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Wallace

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[54] **LOAD-HANDLING GANTRIES**

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[21] Appl. No.: **252,222**

Related U.S. Application Data

[63] Continuation of Ser. No. 864,858, Oct. 8, 1969.

[52] **U.S. Cl.** **104/126,** 212/13
[51] **Int. Cl.** **E01b 23/00**
[58] **Field of Search** 104/123, 124, 126; 212/13

[56] **References Cited**

UNITED STATES PATENTS

2,990,788 7/1961 Wallace 104/126

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[57] **ABSTRACT**

A load-handling gantry, having a beam, from which loads may be suspended, is supported by divergent legs, a pair of which are disposed on opposite sides of the beam, each leg having its upper end pivoted to the beam on an axis slightly offset laterally from the center line of the beam, so that the gantry structure is laterally somewhat flexible but is stabilized by the load, and a stabilizing spring is also employed; the legs being adjustably cross-tied at the bottom. In the preferred form the legs are each longitudinally adjustable, and are pivotally connected to an adjustable cross-tie assembly serving also as a mobile mount, so that the height and the spread of the gantry are independently variable, while at the same time stability and mobility are achieved. Advantages as to space, weight, cost and versatility are among the objects.

13 Claims, 13 Drawing Figures

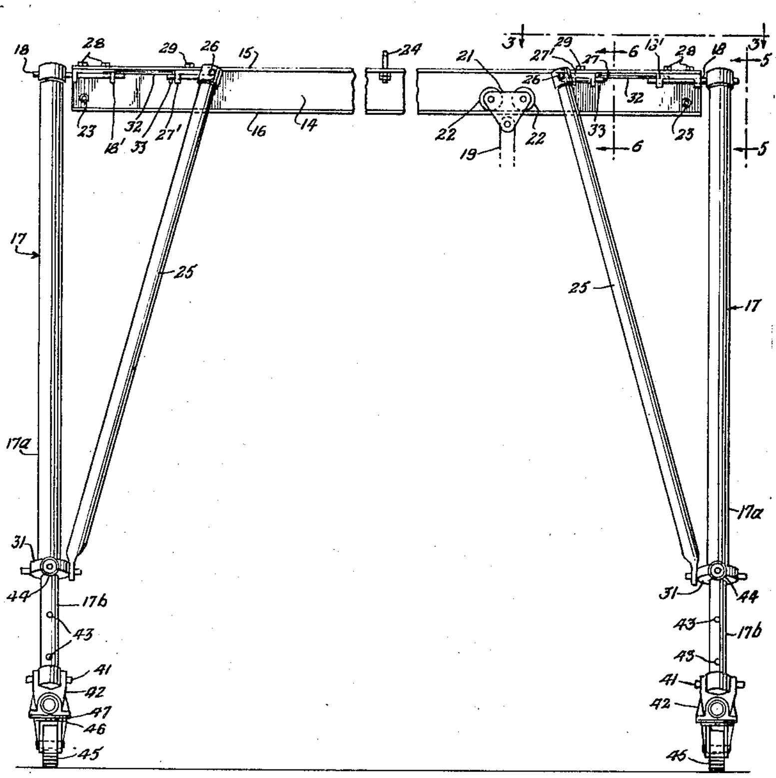


Fig. 1.

