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(54) **TOP MOUNTED INJECTOR FOR COILED TUBING INJECTION**

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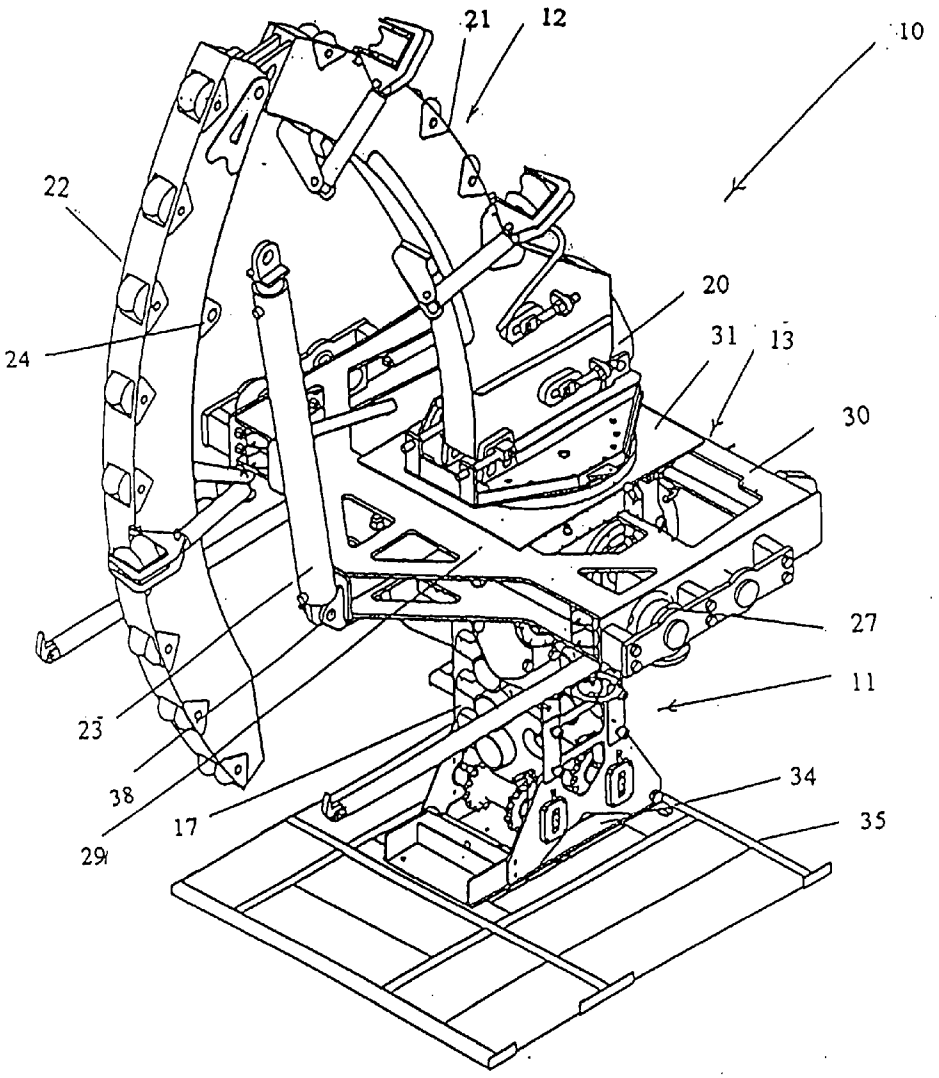
(57) **ABSTRACT**

A tubing injector unit for use in inserting and withdrawing coiled tubing from a well bore hole having in its structure a tubing injector component, a gooseneck component and a mounting component for connection of the overall unit to a supporting structure such as a mast. The mounting component has an upper area for carrying the gooseneck component thereon and a lower underside area forming an injector component supporting structure. The unit in operation thereby supports the injector component in a suspended condition beneath the mounting component so that the working forces which develop in inserting and withdrawing tubing in a bore hole are transferred separately to the mounting component by the injector component and the gooseneck component and thus directly to the supporting structure by the mounting component.



