

March 2, 1971

J. L. McCARTHY

3,566,713

LINK FOR CONTROL LINKAGE

Filed July 16, 1969

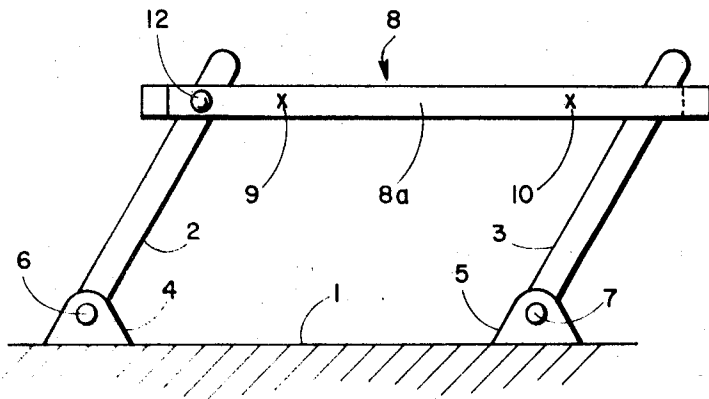


FIG. 1

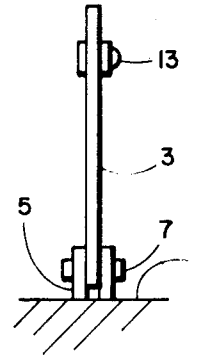


FIG. 2

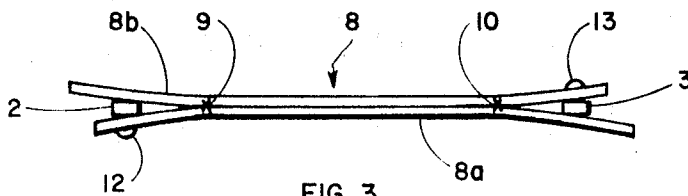


FIG. 3

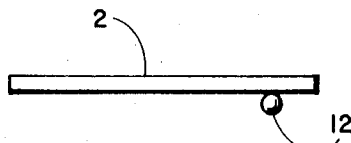


FIG. 4

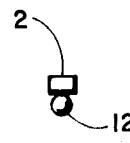


FIG. 5

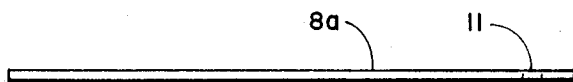


FIG. 6



FIG. 8

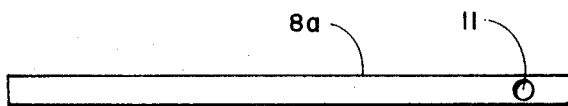


FIG. 7

INVENTOR.

J. L. McCARTHY

BY

*Frederic B. Roedel*

1

3,566,713

**LINK FOR CONTROL LINKAGE**  
James L. McCarthy, Chili, N.Y., assignor to  
Sybron Corporation, Rochester, N.Y.  
Filed July 16, 1969, Ser. No. 842,127  
Int. Cl. G05g 1/24

U.S. Cl. 74—588

7 Claims

## ABSTRACT OF THE DISCLOSURE

A link consisting essentially of two identical elongated spring laminae, each having a hole therethrough, and sandwiched together along their lengths, overlapping each other and secured together at their intermediate portions, so that said link is longer than either lamina. Each lamina has its said hole in its overlapped end, such hole opening over the surface of the corresponding overlapping lamina end. Corresponding laminae ends are manually forcibly spread apart to receive between them another link having a ball or the like which protrudes into the corresponding hole. The latter link is sandwiched between the said laminae when the laminae ends are released from manual force spreading them apart.

## BACKGROUND OF THE INVENTION

### Field of the invention

The field of the invention is control linkage having four-bar linkages wherein the movable links are constructed to be simple, light, substantially without play and reversible.

### Description of the prior art

In U.S. Pat. No. 2,242,021, T. M. Ball, FIG. 4 shows a link somewhat of the character set forth supra in field of the invention.

