



(12) **EUROPEAN PATENT APPLICATION**

(21) Application number : **91307855.6**

(51) Int. Cl.⁵ : **B61G 1/38, B61G 3/04**

(22) Date of filing : **28.08.91**

(30) Priority : **14.09.90 US 582667**

(43) Date of publication of application :
18.03.92 Bulletin 92/12

(84) Designated Contracting States :
ES FR GB SE

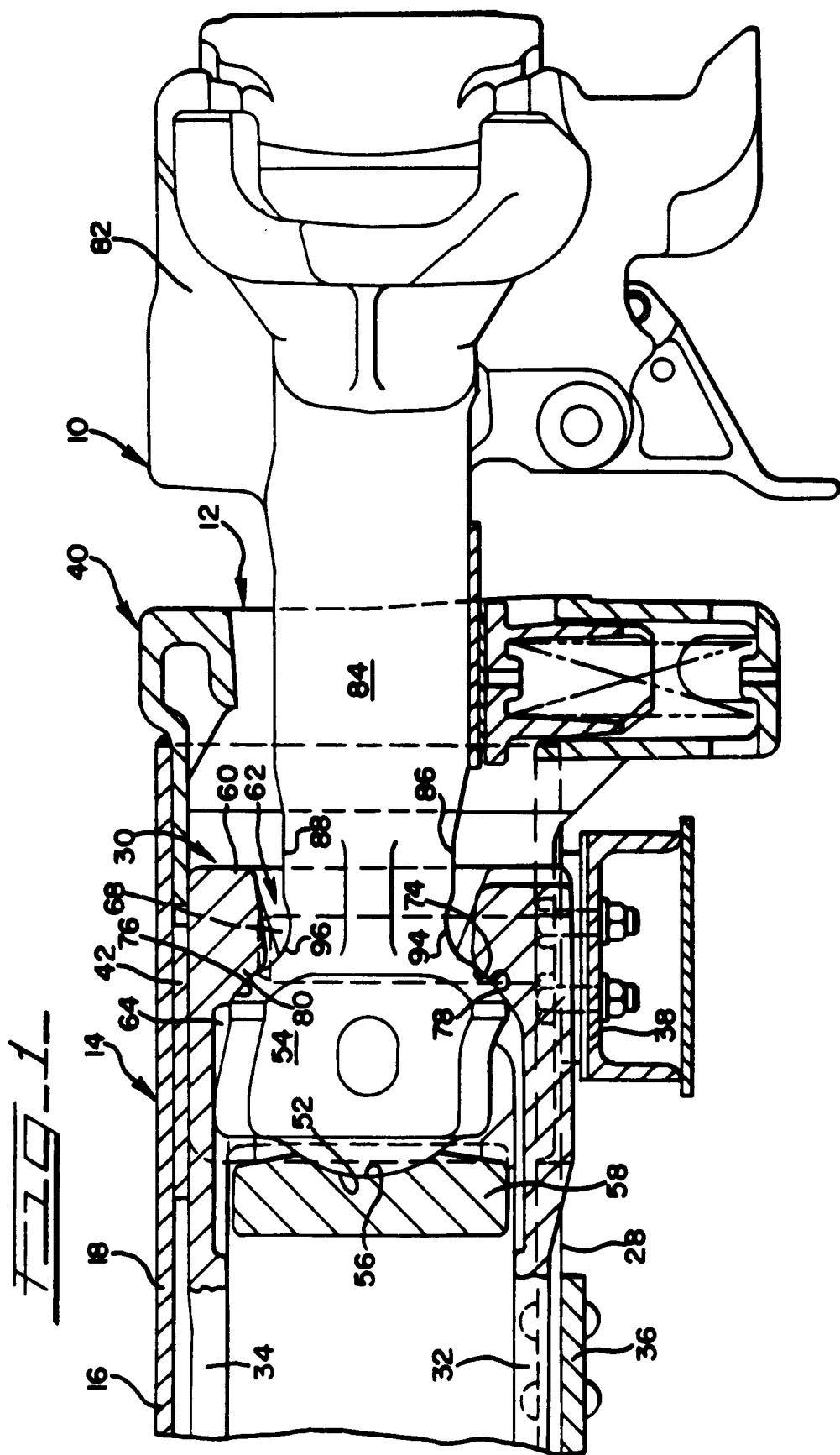
(71) Applicant : **AMSTED Industries Incorporated**
205 North Michigan Avenue 44th Floor
Boulevard Towers South
Chicago Illinois 60601 (US)

