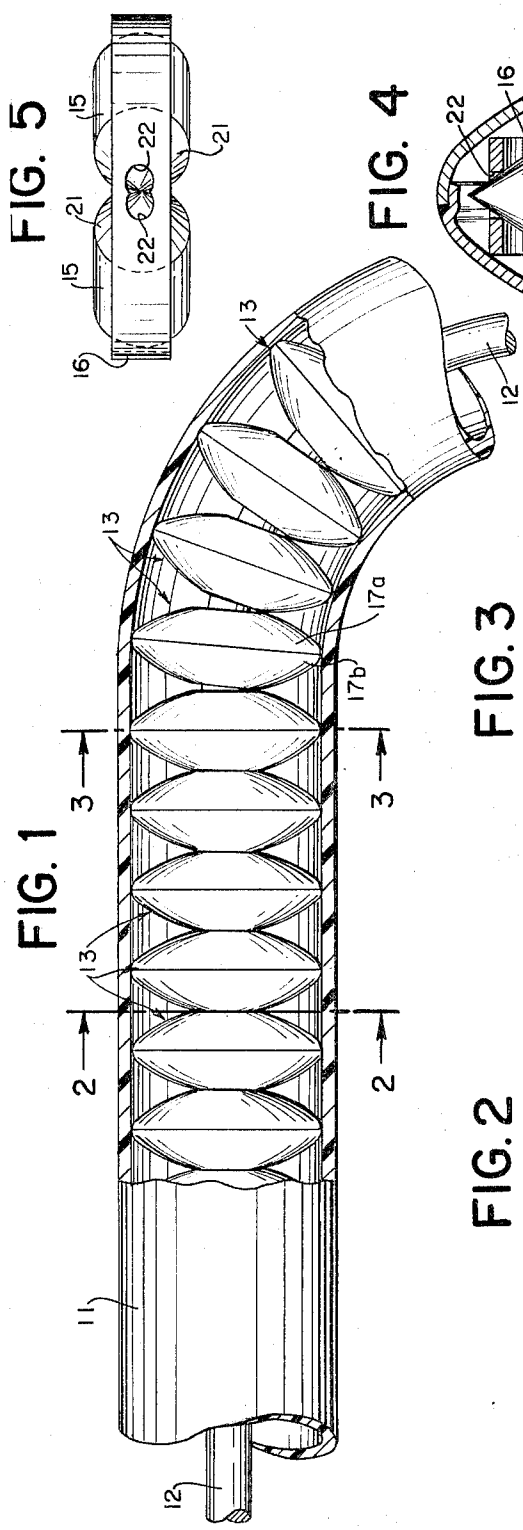
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FLEXIBLE PUSH-PULL CONTROL CABLE

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FLEXIBLE PUSH-PULL CONTROL CABLE

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This invention relates to flexible push-pull control cable.

In general, flexible push-pull remote control cable comprises a flexible, longitudinally movable control rod or wire encased in a flexible, stationary outer sheath. The ends of the cable are connected to a control device (for example, a throttle lever) and to another device that is being controlled (for example, a throttle valve), the cable being adapted to transmit a linear to-and-fro control movement from the control device to the controlled device.

In order to reduce the friction between the longitudinally movable control rod and the stationary outer sheath it has been proposed that the centrally positioned control rod be supported on free rolling balls or rollers disposed between the centrally positioned control rod and the outer sheath. It has also been proposed that the centrally positioned control rod be in the form of a flat metal strip that serves as a kind of movable raceway for the balls. U.S. Patent 2,442,360 illustrates both of the aforementioned proposals.

When the control rod is moved longitudinally to-and-fro it rolls on the supporting balls, and the balls in turn roll on the inner surface of the sheath or on a stationary raceway disposed against the inner surface of the sheath. As a result, the balls move or roll longitudinally one half the distance that the control rod itself is moved longitudinally to-and-fro. The longitudinal movement of the balls requires that there be considerable slack or free play within the sheath to accommodate this movement, or the control cable has to be provided with an elaborate mechanism at the terminal ends thereof as illustrated in U.S. Patent 2,457,910.

