay, floor and wall units are erected between and upon the two previously erected sub-structures, and temporary stabilising beams connecting these two sub-structures are removed. 3. Stressing cables are threaded and joints cured in the sub-structure in the forward bay, and after curing the cables are stressed. The construction work may continue in the rear bay. 4. Temporary beams are erected between the newly erected sub-structure in the forward bay and the adjacent previously completed sub-structure in the rear bay, to stabilise the new sub-structure laterally. The construction work in the rear bay is completed. 5. The crane is moved forwards to the next position.

The said previously erected sub-structure, being in a self-supporting and laterally stable condition, can serve as a temporary support for the platform. For example, the platform may be suspended from this sub-structure on roller supports, to enable the platform to move forward freely relative to these supports. The platform extends still further to the rear, at least as far as the next previously erected sub-structure, from which it can be supported in a like manner. This enables the construction of the permanent load-supporting flooring between the two completed sub-structures to be carried on safely and easily.

One or both ends of the girder of the gantry may project beyond the respective supporting column or columns so that the movable lifting device or devices supported by the girder can pick up loads from a position beyond the column or columns and carry these loads along the girder to the point of use.

The invention may be performed in various ways and a specific embodiment will now be described by way of example with reference to the accompanying somewhat diagrammatic drawings, in which:

FIG. 1 is an overhead perspective view of a structure for the erection of which a gantry crane embodying the invention is used;

FIG. 2 is a perspective view of a gantry crane embodying the invention being used in the erection of parts of the structure shown in FIG. 1;

FIG. 3 is a front elevation of the crane and parts of the structure being erected;

FIG. 4 is a side elevation of the crane and part of the structure, looking from the left in FIG. 3; and

FIG. 5 is a side elevation of portions of the crane and of the structure, partly in section.

Referring to FIG. 1, there is shown a structure **10** which comprises several broad span bridge-like sub-structures **11***a* - **11***k* arranged side by side in spaced relationship. The structure **10** covers an area **12**, such as a railway goods yard or a multi-lane highway. Extending between the sub-structures **11***a* - **11***k* is load-supporting flooring **13**, and on this there are buildings **14**. The whole structure **10** is erected in a manner described below which enables the area **12** to remain in use throughout the whole period of construction, without risk of articles or materials employed in the construction falling to the ground if accidentally dropped, and without obstruction by the erection of temporary scaffolding from ground level.

For the erection of the structure **10** a giant gantry crane **20** (FIGS. 2 to 5) is employed. This comprises two supporting columns **21** and **22** and a girder **23**. Each of the supporting columns comprises a pair of towers **24, 25** and **26, 27**, respectively, spacing girders **28** and **29** between the bottoms of each pair of towers, and cross beams **30** and **31** at the tops of each pair of towers. Each tower is mounted on a wheeled or tracked bogie **32** which is movable on rails or prepared trackways **33** beside the area **12**. The towers are connected by pin joints **34** to the bogies **32**, to facilitate erection of the crane and adjustment of the vertical positioning of the supporting columns. The cross beams **30** and **31** are connected to the tops of the towers by pin joints **35**, also to facilitate erection of the crane. The towers **24-27** are built up from braced sections which are bolted together end to end on the site, in the manner of conventional tower cranes. The girder **23** is also built up from braced sections bolted together, but as can best be seen in FIGS. **2, 4** and **5** there are front sections **36** and rear sections **37**, the forward sections **36** being narrower than the rear sections **37**. The front sections **36** are provided with tracks or rails **38** supporting a crab **39** with lifting gear **40**. The crab **39** is movable along these rails for the whole length of the girder **23**. A monorail **41** is provided at the rear of the sections **37**, which supports movable lifting equipment **42**. The ends of the girder **23** project outwards beyond the supporting columns **21** and **22** so that when the crab **39** or the lifting equipment **42** is moved to either end of the girder its hook or other load-supporting device can be lowered to pick up structural elements or constructional materials from beside the rails or trackways **33** on which the crane is supported, and lift and carry these elements or materials to the point of use between the supporting columns.