(72) Inventor : **Kaufhold, Horst T.**
3221 North Oconto Avenue
Chicago, Illinois 60634 (US)

(74) Representative : **Davies, Christopher Robert et al**
Frank B. Dehn & Co. Imperial House 15-19
Kingsway
London WC2B 6UZ (GB)

(54) **Rotary coupler assembly for railway vehicle.**

(57) A rotary railway coupler (10) is provided having compound fillets (94, 96) of variable increasing radii of curvature inserted between the shank (84) and the butt end (54) of the coupler (10). The compound fillets (94, 96) reduce the stress concentration between the shank (84) and the butt end (54) of the coupler (10) by distributing the stress over a greater curved surface area in order to decrease the possibility of fatigue cracking and failure at the transition surface between the coupler shank (84) and butt end (54). The compound fillet (94, 96) may also be arranged to undercut the surfaces (78, 80, 86, 88) of the coupler shank (84) and butt end (54) in order to reduce metal build-up at this location.



The present invention relates generally to railway vehicle coupler members and more particularly to an improved rotary coupler.

Railway cars are connected together with coupler members, namely drawbars or couplers. Drawbars are integral units known to be used in the railroad industry to extend between and permanently connect two or more railcars. Couplers are independent units in each car which interconnect with one another between adjacent cars, to form a connection. In either instance, a shank and butt end of the drawbar or coupler extends into the center sill of a railway car where it is secured to transmit longitudinal loads to the car.

Rotary couplers permit commodities, such as ore, taconite, coal, grain, phosphate and the like, to be discharged or emptied by rotating each car individually while still connected to an adjacent car.

The couplers used currently in rotary applications have transition surfaces comprising radial fillets which extend between the shank and the butt end at both the top and bottom of the coupler.

With the introduction of high mileage and high load unit trains, forces acting on the couplers have increased drastically. A problem that has occurred in the currently used couplers with the advent of increased mileage and loads is the formation of fatigue cracks in the radial fillets between the shank and the butt end of the coupler. If these cracks become too great, the couplers can fracture causing the coupled connection to fail. Another problem with the currently used couplers is that, as the coupler angles vertically and horizontally within a yoke inside the center sill, metal builds up between the coupler and the yoke at the radial fillets between the shank and the butt end of the coupler. If the metal builds up too greatly, an undesirable bending moment occurs which can result in higher stress and potential fatigue cracks or failure. Such potential failures are a serious enough problem to consider modification of the coupler design.

Accordingly, it is an object of the present invention to provide an improved rotary coupler that has a lessened potential for fatigue cracking in the transition surface between the shank and the butt end of the coupler.

By the present invention, it is proposed to overcome the difficulties encountered heretofore. To this end, it has been discovered that using a compound fillet having a variable radius of curvature instead of a fillet having a constant radius greatly reduces the stress concentration between the shank and the butt end of the coupler by distributing the stress more evenly over a greater surface area. The compound fillet may also be constructed to undercut the surfaces of the shank and the butt end of the coupler which reduces the potential for metal build-up. While a parabolic-shaped compound fillet is preferred, other curves having variable radii of curvature such as ellipses or catenaries could also be used to reduce the stress

concentration. This reduction of stress concentration, in turn, reduces the likelihood of fatigue cracks between the shank and butt end of the coupler.