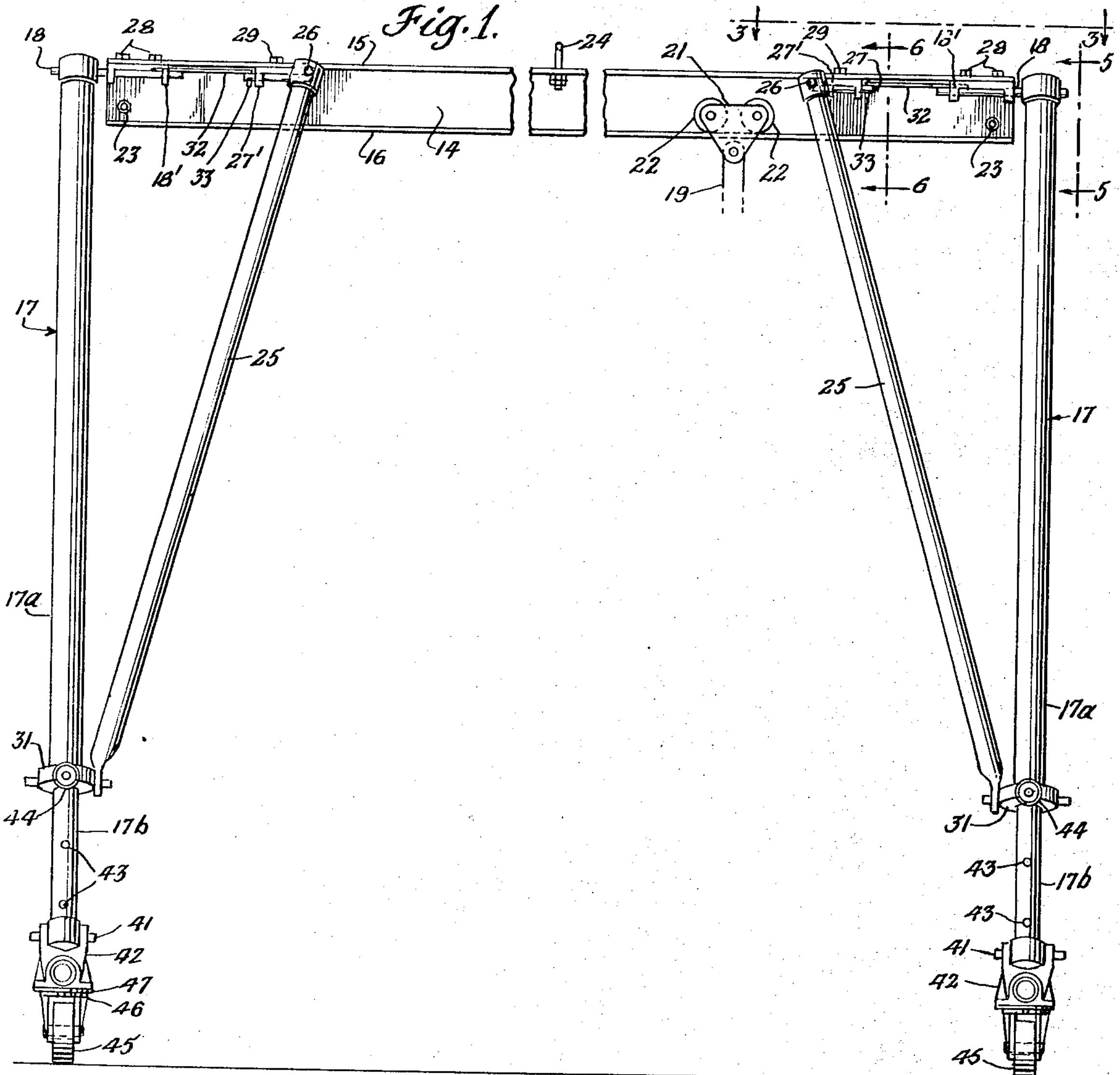


Fig. 5.

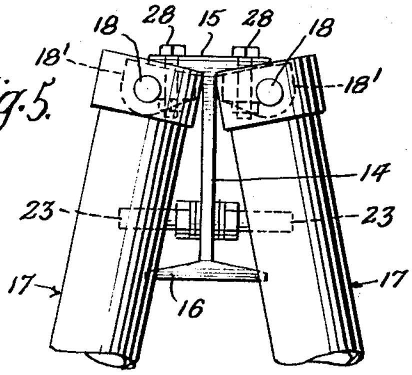
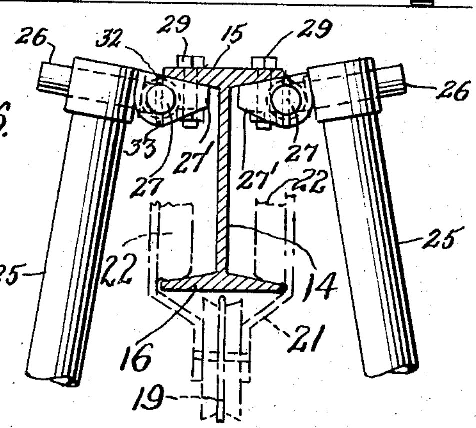


Fig. 6.



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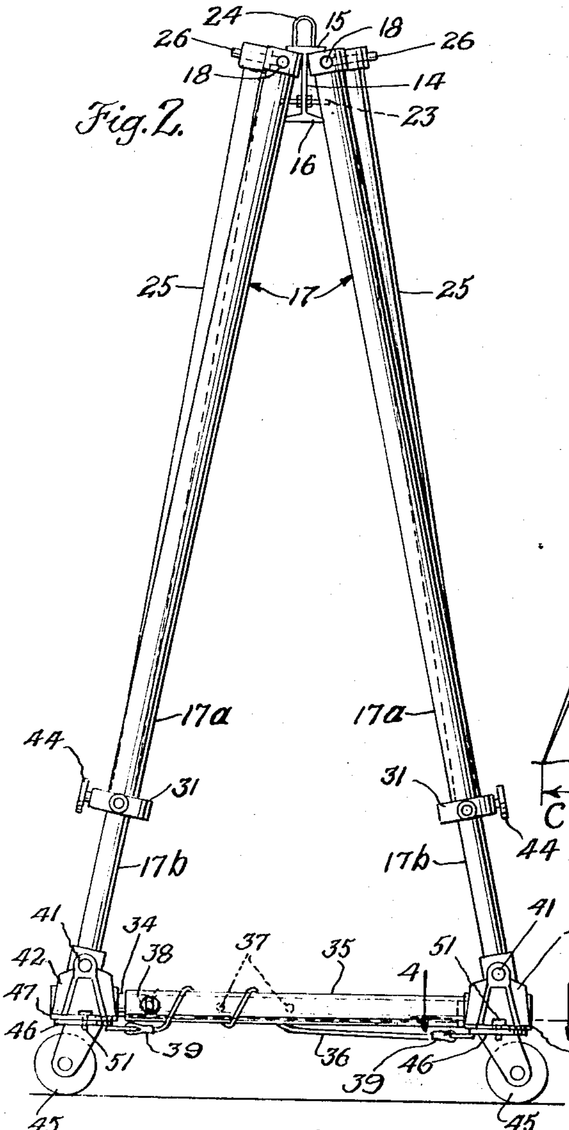

Fig. 2.

