April 3, 1962 E. J. HERBENAR 3,028,172

PARALLELOGRAM STEERING LINKAGE

Filed Oct. 27, 1958

Fig 1

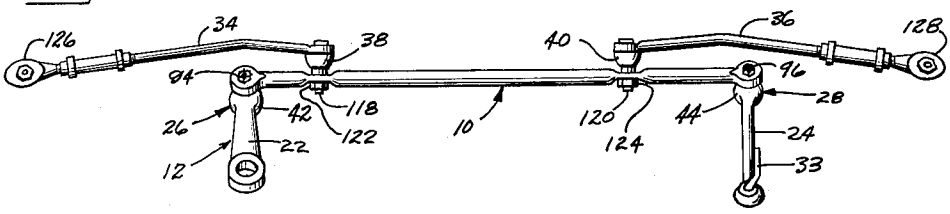


Fig 3

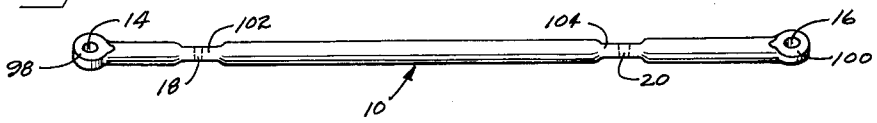


Fig 4

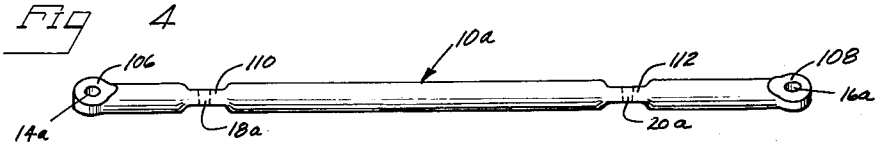


Fig 5

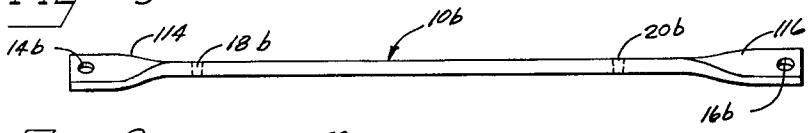
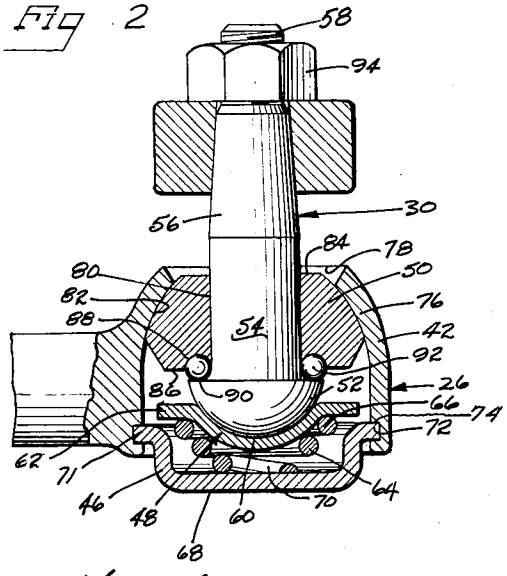


Fig 2



Inventor
EDWARD J. HERBENAR

by Hill, Sherman, Meroni, Gross & Simpson Attys.

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PARALLELOGRAM STEERING LINKAGE

Edward J. Herbenar, Detroit, Mich., assignor to Thompson Ramo Wooldridge Inc., a corporation of Ohio

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This invention relates to a parallelogram steering linkage and more particularly to a construction for the center link of such a linkage wherein a hole is formed in each end of the link and a pair of holes are provided between the end holes, each of the holes being adapted to receive stud shanks projecting from sockets on other steering links to connect the links in steering relation.