An 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 side elevation view, partially in section, of a preferred embodiment of the invention with certain parts broken away for clarity;

Figure 2 is a top section plan view of the apparatus shown in Figure 1;

Figure 3 is an enlarged partial elevation view showing a radial fillet extending between a shank and a butt end of a prior art coupler member;

Figure 4 is an enlarged partial elevation view in which a preferred compound fillet of the present invention has been added and is shown in comparison to the prior art radial fillet (dashed); and Figure 5 is a graph depicting the approximation of an example of a parabolic curve in accordance with the preferred embodiment of the invention.

In Figures 1 and 2, a Type F rotary coupler member embodying the improved design of the present invention is shown generally at 10. The coupler member 10 extends within an open end 12 of a center sill, generally 14, which is secured longitudinally beneath a railway car (not shown). The center sill 14 is of a standard construction comprising an inverted U-shaped channel member 16 having a top wall 18, side walls 20 and 22 and outturned flanges 24 and 26 at the lower open bottom 28.

A coupler yoke 30 is located within the center sill 14 and includes a bottom wall 32 and a top wall 34. The yoke 30 is mounted within the center sill 14 on a support plate 36 and a support channel 38, both of which are fastened to the sill flanges 24 and 26.

A striker assembly 40 is secured within the open end 12 of the center sill 14 and includes a top wall 42 and side walls 44 and 46, the side walls 44 and 46 which extend rearwardly and gradually increase in thickness, terminating at striker stops 48 and 50 respectively.

A spherical face 52 on a butt end 54 of the coupler member 10 fits against a matching spherical face 56 of a follower block 58. The follower block 58 is located between the bottom wall 32 and the top wall 34 of the yoke 30, as well as between the side walls 20 and 22 of the center sill 14. The follower block 58 is further held against the striker stops 48 and 50 of the striker assembly 40 by a draft gear (not shown).

A front portion 60 of the yoke 30 has an opening 62 leading to a cavity 64 for receiving the butt end 54 of the coupler member 10. The opening 62 is elongated from side-to-side. Accordingly, the elongated dimension of the coupler butt end 54 is aligned with the elongated dimension of the opening 62 and inserted through the opening 62 and into the yoke cavity 64. Once the coupler butt end 54 is past the opening

62, it is rotated 90° so the elongated dimension of the coupler butt end 54 is no longer aligned with the elongated dimension of the coupler opening 62 and retainer keys 66 and 68 are inserted in yoke slots 70 and 72 to keep the coupler butt end 54 from undesired removal from the yoke cavity 64 during rotation.

The top wall 32 and the bottom wall 34 of the yoke 30 increase in thickness at the front portion 60 of the yoke 30 and include pocket portions 74 and 76 which receive shoulders 78 and 80 on the butt end 54 of the coupler member 10 to center the butt end 54 of the coupler member 10 within the center sill 14 and transfer the draft loads of the coupler member 10 to the striker assembly 40 and the center sill 14. The buff loads from the coupler member 10 are transmitted directly to the follower block 58 which transfers the loads to the draft gear (not shown) and into rear stops (not shown) for transmittal to the center sill 14. The shoulders 78 and 80 of the coupler butt end 54 and the yoke pocket portions 74 and 76 have spherical surfaces which, along with the spherical faces 52 and 56 of the coupler butt end 54 and the follower block 58 respectively, permit horizontal and vertical angling of the coupler 10 within the center sill 14.

The coupler member 10 further includes a head end 82 for interconnection with another coupler member head (not shown) of a second railway car (not shown) and a shank portion 84 between the butt end 54 and the head end 82 of the coupler member 10. The shank portion 84 has a bottom wall 86, a top wall 88, and side walls 90 and 92. Transition fillets 94 and 96 extend between the shank bottom wall 86 and the bottom spherical shoulder 78 as well as the shank top wall 88 and the top spherical shoulder 80 respectively.

In the prior art, these transition fillets were comprised of a radial fillet having a constant radius of curvature. A top transition fillet 98 of the prior art is shown in Figure 3 to extend between a top wall 100 of a coupler shank 102 and a top spherical shoulder 104 of a coupler butt end 106. It is in the transition fillet 98 that fatigue cracks have been found to form.