I have now developed a new push-pull control cable in which the centrally disposed control rod is supported by groups of rollers, the rollers in turn being rotatably mounted in individual roller retaining units which are stationary with respect to the outer sheath. Because the rollers are mounted in stationary retaining units, my cable does not require excessive slack or free play within the sheath or elaborate terminal mechanisms, to accommodate longitudinal movement of the rollers.

My new push-pull control cable comprises a flexible outer sheath, a flexible control rod centrally positioned within the outer sheath and movable longitudinally with respect thereto, and a plurality of individual roller retaining units disposed about the control rod within the outer sheath. Each of the individual roller retaining units comprises a group of rollers disposed about the control rod in substantial rolling contact therewith, an annular roller-retaining ring disposed about said group of rollers, the rollers of each group being rotatably mounted in said retainer ring, and a roller-retaining shell disposed about said roller retaining ring in substantial contact therewith, the retaining shell being substantially in contact with the inner surface of the outer sheath and being substantially stationary with respect thereto. The individual roller retaining units are disposed side by side within the outer sheath throughout the length of the sheath to provide freely rolling and fully articulated support for the longitudinally movable control rod.

The group of rollers in each roller retaining unit advantageously comprises three rollers disposed in the form of an equilateral triangle about the control rod, the axes

of rotation of the rollers being disposed in a plane substantially perpendicular to the longitudinal axis of the control rod, and both ends of each roller being conically tapered so that the apices of the conical ends of the rollers may be readily rotatably mounted on the annular retainer ring of the unit. Moreover, the roller retaining shell advantageously has a substantially eliptical cross section in a plane containing the longitudinal axis of the control rod and is formed with a central opening through which the control rod extends.

My invention will be better understood from the following description in conjunction with the accompanying drawings of which—

FIG. 1 is a side view, partly in section, of an advantageous embodiment of my new push-pull control cable;

FIG. 2 is a sectional view along lines 2—2 of FIG. 1;

FIG. 3 is a sectional view along lines 3—3 of FIG. 1;

FIG. 4 is an enlarged, fragmentary sectional view of one of the roller retaining units of my device; and

FIG. 5 is a view from above of the rollers and roller retaining ring of my device.

As shown best in FIG. 1, my push-pull control cable comprises a flexible outer sheath 11, a flexible control rod 12 centrally positioned within the sheath 11, and a plurality of individual roller retaining units 13 disposed about the control rod 12 within the outer sheath 11. Each of the roller retaining units 13 contains a group of rollers on which the control rod 12 is rollably supported as hereinafter described, and the units 13 are disposed side by side adjacent but not otherwise connected to each other within the outer sheath 11 as clearly shown in FIG. 1 so that they provide fully articulated, rolling support for the control rod 12 throughout the length of the control cable.

The flexible outer sheath 11 is of conventional construction and may be formed from a flexible resilient material such as rubber or rubberized fabric, or from metal such as helically wound strip or wire, or from a combination of these materials. Similarly, the flexible control rod 12 is of conventional construction and may be in the form of a solid flexible rod or wire, or a plurality of wires wound to form a small cable.

The roller retaining units 13 are disposed about the centrally positioned control rod 12 within the outer sheath 11, each roller retaining unit containing a group of rollers rotatably mounted within the unit 13 so as to provide rolling support for the control rod 12 extending through the unit 13. The roller retaining unit 13 has an approximately eliptical cross section in a plane extending along the longitudinal axis of the control cable so that when the control cable is flexed or bent in the form of a curve the eliptical outer surface of the individual roller retaining units within the sheath 11 will roll against the eliptical outer surfaces of the adjoining units 13 as clearly shown in FIG. 1.

In an advantageous embodiment of my invention shown in FIGS. 2 through 5, each roller retaining unit 13 comprises a group of rollers 15 disposed about the longitudinally movable control rod 12. The rollers 15 are rotatably mounted in a roller retaining ring 16 so that the axes of rotation of the rollers 15 lie in a plane perpendicular to the longitudinal axis of the control rod 12. The retaining ring 16 is disposed within a roller retaining shell 17 advantageously formed from two shell members 17*a* and 17*b* to facilitate assembly of the retaining shell about the group of rollers as shown clearly in FIG. 4. As previously noted, the roller retaining shell 17 of each roller retaining unit 13 has a generally eliptical cross section in a plane containing the longitudinal axis of the control rod 12, and the shell is formed with central openings 19 through which the control rod 12 extends.

