

**EUROPEAN PATENT APPLICATION**

Application number: 78300094.6

Int. Cl.<sup>2</sup>: **B 62 D 21/02, B 62 D 49/00,**  
**E 02 F 3/80**

Date of filing: 27.06.78

Priority: 29.06.77 US 811407

Date of publication of application:  
10.01.79 Bulletin 79/1

Designated Contracting States:  
DE FR GB

Applicant: **MASSEY-FERGUSON INC.,**  
**a Maryland Corporation 12601 Southfield Road,**  
**Detroit Michigan 48232 (US)**

Inventor: **Paul, David S.,**  
**41882 Sutters Lane,**  
**Northville Michigan 48167 (US)**

Representative: **Jones, David Bryn,**  
**Patents and Trade Marks Dept. Massey-Ferguson**  
**Manuf Co. P.O. Box 62,**  
**Banner Lane Coventry. CV4 9GF (GB)**

**Frame for supporting implements on a vehicle and method of making same.**

A frame for supporting implements (18,20) on a vehicle with a chassis including a transversely extending axle housing (110). The frame includes a pair of longitudinally extending rails (58), each rail having first and second end portions and a tower structure (54) extending upwardly from a location intermediate the end portions. First interconnecting means (56) interconnect and maintain the first end portions of the rails in a fixed transversely spaced apart relation, the second end portions being arranged to be secured to second interconnecting means such as a counterweight (118) or backhoe structure (40) to maintain said second end portions in a fixed transversely spaced relation. Means (92, 96) are provided for connecting the first end portions to the vehicle chassis and a stabilizing means (128) extends between the tower structures which permits constrained movement of the tower structures so that the rails can deflect under torsional loading. Attachment means (98) are also provided for attaching each rail to the axle housing (110) intermediate the ends of the rail.

Technical Field

This invention relates to frames for supporting implements on a vehicle and more particularly to such frames which are semi-integrated into an industrial vehicle equipped with earth handling implements fore and/or aft.

An example of such a frame is a frame for supporting a front end loader and a rear mounted backhoe on an industrial tractor.

Implement frames for industrial tractors may be broken down into three categories. The earliest loaders on agricultural tractors were supported by attachable and detachable frames connected to the tractor chassis and dependent solely on the strength of the tractor chassis for their load carrying capability. The second class of frame is the semi-integrated which is permanently attached to the tractor chassis and particularly the axle housing while having sufficient structure in itself to partially support the implements attached thereto and absorb the loadings placed on the implements thereby reducing the loads on the tractor chassis. The third class of implement frame is the integrated frame which consists of a frame fabricated from the start to receive vehicle components such as axles, differential, transmission and engine, all of which are supported from and by the frame which is the support unit for all other components and assemblies including the vehicle wheels.

Background Art

Difficulties have been found in producing a semi-integrated frame which is capable of withstanding the forces imposed on the frame by, for example, the operation of a front

end loader and a rear mounted backhoe without resorting to excessively heavy frame constructions.

Although certain previous constructions have tackled the problem of the bending loads imposed on the frame, particularly during the use of a front end loader, no previous constructions have addressed themselves to the problem of the torsional loads imposed on the frame.

#### Disclosure of Invention

It is an object of the present invention to provide an improved frame of the semi-integrated type referred to above.

According to one aspect of the present invention there is provided a frame for supporting implements on a vehicle with a chassis including a transversely extending axle housing, said frame comprising a pair of rails arranged to extend longitudinally of the vehicle in transversely spaced apart relation, first and second end portions on each rail, a pair of tower structures arranged to be attached one to each rail to extend upwardly from the rails at locations intermediate the end portions thereof, first interconnecting means arranged to interconnect and maintain said first end portions of the rails in a fixed transversely spaced relation, said second end portions being arranged to be secured to second interconnecting means for interconnecting and maintaining said second end portions in a fixed transversely spaced relation, means for connecting said first end portions to the vehicle chassis stabilizing means arranged to extend between said tower structures, said stabilizing means permitting constrained movement of the tower structures whereby the rails can deflect under torsional loading, and attachment means for attaching each rail to the axle housing intermediate said end portions.

The towers of the above frame are used to provide support for the lift arms and operating cylinders of a front end loader and the second interconnecting means may comprise a ballast weight if the vehicle is to be used as a loader only or part of a backhoe structure if the vehicle is to include a backhoe.

A frame in accordance with the present invention is light in weight and capable of flexing in bending and torsion

in order to dissipate the loading imposed on the frame by the implements without unduly loading the chassis to which the frame is secured.

For example, the stabilizing means between the towers ensures that when the towers flex forces are transmitted between the towers by the stabilizing means to equalize the loading on the towers and maintain a spaced relationship between the towers to ensure that the loader does not bind due to tower misalignment.

The torsional characteristics of the frame can be varied by adjusting the flexibility of the stabilizing means. The stabilising means may include a stabilizing plate arranged to extend between the towers, said stabilizing plate having a hole therein generally centrally located to relieve stress therein resulting from torsional loading of the frame.

The stabilizing plate may have a generally Z shaped cross-section when cut by a vertical plane extending generally longitudinally of the frame. The hole in the stabilizing plate is preferably elongated in shape, the direction of elongation being transverse relative to said frame.

The axle housing attachment means preferably includes flexible members which allow relative twisting movement between said rails and axle housing during torsional loading of the frame. This further improves the frame's ability to absorb torsional loading.

The second end portions of the rails are preferably provided with fastening means for securing said second interconnecting means in position, said fastening means including means for carrying shear loads. For example, said shear load carrying means may comprise pins engaging said rails and second interconnecting means. These pins may be tapered at one end to facilitate engagement of the rail ends with the second interconnecting means.

To allow easy assembly of the frame and interchangeability of the various possible forms of second interconnecting means the fastening means preferably includes bolts for detachably securing the second interconnecting means to the rails.

The means for connecting the rails to the chassis may comprise two rail brackets, one for attachment to each rail, and a chassis mounting plate for attachment between the rail brackets.

Preferably the first interconnecting means comprises a steering axle support saddle arranged to extend between said first end portions.

The rails of the frame are preferably structural channel members. These rails may be orientated with their bases extending substantially vertically and their side flanges extending substantially horizontally, the steering axle support saddle being arranged to be secured to the bottom side flanges of the rails.

A further important feature of the frame is that the rails diverge apart so that the frame has a tapering configuration when viewed in plan, the frame having a greater width at its second end portions than at its first end portions. This feature is of importance in enhancing the stability of the frame when supporting a backhoe structure. It removes the need to fabricate the rails with off-sets or bends in order to achieve the necessary frame width at the rear of the frame.