Figure 4 shows an enlarged transition fillet 96 extending from the top wall 88 of the shank portion 84 and the top spherical shoulder 80 of the butt end 54 of the coupler 10. It is to be understood that the design profile in the bottom and the top transition fillets 94 and 96 is similar. The radial fillet of constant radius of curvature has been replaced with the parabolic fillet 96 having a variable radius of curvature that increases with the distance away from the spherical shoulder 80 of the coupler butt end 54. The prior art design profile is shown in dashed lines in Figure 4 to illustrate the modifications in said improved design profile.

The substitution of the parabolic fillet 96 greatly reduces the stress concentration between the top wall 88 of the coupler shank portion 84 and the spherical shoulder 80 of the coupler butt end 84 by distributing the load over a longer, smoother curved surface area,

namely along the entire parabolic curve 96, instead of the mere radial fillet 98 of the prior art design profile. This reduction in stress concentration reduces the likelihood of fatigue cracks forming between the shank portion 84 and the butt end 54 of the coupler member 10.

A static stress comparison between the improved design and the standard design of the prior art has been conducted. Based on axial draft loading to 300 Kips, the improved design provided an average stress reduction of approximately 30% relative to the standard design of the prior art in the transition area between the shank 84 and the butt end 54 of the coupler. These results indicate that the improved design of the present invention will provide for enhanced fatigue strength.

The parabolic fillet 96 undercuts a portion of the top wall 88 of the coupler shank 84 and the spherical shoulder 80 of the coupler butt end 54 which also eliminates the potential for metal build-up which can add an undesirable bending moment and, in turn, higher stress, when the coupler member 10 is angled inside the yoke 30.

A parabolic fillet is preferred due to the small space envelope which is available along the x and y axes as shown in Figure 4. The distance along the y axis may not be increased a great amount over the prior art design since the fillet may not extend any higher into the spherical shoulder 80 of the coupler butt end 54 which interfaces with the pocket portion 76 of the yoke 30. Such an extension of the fillet would result in the loss of interchangeability with yokes of present design. The distance along the y axis may be increased slightly at the bottom undercutting the top wall 88 of the coupler shank portion 84 as shown in Figure 4. The distance along the x axis is greater in the improved design, however, as the parabolic fillet extends further onto the top wall 88 of the coupler shank portion 84 in the direction of the coupler head end 82.

To construct an approximate parabolic fillet 96 profile, the distances along the x and y axes may be divided into the same number of segments and identically numbered from top to bottom and from left to right as shown in Figure 5. Points having the same number are then connected by straight lines resulting in an envelope of gradually increasing radius which approximates a parabolic curve.

The parabolic fillet 96 can also be constructed using the parabolic equation $y^2 = 2fx$ with the origin of the parabola located at point 108 where the spherical shoulder 80 of the coupler butt end 54 meets the fillet 96 as shown in Figure 4. The constant f in the parabolic equation is selected in accordance with the x and y space limits for the given shank and butt transition.

While a parabolic fillet is preferred, other compound curves of variable radii of curvature such as

ellipses or catenaries would also reduce the stress concentration. Furthermore, while an F type coupler head is shown in the drawings, identical modification could be made to other coupler types to achieve the same result.

The foregoing description and drawings explain and illustrate the best known mode of the invention and those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention which is defined in the following claims.

Claims

1. A rotary coupler connection of the type having a rotary coupler member received in a yoke which has been installed in a center sill of a railway vehicle, said rotary coupler member having a head end, a butt end and a shank between said head end and said butt end, wherein

at least one transition surface extends between said shank and said butt end of said coupler member, said transition surface comprising a compound fillet having a variable radius of curvature, said variable radius of curvature increasing with distance away from said butt end of said coupler member.

2. The connection according to claim 1 in which said compound fillet is recessed below a top surface of said shank of said coupler member.