The crane has a forward working bay **70** served by the crab **39** and a rear working bay served by the lifting equipment **42**.

The crane can be erected by assembling the towers on the bogies on the site, these being held vertical by temporary struts **45** equipped with adjusting devices **46** (FIG. 2). The girder **23** can be erected in two halves in a vertical position, one half on each side of the area **12**, between the respective towers **24, 25** and **26, 27**. The cross beams **30** and **31** are attached to the girder halves, in a position turned through 90° from that in which they are shown in the drawings, and joined to the tops of the respective towers by only one set of the pin joints **35**. The halves of the girder are then swung up to a horizontal position, with the cross beams pivoting on the towers about the already fitted pin joints **35**. The struts **45** are adjusted to hold the towers somewhat outwardly from the vertical until the two inner ends of the girder halves are properly aligned. The adjusting devices **46** are then eased to allow the said two ends to meet so that they can be bolted together. The remaining pin joints **35** are then fitted,

Attached to the front lower beam **49** of the girder **23**, near the front crab rail **38**, is a set of hangers **50**. These are termed herein permanent hangers because they can remain in place throughout the erection of the structure **10** in contrast to displaceable hangers **51** and **52** referred to below. The permanent hangers **50** may be rigid tubes, for example.

Attached to another lower beam **53** of the girder **23**, near the rear crab rail **38**, is a first set of displaceable hangers **51**, while attached to a lower beam **54** of the girder **23** intermediate between the beam **53** and the monorail **41** is a second set of displaceable hangers **52**.

Suspended from the hangers **50, 51** and **52** is a platform **55**. This platform is shaped and disposed so as to lie just beneath the bridge-like sub-structures **11** and to span the area **12** from side to side. As best seen in FIGS. **4** and **5**, the platform is long enough to extend beneath three sub-structures, in the case illustrated in these FIGS. the sub-structures **11***d*, **11***e* and **11***f*. The forward end of the platform is somewhat ahead of the set of permanent hangers **50** which are attached to the platform by suitable fasteners **56**. In contrast, the rear portion of the platform extends for some distance beyond the second set of temporary hangers **52**, and to assist in supporting this portion of the platform the rear two **11***d* and **11***e* of the three sub-structures overlying the platform are provided temporarily with rollers **57** and **58**, respectively, which engage longitudinal members **59** of the platform (FIG. 5). The temporary hangers **51** and **52** are attached to the platform by releasable fasteners **61** and **62**, respectively, and these hangers also include jacks or tensioning devices **63** and **64**, respectively.

The method of using the crane will now be described. Let it be assumed that starting from the left or far end of the structure **10** in FIG. **1**, the structure has been erected and provided with load-supporting flooring **13** as far as the sub-structure **11***d*. The adjacent sub-structure **11***e* has been erected and braced against the sub-structure **11***d* by temporary stabilising beams **66** (FIG. 5). The next sub-structure **11***f* is in the course of erection. The crane is in the position in which it is shown in FIGS. **4** and **5**. The platform **55** lies beneath the two completed substructures **11***d*, **11***e* and beneath the foremost substructure **11***f* which is in course of erection. There is no need for the platform to extend any further back than the sub-structure **11***d* because the load-supporting floor **13** is already in place behind this sub-structure. Between sub-structures **11***d* and **11***e*, however, the platform **55** is necessary so that work can be carried out between these sub-structures, e.g., for the construction of a section of load-supporting flooring **13***a* between them, without risk of any articles or