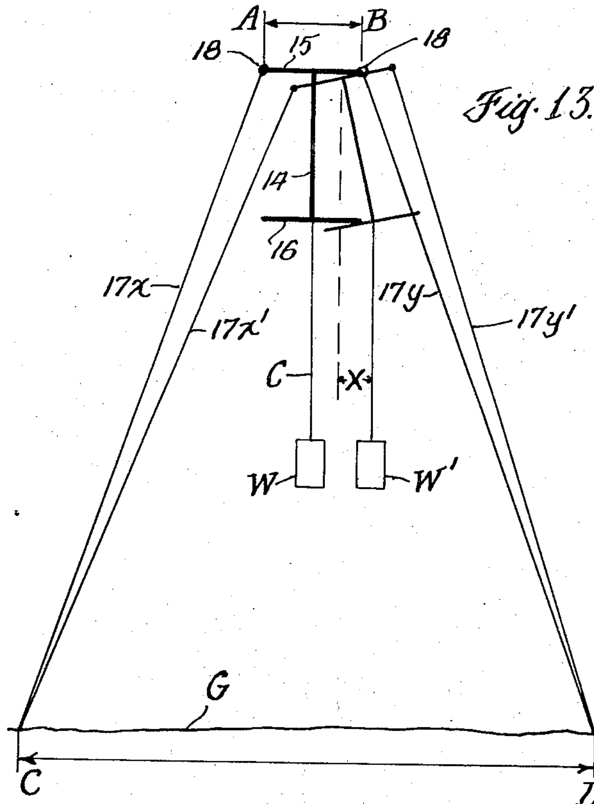

Fig. 13.

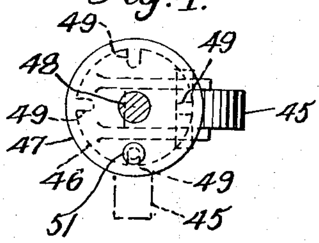

Fig. 4.

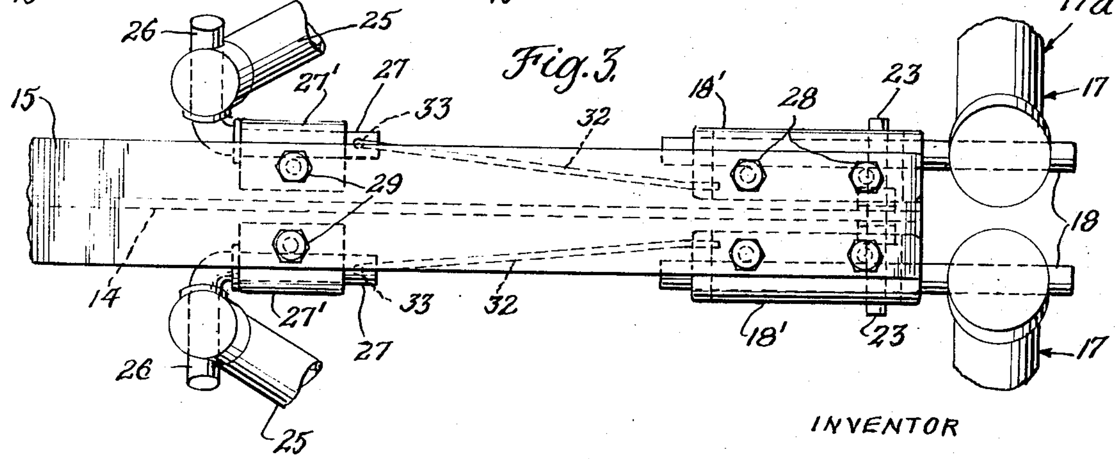

Fig. 3.

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Fig. 8.

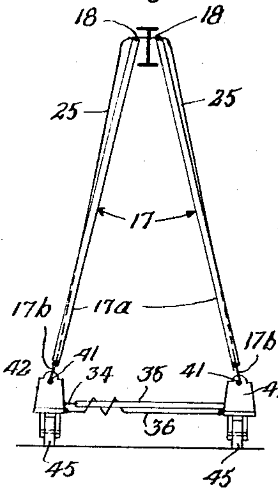


Fig. 7.