3. The connection according to claim 1 or 2 in which said compound fillet is recessed within an outer surface of said butt end of said coupler member.

4. The connection according to claim 1, 2 or 3 in which said compound fillet has a profile which approximates that of a parabolic curve.

5. The connection according to claim 1, 2 or 3 in which said compound fillet has a profile which approximates that of a catenary curve.

6. The connection according to claim 1, 2 or 3 in which said compound fillet has a profile which approximates that of an elliptic curve.

7. The connection according to any preceding claim in which a said transition surface extends between a top wall of said shank and a top shoulder portion of said butt end of said coupler member and a second said transition surface extends between a bottom wall of said shank and a bottom shoulder portion of said butt end of said coupler member, said top and bottom shoulder portions of said butt end of said coupler including spherical

surfaces corresponding to mating surfaces on pocket portions of said yoke.

8. A rotary coupler member for use in a railway vehicle, said rotary coupler member having a head end, a butt end and a shank between said butt end and said head end, wherein:

at least one transition fillet is located between said butt end and said shank of said coupler member, said transition fillet having a compound radius which increases with distance away from said butt end of said coupler member.

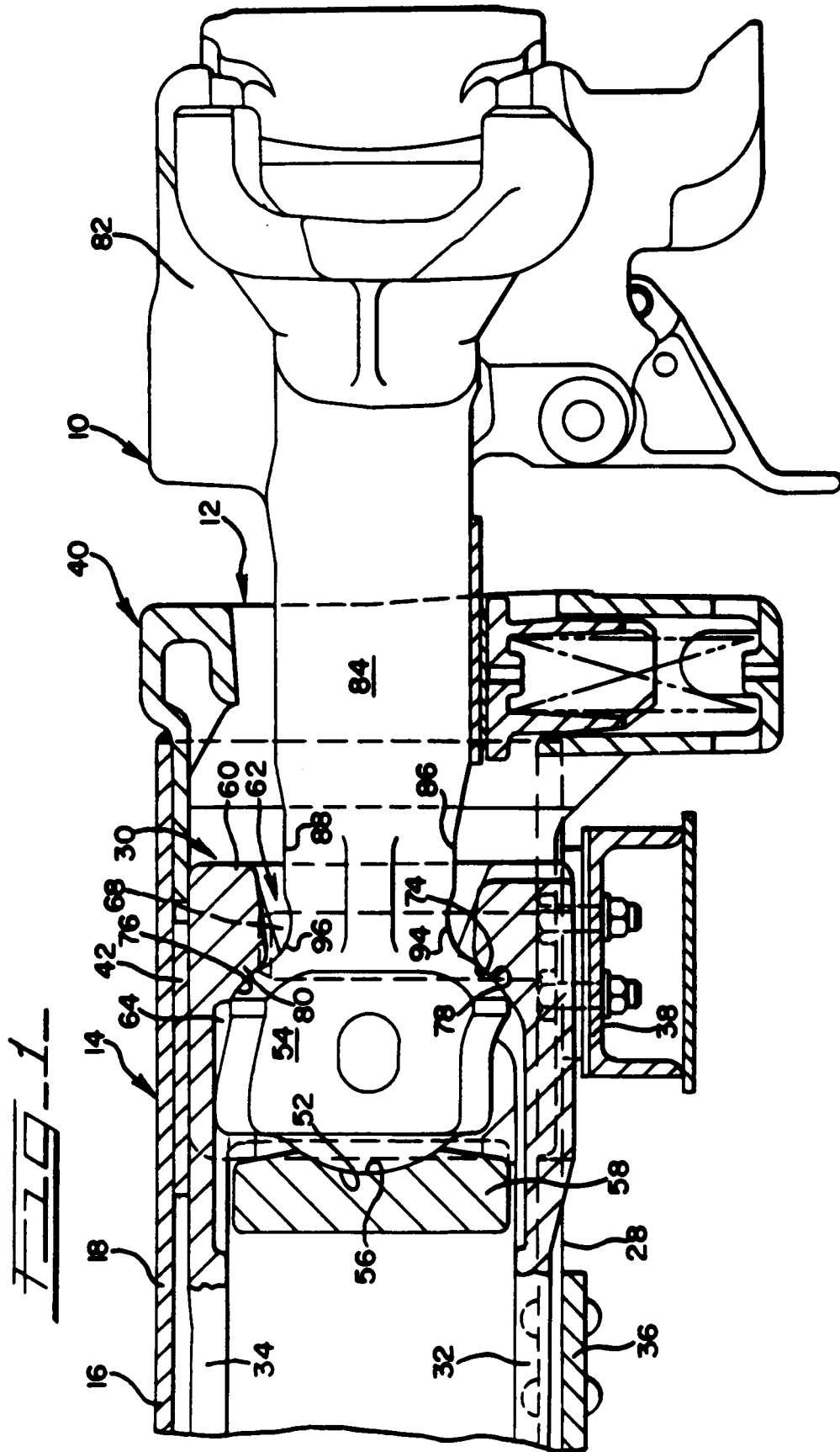
9. The member according to claim 8 in which one said transition fillet is located between a top spherical shoulder portion of said coupler butt end and a top wall of said coupler shank and a second said transition fillet is located between a bottom spherical shoulder portion of said coupler butt end and a bottom wall of said coupler shank.