The invention also provides a method of assembly a frame in accordance with the first aspect of the invention on a vehicle having a chassis including a transversely extending axle housing.

#### Brief Description of the Drawings

One embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a perspective view of a vehicle equipped with an implement frame in accordance with the present invention;

Figure 2 is an elevational view of just the frame of the vehicle in Figure 1;

Figure 3 is a plan view of the frame in Figure 2;

Figure 4 is a cross-sectional view along line 4-4 of Figure 3;

Figure 5 is a partial cross-sectional view along line

5-5 of Figure 2;

Figure 6 is a partial cross-sectional view along lines 6-6 of Figure 3;

Figure 7 is a cross-sectional view along lines 7-7 of Figure 6;

Figure 8 is a schematic view of the frame portion of Figure 6;

Figure 9 is a cross-sectional view along lines 9-9 of Figure 3, and

Figure 10 is a schematic view of a portion of the frame and vehicle of Figure 1.

#### Best Mode of Carrying Out Invention

Referring to Figure 1 of the drawings there is generally designated an industrial tractor 10 having an implement frame 12 thereon in accordance with this invention. The tractor 10 is equipped with front and rear wheels 14 and 16. The forward end of the tractor 10 is equipped with a front end loader 18 and a backhoe 20 is located at the rear of the tractor.

The backhoe 20 includes a bucket 22 pivotally connected to one end of a dipper stick 24 which in turn is pivotally connected at its upper end to a boom 26.

A bucket 22 is swingable through a vertical arc relative to the dipper stick 24. A cylinder 28 is pivotally connected between the bucket 22 and dipper stick 24 for this purpose. The dipper stick 24 is pivoted through a vertical arc relative to the boom 26 by operation of a second cylinder 30 pivotally connected between the dipper stick 24 and the boom 26. The boom 26 is also swingable through a vertical arc and a third cylinder 32 is used to achieve this swing being pivotally connected between the boom 26 and the backhoe 20.

The boom 26 is further swingable through a horizontal arc by virtue of a pair of cylinders, one 34 of which is visible in Figure 1, located on either side of the boom 26 and pivotally connected between the boom 26 and the backhoe 20.

To accommodate the horizontal swing movement the boom 26 is pivotally mounted on a swing casting 36 which in turn

is pivotally mounted on part of a backhoe structure 40 for pivoting about a vertical axis 38. The backhoe structure 40 is equipped with pivotally mounted stabilizers, one 42 of which is visible in Figure 1. These stabilizers are each mounted for movement through a vertical arc by means of their own stabilizer cylinder 44 pivotally connected between the stabilizer 42 and the backhoe structure 40. In Figure 1 the stabilizer 42 is seen in the extended position whereby both sides of the backhoe structure 40 are adequately supported by engagement of the stabilizers 42 with the ground.

At the front of the vehicle the loader 18 has a bucket 46 pivotally mounted at the forward end of loader arms, one 48 of which can be seen in Figure 1, which are located on either side of the tractor. The bucket 46 extends between the load arms 48 and is pivoted thereon. Each loader arm 48 is equipped with pivotally mounted cylinder 50 which is pivotally connected to the bucket 46 to change the bucket position or angle.

The elevation and lowering of the arms 48 is brought about through a second cylinder 52 for each load arm 48, the second cylinder 52 being connected at one end in a pivotal fashion with the load arm 48 with which it is associated and at the other end to the implement frame 12. The implement frame 12 is equipped with a subframe or tower 54 which provides a pivotal mounting for the rear end of the load arms 48.

The tractor 10 illustrated is a conventional agricultural type having an engine, transmission housing and back-axle housing which are bolted together to form the chassis, the sump of the engine being a structural component and constituting part of the chassis. Power is delivered from the engine to a differential located in the back axle housing via the transmission. The back axle housing provides support for the rear wheels 16 and the front wheels 14 are mounted on the chassis via the implement frame 12.

Figures 2 and 3 show the implement frame 12 is equipped with a front axle support portion 56 which supports a conventional steering mechanism actuated by means of a steering

wheel as illustrated in Figure 1.

It will be appreciated that, with the backhoe stabilizers 42 and bucket 22 as well as the front end loader 18 elevated relative to the ground, the tractor 10 in Figure 1 may be conveniently moved from one place to another under its own power as developed by its motor. When the loader 18 is being used the forces directed towards the implement frame 12 occur both from driving the vehicle 10 into a work pile with the bucket 46 orientated to fill the bucket 46 and by operation of the cylinders 50 and 52 on the bucket 46 and lift arms 48 in curling the bucket 46 and elevating the arms 48 as the work load is being engaged.

The operation of the backhoe 20 is usually accompanied by extension of the stabilizers 42 to engage the ground whereby the backhoe structure 40 and stabilizers 42 receive the forces resulting from use of the backhoe 20 rather than the rear wheels 16 and the vehicle chassis therefrom. The operation of the backhoe 20 may result in a wide variety of stresses being applied to the tractor 10 but most particularly the implement frame 12. Torsional stresses arise when the backhoe 20 is pivoted horizontally as to dig on one side or the other of the tractor 10 rather than directly to the rear thereof. The above stress phenomenon is not limited to the operation of the backhoe 20 but may also be present in the operation of the front end loader 18 when one side of the bucket 46 encounters the load so as to eccentrically load the bucket 46 and implement frame 12.

Bending stress is also developed by the cantilever arrangement of the two implements 18 and 20 mounted on either extreme of the implement frame 12. In the past, where loader frames have been supplemented with rear counterweight in order to counterbalance the load on the front of a tractor, the bending stress transmitted to the tractor chassis to which the loader frames were previously attached as load receiving members resulted in localized bending stresses intermediate the length of the vehicle. Extreme cases resulted in actually breaking the vehicle in two. The above problem could be solved by

using longitudinal frame members sufficiently strong so as not to bend and thereby not stress the chassis of the tractor, but such members were found to be excessively heavy. The addition of a backhoe in this operation imposed additional and extremely serious problems of localized bending stress. For example, where both implements, the front end loader and the backhoe, were used in conjunction to extract a mired vehicle the resultant bending stresses were a complete reversal of those experienced under normal operation conditions.