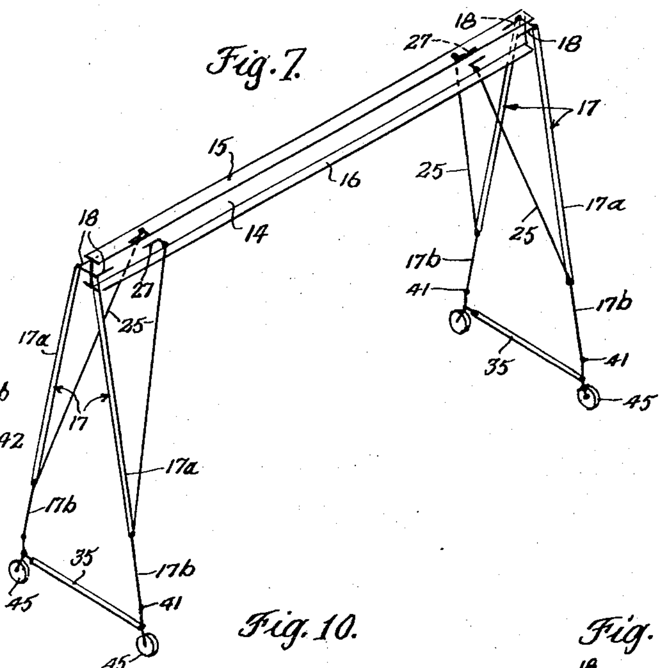


Fig. 9.

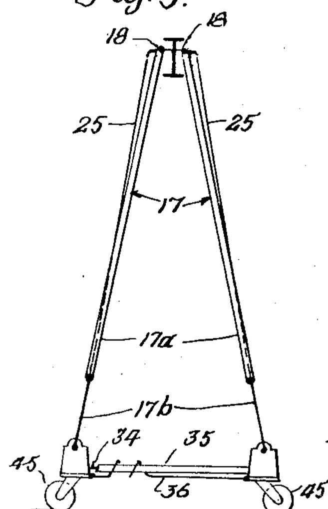


Fig. 10.

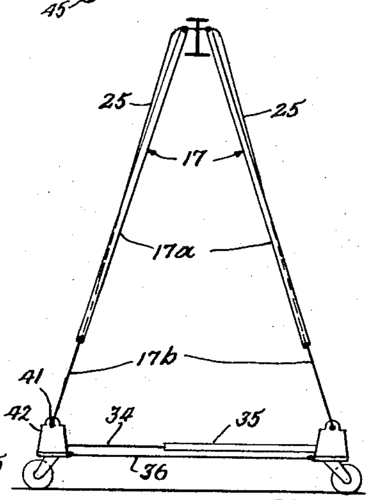
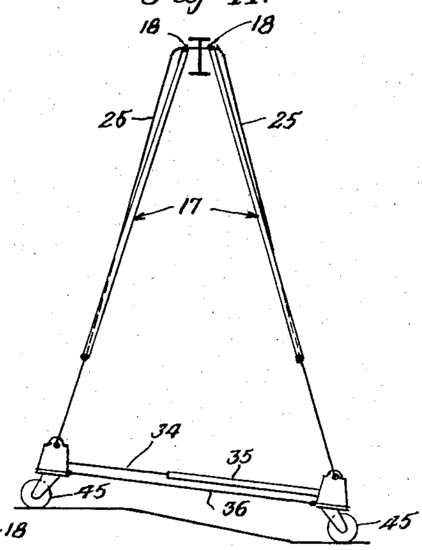


Fig. 11.



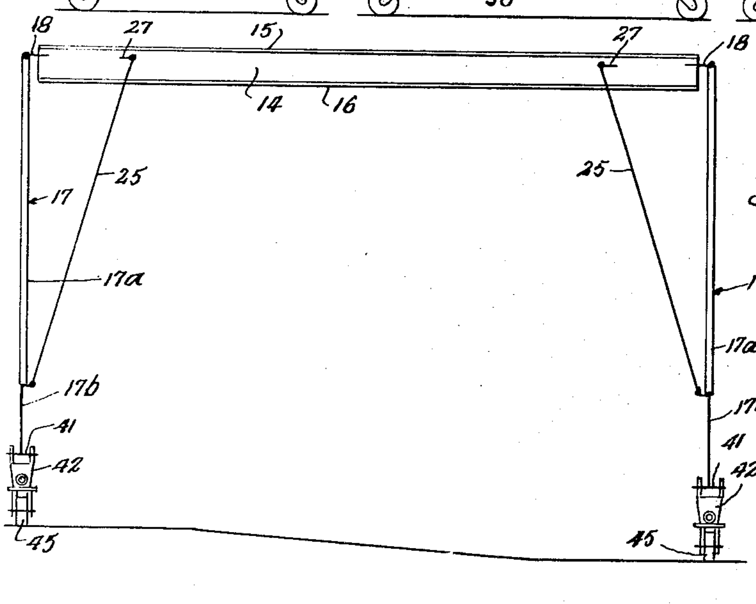


Fig. 12

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LOAD-HANDLING GANTRIES

This application is a continuation of Ser. No. 864,858 filed 10/8/69.