Heretofore, the center link of a parallelogram linkage has generally had a socket forged at one or both ends for connection with pitman arm and idler arm means and has had a pair of holes formed intermediately of the sockets through which studs projected for engaging the inner ends of the tie rods. The cost of forging such sockets is considerable, and though there have been attempts to utilize replaceable sockets in substitution for the forged sockets in general use, such attempts have involved substantial complexity in order to provide suitable connections between the sockets and the ends of the cross-links.

Accordingly, the present invention comprises a center link for a parallelogram linkage which defines smoothly tapered holes at its ends for receiving complementary studs and sockets for the studs which are integrally forged in the pitman arm and the idler arm, a pair of holes being spaced inwardly from the end holes for receiving tapered tie rod joint studs in the usual way. A great deal of expense is saved in thus eliminating forging of the cross-link ends, while forging sockets in the pitman and idler arms adds but little to the cost of forging which would be required to form openings therein in any event.

In one embodiment, the center link has a relatively small diameter and bosses defining the holes are made by gathering the material locally and flattening it. The holes are then machined in the bosses to the desired taper.

In another embodiment, the center link has a sufficient diameter so that the hole-defining bosses can be formed by flattening the center link in the desired locations and angles without gathering the material locally. In another embodiment the center link is made from rectangular bar stock of a predetermined size and strength. The ends are twisted to the desired angles and tapered holes are drilled therethrough, the holes for engaging the tie rod being formed without any working of the material being required.

The joints for the articulated connections between the idler and pitman arms and the center link have the sockets forged integrally at the ends of the idler and pitman arms, as stated, and are desirably of the ball joint variety, defining segmental spherical bearing walls converging from the side walls to reduced diameter openings. A closure is provided at the other end of the casing and a tapered stud is received in the socket which has a ball head on a cylindrical shank portion engaging a spring loaded retainer in rockable relation. A fragmental ball member is disposed in the socket having an axial bore receiving the cylindrical stud shank portion and a spherical bearing wall riding on the spherical bearing portion of the socket. Anti-friction elements are disposed between the shoulder defined by the ball head and cylindrical shank portion of the stud and an end face of the ball member to facilitate rotation of the stud ball member. The end of the stud is, as stated, tapered for mating engagement in the end holes of the cross-links, and is threaded for receiving a

nut for holding the stud in position in the cross-link. The joint for connecting the inner ends of the tie rods and the cross-link may be of any conventional construction, with a tapered stud adapted to be received in mating relation within a corresponding tapered hole intermediate the end holes of the cross-link, the tip of the stud being threaded beyond the tapered portion thereof so that a nut may be threaded thereon to maintain the relative position of the parts.

Accordingly, it is an object of the present invention to provide a parallelogram steering linkage in which sockets are forged in the inner ends of the pitman and idler arms, rather than in the ends of the cross-link, in providing a connection between these respective parts.

Another object of the invention is to provide a center link which defines end holes for receiving studs in the pitman arm and idler arm joints.

Another object of the invention is to provide a cross-link as described in which the end holes are smoothly tapered for mating engagement with tapered studs of the joints described.

Another object is to provide a parallelogram steering linkage in which the center link defines end holes as described and holes between the end holes for receiving the studs in tie rod joints.

Another object of the invention is to provide a parallelogram steering linkage as described in which sockets for a ball joint are forged in the pitman and idler arms, for connection with the center link.

Another object of the invention is to provide methods for making the several embodiments of the cross-link of the invention which afford savings in costs and material.

Other objects and advantages of the invention will become apparent as the description proceeds in accordance with the drawings in which:

FIGURE 1 is a perspective view of a steering linkage according to the present invention;

FIGURE 2 is an enlarged vertical sectional view of a joint construction according to the invention;

FIGURE 3 is a plan view of one embodiment of the center link of the invention;

FIGURE 4 is a plan view of another embodiment of the center link of the invention; and

FIGURE 5 is yet another embodiment of the center link of the invention.