It is to be appreciated that the above operation is a desirable one for a vehicle of an industrial nature which should be suitable for use on job sights even where ground conditions are soft. Thus, the implement frame 12 should be suitable for enabling the front and rear implements 18 and 20 to literally raise the tractor 10 off the ground. While prior art structures had addressed themselves to the problem of bending stresses which are accommodated in the implement frame, the same has not been true for the torsional stresses which tend to twist the implement frame longitudinal members, or rails, about their longitudinal axis. At best the prior art structures disclose reinforcing the implement frame to thereby make the frame more rigid and prevent movement of the implement frame. Thus, it can be seen that such stresses not being able to be taken by deflection of the frame again are transmitted to the chassis of the vehicle. As was found in the case of the bending stresses above, the transmission of forces from the frame to the vehicle chassis is undesirable and therefore the frames had to be increased in strength, and therefore weight, as was done previously for the frames in bending. The point is again reached where the frames become excessively heavy.

In the present structure the above is not the case and the advantageous operation of the implement frame 12 being flexible in torsion as well as in bending is achieved through employment of a semi-integrated frame construction of an arr-

angement which will now be described with particular reference to Figures 2-9.

Referring to Figures 2 and 3 the primary longitudinal members or rails of the frame 12 illustrated are seen to be structural channel members 58 to which the tower assemblies 54 are welded. The towers contain bossed apertures for receiving pivots for the lift arm cylinders 52 in the lower bosses 60, for the lift arms 48 themselves in the upper left hand bosses 62, and for a member of the bucket linkage in the upper right hand boss 64. The towers 54 are located intermediate the ends of the channels 58.

The front end of each channel 58 has an angle member 66 welded thereto and extending there beyond with apertures 68 therein for receiving the nose and grill of the tractor 10. The front axle support saddle 56 constitutes a first interconnecting means extending between the rails 58. The saddle 56 extends downwardly from the front of the channels 58 and includes front and rear mounting plates 70, 72 having bosses 74 centrally mounted therein on the longitudinal centre line of the frame 12 to provide a pivot axis A for the oscillation of the front axle, a C-shaped stiffener 76 extends longitudinally between the front and rear plates 70 and 72 with a gusset 78 extending transversely thereof acting as a stiffener. A pair of flange plates 80 and 82 have a series of apertures 84 corresponding to apertures 86 in the lower legs 88 of the frame channels 58 whereby bolts 90 may be passed through to bolt the axle support saddle 56 to the channels 58.

Between the front axle saddle 56 and the towers 54 an engine support member in the form of a L-shaped bracket 92 extends downwardly from each channel member 58 with apertures 94 in the lower leg thereof for receiving means for fastening the bracket 92 to a mounting plate 96 on the engine of the tractor 10 as best seen in Figure 4. The L-shaped brackets and plate 96 provide rail connecting means to the engine which thus firmly attach the frame 12 to the tractor chassis while at the same time accommodating some flexing of the rail about its longitudinal axis B and corner to corner deflection of the

frame 12 in the horizontal plane due to eccentric loads.

Between the tower 54 and the rear end of the frame 12, axle housing attachment means are welded to the channels 58 taking the form of L-shaped ears 98. The upstanding leg 102 of each ear 98 has a recess 100 to increase the weld area of the member. Thus each ear 98 is welded to the associated channel 58 around the entire periphery of the recess 100 as well as along the two sides 104 forming the upper apex of the leg 102. The welds along the sides 104 terminate a point just short of the bottom of the channel 58 to leave a portion at the bottom of the channel is free of weld. The ears 98 each have a horizontal leg 106 with apertures 108 therein for receiving fastening means for fixedly attaching the leg 106 to the axle housing 110 of the tractor 10. The legs 106 together with the unwelded portion of the upper legs 102 provide for flexibility between the axle housing 110 and the channel members 58. Thus, again the channel members 58 may flex about their longitudinal axes B under torsional loading.

At the rear of each channel 58 a face plate 112 is welded to the butt end thereof. Each plate 112 has a pin 114 welded in an aperture therein with the end of the pin 114 extending from the plate 112 and having a taper 116 thereon for guiding the pin 114 into a countereieght 118 attached thereto.

The counterweight 118, illustrated in Figures 2 and 3, is an alternate to the embodiment in Figure 1 replacing the centre mount backhoe 20 illustrated in Figure 1. As a further alternative, a side shift backhoe structure could also be mounted on the present frame. All of these alternatives provide second interconnecting means for interconnecting the rear ends of the rails.

All the above assemblies and their loads are supported in shear by the pins 114 in the face plates 112 and are attached by four bolts 116 passing through apertures 118 in the face plates 112 as best illustrated in Figure 5. The counterweight 118 at the rear of the vehicle and the front axle support saddle

56 at the front of the frame 12 form a box structure wherein the channel 58 between these two points is able to flex under torsional stress about its longitudinal axis B and able to flex under bending stress between the rear axle housing 110 connection and the rail connection to the engine in the manner of a simply supported beam supported at the above two connections.

The box structure formed by the rails 58, the axle support 56 and the counterweight 118 is clearly shown in Figure 3.

In addition each tower structure 54 as can be seen from Figures 3 and 6 consists of an inner upwardly extending plate 120 welded to the outside of the associate rail 58. An outer plate 112 of the same configuration as the inner plate 120 extends over the face of the inner plate 120 being terminated just short of the bottom thereof by bending the plate 122 inwardly and extending it to the inner plate 122 to which it is welded. A horizontal gusset plate 124 extends between the inner and outer plates 120 and 122 to maintain them spaced apart and a back plate 126 extending over the total height of the tower 54 completes the assembly. The bosses 62 and 60 for the lift arm 48 and lift arm cylinder 52 are provided in both the inner and outer plates 120 and 122 with the bosses 60 for the lift arm cylinders 52 passing through both the inner plate 120 and the web of the channel 58. The bosses 64 for the lift arm link 63 on the other hand are continuous extending between the inner and outer plates 120 and 122.

Figure 3 further illustrates a Z-shaped plate 128 which provides a stabilizing means between the towers 54. In the illustrated embodiment the plate 128 has a stress relief hole 130 therein as best illustrated in Figures 6 and 7. Although the plate 128 stabilizes the towers 54 it allows enough freedom for flexure of the channels 58 on which the towers 54 are mounted under torsional stress, see Figure 3. The plate 128 has opposite hand end plates 132 welded to each end thereof with apertures 134 therein for receiving bolts for bolting the end plates 132 and thereby the plate 128 to the towers 54. In Figures 6 and 7, the stress relief hole 130

in the plate 128 can be seen to be elongated with the upper and lower sides 136 and 138, forming its border, being longer than the sides 140 and 142 which complete the hole's border. Thus, a full cross-section of plate 128 exists adjacent the end plates 132 to act as a reinforcing stiffener because the stabilizing means is symmetrical about line C. At the same time, the configuration of the hole 130 provides a lesser cross section of material at the top and bottom of the plate 128 where the line C intersects it to permit flexing of these portions when the channels 58 flex in torsion due to transverse deflection of the towers 54 under eccentric loading of the frame 12. The lips 144 and 146 in Figure 7 together with the above lesser cross section of the plate 128 form angle reinforcements uniform in cross section between the towers 54 to transfer loads therebetween and maintain the spacing between the towers 54 necessary for the desired operation of the loader 18 via the arms 48 and linkage 63 attached to the towers 54. Thus, the plate acts as an equalizer for forces on the towers 54.

