Dec. 27, 1955 J. A. EVANS 2,728,424

FLEXIBLE CONNECTION FOR RUNWAY GIRDERS

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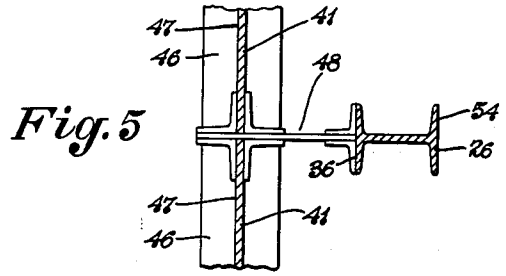


Fig. 5

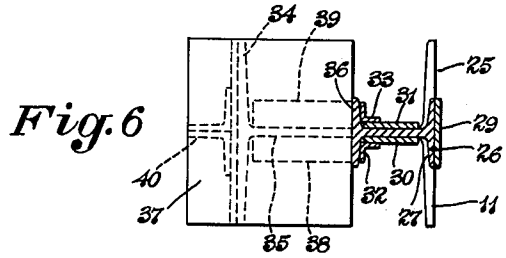


Fig. 6

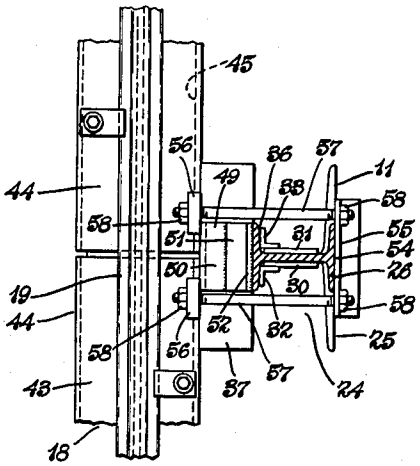


Fig. 4

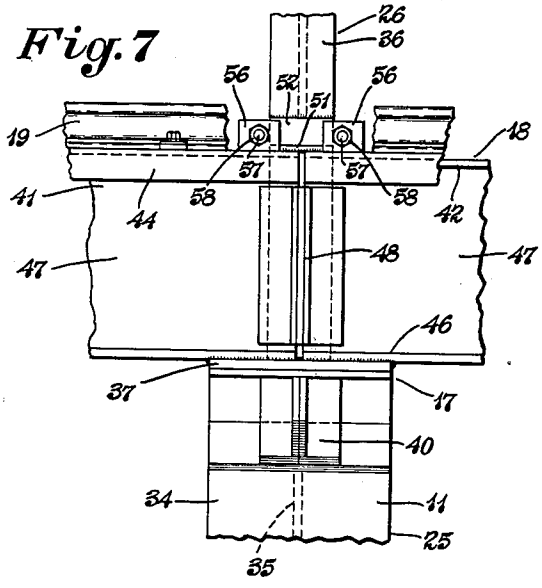


Fig. 7

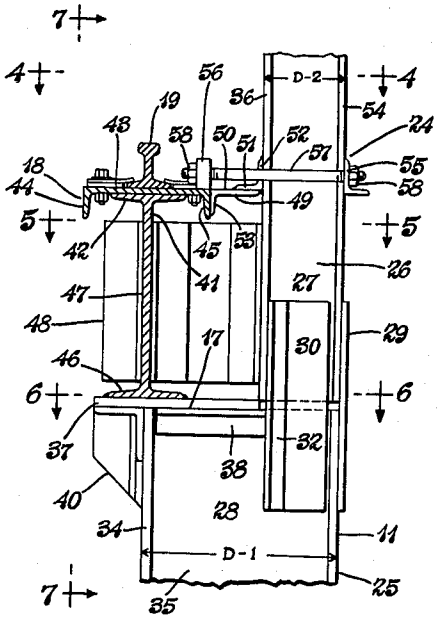


Fig. 3

Fig. 1

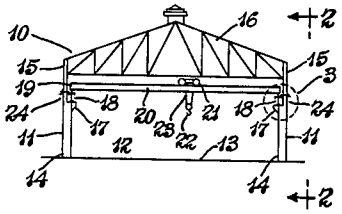
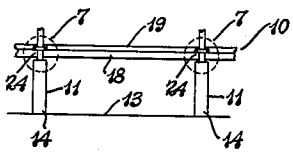