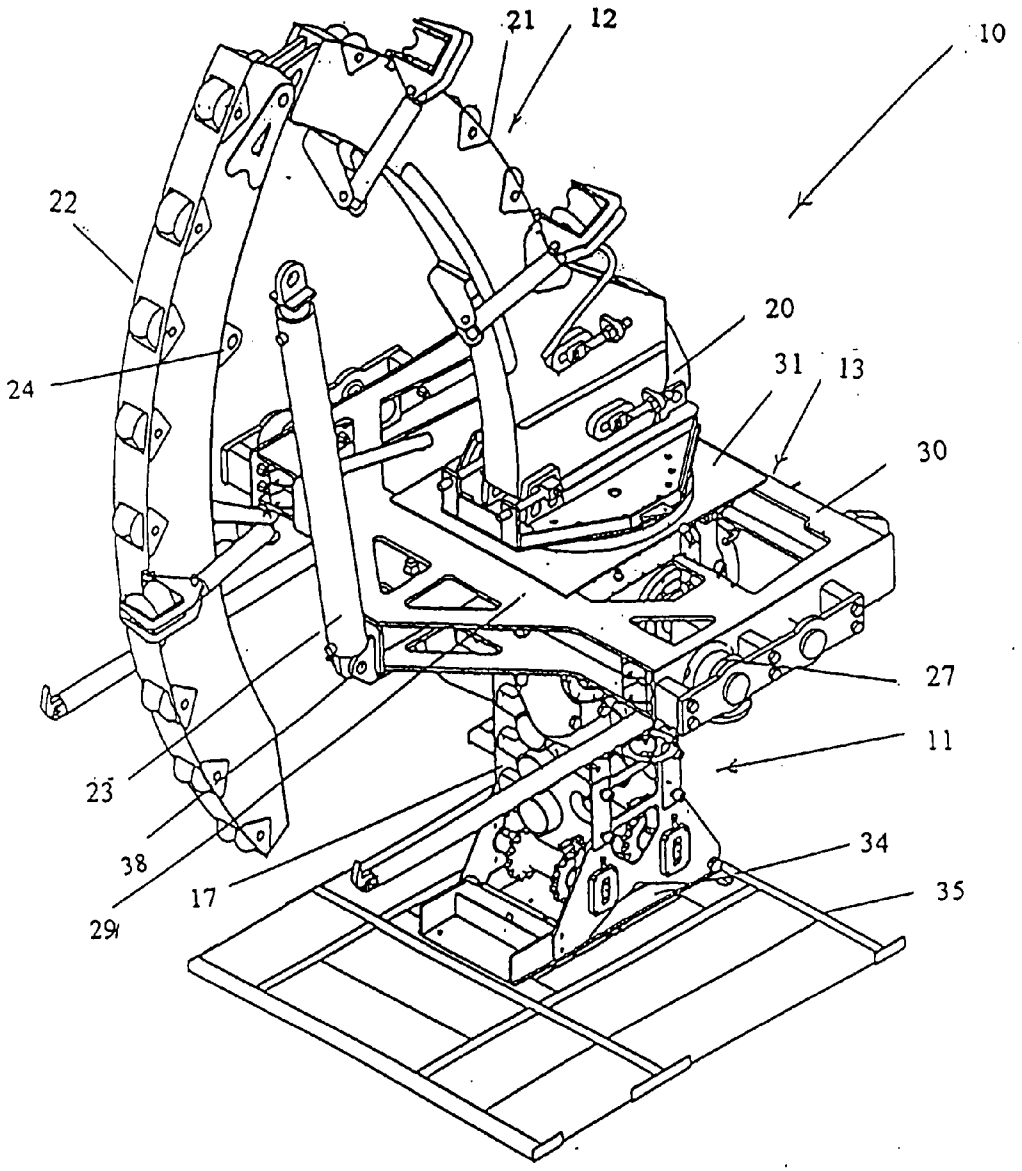


FIG 1

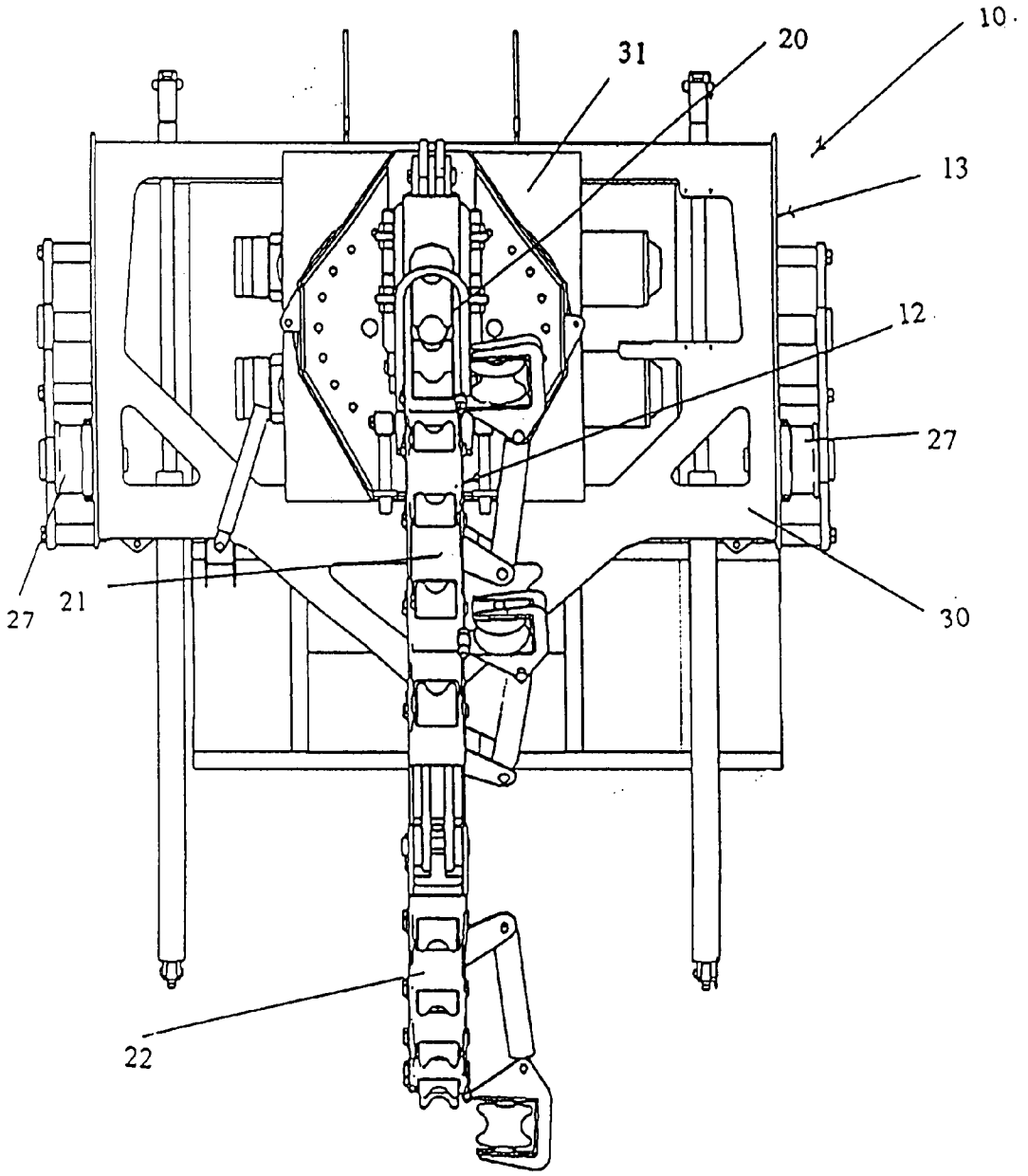


FIG 2

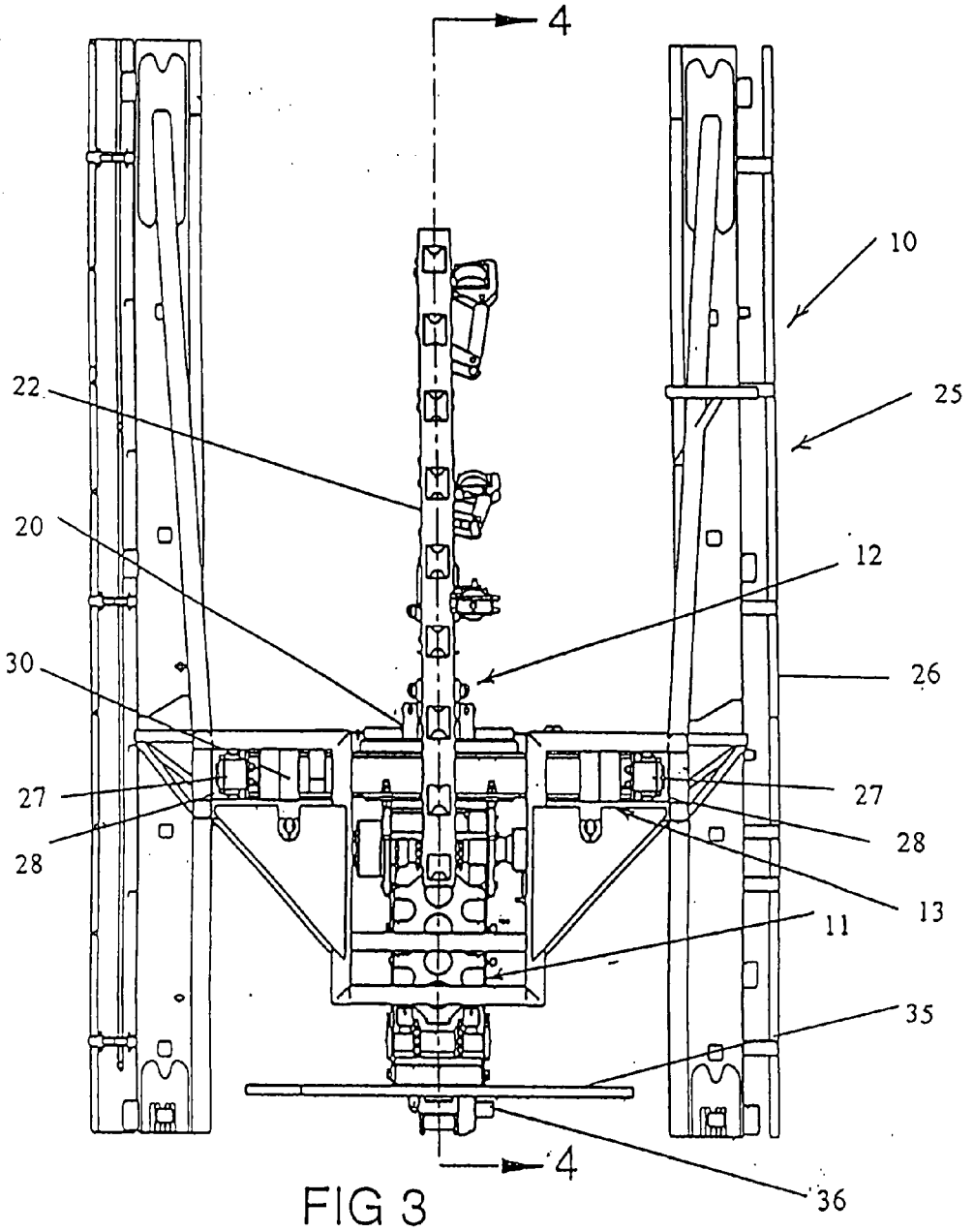


FIG 3

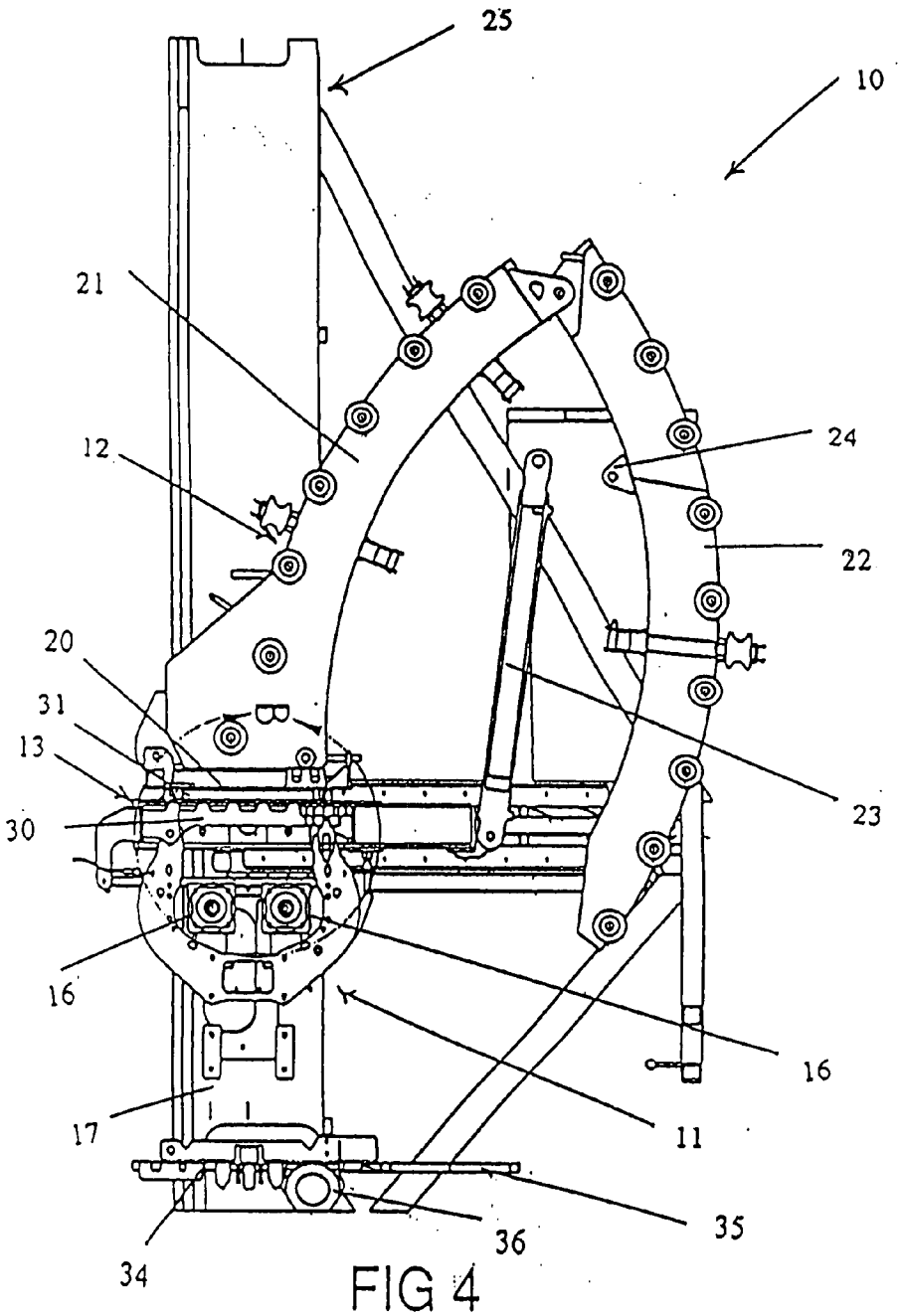


FIG 4

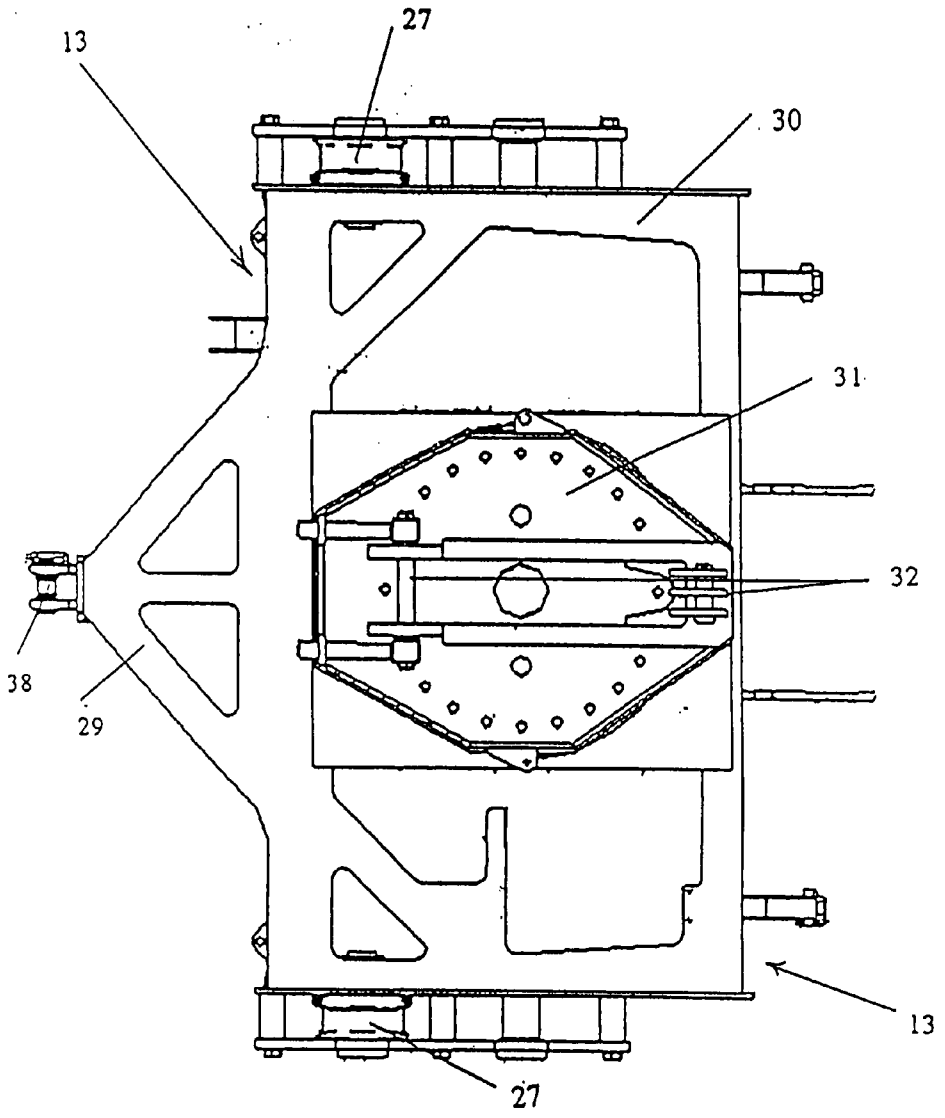


FIG 5

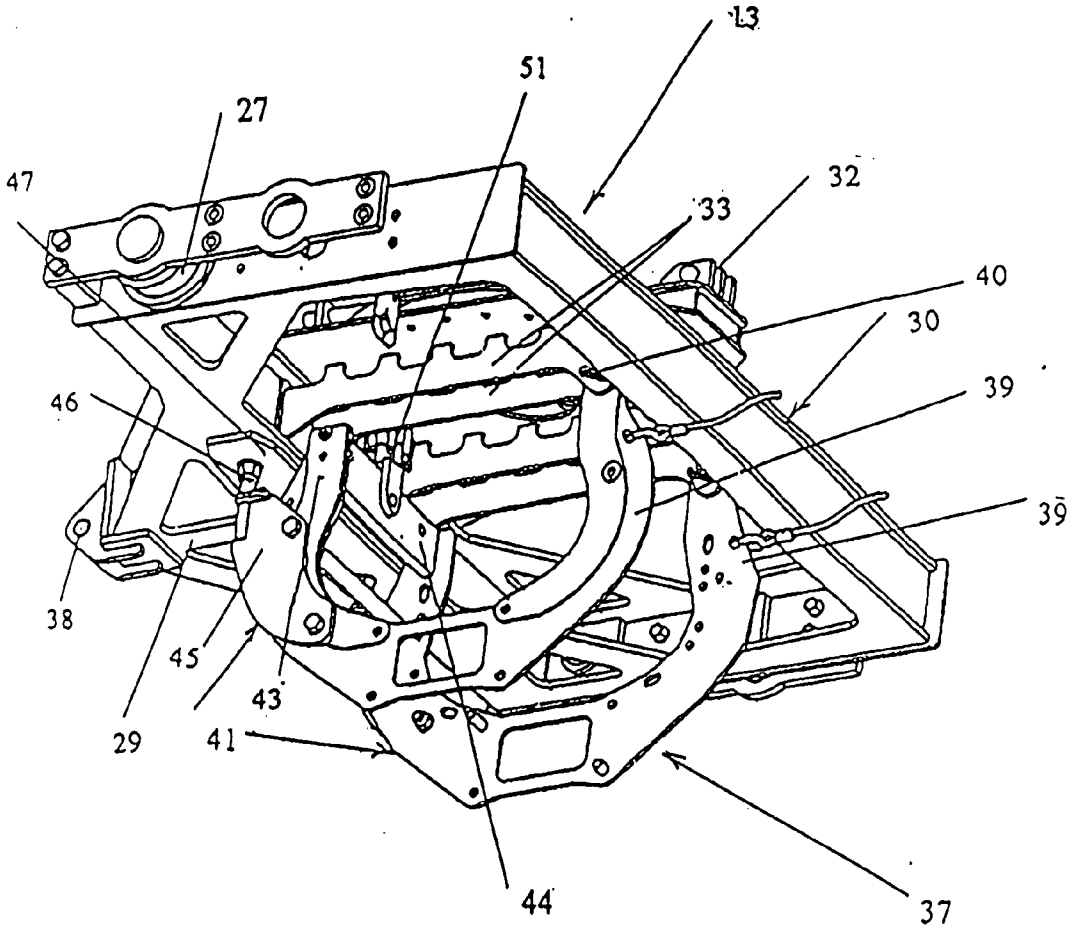


FIG 6

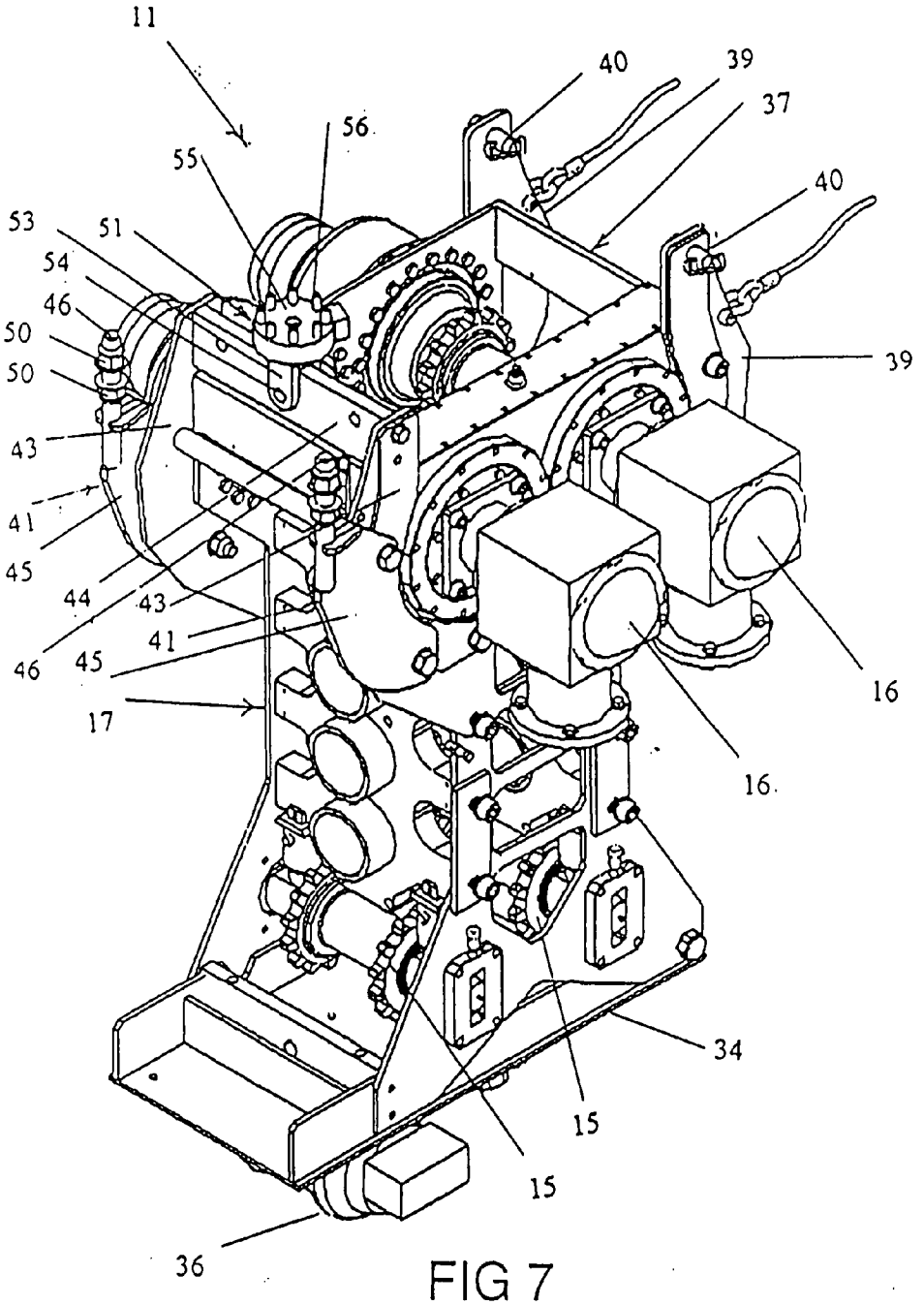

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FIG 7

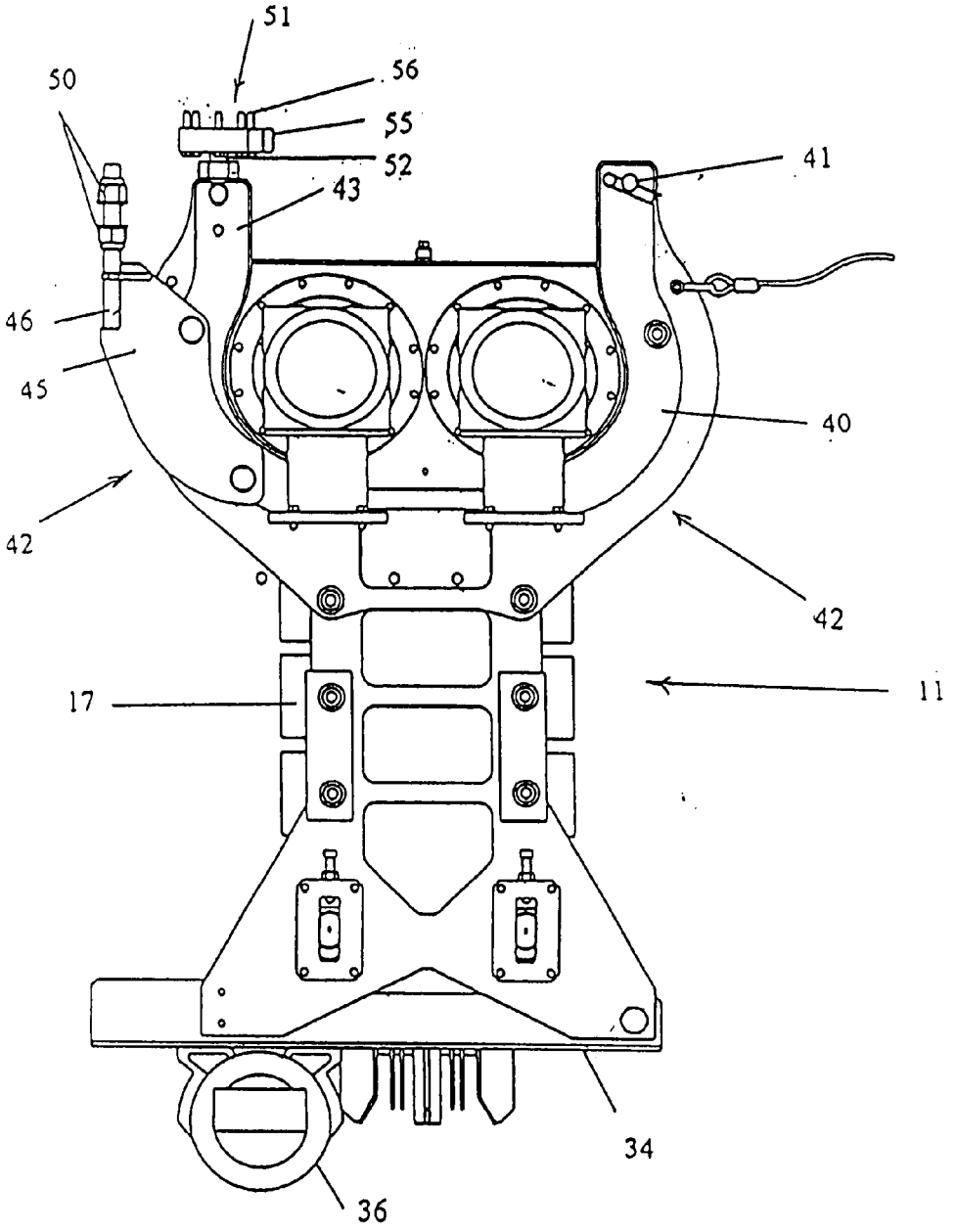

FIG 8

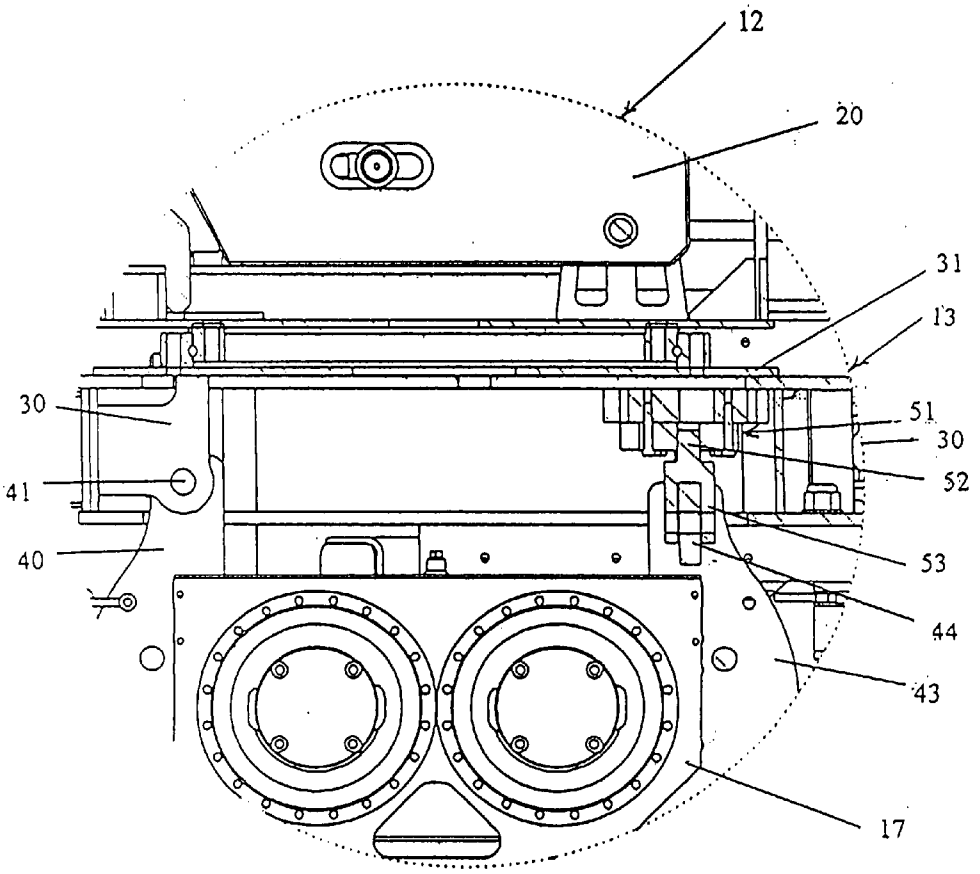

FIG 9

TOP MOUNTED INJECTOR FOR COILED TUBING INJECTION

CONVENTION PRIORITY CLAIM

[0001] This application claims the benefit of convention priority based on Canadian Application No. 2,590,562, filed May 28, 2007, entitled Top Mounted Injector For Coiled Tubing Injection, the disclosures of which are incorporated herein in the entireties.