In Figure 8 a schematic example is given of one type of tower deflection which may occur being exaggerated for purposes of illustration. Note the twisting of the channels 58 under the loading created by the force F in the direction indicated by the arrow. The force is a component resulting from eccentric loading on the frame 12 from, for example, use of one corner of the loader bucket 46 as described above. Another example would be deflection of the towers 54 relative to each other in the longitudinal direction of the channels 58 causing the plate 128 to twist. In this instance, the lesser cross section and lips 144 and 146 forming the angle reinforcements would be able to twist in a manner similar to that illustrated in Figure 8 for the channels 58. In each case the ability of a structural member to deflect prevents excessive stress on the plate 128 to tower 54 connection to avoid tearing the structure apart.

In Figures 2 and 3 at the rear of the frame 12 the face plate 112 can be seen to be reinforced by inner and outer gusset plates 148 and 150 as well as a bottom gusset plate 152 as further illustrated in Figure 9. The bottom gusset plate 152 extends over the outer gusset plate 150 and to both the channel 58 and the face plate 112. The outer gusset plate 150 has three slotted apertures 154 for receiving alignment pins and the inner gusset plate 148 can be seen to have a bend in it to permit the plate to extend from the outer portion of the channel 58 upper leg to the inner portion of its lower leg. In Figure 2 the inner gusset plate 148 can be seen to have two legs 156 and 158 which extend towards the front of the frame 12 and are tapered in the direction of their extension. A gusseted angle member in Figure 9 is attached to the inner gusset plate 148 to provide a bracket 160 for supporting tractor components.

In Figure 10 a schematic example is given of one type of channel deflection which occurs under torsional loading of the frame 12, being exaggerated for purposes of illustration. It can be seen that the twisting of the channels 58 causes deflection of the L-shaped ears 98 to prevent excessive stresses from arising and/or excessive loading of the axle housing 110.

In Figure 3 the channels 58 can be seen to diverge from front (left) to rear (right) to accommodate the gauge of the front wheels 14 while providing as wide, and therefore as stable, a connection as possible to receive the loading from the backhoe 20. The frame thus has a tapering configuration when viewed in plan. The rear ends of the channels 58 are fixed in spaced apart relation in a plane transverse to the longitudinal axis D of the tractor 10 and its frame 12 by means connecting the ends of the channels 58, such as the counterweight 118 or backhoe structure 40, to maintain the channels 58 in an outwardly diverging unbroken line from each other.

Previously, the frames for supporting implements have either not taken advantage of a widened backhoe connection

by maintaining the gauge of the front wheels, or where the gauge of the frame was changed the frame was fabricated with accommodating offsets or bent to achieve the same result. In both above cases the bends or fabricated joints presented points for high stresses under loading and if torsional stress were allowed to twist the frame members as in the present application there would be likelihood of failure of the frame at these points.

The frame 12 is assembled as follows. First a rail 58 and a tower 54 are secured in a jig to align these components in their correct relative positions, the bosses 60-64 being used for alignment purposes. The tower and rail are then welded together to form a first subassembly which also includes the bracket 92, 160, member 60, plate 112, pin 114 and ear 98. This process is then repeated to produce a second subassembly consisting of the rail and tower for the other side of the frame 12.

These two subassemblies are then moved to a vehicle chassis and are loosely bolted to the back axle 110 using bolts extending through apertures 108 in the ears 98.

The front ends of the rails 58 are then secured in a jig at the correct spacing and the rear ends of the rails are then canted outwardly, that is moved away from the longitudinal axis D of the frame to give the desired tapering frame shape. The rear ends of the rails are then held in their correct relative positions by a further jig which extends between the rear ends of the rails and uses the pins 114 for location.

The plate 128 is then secured between the towers 54 and bolted up tight. The mounting plate 96 and axle saddle 56 are then secured firmly between the rails and the bolts securing the rails to the back axle are then tightened. The jigs extending between the front and rear ends of the rails can now be removed and the frame moved to the next assembly point on the line.

The above frame 12 results in a lightweight rugged semi-integrated structure for carrying implements on a vehicle which can be stressed in both bending and torsion without adverse effect on the chassis of the vehicle to which the frame 12 is attached while at the same time providing sufficient connection to the chassis of the vehicle to obtain all the advantages of an integrated frame. Thus, the frame 12 optimizes the advantages of the lightweight of the attachable type loader frames while providing the strength and ruggedness approaching that of an integrated frame.

## CLAIMS:-

1. A frame for supporting implements on a vehicle with a chassis including a transversely extending axle housing said frame being characterised by comprising a pair of rails (58) arranged to extend longitudinally of the vehicle (10) in transversely spaced apart relation, first and second end portions on each rail, a pair of tower structures (54) arranged to be attached one to each rail to extend upwardly from the rails at locations intermediate the end portions thereof, first interconnecting means (56) arranged to interconnect and maintain said first end portions of the rails in a fixed transversely spaced apart relation, said second end portions being arranged to be secured to second interconnecting means (118;40) for interconnecting and maintaining said second end portions in a fixed transversely spaced relation, means (92,96) for connecting said first end portions to the vehicle chassis, stabilizing means (128) arranged to extend between said tower structures, said stabilizing means permitting constrained movement of the tower structures whereby the rails can deflect under torsional loading, and attachment means (98) for attaching each rail to the axle housing (110) intermediate said end portions.

2. A frame according to claim 1 characterised in that said stabilizing means includes a stabilizing plate (128) arranged to extend between said towers (54), said stabilizing plate having a hole (130) therein generally centrally located to relieve stress therein resulting from torsional loading of the frame (12).

3. A frame according to claim 2 characterised in that said stabilizing plate (128) has a generally Z-shaped cross

section when cut by a vertical plane extending generally longitudinally of the frame (12).

4. A frame according to claim 2 or claim 3 characterized in that the hole (130) has an elongated shape, the direction of said elongation being transverse relative to said frame (12).