In the preferred embodiment of my invention shown in the drawing the rollers **15** are disposed in groups of three about the control rod **12** in the form of an equilateral triangle, the control rod **12** being substantially in rolling contact with the adjacent surfaces of the three rollers **15** of each group. The ends **21** of each roller **15** are conically tapered at an angle of not more than about 30° with respect to the axis of rotation of the roller so that the ends of adjacent rollers will rest against each other as shown best in FIG. 3. The tapered ends **21** of adjoining rollers extend through elongated openings **22** formed in the retaining ring **16**, the openings **22** comprising the bearings in which the rollers are journaled. Other means for rotatably mounting the rollers **15** in the retaining ring **16** may be employed as will be understood by workers skilled in the art.

The individual roller retaining units **13** are disposed side by side throughout the length of the control cable (as shown in FIG. 1) so as to provide rolling support for the longitudinally movable control rod **12**. The roller retaining units **13** are substantially stationary with respect to the outer sheath **11** and therefore it is not necessary to make provision for longitudinal movement of the roller **15** when the control rod **12** is moved longitudinally. The eliptical longitudinal cross section of the roller retaining unit **13** permits the control cable to be flexed or curved in any direction with respect to the longitudinal axis of the cable. As a result, my new control cable provides free rolling, fully articulated support for the control rod **12** throughout the length of the cable.

I claim:

1. A flexible push-pull control cable which comprises:
- a flexible outer sheath,
- a flexible control rod centrally positioned within the outer sheath and movable longitudinally with respect thereto, and
- a plurality of individual roller retaining units disposed about the control rod within the outer sheath in substantially stationary contact with said sheath, each roller retaining unit comprising
- a group of rollers disposed about the control rod in substantial rolling contact therewith, the axes of rotation of the rollers of each group being disposed in a plane substantially perpendicular to the longitudinal axis of the control rod,
- an annular roller retainer ring disposed about said group of rollers, the rollers of said group being rotatably mounted in said retainer ring, and
- a roller retaining shell disposed about said roller retainer ring in substantial contact therewith, said retaining shell being substantially in contact with the inner surface of the outer sheath and being substantially stationary with respect thereto,
- said individual roller retaining units being disposed side by side within the outer sheath throughout the length of the sheath to provide freely rolling and fully articulated support for the longitudinally movable control rod.

2. A control cable according to claim **2** in which the group of rollers in each roller retaining unit comprises three rollers disposed in the form of an equilateral triangle about the control rod, both ends of each roller being conically tapered at an angle of not more than 30°, the apices of the conical ends of said rollers being rotatably mounted on the annular roller retainer ring of the unit.

3. A flexible push-pull control cable which comprises:
- a flexible outer sheath,
- a flexible control rod centrally positioned within the outer sheath and movable longitudinally with respect thereto, and
- a plurality of individual roller retaining units disposed about the control rod within the outer sheath in substantially stationary contact with said sheath, each roller retaining unit comprising
- a group of rollers disposed about the control rod in substantial rolling contact therewith, the axes of rotation of the rollers of each group being disposed in a plane substantially perpendicular to the longitudinal axis of the control rod,
- an annular roller retainer ring disposed about said group of rollers, the rollers of said group being rotatably mounted in said retainer ring, and
- a roller retaining shell disposed about said roller retainer ring in substantial contact therewith, said retaining shell being substantially in contact with the inner surface of the outer sheath and being substantially stationary with respect thereto, said retaining shell having a substantially eliptical cross section in a plane extending along the longitudinal axis of the control rod and being formed with a central opening through which said control rod extends,
- said individual roller retaining units being disposed side by side within the outer sheath throughout the length of the sheath to provide freely rolling and fully articulated support for the longitudinally movable control rod.

4. A control cable according to claim **3** in which the group of rollers in each roller retaining unit comprises three rollers disposed in the form of an equilateral triangle about the control rod, both ends of each roller being conically tapered at an angle of not more than 30°, the apices of the conical ends of said rollers being rotatably mounted on the annular roller retainer ring of the unit.

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