This invention relates to load-handling gantries in general, and is of especial advantage in connection with gantries having a beam which is supported at longitudinally-spaced-apart stations, typically by pairs of pivoted variably-divergent legs.

In such gantries, the beam may be an I-beam, the lower flange of which may carry a trolley, from which a load may be movably suspended and may be raised and lowered by a winch or the like; and the divergent supporting legs and such braces as may be employed for the legs must be so disposed as to provide clearance, not only for the beam but also for the trolley, winch and load; and, in a known type of gantry, this clearance has been achieved by placing pivot means, for the legs and their braces, centrally above the beam and securing the pivoted members thereon by means of independent brackets or other parts passing diagonally upwardly and inwardly to the central pivot location over the beam.

The principal object of the present invention is to save on the weight, cost, complexity and head-room requirements of such gantries, while at the same time preserving or enhancing the advantageous operational characteristics of the known gantries (typified by my prior U.S. Pat. No. 2,990,788, granted July 4, 1961), and increasing the versatility thereof.

More particularly, the invention contemplates the accomplishment of the foregoing by the provision, in a gantry, of a load-carrying member, such as a beam, having support means including a pair of variably downwardly-divergent legs which, at their upper ends, are connected to said member at opposite sides thereof by pivots, whose axes are laterally spaced apart within such limits that a load on said member tends to stabilize the gantry when the lower ends of said legs are held at fixed points.

Still further, the invention contemplates the provision of such a gantry with adjustable tie means between the legs, such as a rigid tie-bar of variable length and pivotally connected to the legs adjacent their lower ends, and preferably having means, selectively operable or inoperable, to render the gantry mobile, at will, in at least two directions at right angles to each other.

Additionally, the invention contempates the provision of such a gantry incorporating supplemental stabilizing means, such as spring devices reacting between the beam and the variably-divergent legs, and preferably the provision of pivoted leg braces adapted also to serve as elements in the stabilizing system.

In the preferred embodiment, the invention contemplates a gantry having one or more of the objects, features and advantages above referred-to, and, in combination therewith, means for varying the length of the divergent legs, so that the gantry height and the gantry base (or leg-spread) are independently, as well as conjointly, variable.

How the foregoing, and such other objects and advantages of the invention as are inherent in it or incidental thereto, may be obtained, will become clear to those skilled in the art, by the reading of the following description, taken together with the accompanying drawings, which illustrate fully the present preferred embodiment of the invention, and in diagrammatic form another embodiment.

FIG. 1 of the drawings is a side elevational view of a gantry embodying the invention, in its preferred form, portions of the load-carrying beam being broken out, to shorten the figure.

FIG. 2 is an end elevational view of the gantry of FIG. 1.

FIG. 3 is a fragmentary plan view of the structure of FIG. 1, taken on the line 3—3 of that figure but to a larger scale.

FIG. 4 is an enlarged fragmentary plan section, taken on the line 4—4 of FIG. 2, and illustrating a releasable lock as provided for the casters of the gantry.

FIG. 5 is a fragmentary end elevation, taken at line 5—5 of FIG. 1, but to a larger scale, to show the spaced-apart pivots at the top of a pair of the gantry legs.

FIG. 6 is a fragmentary vertical section, on line 6—6 of FIG. 1, on the scale of FIGS. 3 and 5, to show the upper ends of the leg braces for the legs seen in FIG. 5 and the mounting of said braces by spaced-apart pivots coaxial with the pivots for the legs.

FIG. 7 is a somewhat diagrammatic isometric view of the gantry of FIGS. 1 to 6.

FIG. 8 is an end elevational diagrammatic view, showing one adjusted configuration of the gantry.

FIGS. 9, 10 and 11 are views similar to FIG. 8, showing three other adjusted configurations.

FIG. 12 is a side elevational diagrammatic view, showing still another adjusted configuration of the gantry.

FIG. 13 is a diagrammatic line diagram of a simplified, but less versatile, gantry structure, with the addition of a diagrammatic illustration of a load, showing the manner in which the load tends to stabilize the gantry, either of the construction shown in this form or of the construction shown in FIGS. 1 to 12.

Referring now to FIGS. 1 to 7, it will be seen that a load-carrying member, such as an I-beam comprising vertical web 14 and upper and lower flanges 15 and 16, extends longitudinally of the gantry and has supporting means at stations spaced-apart lengthwise of the beam, in this case at the two ends of the beam, and as illustrated in these figures the supports for the two ends of the beam are similar, so that a description of the support means for the right-hand end of the beam (in FIG. 1) may be taken as typical.