Referring now to the drawings, a center link **10** is shown according to the present invention, in assembled position in a parallelogram steering linkage **12**. The center link **10** defines a pair of end holes **14** and **16** and a pair of holes **18** and **20** between the end holes. The center link is connected to a pitman arm **22** and an idler arm **24** by joints **26** and **28** having studs such as the stud **30** engaged in the openings **14** and **16**. The pitman arm **22** is driven by the conventional steering gear box (not shown) and the idler arm **24** is pivotally supported on the automobile frame on the side of the vehicle opposite the pitman arm by means of a bracket structure **33**, also in a conventional manner.

Tie rods **34** and **36** are connected to the center link by ball joints **38** and **40** of any suitable type.

In accordance with the invention, the joints **26** and **28** are made at a considerably lower cost than has been possible with joints heretofore available for the purpose, by forging sockets **42** and **44** at the inner ends of the pitman arm **22** and the idler arm **24**. These ends would require forging even with conventional constructions, for the purpose of providing openings for receiving studs in sockets in the cross-link ends, and thus there is little added expense involved in forging the sockets of the invention. However, the consequent elimination of the

need for forging or otherwise providing for sockets on the center link results in a relatively large over-all saving.

The joints **26** and **28** may be of any desired universal joint type such as a ball and socket but preferably having separate sets of cooperating bearing surfaces respectively accommodating tilting of the stud relative to the housing and rotation of the stud about its own longitudinal axis. An example of such joints is shown in FIGURE 2. Such joints include, in addition to the studs **30** and the sockets **42** and **44**, closures such as the closure **46** for supporting spring-biased retainers such as the retainer **48** and fragmental spherical bearings **50**, also seen in FIGURE 2.

The studs **30** have a rounded head such as indicated at **52**, a cylindrical shank portion **54** immediately adjacent the head, a tapered end shank portion **56** and a threaded tip **58**.

The retainers, such as the retainer **48**, preferably define concave bearing surfaces **60** for rockably engaging the rounded heads **52** and radial flanges **62** against which helical springs such as **64** bear at their wider end coil portions **66**. The closures **46** are preferably cup shaped to provide bottom walls **68** against which the small ends **70** of the springs are engaged, and define radial flanges **72**.

The sockets **42** and **44** are counterbored to provide shoulders **74** against which the flanges **72** are seated, the sockets being spun over the flanges to secure the closures in position, the sockets also having segmental spherical bearing walls **76** defining reduced openings **78** for receiving the stud shanks therethrough.

The bearings **50** define bores **80** for rotatably receiving the stud shanks, and have fragmental spherical surfaces **82** adapted to bear against the walls **76** in tiltable relation. The bearings also define opposed end walls **84** and **86** and central recesses **88**, the recesses **88** cooperating with the shoulders **90** defined by the stud heads **52** and cylindrical shank portions **54** to provide a ball race for ball bearings **92**, the spring **66** thus urging the respective bearing elements into appropriate bearing relationship.

In accordance with the invention, the holes **14** and **16** are formed with smoothly tapered walls to afford mating engagement with the tapered shank portions **56** of the studs **30**. The studs are held in position by suitable nuts **94** and **96** which are threaded onto the tips **58** and into abutting engagement with the cross-link **10**.

In the embodiment of FIGURE 3, the cross-link **10** is of generally cylindrical configuration and is adapted for use in a vehicle where a relatively small diameter is suitable, as for example, .88 inch. The ends of the cross-link are gathered locally, by either hot or cold methods, and flattened to a suitable angle to define bosses **98** and **100** which are then drilled and reamed to form the tapered holes **14** and **16**. The holes **18** and **20** are similarly formed in bosses **102** and **104**.

