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SLIP RING APPARATUS FOR SIGNAL TRANSFER

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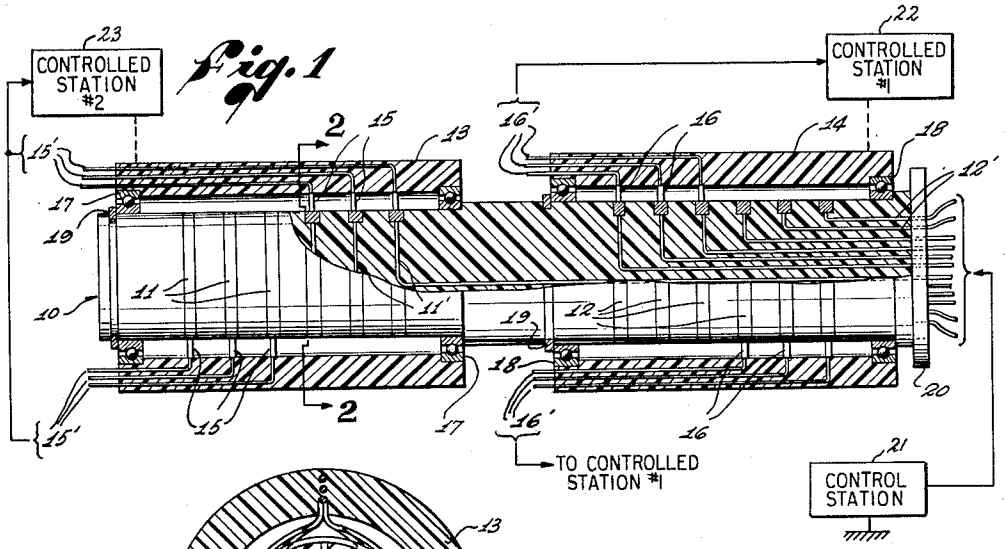


Fig. 1

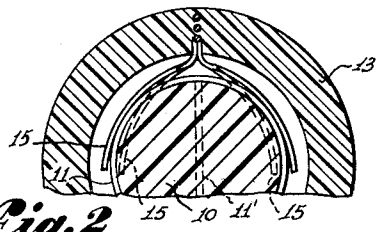


Fig. 2

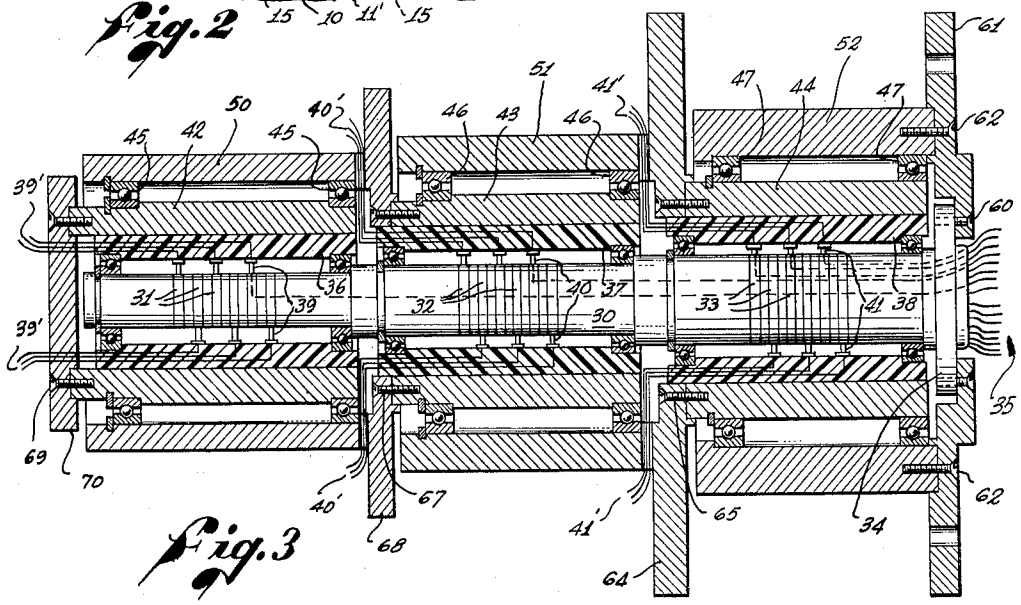


Fig. 3

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SLIP RING APPARATUS FOR SIGNAL TRANSFER

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This invention relates to rotary signal apparatus, and more particularly to a unique brush and slip ring assembly for transferring a multiplicity of separate signals simultaneously through separate connections between relatively movable parts.

