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(19)


## (54) ENERGY-ABSORBING STEERING COLUMNS

(71) We, TI ACCLES & POLLOCK LIMITED, a British Company of Oldbury, Warley, West Midlands, B69 2DF, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to collapsable steering columns for road vehicles. There have been many proposals for arranging that the steering column of a vehicle should collapse in a controlled manner, whilst absorbing energy, when in the event of an accident it is struck at its lower end by another vehicle and/or at its upper end by the driver's chest. In some of these it is the stationary outer column that absorbs the energy, while the actual shaft that transmits the steering torque is allowed simply to collapse or to become disconnected. In others the shaft itself is designed to absorb energy as it collapses, either instead of or in addition to the outer column.

The present invention is concerned with the first of these types, i.e. ones in which the movement of the outer column in relation to the surrounding structure of the vehicle under impact is arranged to absorb energy.

Various proposals have already been made on these lines. For example in U.S. Patent Specification No. 3 006 971 of American Motors Corporation there is shown an arrangement in which two loops of metal strip of hairpin-like shape are spaced apart around the outside of the column, one end of each strip being secured to the column and the other to the vehicle structure, so that in the event of an impact that displaces the column forwards and downwards in relation to the structure the loops are stretched, being plastically deformed to absorb energy and, at least to some extent, performing a rolling action. British Patent Specification No. 1 296 527 of Cam Gears Limited show the use of a U-shaped strip which tears when stretched. German Offenlegungschrift 2 604 214 of B.M.W. shows a layout similar to the above-mentioned U.S. Patent Specification, i.e. in which a strip of sheet metal is bent to a U-shape, with its limbs connected respectively to the column and to the vehicle structure, and it undergoes a rolling action, absorbing energy, in the event of an impact that displaces the column.

Finally British Patent Specification No. 1 120 799 of Ford Motor Company Limited shows a layout in which two strips lying on opposite sides of the steering column are guided around rollers to flex then and hence absorb energy.

A drawback of those known arrangements in which a bent loop is simply attached at one end to the column and at the other end to the vehicle structure is that the loop collapses and bends in an arbitrary manner, for example undergoing severe bending or kinking at one point, whilst hardly bending at all at another, and a true rolling action is difficult to achieve, so that the collapsing characteristics of a given design is difficult to predict with certainty.

The aim of the invention is to provide a simple form of energy-absorbing mounting on a steering column, low in cost yet predictable and consistent in behaviour.

According to the invention there is provided a collapsable steering column for a road vehicle in which the column is adapted to be connected to the surrounding vehicle structure through an energy-absorbing strip of metal bent to a U-shape with its limbs extending substantially in the direction of collapse of the column, the free end of one of the limbs being secured to the column and the free end of the other limb being adapted to be secured to the structure, the strip being confined in a box with the limbs lying against opposed sides of the box to

define and control the rolling radius of the strip as it is deformed.

The box is preferably of substantially oblong-rectangular cross-section, and of width only slightly greater than that of the strip, but boxes of other cross-sections, such as square or circular, may be used.

The box may be open at both ends, and the bight of the strip may project beyond one end whilst at least one of the limbs may project beyond the other.

The box may be formed by a channel-shaped pressing defining three sides, whilst the fourth side is formed by the external surface of the column itself.

Instead of using a member of plain U-shape a complete loop may be used, effectively comprising a pair of oppositely facing U-shaped members with the free ends of their corresponding limbs joined.

The invention will now be further described by way of example with reference to the accompanying drawings, in which:-

*Figure 1* is an isometric view of a first embodiment of the invention, showing part of an outer steering column and of the steering shaft within it;

*Figure 2* is a side view of the column of Figure 1 in normal use, i.e. before collapse;

*Figure 3* is a view similar to Figure 2 but showing the same column after collapse;

*Figure 4* is a view like Figure 1 showing a second embodiment;

*Figure 5* shows a box unit used in the embodiment of Figure 4;

*Figure 6* is a side view, similar to Figure 2, showing the embodiment of Figure 4 before collapse;

*Figure 7* is a view similar to Figure 1 showing a third embodiment; and

*Figure 8* is a view similar to Figure 2 showing the third embodiment before collapse.