Referring to FIGURE 4, a cross-link **10***a* is shown which has a diameter such that the material at the ends may be flattened without gathering the material to provide bosses **106** and **108** at a suitable angle relative to similarly formed bosses **110** and **112**. The holes **14***a* and **16***a*, and **18***a* and **20***a* are formed by expanding the metal outwardly, which also serves to fill out the bosses still further. It has been found that a cross-link having a diameter of in the neighborhood of .94 inch, for example, will afford bosses of a suitable thickness and diamter.

If a still greater diameter bar is used for the cross-link, i.e., a diameter of 1.00 inch, the bosses may be formed by flattening alone, and the holes then are drilled and reamed therein. The methods thus described with respect to FIGURE 4 are relatively less expensive than the method described with respect to FIGURE 3.

In FIGURE 5, a third embodiment of the invention is shown at **10***b* wherein a substantially rectangular bar is twisted adjacent its ends to provide angularly offset end portions **114** and **116**, in which the holes **14***b* and **16***b* are drilled in a smoothly tapered configuration. The holes **18***b* and **20***b* may thus be drilled between the holes **14***b* and **16***b* without further preliminary steps being required.

The tie rod joints **38** and **40** tiltable and rotatably receive tapered studs **118** and **120** for mating engagement with the holes **18** and **20** of the cross-link, as seen in the embodiment of FIGURES 1 and 2, nuts **122** and **124** holding the respective parts in assembled relation. The outer ends of the tie rods are provided with suitable joint means **126** and **128** for engaging the steering arms of a vehicle (not shown).

It will thus be seen that a steering linkage has been provided which is of exceptionally strong construction. The center link member thereof may be made without extensive working of the material and the forging of the idler arm and pitman arm sockets requires very little more effort than would be entailed in forging the usual end holes therein, so that exceptional savings in manufacturing costs are achieved.

Although I have herein set forth and described my invention with respect to certain specific principles and details thereof, it will be understood by those skilled in the art that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim as my invention:

1. A parallelogram steering linkage for an automotive vehicle which comprises a pitman arm having a ball joint socket on the swinging end thereof, an idler arm having a ball joint socket on the swinging end thereof, a pair of opposed laterally extending tie rods having ball joint sockets on their inner ends, a ball joint assembly in each of said sockets including a stud with a tapered shank converging to a threaded end portion extending from each socket, a one-piece center link, a first pair of tapered holes in said link each adjacent an end of the link, a second pair of tapered holes in said link between said first pair, said first pair of holes having axes in the same first plane, said second pair of holes having axes in the same second plane, said first and second planes being offset from each other, the stud shanks of the ball joints in the sockets of said pitman and idler arms extending through and mating with said first pair of holes, the stud shanks of the ball joints in the sockets of said tie rods extending through and mating with said second pair of holes, said center link having flat faces surrounding the small ends of the tapered holes, and nuts on the threaded end portions of the studs bottomed on said flat faces to wedge lock the tapered shanks in the tapered holes.

2. A parallelogram steering linkage for an automotive vehicle which comprises a pitman arm, an idler arm, a pair of tie rods, each of said arms and rods having a ball joint socket on an end thereof, a one-piece metal bar center link having a first pair of integral bosses adjacent the ends thereof and a second pair of integral bosses between said first pair, said first pair of bosses being angularly offset from said second pair of bosses, said first pair of bosses having tapered holes therethrough converging in the same first direction, said second pair of bosses having tapered holes therethrough converging in the same second direction and opposite to said first direction whereby the small ends of the holes of the first pair of bosses are on one side of the center link and the small ends of the holes of the second pair of bosses are on the opposite side of the center link, ball joint assemblies in the sockets of said arms and rods each having a tapered stud with a threaded end extending through and mating with the tapered holes of the link, the studs projecting from the arm sockets extending through the holes of the first pair of bosses, the studs projecting from the rod sockets extending through the holes of the second pair of bosses whereby the arms and rods will lie on opposite sides of the link, and nuts threaded on the threaded ends

of the studs bottomed on the bosses to wedge the tapered studs in the tapered holes.

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