Fig. 2



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FLEXIBLE CONNECTION FOR RUNWAY GIRDERS

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3 Claims. (Cl. 189—36)

The invention or discovery relates generally to support and connected spanning structures, and particularly to column and connected girder construction made of structural metal shapes and members, and the metal being usually steel. More particularly, the invention or discovery relates to structural steel column and connected girder construction used in industrial or mill buildings, and in which the girders are crane runway girders and have rails mounted on their top flanges.

In a structural steel industrial or mill building equipped with a travelling crane, parallel rows of columns are located on each side of the crane runway bay, and each row of column supports a set of end registering girders on the top flanges of which a set of rails is secured in end registering relation with each other. The sets of rails at the opposite sides of the bay form the runway track for the crane, which includes a bridge spanning across the bay and over the sets of rails, and a truck on each end of the crane bridge includes flanged wheels which roll on the set of rails at that side of the bay. The crane bridge has parallel sets of rails mounted thereon, and the crane bridge sets of rails form a track on which a crane trolley rolls.

The crane trolley carries the cable drum on which the crane cable is wound and unwound, and the lower end of the crane cable is connected with the pick-up load. The weight of the pickup load plus the weight of the trolley constitutes a horizontal thrust which is intermittently imposed on one of the sets of crane runway rails on the girders at one side of the bay each time the crane trolley is started or stopped. These horizontal crane thrusts imposed on the crane runway girders must be absorbed by their supporting columns.

Other intermittent and varying loads which are imposed by the crane runway girders on their supporting columns arise from longitudinal expansion and contraction of the girders due to variations in their temperature caused by temperature changes in the surrounding atmosphere.

In addition, when the crane bridge is located on the runway girders between opposite pairs of longitudinally spaced columns, the vertical load of the crane bridge produces vertical deflections in the girders throughout their lengths and extending to their ends supported on the columns.

The loads due to horizontal crane thrusts, expansion and contraction due to temperature changes, and vertical loads of the crane bridge are very frequently combined. In prior structural steel industrial or mill building constructions many different forms of connections have been used between the columns and the crane runway girders supported thereon. Each column is usually built up, and includes a lower section having a relatively deep transverse dimension, and an upper section having a shallower transverse dimension. The upper column section has its lower end connected with the upper end of the lower column section, the outer flanges of the column sections being aligned with each other.

The inside flange of the lower column section and a portion of its web are thus transversely spaced and extend inwardly from the plane of the inside flange of the upper column section. A girder seat plate is secured on the shoulder formed by the upper ends of the inside flange and the inwardly extending web portion of the lower column section. A pair of end registering crane runway girders have their bottom flanges seated on the seat plate of each intermediate column in a row. A diaphragm connects the adjacent webs of the end registering girders with the inside flange of the upper column section. Serious difficulties are encountered with respect to the top flanges of the crane runway girders.

The top flange of each crane runway girder may be an inverted channel. A built-up spacer strut is usually interposed between the outside downwardly extending flange of the channel and the inside flange of the upper column section. A rigid connection, as by rivets or welds, is made between the outside end of the spacer strut and the inside flange of the upper column section.

When the joint between the inside end of the spacer strut and the outside flange of the girders top channel is rigid, as by means of rivets or welds, then one or more of the above described loads imposed on the strut by the crane runway girder, more frequently the loads imposed due to thermal expansion or contraction, and vertical deflection due to the crane load, break the rivets or welds connecting the girder top channel with the strut.

When no strut or spacer member is interposed between the girder top flange or channel, then horizontal crane thrust breaks the girder web above the diaphragm.