## SUMMARY OF THE INVENTION

A link according to the present invention fulfills to the highest degree the prerequisites set forth supra in field of the invention. Thus, a link according to the invention consists essentially of two identical, elongated spring laminae, each having a hole therethrough, and sandwiched together along their lengths, overlapping each other and secured together at their intermediate portions, so that said link is longer than either lamina. Each lamina has its said hole in its overlapped end, such hole opening over the surface of the corresponding overlapping lamina end. Corresponding laminae ends are manually forcibly spread apart to receive between them another link having a ball or the like which protrudes into the corresponding hole. The latter link is sandwiched between the said laminae when the laminae ends are released from manual force spreading them apart.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows the link of the invention as part of a classical four-bar linkage.

FIGS. 2 and 3 are, respectively, a side elevation and a plan view of the linkage of FIG. 1.

FIGS. 4 and 5 are, respectively, a side view and an end view of one of the links used in the linkage of FIG. 1 with a link according to the invention.

FIGS. 6, 7 and 8 are, respectively, side, plan and end views of either one of the two laminae forming the link according to the invention as shown in FIG. 1.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

As mechanical devices having movable parts are ultimately reducible to a so-called "four-bar linkage," or

2

some combination thereof, such linkage is shown in FIG. 1 as generally representative of all mechanical devices with which the link according to the invention may be used. Thus, reference numeral 1 represents the usual fixed link to which all motion of the linkage is referred. Reference numerals 2, 3 and 8, on the other hand, denote the three movable links of the four-bar linkage.

Links 2 and 3 are respectively pivoted by mountings 4 and 5 to link 1, say by virtue of pivot pins 6 and 7 passing through the mountings and the link ends. Mountings 4 and 5 are fixed to link 1 and it is to be supposed that the links 2 and 3 are constrained to deflection about axes defined by pins 6 and 7, which axes are normal to the plane of the paper. The structure of links 1, 2 and 3 and of their interconnections may be quite different than illustrated, for the invention relates purely to the link 8 and its connections to the upper ends of links 2 and 3. What has thus far been described of the four-bar linkage is old in the art, and is subject to wider structural variations than is practical to indicate here, except briefly. For instance, links 2 and 3 could be cantilever springs rigidly fixed at their lower ends to link 1, in which case, the pivot function would be served by cantilever bending action.

The novel link 8 consists essentially of two identical flat spring laminae 8a and 8b, sandwiched together as shown in FIG. 3, and being fixed to one another, as by spot welds 9 and 10 (shown as X's in FIGS. 1 and 3). That is to say, but for links 2 and 3, which spread the adjacent ends of laminae 8a and 8b, the laminae surfaces would seat on each other flush over approximately the entire two larger dimensions of the laminae. As can be seen from FIGS. 1 and 3, the laminae are, lengthwise, a little out of congruence, i.e., each of the laminae has one end overlapping the corresponding end of the other thereof. This overlap is to provide for manually spreading the adjacent ends of the laminae in order to slip in between them the end of a link 2 or link 3. The effect of the overlap is to provide what amounts to a handle or finger piece, or the like expedient, easily operable manually to help spread the laminae. In the Ball patent, for example, will be observed that a forming operation leaves the link ends permanently spread so that a ball link can be forced between the ends, and in fact the ball link, or equivalent form, is a necessary aspect of the said expedient as provided by Ball.

The link of the present invention, merely because of the laminae overlap, provides the complete expedient for spreading the laminae ends. Thus, due to the welds, the two laminae make the link 8 relatively stiff in its intermediate portion, so that it is relatively easy to spread the overlap of one lamina away from the adjacent overlapped lamina while holding fast to the intermediate portion of the link 8.

The proportions used in the figures, it is to be noted, are exaggerated for clarity of illustration. Thus, FIG. 2 shows link 3 seating flat on both laminae, whereas FIG. 3 shows it seating flat on neither. In actual practice, e.g., with the specific example given infra, it would be flush with but one lamina, but to the naked eye it would appear that it was flush to both laminae.

To provide for pivoting to the links 2 and 3, each of the laminae 8a and 8b is provided with a single hole in its overlapped end. Thus, FIGS. 6, 7 and 8 shows a hole 11 in lamina 8a, for providing a socket for a ball 12 on link 2. It will be observed that FIGS. 4, 5, 6, 7 and 8 could as easily have been described as showing link 3 and lamina 8b, since the only difference would be reference numerals. In short, two laminae exactly as shown in FIGS. 5, 6 and 7 provide the link 8. In any event, the link 8 would have a ball 13 socketed in a role in

3

lamina 8b corresponding to hole 11 in lamina 8a. It is further to be noted that a cylindrical stud, a conical stud, etc., could be used instead of the ball 12 or 13. Moreover, the stud, ball or the like, could be on the lamina 8a or 8b, and the socket or hole could be on the link 2 or 3.