material falling into the area **12.** This work is carried out with the aid of the lifting equipment **42** in the rear bay **71** of the crane. The sub-structure **11***f* is erected in the front bay **70** of the crane with the aid of the crab **39** and its lifting gear **40.** The platform also underlies the front bay **70.** In the front bay **70,** structural elements **72** for the sub-structure **11***f* are hoisted into position by the crab **39** and its lifting gear **40,** aligned and then jointed. In the rear bay **71,** units to form the floor **13***a* are placed between the sub-structures **11***d* and **11***e,* whereupon the temporary stabilising beams **66** are removed. Wall units are also erected in this bay. In the front bay **70,** stressing cables are threaded and joints cured in the sub-structure **11***f,* and after curing the cables are stressed. The construction work may continue simultaneously in the rear bay. Next, the temporary stabilising beams **66** are placed between the sub-structure **11***e,* now stabilised by permanent connexion to the sub-structure **11***d* on completion of the floor **13***a,* and the newly completed sub-structure **11***f,* and the construction work in the rear bay **71** is completed. The crane now has to be moved forwards by a distance equal to the spacing of the sub-structures so that the next sub-structure **11***g* can be erected and flooring and other work can be carried on between the sub-structures **11***e* and **11***f.* This forward movement of the crane is accomplished as follows.

The jacks **63** for the first set of displaceable hangers **51** are slacked off and the fasteners **61** at the lower ends of these hangers are released. These hangers can now be hitched up to clear the sub-structure **11***f* as the crane is moved forward along the rails or trackways **33.** When the hangers **51** have passed over the sub-structure **11***f,* but before the second row of displaceable hangers **52** have reached the sub-structure **11***f* the fasteners **61** are re-connected and the jacks **63** tightened to tension the hangers **51.** Also, the jacks **64** for the second set of displaceable hangers **52** are slacked off, the fasteners **62** are released and the hangers **52** are hitched up to clear the sub-structure **11***f* as the crane is moved further forward to its new working position. The rollers **58** which supported the rear portion of the platform **55** on the sub-structure **11***d* may be removed when the platform has moved away from these rollers, and they are then fitted to the sub-structure **11***f.*

The displaceable hangers **51** and **52** need not be cables, as so far described. For example, they may consist of upright lattice panels each having a foldable hinged portion which can be swung out of the way of the sub-structures as the crane is being moved forward, or each of the panels could have a separate removable portion which is bolted in place when the crane is in a working position.

The girder **23** may be given an upward camber in its unloaded condition, such that when it is under load it is straight and horizontal.

There may be pin joints **68** near the tops of the towers of one of the supporting columns to prevent flexure of the girder **23** imposing bending forces on the columns see FIG. **3**).

What we claim as our invention and desire to secure by Letters Patent is:

1. A movable gantry crane useful in the erection of a structure comprising several bridge-like sub-structures arranged side by side in spaced relationship; which crane comprises a girder long enough to span the structure, supported by movable supporting columns, at least two sets of hangers which suspend a platform from the girder in a position to lie beneath a bridge-like sub-structure to be erected with the aid of the crane, at least one set being disposed to occupy a position in front of the said sub-structure and at least one other set being disposed to occupy a position to the rear of the said sub-structure, a lifting device movable along the girder between sets of hangers disposed to occupy positions respectively in front of and to the rear of the said sub-structure, and the hangers of the said other set or sets being removable or displaceable to permit the crane including the platform to be moved forwards when this sub-structure has been made self-supporting and laterally stable.

2. A gantry crane as claimed in claim **1** in which there is one set of hangers disposed to occupy a position in front of the said sub-structure and two sets of removable or displaceable hangers disposed to occupy positions to the rear of the said sub-structure at different distances therefrom sub-structure, said two sets being disposed at different distances rearwardly from said last-mentioned sub-structure.

3. A gantry crane as claimed in claim **1** in which there is another lifting device movable along said girder to the rear of said at least one other set of hangers.

4. A gantry crane as claimed in claim **1** in which said platform is long enough to encompass three of said sub-structures.

5. A gantry crane as claimed in claim **4** in which there is another lifting device movable along said girder to the rear of said at least one other set of hangers and said crane has a forward working bay served by said first-mentioned movable lifting device and a rear working bay served by said other movable lifting device.

6. A gantry crane as claimed in claim **4** in which said platform is adapted to co-operate with roller supports therefor mounted on at least one of said sub-structures which is in a self-supporting and laterally stable condition.

7. A gantry crane as claimed in claim **1** in which at least one end of said girder projects beyond the respective supporting column.

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