The damage caused by such breaks in usual column and connected girder constructions is not confined to the broken members, but may extend to the column. Deflections may be set up in the crane runway girders, which derail the crane bridge trucks, and result in damage to the crane parts. Injury to the crane operator and other plant personnel may also result.

The objects of the present invention or discovery include the provision of a new and improved construction for supports and connected spanning structures, and particularly column and connected girder construction particularly adapted for crane runway girders, and by which direct thrusts only are transmitted from the girder top flange or top channel to the column, and by which all twisting forces set up in the grider top flange or top channel are resolved into direct thrusts and deflections indirectly transmitted to the column.

A further object of the present invention or discovery is to provide such a new and improved construction for supports and connected spanning structures having a simplified construction and arrangement of parts, permitting economical manufacture and installation and maintenance, and convenience in use.

The foregoing and other objects are attained by the construction for supports and connected spanning structures, parts, combinations, and sub-combinations, which comprise the present invention or discovery, and the nature of which is set forth in the following general statement, and preferred embodiments of which are set forth in the following description, and which are particularly and distinctly pointed out and set forth in the appended claims forming part hereof.

The nature of the present invention or discovery may be stated in general terms as embodying in one form column and connected girder construction including a column having a lower section extending longitudinally below and an upper section extending longitudinally above a transverse junction plane. The upper column section has a longitudinally extending web and transversely spaced flanges extending longitudinally on opposite sides of the

web. A seat shoulder on the lower column section extends transversely in the junction plane from one of the flanges of the upper column section. Girders having registering ends are supported on the seat shoulder, and each girder has a bottom flange and a web and a top flange. The bottom flange of each registering girder end is seated on the column seat shoulder. Means connect the bottom flange of each registering girder end with the column. A spacer strut has one end connected with the upper column section and another end in sliding abutment with each girder end top flange, and tension means connect each girder end top flange with the upper column section.

By way of example embodiments of the new and improved column and connected girder construction and component parts of the present invention or discovery are illustrated in the accompanying drawing forming part hereof in which:

Figure 1 is a diagrammatic vertical elevational and sectional view of a bent of a mill building having a crane runway including the improved column and connected girder construction of the present invention or discovery;

Fig. 2 is a fragmentary diagrammatic side elevational view thereof looking in the direction of the arrows **2—2**, Fig. 1;

Fig. 3 is an enlarged elevational and sectional view of one of the column and connected girder constructions thereof, as enclosed by the dotted circle **3**, Fig. 1;

Fig. 4 is a fragmentary top plan and sectional view of the column and connected girder construction of Fig. 3, looking in the direction of the arrows **4—4**, Fig. 3;

Fig. 5 is a plan sectional view thereof, as on line **5—5**, Fig. 3, looking in the direction of the arrows, and with distant parts removed;

Fig. 6 is another plan sectional view thereof, as on line **6—6**, Fig. 3, looking in the direction of the arrows, and with distant parts removed; and

Fig. 7 is a fragmentary elevational view thereof, looking in the direction of the arrows **7—7**, Fig. 3, and showing portions and parts enclosed by either of the dotted circles **7** in Fig. 2.

Similar numerals refer to similar parts throughout the several views of the drawings.

The mill building shown diagrammatically in Figs. 1 and 2, is indicated generally by **10**, and includes parallel rows of columns **11** at opposite sides of the building bay **12**. The columns **11** extend upwardly from the floor level **13**, and have bottom ends **14** mounted on usual bases and footings or foundations not shown.

The columns **11** also have top ends **15**. Each column **11** in one row at one side of the bay is opposite another column **11** at the other side of the bay. Each set of opposite column **11** supports at their upper ends **15**, a roof truss **16**, in a usual manner.

Intermediate the bottom and top of each column **11**, there is located a seat shoulder **17** which extends transversely inwardly toward the bay **12**. Each seat shoulder **17** supports usually two aligned ends of spanning members **18**, each of which extends above and is supported by at least one longitudinally spaced pair of columns **11** in one of the rows of columns at one side of the bay **12**.