5. A frame according to any one of claims 2 to 4 characterized in that said stabilizing means further includes a pair of flange plates (132) abutting the ends of said stabilizing plate (128), said flange plates being fixedly attached to said plate and arranged to be connected (135) to said towers (54).

6. A frame according to claim 5 characterised in that said flange plates (132) are arranged to be connected to said towers by bolts (135).

7. A frame according to any one of claims 1 to 6 characterised in that said axle housing attachment means includes flexible members (98) which allow relative twisting movement between said rails (58) and axle housing (110) during torsional loading of the frame (12).

8. A frame according to claim 7 characterised in that said flexible members (98) are L-shaped in form with one leg (102) thereof connected to said rails (58) and the other leg (106) arranged to be connected to said axle housing (110).

9. A frame according to claim 8 characterised in that

said other leg (106) includes apertures (108) therein and said axle housing attachment means includes bolts for passing through the apertures in said other leg to affix said other leg to said axle housing (110).

10. A frame according to claim 8 or claim 9 characterised in that the free edges (104) of said one leg (102) of each flexible member (98) are welded to the associated rail (58).

11. A frame according to any one of claims 1 to 10 characterised in that the second end portions of the rails (58) are provided with fastening means (112,114) for securing said second interconnecting means (118;40) in position, said fastening means including means (114) for carrying shear loads.

12. A frame according to claim 11 characterised in that said shear load carrying means comprise pins (114) engaging said rails and said second interconnecting means (118;40).

13. A frame according to claim 12 characterised in that said pins (114) are tapered (116) at one end thereof to facilitate engagement of said rail ends with said second interconnecting means (118;40).

14. A frame according to any one of claims 1 to 13 characterised in that said second interconnecting means is part of a backhoe structure (40).

15. A frame according to any one of claims 1 to 13



characterised in that said second interconnecting means is a counterweight (118).

16. A frame according to claim 14 or claim 15 characterised in that said fastening means includes bolts (119) for detachably securing said second interconnecting means (118;40) to said rails (58).

17. A frame according to any one of claims 1 to 16 characterised in that said means for connecting the rails to the chassis comprises two rail brackets (92), one for attachment to each rail, and a chassis mounting plate (96) for attachment between the rail brackets.

18. A frame according to any one of claims 1 to 17 characterised in that the first interconnecting means comprises a steering axle support saddle (56) arranged to extend between said first end portions.

19. A frame according to any one of claims 1 to 18 characterised in that said rails (58) are structural channel members.

20. A frame according to claim 18 and claim 19 characterised in that the channel members (58) are orientated with their bases extending substantially vertically and their side flanges extending substantially horizontally, the steering axle support saddle (56) being arranged to be secured to the bottom side flange of the channel members.

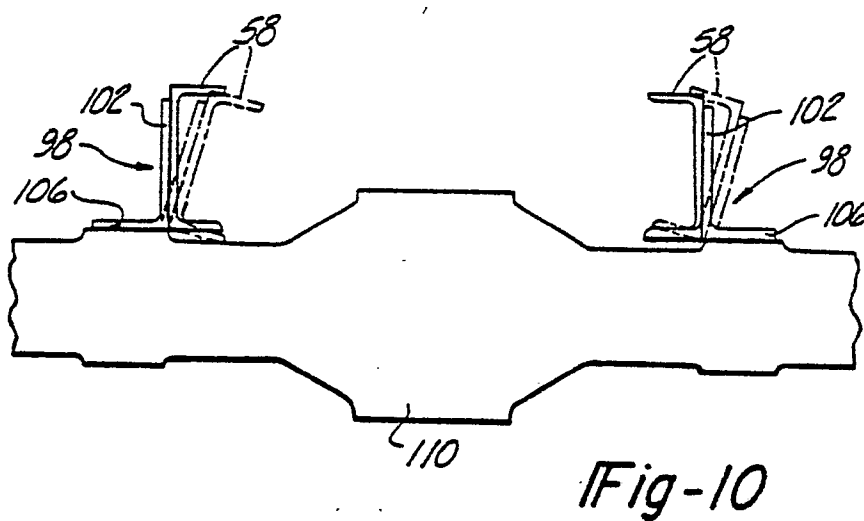
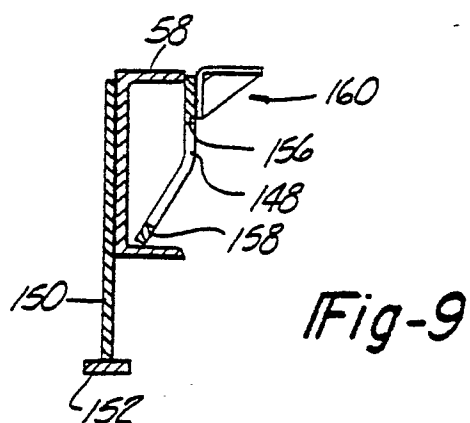
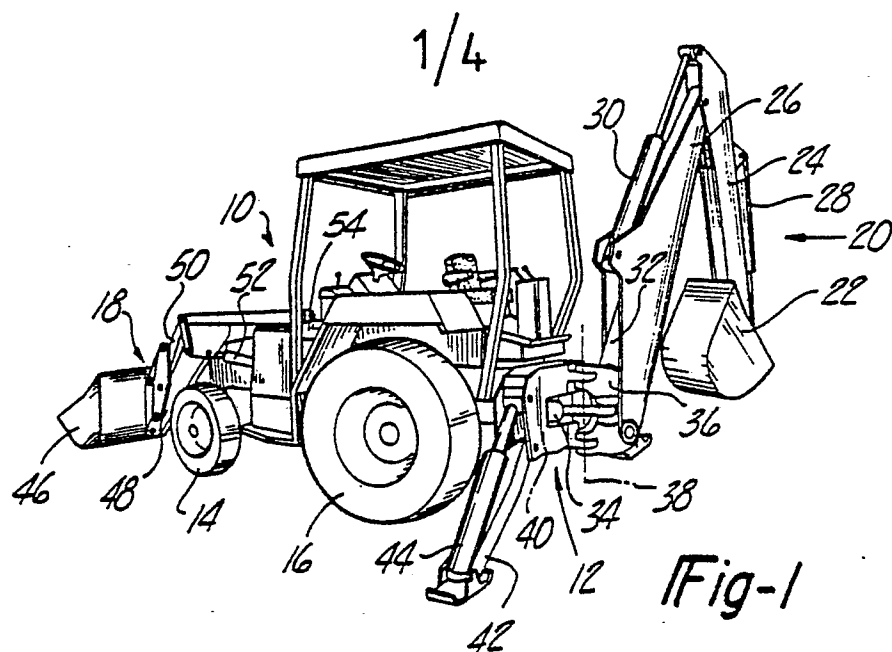
21. A frame according to any one of claims 1 to 20 characterised in that the rails (58) diverge apart so that the frame has a tapering configuration when viewed in plan, the