In a variety of situations, it is necessary to couple parts of an electrical system that are supported on relatively movable coaxial structures. For example, a system may include a control center on one structure, and apparatus on the other structures to receive a plurality of signals from the control center.

It will be apparent that numerous wires or leads are needed for such equipment. As will also be apparent, it is highly desirable for many purposes that the size and complexity of means for transferring signals from the control center leads to the controlled apparatus leads should be kept to a minimum.

As heretofore known, no satisfactory signal transfer mechanism has been devised for coaxial structures wherein respective ones of a number of leads from apparatus on one structure are to be connected to leads of respective apparatus on different structures. Such transfer mechanisms as have been employed have various undesired characteristics, in that they require too many moving parts, wire connections are unduly complex, and they are not capable of being combined so as to provide a desired small, compact mechanism.

It is another object of my invention to provide a unique signal transfer apparatus in which a single element carries sets of compact elements for each of a number of devices coaxial therewith.

A further object of my invention is to provide rotary signal apparatus that is characterized by great ease of assembly and disassembly.

A still further object of my invention is to provide signal transfer apparatus for devices that are relatively movable about a common axis, which employs a minimum number of component parts of simple design and rugged construction.

The above and other objects and advantages of my invention will become apparent from the following description taken in conjunction with the accompanying drawing of illustrative embodiments thereof, in which:

FIGURE 1 is a longitudinal sectional view of a rotary signal transfer device in accordance with my invention, showing different sets of slip rings held on a common shaft of insulating material, with leads to each of the slip rings of both sets being led to the rings by one end of the shaft, and showing separate brush assemblies having housings separately and rotatably mounted on the shaft, with respective leads in contact with each of the slip rings being embedded in the associated brush housing;

FIGURE 2 is a fragmentary sectional view taken along the line 2—2 of FIGURE 1, to illustrate a suitable brush arrangement; and

FIGURE 3 is a longitudinal sectional view of signal transfer apparatus of my invention employing multiple sets of slip rings and brush assemblies for a plurality of different structures that are rotatable about a common axis.

Referring to FIGURE 1, there is shown a shaft **10** that supports spaced sets **11**, **12** of slip rings of conductive metal. Surrounding the shaft **10** are spaced sleeves,

shown by way of example as cylinders **13**, **14** which carry respective sets of wire contacts or brushes **15**, **16** for engaging the rings **11**, **12**. As shown, the cylinders **13**, **14** are mounted for rotation relative to the shaft **10** by means of respective pairs of ball bearings **17**, **18**.

As in the embodiment shown, the cylinders **13**, **14** surround portions of the shaft **10** that may be of different diameters, so that the inner races of one of the bearings of the pairs **17**, **18** are in abutment with the radial transitions between the different diameters. Snap rings **19** are employed to engage the inner races of the remaining bearings of the pairs **17**, **18**. The sleeves **13**, **14** are captured between the outer races of the bearings, and for this purpose the ends of the cylinders **13**, **14** are suitably grooved.

The brushes **15**, **16** are extensions of lead wires **15'**, **16'** that are embedded in the bodies of the cylinders **13**, **14**. The slip ring assembly is also provided with leads **11'**, **12'** that are embedded in the shaft **10**. The leads **11'**, **12'** are led through the rings **11**, **12** to one end of the shaft **10**, and through a disk **20** that is molded to the shaft at that end. With this arrangement, the leads **11'**, **12'** extending from the one end of the shaft **10**, and the leads **15'**, **16'** extending from respective ends of the cylinders **13**, **14** are arranged for connection to respective sets of electrical apparatus.