Referring first to Figure 1, a hollow non-rotating steering outer column 1 of a motor vehicle contains a rotatably mounted steering shaft 2, of which the upper end 3 is designed to receive a steering wheel, not shown. The lower end of the shaft incorporates telescopic or other collapsing or detaching arrangements (not shown), which form no part of the present invention. The outer column 1 is secured to the vehicle structure by means of a bracket 4 formed by pressing and having a central part-cylindrical portion that receives the column and two wings 5, each in the shape of a hollow substantially rectangular-section open-ended box. The two boxes 5 lies on opposite sides of the column 1.

The uppermost end (i.e. that nearer the steering wheel) of each box 5 has its upper wall notched to receive a block 6 of hard plastics through which passes a bolt 7 by means of which the bracket is secured to the surrounding structure (not shown) of the vehicle. In the event of a heavy downward impact on the column in the direction of its length, for example as a result of the driver striking the steering wheel following an accident, the boxes 5 can become disengaged from the blocks 6, which are only held frictionally in the notches in the ends of the boxes; this arrangement can be as shown in our British Patent Specification No. 1 300 284.

Within each box 5 is a strip 8 of deformable metal, e.g. mild steel, bent to a U-shape, the bight 9 of each strip just projecting from the lower end of the box. The upper limb of each strip lies against the inside of the upper wall of the box and its free end is secured to this wall by a bolt 10. The lower limb of each strip lies along the bottom wall of the box and its free end is exposed where the box is cut away, as shown at 11. This end of the strip is held under the head of the bolt 7, spaced away from the block 6 by a bush 12, and is thereby rigidly attached to the vehicle structure.

In the event of an impact that causes the column 1 to move downwards in the direction of its length, each strip 8 is deformed in a rolling manner, elements of the upper limb passing through the bight and becoming part of the lower limb, the limiting position being that shown in Figure 3. The resulting deformation, bending and then straightening successive elements of the strip, absorbs energy and brings the column to a halt in a controlled manner. In contrast to arrangements employing an unconfined loop, the box 5 ensures that the deformation is smooth and consistent, holding both limbs of the strip 8 substantially straight and restricting the rolling radius of the bight 9 to a known value. Also the sides of the boxes prevent excessive lateral displacement, ensuring that the column moves downwards in relation to the vehicle structure without significant sideways movement.

Figure 4 shows an arrangement similar to that of Figures 1 to 3 except that the bracket, shown at 4', has flat flanged wings 5' to which separately made open-ended rectangular boxes 13 are secured by bolts 14. As shown in Figure 6, in this case it is the lower limb of the strip 8' that is secured to the box 13 by a bolt 10' of the upper limb is secured under the head of the bolt 7 without the interposition of a bush. As in the embodiment described earlier, the box defines and controls the rolling radius of the strip.

It will be appreciated that in the version shown in Figures 4, 5 and 6 it is possible to replace the energy-absorbing units, comprising the boxes 13 and strips 8' after an accident and the bracket 5' should be undamaged. In the earlier version, as long as the

bracket 5 is undamaged, it should be possible to replace the strips 8 alone.

Figures 7 and 8 show a third embodiment in which the energy-absorbing arrangement is separate from the mounting bracket. Here a pressed bracket 4' like that of Figure 4 receives the column 1 and has its wings 5' attached through 'break-away' blocks 6 to bolts 7 and thereby to the vehicle structure (not shown). A rolling energy-absorbing strip 15 is confined in a substantially rectangular-section open-ended box formed by a channel-shaped pressing 16 welded to the outer surface of the column 1. The lower limb of the strip 15 has its free end welded to the outside of the column at 17 and its upper lumb projects from the upper end of the box to be secured to the vehicle structure by a bolt (not shown) separate from the bolts 7. In this case, therefore, the energy-absorbing strip is separate from the breakaway mounting means, but is still confined in a box, the upper and lower walls of which define and control the rolling radius of the strip as it is deformed. Also, as the width of the strip is nearly equal to that of the inside of the box, the side walls of the box guide the strip and resist sideways movement of the steering column at least over the greater part of the travel on collapse.

While the above arrangements are particularly suitable for use with steering columns which collapse axially, the present invention may be applied to non-axially collapsing columns, in which case the limbs of the U-shaped strip of metal and the axis of the box will extend substantially in the direction of collapse of the column.