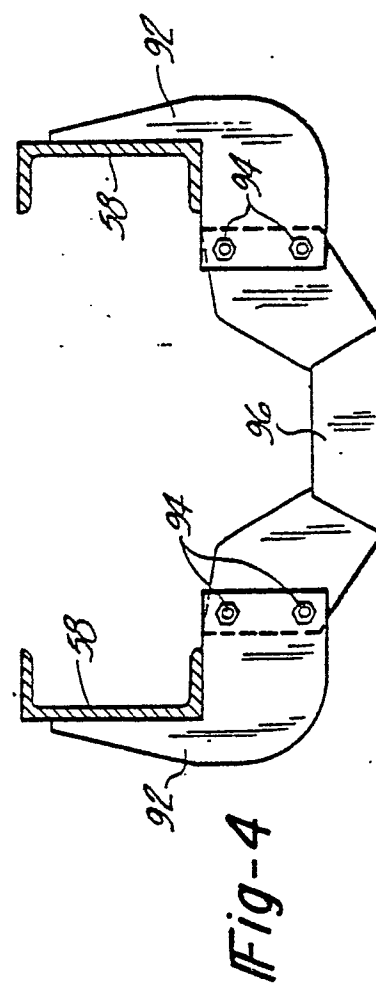
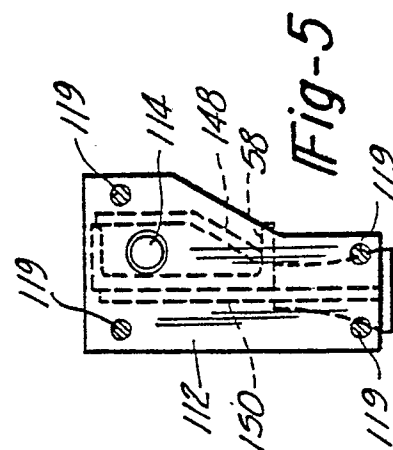
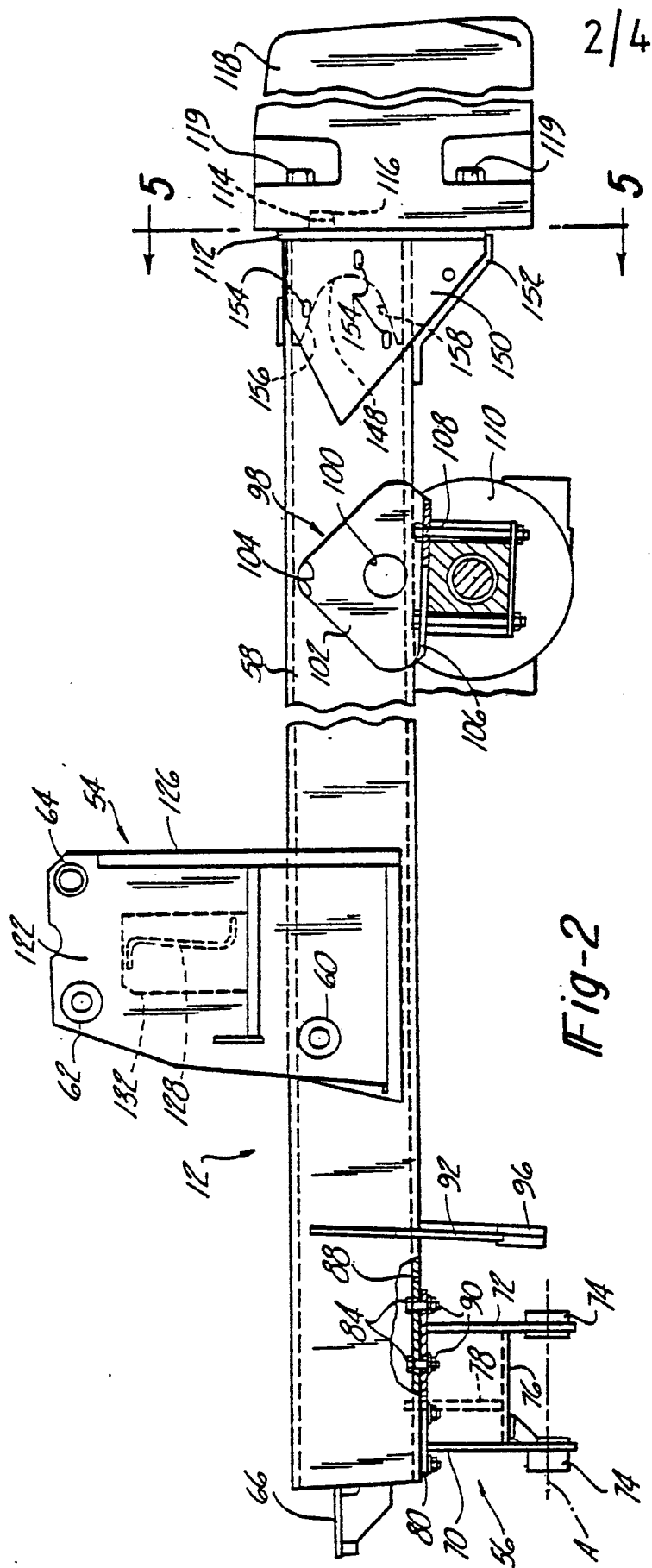
frame having a greater width at its second end portions than at its first end portions.