FILED OF THE INVENTION

[0002] This invention relates to a mounting arrangement for use with a coiled tubing injector of the type for inserting and withdrawing coiled tubing in a well.

BACKGROUND OF THE INVENTION

[0003] A wide variety of coiled tubing injectors and the manner in which they are mounted over a well being serviced have been developed in the last couple of decades as have been the designs of the gripper driving system which engages the tubing and pushes it into the well and withdraws it therefrom. The gripper driven system has been commonly mounted within a framework which normally also carries thereon a gooseneck providing the guide for feeding the tubing from and returning it to a storage reel. Various methods are utilized in mounting the injector above a well head, and more recently it has been common practice for the framework of the injector component to be associated with a mast which is raised to an injector operating position above the well.

[0004] The overall framework and injector combination has commonly included a heavy, lower base structure which may also provide a working platform. The forces which occur in the injector, and particularly those which developed in pushing the tubing into a bore hole and subsequently drawing it out, are transferred to the well head or mast framework through the base structure. There is commonly provided between the base and the structure to which the load is transferred from the injector component, a strain gauge which provides information as to the load the injector is being subjected by its insertion into and withdrawal of the coiled tubing from the well.

[0005] The framework of the overall injector component in such known structures must include a heavy top frame portion above the gripper driving system for the mounting of the gooseneck which transfers a significant load from the effect of the tubing being pulled or pushed over the gooseneck which itself extends a considerable distance upwardly and laterally from the top frame portion of the framework of the injector component. The framework has had to include therefore an intermediate force transmitting frame components extending between the heavy base portion and the top portion which components are usually positioned about the actual grip and feed mechanism. These frame components which are spaced about the gripper drive and provide part of the framework are commonly referred to as a crash cage. This commonly used design accordingly adds considerable weight to the total injector component, which in turn adds to the cost of its production and its use in the field. Moreover, even while adding to the weight of the total structure, there are known instances of the crash cage deflecting under service load conditions, thus resulting in misalignment in the feeding of the coiled tubing to the extent of affecting its path of travel.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide an injector mounting system which is of reduced weight and thus less costly to produce, transport and operate in the field.

[0007] It is a further object of the present invention to provide an injector mounting system in a top mounted fashion which is not only of a simpler design but is not subject to the same adverse operating conditions experienced by the commonly used form of injector structures now in use.