On the upper faces of each set of aligned spanning members **18**, there is secured a set of end aligned rails **19**, and a crane runway track is formed by the opposite parallel sets of rails **19**.

A crane bridge **20** spans the bay **12** above the sets of rails **19**. A truck not shown is located on the crane bridge above each set of rails **19**, and each truck includes in a usual manner, a set of flanged wheels not shown which rolls on the set of rails **19** below.

A crane trolley **21** of usual construction rolls laterally on trucks not shown on the crane bridge **20**. From the crane trolley **21** there depends a crane hook **22** at the lower end of a cable loop **23** which may be raised and lowered in a usual manner by a power driven hoist drum not shown on the crane trolley **21**.

At each seat shoulder **17** improved tension and compression means indicated generally by **24** are connected with the column **11** and have an improved movable articulation with the spanning member or members **18** supported on the seat shoulder **17**. The improved tension and compression means **24** and their connections with the spanning member or members **18**, and other parts, constitute separately and in combination, the present invention or discovery.

Details of one embodiment of the improved column and connected girder construction of the present invention or discovery, are illustrated in Figs. 3 to 7, inclusive, and include parts previously described.

Each column **11**, as shown includes a lower section **25** having a relatively deep transverse dimension D–1, and an upper section **26** having a shallower transverse dimension D–2. The upper column section **26** has its lower end **27** connected with the upper end **28** of the lower column section **25**.

As shown each column section has an H cross-section, and the webs and outer flanges of the column sections **25** and **26** are aligned with each other.

As shown the connections between the ends **27** and **28** of the upper and lower column sections is effected by means of a flange connection plate **29**, opposite web connection plates **30** and **31**, and connection angles **32** and **33**, which may be assembled by rivets or welds.

The inside flange **34** of the lower column section **25** and a portion of its web **35** are thus transversely spaced from and extend inwardly from the external face or plane of the inside flange **36** of the upper column section **26**. The seat shoulder **17** is formed by the upper end faces of the inside flange **34** and the inwardly extending portion of the web **35** of the lower column section **25**.

Preferably as shown, a seat plate **37** is secured on the seat shoulder **17**, as by web connection angles **38** and **39**, and a built-up shelf bracket **40**. The angles **38** and **39** have legs connected to opposite sides of the web **35** of the lower column section **25**. The other legs of the angles **38** and **39** are connected to the underside of the seat plate **37**. The shelf bracket **40** is connected to the external face of the inside flange **34** of the lower column section **25**, and to underside of the seat plate **37**.

Each spanning member **18** as shown is a built-up girder including a lower I beam **41** on the top flange **42** of which is connected the web **43** of an inverted channel **44** having an outer downwardly extending border flange **45**. The I beam top flange **42** and the channel **44** constitute a composite top chord flange for the girder **18** as a whole.

Each girder I beam **41** has a bottom flange **46** which is the bottom chord flange of the girder **18** as a whole. As shown in Figs. 2 to 7, inclusive, the column **11** is an intermediate column and supports spaced aligned ends of two girders **18**, the end of the bottom flange **46** of each girder **18** being seated on and connected with the seat plate **37**. The adjacent ends of the webs **47** of the girder I beams **18** are connected by a diaphragm **48** with the inside flange **36** of the upper column section **26**. The diaphragm **48** is of usual plate and angle construction, as shown.

The improved tension and compression means **24** includes, as a compression member, a strut or spacer member **49**, which as shown is composed of two angles having connected back to back legs **50** and **51**, an upwardly extending outside leg **52**, and a downwardly extending inside leg **53**. The strut **49** is thus a built-up Z member. The outside leg **52** is connected to the inside flange **36** of the upper column section **26**. The inside leg **53** is in sliding abutment with the end of the downwardly extending outside flange **45** of the top channel flange member **44** of each girder **18** supported on the column seat plate **37**.

On the outside flange **54** of the upper column section

26, there is connected the upwardly extending leg 55 of a longitudinally extending connection angle, and the angle leg 55 has a hole formed therein at each side of the outside flange 54. At the outside border of the end of the web 43 of each girder top channel 44, there is secured an upwardly extending sleeve lug 56 whose hole is aligned with one of the holes in the angle leg 55.