WHAT WE CLAIM IS:-

1. A collapsable steering column for a road vehicle in which the column is adapted to be connected to the surrounding venicle structure through an energy-absorbing strip of metal bent to a U-shape with its limbs extending substantially in the direction of collapse of the column, the free end of one of the limbs being secured to the column and the free end of the other limb being adapted to be secured to the structure, the strip being confined in a box with the limbs lying against opposed sides of the box to define and control the rolling radius of the strip as it is deformed.

2. A steering column according to claim 1 in which the box is of rectangular cross-section, its width being only slightly greater than that of the strip.

3. A steering column according to claim 2 in which the box has both ends open.

4. A steering column according to any one of claims 1 to 3 in which the box is formed by part of a bracket by means of which the column is adapted to be releasably attached to the vehicle structure.

5. A steering column according to any one of claims 1 to 3 in which the box is detachably secured to a bracket by means of which the column is adapted to be releasably attached to the vehicle structure.

6. A steering column according to any one of claims 1 to 3 in which the box is formed by a channel-shaped pressing secured to the outside of the column, one of the walls of the box being formed by the surface of the column itself.

7. A steering column according to any one of the preceding claims in which the strap is in the form of a closed loop.

8. An energy-absorbing steering column substantially as described with reference to Figures 1 to 3 of the accompanying drawings.

9. An energy-absorbing steering column substantially as described with reference to Figures 4 to 6 of the accompanying drawings.

10. An energy-absorbing steering column substantially as described with reference to Figures 7 and 8 of the accompanying drawings.

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1584984 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