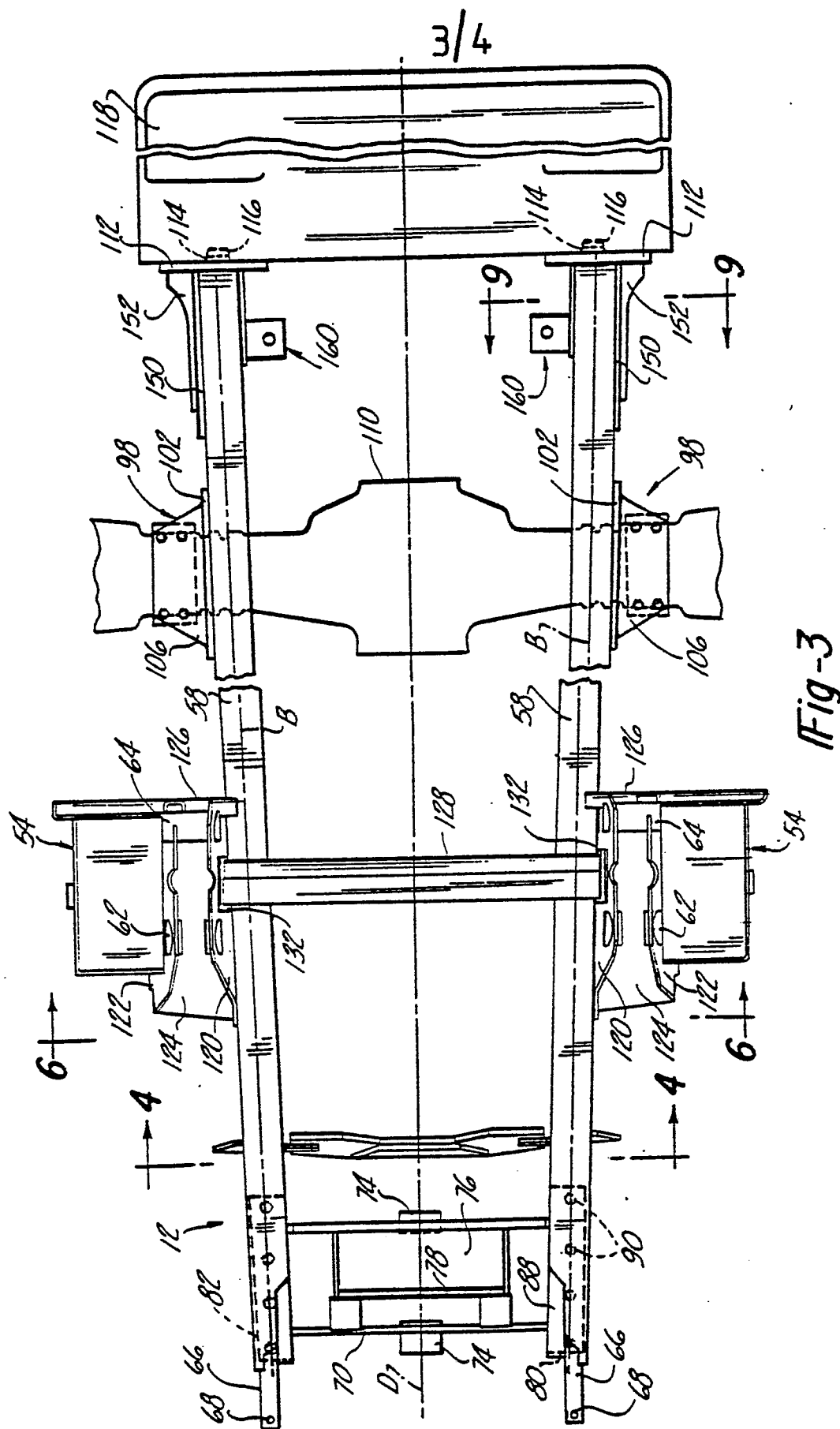
22. A method of assembling a frame according to claim 1 on a vehicle with a chassis including a transversely extending axle housing, being characterised by including the steps of:-

forming a first subassembly by securing a rail (58) and a tower (54) in an alignment jig and welding the tower to the rail;  
forming a second similar subassembly by repeating the above step with a further rail and tower;  
transporting the two subassemblies to the chassis;  
loosely fastening each subassembly to the chassis;  
fixing a jig between the first or second end portions of the rails;  
canting the rails so that the frame has a longitudinally tapering configuration when viewed in plan;  
fixing a further jig between the other end portions of the rails;  
securing the stabilizing means (128) between the towers;  
fastening the first (56) and second (118;40) interconnecting means between the end portions of the rails, and tightening the fastening of the rails to the chassis.

23. A method according to claim 22 characterised in that in the previously referred to step of loosely fastening the rails to the chassis the rails (58) are in fact loosely fastened to the back axle housing (110).