Such support comprises a pair of legs 17, disposed respectively at opposite sides of the beam and diverging downwardly when the gantry is in use. The legs have their upper ends connected with the beam, each by a piot 18, the pivot axes being substantially parallel with each other and with the longitudinal axis of the beam but laterally offset from the vertical longitudinal midplane of the beam, the lateral offset being so limited that, with the legs of the pair disposed on said pivots in downwardly diverging positions and the lower ends of the legs held at fixed points, down-load on the beam will tend to stabilize the gantry laterally.

This stabilizing effect is enhanced by disposing the pivots 18 close to the upper flange 15 of the beam, and further by using a beam having a web 14 of substantial vertical depth, particularly with the load suspended from the lower flange 16 of the beam, as herein shown (and as will be further brought out by the description, later on, with reference to FIG. 13). The load may be suspended from the beam in any suitable manner, but is usually slung from a winch, carried, through winch cable or chain **19,** from a trolley **21** whose wheels **22** ride on the lower flange **16** of the beam for ready travel therealong. Stops for the trolley are shown at **23** at each end of the beam. A slinging ring or hook **24** may be centrally disposed on top of the beam for lifting it, or for lifting the entire gantry when desired.

It will be observed that the pair of legs **17** is located beyond the end of the beam, as seen in FIGS. **1** and **3,** so that, even though the spacing of leg pivots **18** is very close to the plane of the beam web **14,** the legs may be swung close together if desired (as for folding and shipment of the structure) without having said legs strike against the beam.

The tubular legs **17** may be braced by the diagonal tubular struts **25,** respectively disposed on opposite sides of the beam, the upper end of each brace being mounted on a lateral outward extension **26** integral with a longitudinal pivot **27.** Each pivot **27** is coaxial with a leg pivot **18,** as shown, and the pviots **18** and **27** may be rotatively mounted in fixed brackets **18'** and **27',** secured to the under side of upper flange **15** by bolts **28, 29.** Since, when the braces **25** swing inwardly with the legs **17,** they must not foul upon the flange **16,** they are mounted outboard of their pivots **27** by means of the lateral extensions **26.** The lower end of each brace **25** is coupled to its adjacent leg **17** by a bracket **31** fixed on the leg, as shown in FIGS. **1** and **2.**

Before considering further features of the preferred construction of the gantry legs and related parts, reference will now be made to an additional lateral stabilizing means, conveniently in the form of a torsion spring **32,** adapted to be effective when there is little or no load on the gantry, so as to prevent the beam from turning or cocking with reference to the legs, which action might otherwise occur, with a possible bumping of one edge or the other of flange **16** against leg braces **25.** As seen in FIGS. **1, 3** and **6,** by fixing one end of each spring **32** in the leg pivot bracket **18,** and having the opposite end **33** bent down and passing through a vertical hole in brace pivot **27,** a pivotal movement of the leg and brace assembly relative to the plane of the beam, from a predetermined position of relative angularity, is yieldingly resisted by the stabilizing spring device **32.**

While ground contact may, under certain circumstances, be relied upon to hold the lower ends of the legs from undesired angular spread, the preferred construction incorporates tie means between the legs of a pair, which means may take the form of a flexible tension member, or a rigid tie, with length-adjustment means; and in the present instance I provide an assembly of these elements, e.g., a telescopic tie-bar **34, 35,** and a supplemental flexible safety cable **36,** with detachable connections **39.** As seen in FIG. **2,** the rigid tie **34, 35,** is variable as to its length, as by means of holes **37** and a bolt **38.**

To accomodate the relative angling between the legs and the tie (where a rigid tie is used) the juncture between them is by means of horizontal pivots **41** extending longitudinally of the gantry, and each pivot extends through a leg and through a bracket **42** fixed on the adjacent end of the tie-bar. The construction just described permits of adjustment of the base or "spread" of the gantry, and thus to a limited extent the height, as a concomitant thereto, but it has further advantages when used in combination with other features now to be dealt with.

By employing telescopic members, **17***a*, **17***b*, as clearly seen in FIGS. **1, 2,** and **7** to **12,** each leg of the gantry may be varied as to its length, and may be adjustably set, for example, by means of holes **43** and a pin **44** in bracket **31.** This adjustment takes place below the leg brace **25,** and accordingly has no effect upon the connection of said brace to the leg by means of the bracket **31.**

The ability to alter the length of legs **17** and of the tie-bar **34, 35,** permits of a substantial range of independent, as well as of coordinated, variations in the height and the spread of the gantry. The versatility of such variations is not only of value in connection with the type, size and weight of the load to be handled, but also in connection with the terrain on which the gantry is operating, and further in connection with the matter of head-room and side-clearance whrn the gantry is to be moved from place to place, as in a confined area in a plant or shop.