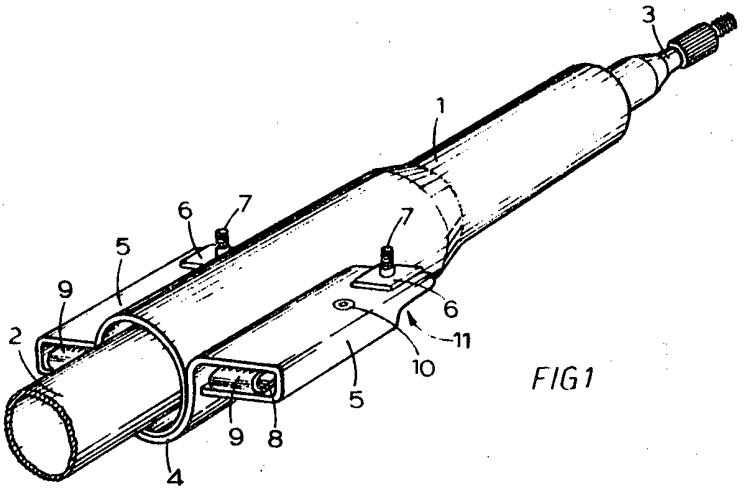


FIG1

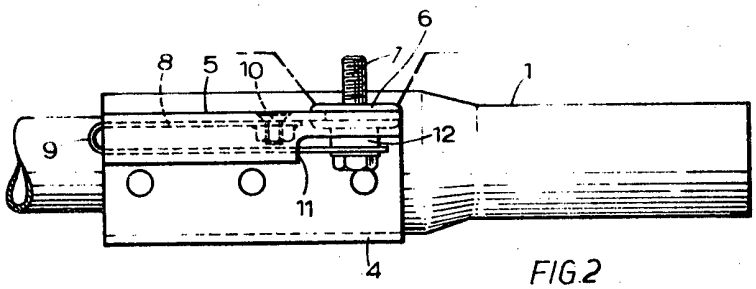


FIG.2

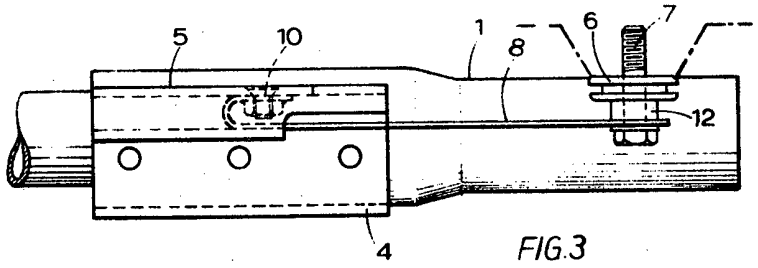


FIG.3

1584984 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

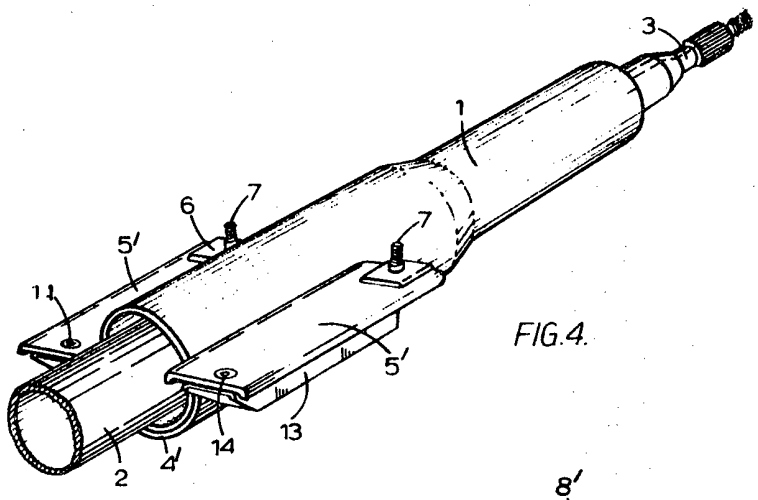


FIG.4.

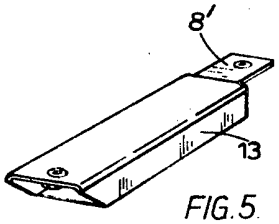


FIG.5.

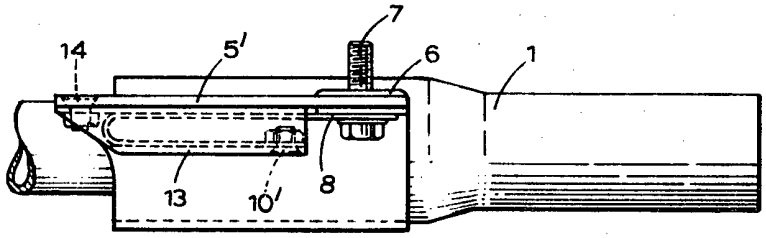


FIG.6

1584984 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

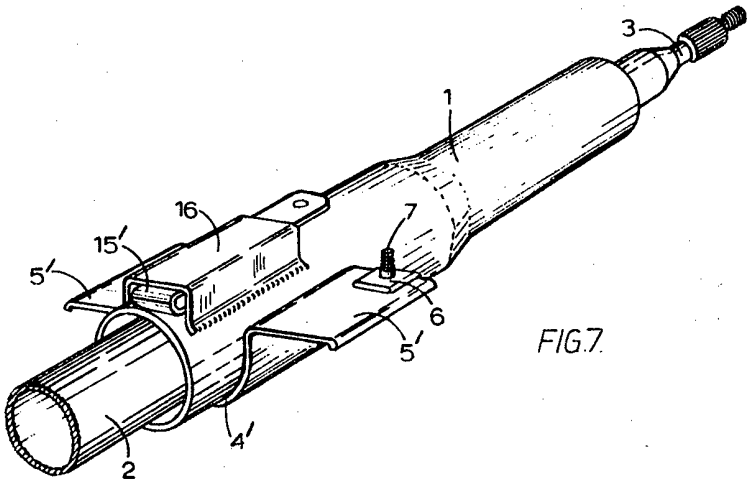


FIG.7.

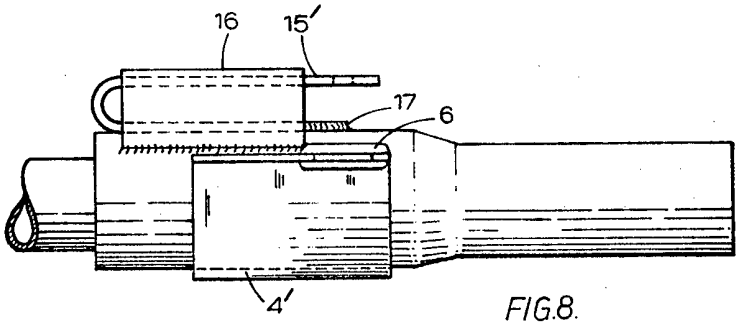


FIG.8.