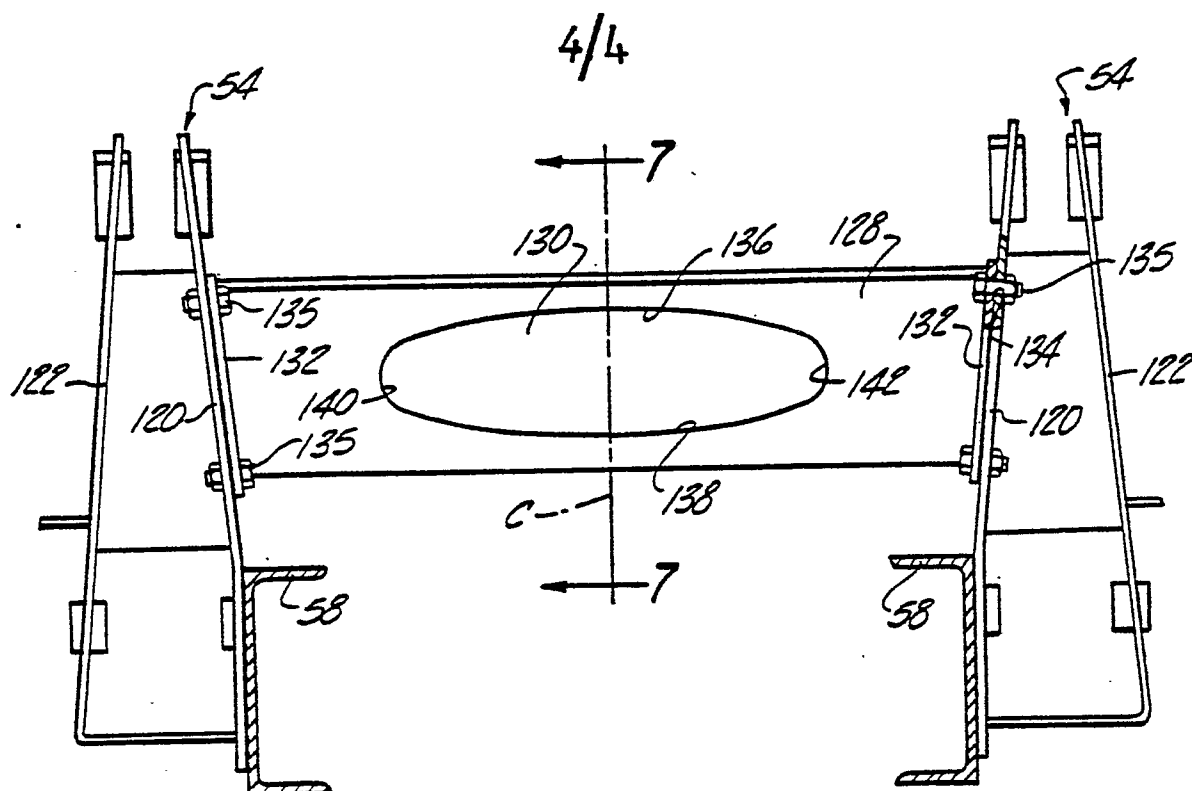


Fig-6

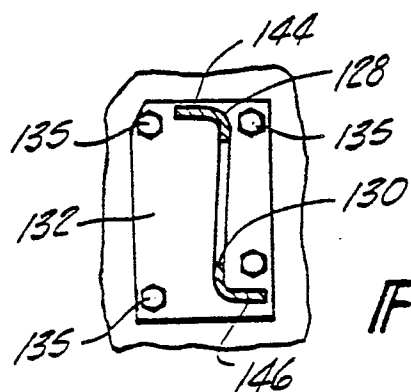
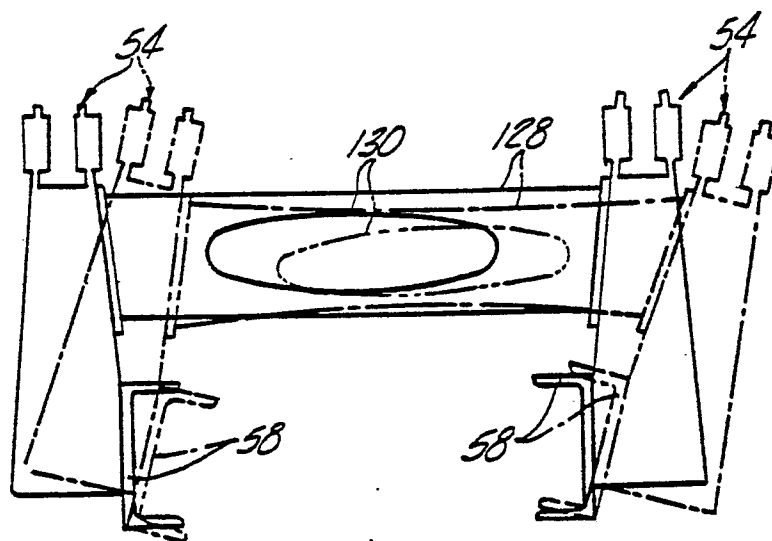


Fig-7

Fig-8





| DOCUMENTS CONSIDERED TO BE RELEVANT                        |                                                                                                                                                       |                                 | CLASSIFICATION OF THE APPLICATION (Int. Cl.)                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Category                                                   | Citation of document with indication, where appropriate, of relevant passages                                                                         | Relevant to claim               |                                                                                                                                                                                                                                                                                                                                          |
| X                                                          | <p><u>US - A - 3 047 170 (HOUGH)</u></p> <p>* Column 3, lines 42-46; column 4, lines 17-21; column 4, line 40 - column 7, line 8; figures 2-7 *</p>   | 1, 2, 5, 11, 14, 15, 17, 19, 20 | <p>B 62 D 21/02</p> <p>B 62 D 49/00</p> <p>E 02 F 3/80</p>                                                                                                                                                                                                                                                                               |
| X                                                          | <p><u>US - A - 2 801 863 (RANEY)</u></p> <p>* Column 2, line 28 - column 3, line 47; figures 2, 3 *</p>                                               | 1, 11-13, 16, 19                |                                                                                                                                                                                                                                                                                                                                          |
|                                                            | <p><u>GB - A - 1 178 387 (MIDLAND IND.)</u></p> <p>* Page 2, lines 13-59; claim 1; figures 1, 2 *</p>                                                 | 1, 2, 5, 6                      | <p>TECHNICAL FIELDS SEARCHED (Int. Cl.)</p>                                                                                                                                                                                                                                                                                              |
|                                                            | <p><u>US - A - 2 345 351 (MAXON)</u></p> <p>* Page 2, column 1, line 46 - column 2, line 42; page 3, column 1, lines 48-65; figures 1-4 *</p>         | 1, 20, 21                       | <p>B 62 D 21/02</p> <p>B 62 D 21/18</p> <p>B 62 D 49/00</p> <p>B 62 D 49/02</p> <p>B 62 D 49/04</p> <p>E 02 F 3/80</p> <p>E 02 F 3/96</p> <p>E 02 F 9/3</p>                                                                                                                                                                              |
|                                                            | <p><u>US - A - 3 725 996 (SKANES)</u></p> <p>* Column 2, lines 32-39; column 2, line 57 - column 3, line 17; column 4, lines 22-58; figures 3-7 *</p> | 2, 3                            |                                                                                                                                                                                                                                                                                                                                          |
|                                                            | <p><u>GB - A - 405 507 (BROULHIET)</u></p> <p>* Page 1, lines 80-93; page 2, lines 34-51; figure 2 *</p>                                              | 8, 9, 21                        | <p>CATEGORY OF CITED DOCUMENTS</p> <p>X: particularly relevant</p> <p>A: technological background</p> <p>O: non-written disclosure</p> <p>P: intermediate document</p> <p>T: theory or principle of the invention</p> <p>E: conflicting application</p> <p>D: document cited in the application</p> <p>L: citation for other reasons</p> |
|                                                            | <p><u>US - A - 3 730 545 (ALLORI)</u></p> <p>* Column 1, line 66 - column 2, line 47; figure 2 *</p>                                                  | 11-13, 15, 16                   |                                                                                                                                                                                                                                                                                                                                          |
| The present search report has been drawn up for all claims |                                                                                                                                                       |                                 | <p>8: member of the same family,</p> <p>corresponding</p> <p><b>ORIGINAL</b></p>                                                                                                                                                                                                                                                         |

0000281

| DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                |                   | CLASSIFICATION OF THE APPLICATION (Int. Cl. 7) |
|-------------------------------------|------------------------------------------------------------------------------------------------|-------------------|------------------------------------------------|
| Category                            | Citation of document with indication, where appropriate, of relevant passages                  | Relevant to claim |                                                |
| A                                   | <u>FR - A - 2 291 061 (HOBENSIEFKEN)</u><br>* Page 2, lines 15-18; page 4, lines 1-10 *<br>--- | 17, 19            |                                                |
|                                     | <u>FR - A - 993 712 (AMETRA)</u><br>----                                                       |                   | TECHNICAL FIELDS SEARCHED (Int. Cl. 7)         |
|                                     |                                                                                                |                   |                                                |