[0008] According to the present invention, there is provided an injector assembly of a type mountable in a support system, such as a mast, above a well head for use in inserting and withdrawing coiled tubing in relation to a well bore hole. The injector assembly includes an injector component containing drive means engageable with the tubing for forcing the tubing therethrough in upward or downward directions, and a mounting component engageable with the support system for holding the injector component in an operable position above the bore hole with the injector component suspended only by the mounting component. The mounting component includes carrier means engageable with the support system for transferring to the support system the forces transferred to the mounting component from the injector component during the injection and withdrawal of the tubing by the injector component.

[0009] In a preferred embodiment of the invention, there is provided an injector structure of the type mountable in a support structure above a well head for use in inserting and withdrawing operations of coiled tubing in relation to a well bore hole, and including a mounting component, a tubular injection component and a gooseneck component. The mounting component is adapted to be located in a working position on the support system, and the tubular injection component contains drive means engageable with the coiled tubing for forcing the tubing longitudinally in either direction in the well bore hole. The gooseneck component is adapted to receive the coiled tubing from a storage reel and direct the tubing from the storage reel to the drive means of the injection component during the inserting operation. Alternatively, the gooseneck component receives the tubing from the injector component and directs it to the storage reel during the withdrawal operation from the borehole. The injector component has a top portion providing upper connection means, and the gooseneck component has a mounting base providing lower connecting means. The mounting component has an upper surface area for engagement with the mounting base of the gooseneck component and includes attachment means interacting with the lower connection means of the gooseneck component so as to support the gooseneck thereabove. The mounting component further has an underside providing inter-locking means for engaging the upper connection means of the injection component for thereby suspending the injection component thereunder. Thus, the mounting component is disposed between the top portion of the injector component and the mounting base of the gooseneck component so that during operation of the injector all forces developed in the injection component and the gooseneck component are

thereby transferred to the supporting structure through the intermediately located mounting component.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the accompanying drawings which show an embodiment of invention by way of example:

[0011] FIG. **1** is a perspective view showing the injector assembly of the present invention as it would be carried in a mast structure or the like above a well head;

[0012] FIG. **2** is a top view of the overall injector assembly of FIG. **1**;

[0013] FIG. **3** is a frontal view of the assembly as shown on FIG. **1**, but showing it mounted in a mast in an operational arrangement;

[0014] FIG. **4** is cross section view of the injector assembly mounted in the mast as seen from the line **4-4** of FIG. **3**;

[0015] FIG. **5** is a top view of the injector assembly of FIG. **1**, but on an enlarged scale with the gooseneck component removed so as to show a top deck of the mounting component of the invention;

[0016] FIG. **6** is a bottom perspective view of the mounting component and showing the relationship of the interconnecting parts of the injector component to the bottom structure of the mounting component of the invention;

[0017] FIG. **7** is a perspective view of the complete injector component per se showing the top front and from opposite the side to that of FIG. **1**;

[0018] FIG. **8** is a side view of the injector component per se in an unmounted condition, as seen from the side opposite to that of FIG. **4**; and

[0019] FIG. **9** is an enlarged partial side view showing in detail the interconnection between the injector component and mounting component as would be seen looking in the same direction as in FIG. **4**.

DETAILED DESCRIPTION

[0020] In the drawings, reference number **10** generally denotes the overall coiled tubing injector system of the present invention and wherein the overall injector system **10** consists in operation of three major components, including an injector component **11**, a gooseneck component **12**, and a mounting component **13**.

[0021] The basic working components of the injector component **11** may be of known designs which include two sets of continuous linked drive chains (not shown) having opposed flights on opposite sides of the passage of the coiled tubing to be driven into and out of a bore hole. These drive chains normally carry gripping members for engaging the tubing and driving the tubing as the drive chains are circulated. Each set of drive chains is driven by a pair of upper drive sprockets **14**, **14**, as best seen in FIG. **7**, the chains passing around upper drive sprockets **14**,**14** and lower idler sprocket **15**,**15**. The upper drive sprockets **14**,**14** are driven by a pair of drive motors **16**,**16** having reversible output. The injector component **11** includes other features, such as the mechanism for forcing the gripping member into contact with the tubing, but these may be of types well known in the art, and thus are not shown in the drawings or further described herein.

[0022] A significant novel aspect of the injector component of the present invention is that its overall framework **17** may be formed of a much lighter construction than in known designs, and the reason for this being possible will become hereinafter. Further features of the injector component **11**, particularly with its mounting arrangement will also be described in more detail below.

[0023] With reference to the gooseneck component **12**, which is shown in FIGS. **1** to **4**, its overall basic design, nevertheless, may be much in accordance with known designs. As shown in FIG. **1**, for example, it includes a base portion **20** with a first inner section **21** of the member forming on arched track, over which the tubing is pulled during operation. The gooseneck is shown as being formed integrally with the base portion **10**. For the sake of forming a more compact unit when not in use, the gooseneck has an outer section **22** which is hinged to an outer end of the inner portion **21**. An outer end of a hydraulic cylinder **23**, which is pivotally connected by a pivot pin **38** at the forwardly projecting front portion **29** of the mounting component **13**, can be optionally connected to a lug **24** on an underside of the outer section **22**. Thus, on expansion of the hydraulic cylinder **23**, the outer section is pushed to an operative position forming a continuous arcuate path with inner section **21** for the travel of the tubing on entering or leaving the injector component **11**.

[0024] The overall injector system **10** of the present invention is adapted to be mounted over the well head (not shown) and may be carried by way of its mounting component **13** on a support system generally shown at **25** (FIG. **3**). The support system **13** is illustrated herein as being a conventional mast, or the like, shown generally as **26** (FIGS. **3** and **4**). The mounting component **13** is made up of a framework **30**, which may be provided with means for rigidly attaching it within the structure of the mast. In the embodiment shown, however, the mounting component is in the form of a dolly-like platform which is held in position by an engagement of two pairs of rollers **27**, one of each pair being shown on each side of the platform (FIG. **3**). Such rollers **27** are closely received within a pair of channel members **28**,**28** which are rigidly affixed to the mast and form tracks at either side of the mounting component **13**, as is best seen in FIG. **3**. This is well known in the method of mounting an injector in a mast to allow the movement of the injector into a working position in alignment with the well head. However, other means of affixing the platform **30** in a mast, or like structure, above a well head are known. Such means must have the capability of rigidly holding the vertical positioning of the injector system **10**, and be capable of transferring to the mast the weight and working forces which are transferred thereto from the injector component **11** and gooseneck component **12**.