In respect of the mobility of the gantry, I utilize the end brackets **42** of the tie-bar assembly as mounts for the casters **45.** As seen in FIGS. **1** to **4,** each caster has a flange **46,** which can rotate beneath a flange **47** fixed on the bracket **42.** The caster **45** may be allowed to so swivel, at will, about axis **48,** or it may be locked, at least in either of two positions (e.g. the full-line and chain-dotted line positions of FIG. **4**) but preferably in any of four positions, as by means of the four slots **49** and the bolt **51** which passes through a hole in the fixed plate **47.** Thus, changes as to the casters' locations on the floor or ground may be effected; also changes in their direction, relative to the length and width of the gantry; and, further, changes of plane, as between casters — for example, one caster may be disposed at right angles relative to another, and the casters thus locked so as to minimize movement of the gantry; or they may all be allowed to trail in one direction, or positively locked to track in one direction, (as indicated by FIG. **8**), for convenience in moving the gantry endwise, as through a narrow aisle.

It will be clear from the foregoing that, no matter what may be the variation in angular adjustment between the legs (as illustrated, for example, by FIGS. **2, 9** and **10**), the construction and arrangement of the foot mounting is such that the castering axes **48** (FIG. **4**) remain at right angles to the tie-bar **34,35.** The mobile mounting thus remains stable and of constant vertical height, and the positioning of the lower ends of the legs (at pivot points **41**) relative to the level of the supporting surface remains substantially constant, throughout a large range of leg-divergencies, as well as undisturbed by the castering action involved in the mobile mount.

The versatility and adaptability of the preferred embodiment of this invention is well illustrated by the diagrammatic views of FIGS. **7** to **12.** In FIG. **7,** the gantry is shown adjusted to a substantial height and to its minimum working width or spread. (From this condition, it can be substantially collapsed for storage, if desired, by removing the tie-bars, telescoping the legs, and swinging the legs of each pair to substantial parallelism with each other.)

FIG. **8** shows the adjustment of the gantry to minimum width and minimum height, for working or travelling under conditions of close head-room and side-clearance.

FIG. **9** shows an adjustment of the gantry to an increased height, with no increase in width, as compared with FIG. **8.**

FIG. **10** shows the gantry set to the same height as in FIG. **9** but with an increase in its width at the bottom. This is accomplished by extending the leg adjustment while at the same time the tie-bar is extended.

FIG. **11** shows a maintenance of the same position of the load-carrying beam as in FIG. **10,** although the gantry is on irregular terrain, where the legs at the right of the figure are extended to a greater extent than those at the left.

FIG. **12** shows a condition where the terrain (or floor) is stepped, or inclined to a lower level, at one end of the gantry than at the other end. Here the level of the beam is maintained, by extending the legs at one end more than the legs at the other end.

FIG. **13** illustrates a configuration wherein two gantry tubes **17***x*, **17***y*, rest on the ground G and at their upper ends are pivoted at **18, 18,** to upper flange **15** of beam **14.** A weight W is suspended by a cable C from bottom flange **16.** As the configuration is laterally deformable, or "flexible" so to speak, it is geometrically possible for leg **17***x* to move to the right to position **17***x'* and leg **17***y* to move to the right to position **17***y'*, so that the beam is rocked (counterclockwise in this example), and this distortion of the configuration of the gantry could occur until stopped by flange **16** abutting against leg **17***y* in its position **17***y'*, with the weight or load W in position W'. However, if the distance A–B is kept sufficiently small, relative to the distance C–D, the gantry will be stabilized, with the beam web **14** in its vertical position, by means of the load W acting through the restoring moment arm X.

Thus, with a small offset of pivots **18** from the center of the beam, suitably limited with reference to the minimum normal working spread of the gantry legs, the gantry is self-stabilizing under loaded conditions. This also is true of the preferred construction, shown in FIGS. **1** to **12.** To avoid undesired distortions of the configuration and possible knocking of the gantry legs by the beam, under unloaded conditions, the spring devices **32** are introduced.

It will be clear from the foregoing that the pivoting of the gantry legs on separate pivots, to the sides of the beam, preferably close beneath the upper flange thereof, reduces the complexity, the cost and the weight as compared with prior constructions, and conserves head-room (or alternatively permits an increase in working height adjustment). The other features illustrated and described, in combination with the foregoing, provide for a maximum of versatility and of operational, translational and folding and shipping advantages.

It may be noted that by placing the pivots **18** and **27** above the horizontal plane containing the longitudinal axis of the beam, and preferably close to the upper flange **15,** the stability of the gantry is enhanced and its load carrying capacity increased, and better clearance is provided for the trolley.

I claim:

1. A flexible and adjustable gantry comprising an elevated load-carrying beam, individually adjustable supports therefor at stations spaced-apart lengthwise of the beam, at least one such support comprising a pair of variably-downwardly-divergent legs, each separately adjustable as to length, equally or differentially, under normal operating conditions, and respectively disposed at opposite sides of the vertical mid-plane of the beam in such positions that said legs are normally free of contact with said beam throughout a substantial range of variably-divergent operating angles, connections between the upper ends of said legs and said beam including for each leg a pivot whose axis is above the level of, and substantially parallel with, the longitudinal axis of the beam but laterally offset from said vertical mid-plane, whereby said beam may bodily rock laterally from a position of symmetry relative to said legs, tie means between said legs, adjustable independently of leg length adjustment, adapted to variably adjust the angularity between said legs, with or without change of length of either or both of said legs, the lateral offset of said pivot axes being so limited that, with the legs of said pair disposed on said pivots in any of a variety of variably-divergent positions within their normal operating range of angles, and with their foot-ends fixed relative to each other in any normal operating position of said adjustable tie means, a load carried on said beam in suspension from a point below said longitudinal axis will tend to stabilize said beam and said gantry legs on said pivots with free clearance between beam and legs, and a mobile mounting for the foot-ends of the divergent gantry legs so constructed and arranged as to provide a stable and substantially constant level of support therefor throughout a large range of divergent angles thereof.