A tension rod 57 extends through the hole in each sleeve lug 56 and the opposite aligned hole in the angle leg 55. The ends of each tension rod 57 are threaded and the extremities thereof extend beyond the associated lug 56 and the angle leg 55. A nut 58 is screwed on each threaded extremity of each tension rod 57, each nut abutting either in its associated sleeve lug 56 or angle leg 55.

The holes in the sleeve lugs 56 and angle leg 55 have a substantial clearance around the tension rod 57 passing therethrough. The effective tension between the top channel 44 of each girder 18 and the upper column section 26 may thus be varied by screw adjustment of the nuts 58 on each tension rod 57.

The connection between the outer end of each tension rod 57 and the upper column section 26 is thus a swivel connection which is also hinge-like. Similarly, the connection between the inner end of each tension rod 57 and each girder top channel 44 is a swivel connection which is also hinge-like.

From a broader standpoint, there is thus provided a movable articulation between the inner end of the tension and compression means 24 taken as a combined entity, and each girder top flange formed as shown by a channel 44.

In the improved column and connected girder construction, as above described, relative movement is permitted between the ends of the top flange channels 44 of the girders 18 and the inner angle 53 of the strut 49 slidably abutting the channel outer flanges 45. During such relative movement the tension rods may swing slightly, because of the swivel or hinge-like connections of their ends with the girders 18 and the upper column section 26. Such relative movements may arise from vertical deflection, due to load expansion or contraction due to temperature changes, or horizontal deflection due to crane thrust, or a combination of two or three of these position or dimension changes in the supported ends of the girders 18.

At all times, however, the horizontal spacing of the girder end top flange channels 44 from the upper column section 26 is maintained. This is accomplished by the combined push of the strut 49 and pull of the tension rods 57 on the girder end top flange channels 44. The tendency to failure of the supported ends of the girders 18 is thus substantially reduced, as compared to prior constructions.

From a broad standpoint the girders or spanning members 18 may be termed spanning structures. The girders or spanning members 18 may be continuous over some of the seat plates or supports. The supports may be other than a seat shoulder on a column, such as

1. A girder web riveted to a column;

2. A long girder supporting a shorter rail carrying girder; or

3. A long truss carrying rail supporting girders, as in an ore bridge.

Furthermore, the load on the girders may be other than from a crane.

The improved construction may be advantageously added to existing crane runway or similar structures.

In the foregoing description, certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiments of the improved construction illustrated and described herein are by way of example, and the scope of the present invention is not limited to the exact details of construction.

Having now described the invention, the construction, the operation and use of preferred embodiments thereof, and the advantageous new and useful results obtained thereby; the new and useful constructions, and reasonable mechanical equivalents thereof obvious to those skilled in the art, are set forth in the appended claims.

I claim:

1. A flexible connection for runway girders, including an end support having a lower section extending longitudinally below and an upper section extending longitudinally above a transverse junction plane, the upper section of the end support having transversely spaced flanges, a seat shoulder on the lower section of the end support extending transversely in the junction plane from one of the flanges of the upper section of the end support, girders having longitudinally aligned ends, each girder having a bottom flange, a web and a top flange, the bottom flange of each girder end being supported on the end support seat shoulder, means connecting the bottom flange of each girder end with the end support, a spacer strut having one end connected with the upper section of the end support and another end in sliding abutment with each girder end top flange, and tension means connecting said girder end top flange with the upper end support.

2. A flexible connection for runway girders as set forth in claim 1 in which the tension means is a tie rod having one end movably connected with one of the girder end top flanges and the other end having a movable connection with the upper section of the end support.

3. A flexible connection for runway girders as set forth in claim 1 in which the tension means is a tie rod and is connected to the upper section of the end support and the girder by a screw and nut adjustable connection, the screw and nut passing through an enlarged aperture permitting limited movement in the connections.

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