10. The member according to claim 9 in which said transition fillets undercut said top and bottom spherical shoulder portions of said coupler butt end and said top and bottom walls of said coupler shank.

11. The member according to claim 8, 9 or 10 in which said transition fillet has a profile which approximates that of a parabolic curve.

12. The member according to claim 8, 9 or 10, in which said transition fillet has a profile which approximates that of a catenary curve.

13. The member according to claim 8, 9 or 10, in which said transition fillet has a profile which approximates that of an elliptic curve.



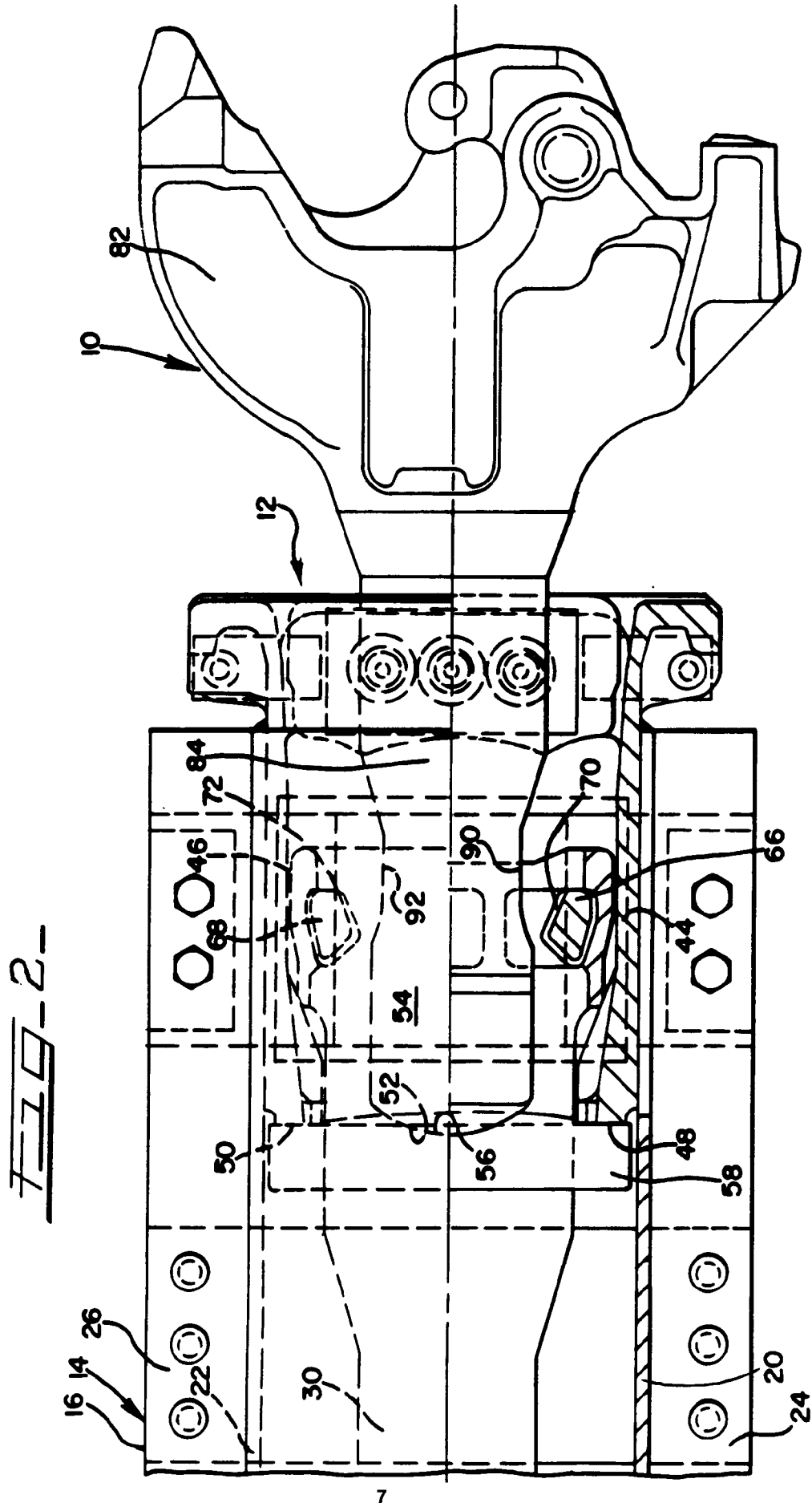


FIG. 3
PRIOR ART

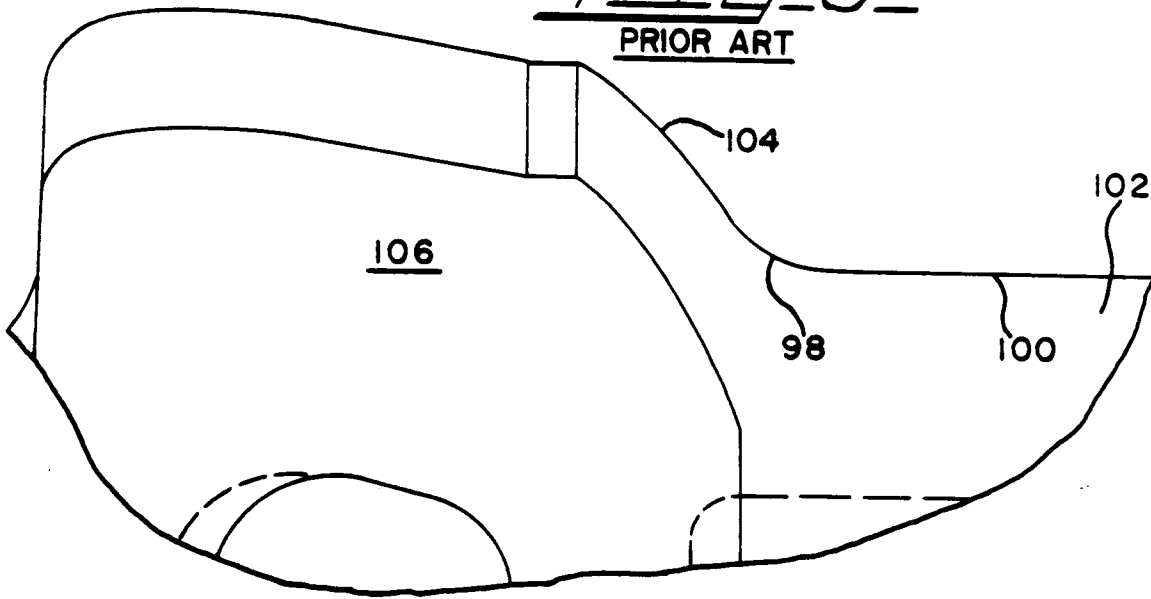


FIG. 4

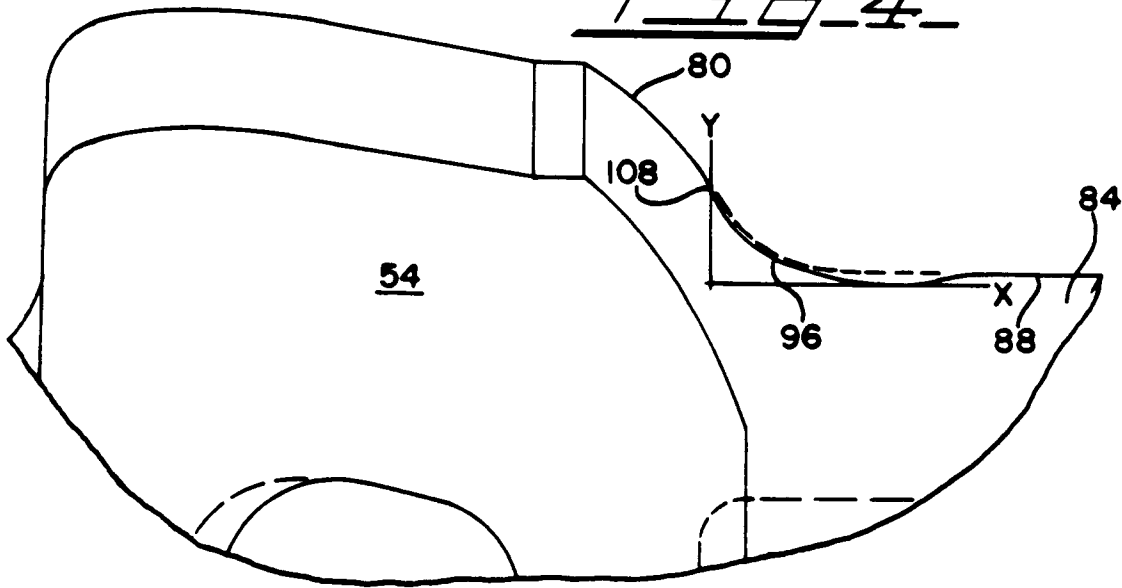
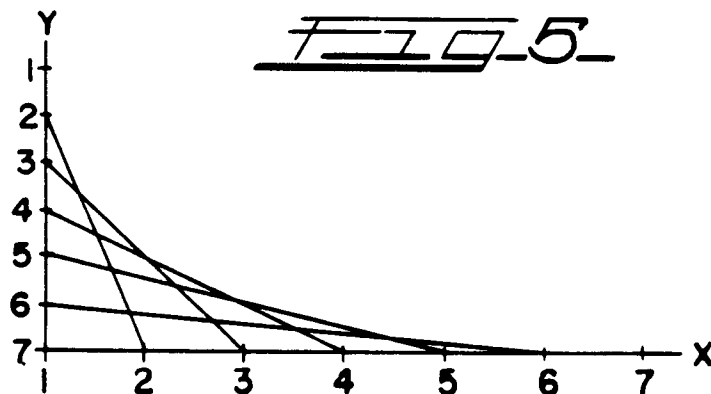


FIG. 5





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 30 7855

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 420 088 (W. J. METZGER) * column 1, line 34 - column 4, line 37; figures 1,2 *	1,2,8,10	B61G1/38 B61G3/04
A	US-A-3 250 403 (C. E. TACK AND M. E. ANDERSON) * column 1, line 65 - column 2, line 50 * * column 2, line 65 - column 3, line 6; figures 1-3,8 *	1,8	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B61G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03 DECEMBER 1991	Examiner CHLOSTA P.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 150 (03.82 (P0401))