[0025] In any event, it may be seen that the overall framework **30** of the mounting component **13** of the present invention may be relatively simple. As the forces which are transferred to the lower and upper parts of the mounting component **13** from the two major components **11** and **12** used in the injecting process, such forces are then transferred from this intermediate mounting component **13** to the supporting system **25**. The mounting component **13** has little depth, as the base portion **20** of the gooseneck component **12** is mounted on a base plate **31** forming an upper surface on the framework **30** by way of interlocking parts **32** (FIG. **5**) affixed to the base plate **31**. As will be described in more detail below, there are provided within the framework **30**, inner ribs **33** providing appropriate openings for receiving connecting pins associated with mating openings in upwardly projecting connecting members of the injector component **11**, whereby the injector component affixed beneath the mounting component **13** is in an entirely suspended condition relative to the mounting component.

[0026] As previously indicated, because the forces from both the gooseneck component **12** and the injector component **11** itself are not transferred to a lower portion of the injector component, the framework **17** of the injector component **11** per se does not have to be structurally large nor does it have to be provided with an external force transmitting framework or cage to transfer forces developed in the gooseneck component **12**. Thus, at the bottom of the injector component **11** there is no need for the conventional heavy base portion. It is preferable, however, to affix to a flat bottom portion **34** of the injector component **11**, a laterally projecting work platform **35** for the convenience of personnel during maintenance of the injector component. For obvious reasons the work platform **35** need only be of a construction which is very light in relation to normal framing used in the lower part of known injection components. This platform **35** is not shown in place in FIG. **7** and **8**, but there is apparent in these Figure the presence of a winch **36**, which is attached to the bottom of the injector component **11** for use in the operation of the injector system and in maintenance work.

[0027] With particular reference to FIGS. **4** and **6** to **9**, one arrangement in which the injector component **11** is suspended from beneath the mounting component **13** will now be given. Generally supporting framework **37** which is part of, or as shown, is affixed rigidly to the main frame of the injector component projects upwardly from the injector component **11** and into the space within the mounting component **13** encompassed by its framework **30**. This framework **37** of the injector component includes a rearward set of upwardly turned support structures **39** which are provided with pin receiving openings for alignment with openings in ribs **33** exposed in the underside of the framework **30** forming the mounting component **13**. Pins **40** are received in the aligned openings to support the rear portion of the injector component in a suspended form beneath the framework **30**. The framework **37** further includes a pair of upturned flange means **41** at the forward side of the injector component. Rearward portions **43** of the pair of flange means **41** are connected by a transverse connecting beam member **44** extending therebetween. Forward portions **45**, **45** of the upturned flange means **41** are provided with vertical threaded bolts **46**,**46**. Beneath the forward portion of the framework **30** of the mounting component **13** there is included a horizontally disposed panel member **47** (FIG. **6**) which includes openings for receiving the bolts **46**,**46**. Nuts **50**,**50** are provided for each bolt **46**,**46** and are positioned one each above and below the panel **47** of the framework **30**.

[0028] There is provided a strain gauge **51** for connection between the injector component **11** and the mounting component **13**, as best seen in FIGS. **7** to **9**, for providing a continuous indication of the forces developed in injecting or withdrawing the tubing from the bore hole and therefore an indication of force transferred between the injector component **11** to the mast **26** via the mounting component **13**. The strain gauge **51** is provided with a mounting stem **52** (FIG. **8**) which has a lower bifurcated end **53** adapted to straddle the transverse beam **44** which, as described above, forms part of the injector component **11**. The stem **52** is thus connected to the beam **44** with a bolt **54** which passes through aligned openings in the bifurcated end **53** and an opening in the transverse beam **44** of the injector component **11**. A head portion **55** of the strain gauge **51** is provided with a plurality of fastener **56** which are connected beneath the framework **30** of the mounting component **13**.

[0029] Various modifications to the disclosed embodiment of the invention will be obvious to those skilled in the art without departing from the spirit of the invention as defined in the appending claims.

1. An injector assembly of a type mountable in a support system above a well head for use in inserting and withdrawing coiled tubing in relation to a well bore hole; said injector assembly comprising:

an injector component containing drive means engageable with said tubing for forcing said tubing therethrough in upward or downward directions,

a mounting component engageable with said support system for holding said injector component in an operable position suspended therefrom below said mounting component above said bore hole,

said mounting component including carrier means engageable with said support system for transferring to said support system the forces transferred to said mounting component from said injector component during the injection and withdrawal of said tubing by said injector component.

2. An injector assembly as defined in claim **1** wherein said mounting component includes a framework body providing mounting means for supporting thereon a gooseneck assembly above said injector component.

3. An injector assembly as defined in claim **2**, and further comprising load cell means in said framework body for providing data relating to external forces encountered in said injector component and thus transferred to said framework body of said mounting component in the operation of the injector component in forcing said tubing into and out of said well borehole.

4. An injector system as defined in claim **2**, and wherein said support system includes a mast, said framework body of said mounting component being carried within said mast for transferring to said mast all forces transferred thereto from said injector component and said gooseneck.

5. An injector assembly as defined in claim **4**, wherein said injector component includes a lower end portion spaced below said mounting component, and further comprising:

a laterally projecting work platform carried at said lower end of said injector component for positioning within said mast.

6. An injector structure of the type mountable in a support structure above a well head for use in inserting and withdrawing operations of coiled tubing in relation to a well bore hole;

a mounting component for location in a working position on said support structure,

a tubular injection component containing drive means engageable with the coiled tubing for forcing said tubing longitudinally in either direction in said well bore hole;

said injector component having a top portion providing upper connection means,

a gooseneck component for receiving said coiled tubing from a storage reel and directing said tubing from the storage reel to said drive means of said injection component during the inserting operation or receiving said tubing from said injector component and directing said coiled tubing to the storage reel during the withdrawal operation,

said gooseneck component having a mounting base providing lower connecting means,

said mounting component having an upper surface area for engagement with said mounting base of said gooseneck component and including attachment means interacting with said connection means of said gooseneck component so as to support said gooseneck thereabove,

said mounting component further having an underside providing inter-locking means engaging said upper connection means of said injection component for thereby suspending said injection component thereunder,

said mounting component being thereby disposed between the top portion of said injector component and said mounting base of said gooseneck component;

whereby during operation of said injector all forces developed in said injection component and said gooseneck component are transferred to said supporting structure through said mounting component.

7. An injector assembly as defined in claim **6**, wherein said injector component includes a lower end portion spaced below said mounting component, and further comprising:

a laterally projecting work platform carried at said lower end of said injector component for positioning within said mast.

* * * * *