2. The gantry of claim **1,** wherein said mobile mounting includes a caster for each of said divergent legs, said casters being mounted to swivel, respectively, about spaced apart parallel upright axes which are at right angles to the tie means between said legs in all positions of adjustment of said tie means, regardless of the variable angles between said legs and between each leg and said tie means.

3. The ganry of claim **2** wherein said casters are each lockable selectively in at least two positions of swivelling, one of which positons is parallel with the length of said tie means and the other at right angles thereto.

4. The gangry of claim **1** having lateral stabilizing means effective when there is little or no load suspended from the beam.

5. The gantry of claim **4** wherein said lateral stabilizing means is of a resilient nature and acts to urge a centering of the beam relative to the angle between the legs.

6. The gantry of claim **1** having rigid tie means pivoted to each of said legs on an axis paralleling the pivot axes at the upper ends of the legs.

7. The gantry of claim **1** having a supplemental flexible connection between said legs.

8. The gantry of claim **1** wherein said pivot axes, although above the longitudinal axis of the beam, are below the top of the beam.

9. The gantry of claim **1** having means to restrict the lateral rocking of the beam.

10. The gantry of claim **9** wherein said means comprises a yielding resistance device.

11. An adjustable gantry comprising a beam, adjustable supports therefor at stations spaced-apart lengthwise of the beam, at least one such support comprising a pair of legs, each adjustable as to length, and respectively disposed at opposite sides of the beam, and connections between the upper ends of said legs and the beam including for each leg a pivot whose axis is above the level of, and substantially parallel with, the longitudinal axis of the beam but laterally offset from the vertical longitudinal mid-plane of the beam, the lateral offset of said pivot axes being so limited that, with the legs of said pair disposed on said pivots in downwardly diverging positions and the lower ends thereof held at fixed points, a load on said beam will stabilize the gantry laterally, together with lateral stabilizing means effective when there is little or no load on the gantry, said means comprising a yielding resistance device which includes spring means actuable by change in angular relation between a leg and the vertical longitudinal mid-plane of the beam.

12. An adjustable gantry comprising a beam, adjustable supports therefor at stations spaced-apart lengthwise of the beam, at least one such support comprising a pair of legs, each adjustable as to length, and respectively disposed at opposite sides of the beam, and connections between the upper ends of said legs and the beam including for each leg a pivot whose axis is above the level of, and substantially parallel with, the longitudinal axis of the beam but laterally offset from the vertical longitudinal mid-plane of the beam, the lateral offset of said pivot axes being so limited that, with the legs of said pair disposed on said pivots in downwardly diverging positions and the lower ends thereof held at fixed points, a load on said beam will stabilize the gantry laterally, each leg having a brace extending therefrom to a point along the beam spaced from the pivot of said leg and there having a brace pivot whose axis is substantially coaxial with the axis of the pivot of said leg, together with a stabilizing spring reacting between the beam and said brace.

13. A flexible and adjustable gantry comprising an elevated load-carrying beam, individually adjustable supports therefor at stations spaced-apart lengthwise of the beam, at least one such support comprising a pair of variably-downwardly-divergent legs, each separately adjustable as to length, equally or differentially, under normal operating conditions, and respectively disposed at opposite sides of the vertical mid-plane of the beam in such positions that said legs are normally free of contact with said beam throughout a substantial range of variably-divergent operating angles, connections between the upper ends of said legs and said beam including for each leg a pivot whose axis is above the level of, and substantially parallel with, the longitudinal axis of the beam but laterally offset from said vertical mid-plane, whereby said beam may bodily rock laterally from a position of symmetry relative to said legs, tie means between said legs, adjustable independently of leg length adjustment, adapted to variably adjust the angularity between said legs, with or without change of length of either or both of said legs, the lateral offset of said pivot axes being so limited that, with the legs of said pair disposed on said pivots in any of a variety of variably-divergent positions within their normal operating range of angles, and with their foot-ends fixed relative to each other in any normal operating position of said adjustable tie means, a load carried on said beam in suspension from a point below said longitudinal axis will tend to stabilize said beam and said gantry legs on said pivots with free clearance between beam and legs, and a mounting for the foot-ends of the divergent gantry legs so constructed and arranged as to provide a stable and substantially constant level of support therefor throughout a large range of divergent angles thereof.

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