Constructing the link 8 is extremely simple. Though it is two parts, the parts are identical, and of about the simplest imaginable form. The two ends of the link are identical, so the link is reversible. Thus, the link may be removed from the linkage, and then put back without concern as to which end is which.

The lamina 8a and 8b have been termed springs, since they must be sprung apart to receive links 2 and 3 and must do so without taking a permanent set. However, there is much latitude in choice of material. In one actual form the laminae 8a and 8b are made from Type 302 stainless steel strip stock, 0.017 to 0.019 inch thick and 0.120 to 0.130 inch wide, cut into equi-length portions, each of which is punched with one hole 0.040 to 0.041 inch in diameter. The links 2 and 3 may be cut from similar or even heavier stock, and 1 mm. balls are welded thereto. The lamina 8a and 8b typically must spread enough to pass about 1.5 to 2 mm. overall thickness of link 2 or 3 therebetween. When the balls are socketed in the holes 11 and 12, there is then about 1/2 to 1 mm. thickness of material spreading the laminae ends. The welds 9 and 10 may be less than an inch from the corresponding holes, without the specified material taking a permanent set from spreading the laminae ends to receive links 2 and 3.

A typical link 8 may be some four inches long, and joined with a link 2 or 3, as above described, makes for highly stable and precise four-bar linkage operation. The link 2 or 3 is, of course, gripped by the laminae 8a and 8b with a certain amount of force due to the elasticity of the material of the laminae, and therefore there is some frictional resistance to operating the linkage. However, the link was created in contemplation of manual operation of control mechanism. For instance, a manual operator may be used to push or pull the link 2. The push or pull is transmitted substantially play-free by means of link 8, which in turn deflects link 3 and causes it to push or pull some device such as a valve, or the like, in just such amount as corresponds to the original deflection of link 2.

Those skilled in the art will be aware of many uses to which my novel link may be put, and various modifications thereof will be obvious. Hence, having set forth my invention in the manner required by 35 USC 112.

I claim:

1. In control linkage comprising a link, a first movable member having a portion pivoted to one end of said link for transferring motion to said member via said link, a second movable member having a portion pivoted to the other end of said link for transferring motion from said

4

second to said first member via said link, the improvement wherein

said link consists essentially of a pair of equi-length spring laminae secured together in substantial congruence and in the form of a sandwich wider than it is thick, and longer than it is wide and wherein adjacent ends of the laminae are offset one from another so that said sandwich provides a link that is longer than either laminae by twice the distance of such offset, said adjacent ends of said laminae being free so as to be spreadable apart for clipping said link to said portions of said movable members.

2. The invention of claim 1, wherein one said portion is a ball element, and the end of one of said laminae has a socket element pivotally receiving said ball element.

3. The invention of claim 2, wherein said socket element is a hole through said end and over the end of the adjacent lamina.

4. The invention of claim 1, wherein said first movable member is a laminar element sandwiched between adjacent ends of said laminae, and one of the last said ends having a socket element over said laminar element; said laminar element having a ball element fixed thereto and pivotally received in said socket element.

5. A two-part link for a control linkage, said link consisting essentially of a pair of equi-length, elongated spring laminae sandwiched together substantially flush to each other and substantially congruent except as to their long dimensions which are offset one from the other at the ends of said link;

there being means fixing together the intermediate portions of said laminae, the end portions of said laminae being free for allowing adjacent ends of said laminae to be spread apart;

and there being means at one end of said link for pivotally connecting to a control linkage element.

6. The invention of claim 5, wherein the last said means is a socket element in one of said end portions, said one of said end portions forming part of said one end of said link.

7. The invention of claim 6, wherein said socket element is a hole through said one of said end portions and over the adjacent end portion of the adjacent lamina.

#### References Cited

#### UNITED STATES PATENTS

|         |        |                   |         |
|---------|--------|-------------------|---------|
| 106,339 | 8/1870 | Dixon et al. .... | 287—100 |
| 190,860 | 5/1877 | Hopkins .....     | 74—588X |

FRED C. MATTERN, JR., Primary Examiner

F. D. SHOEMAKER, Assistant Examiner

U.S. CI. X.R.

287—100