The leads **11'**, **12'** are connected to apparatus **21** that functions to control apparatus **22**, **23** contained on structures that rotate, relative to each other and to the control apparatus **21**, about the axis of the shaft **10**. The control apparatus **21** and the controlled apparatus **22**, **23** may, for example, include coaxially arranged and independently rotatable multi-position switch stations, wherein the central or control station supplies signals to slip rings selectively, and the associated brush connections present the signals at corresponding terminals about the respective switch stations. In such an arrangement, circuits may be connected to switch terminals so as to operate in accordance with the angular position of the associated switch station and the manner in which signals are programmed to the slip rings. The arrangement is also one of greatest simplicity of arrangement of the parts and the lead wires, and is well adapted for a compact structure to occupy a minimum of space.

In fabricating a structure of the type above described, the respective leads **11'**, **12'** are connected, as by soldering, to the rings **11**, **12**. Each of the leads **11'**, **12'** is then led through the centers of the rings **11**, **12** to one end. The rings **11**, **12** are located in a mold having the desired cylindrical shape, and plastic material is injected into the mold to fill all spaces in the cavity not occupied by the rings **11**, **12** and the leads **11'**, **12'**. The plastic shaft is then cured, and subsequently grooved at the desired locations to receive the snap ring **19**. The disk **20** is prepared with the appropriate number of openings and the leads **11'**, **12'** are threaded through the disk **20**, which is then molded onto the end of the shaft **10**.

The cylinders **13**, **14** are formed in a similar manner. The brushes **15**, **16** are arranged with the leads **15'**, **16'** extending in an axial direction. Thus arranged in a suitable mold, plastic material is injected into the mold, and subsequently cured to provide the cylinders **13**, **14**. After grooving the cylinders **13**, **14**, so as to provide radial shoulders to be located between the confronting edges of the outer races of the bearings **17**, **18**, the cylinders **13**, **14** are located on the respective sets of bearings **17**, **18**, and the snap rings **19** are located in the grooves formed therefor.

In locating the cylinders **13**, **14** on the shaft **10**, care is exercised to insure that the brushes **15**, **16** are in firm biased engagement with the slip rings **11**, **12**. To this

end, the brushes **15**, **16** may be formed of spring metal, with the ends thereof normally spaced from the center of the cylinder a distance less than the radius of the shaft **10** (see FIGURE 2). When the cylinders are located on the shaft, the brushes are forced out of the way. Thereafter, the brushes are self-biased against the rings.

In the embodiment of my invention shown in FIGURE 3, a shaft **30** is provided with three sets of slip rings **31**, **32**, **33**, all of which have leads that extend through one end of the shaft **30**, and through a disk **34** that is bonded to the shaft. The portions of the leads extending through the disk **34** are indicated at **35** in FIGURE 3.

Spaced along the shaft **30**, and mounted for rotation thereon in the manner of the cylinders **13**, **14** of FIGURE 1, are spaced cylinders **36**, **37**, **38**. The cylinders **36–38** support respective sets of brushes **39–41**, and have leads **39–41'** embedded therein and extending therefrom, e.g., from one end thereof.

The cylinders **36–38** are mounted in sleeve elements **42–44** for unitary rotation therewith, e.g., by frictional engagement. Mounted on the lateral surfaces of the sleeves **42–44** are respective pairs of bearings **45–47**, and supported on the outer races of the bearings **45–47** are respective sleeve structures **50**, **51**, **52** which it is desired shall be able to undergo angular movement relative to each other.

The disk **34** is adapted to be secured, as at **60**, to a frame structure **61**. As shown in FIGURE 2, the frame **61** is also secured, as at **62**, to the sleeve **52**. The sleeve **51** is provided with an end ring **64** having an inner diameter substantially the same as that of the sleeve **44**, the sleeve **44** being secured as at **65** to the ring **64**. Similarly, the sleeve **43** is secured at **67** to an integral ring **68** on the sleeve **50**. The sleeve **42** is secured at **69** to a disk **70**.

With the above-described structural arrangement, it will be seen that the sleeves **42**, **43**, **44** may be attached to structures movable on a common axis by the rings **64**, **68** and the disk **70**. Signal controlled apparatus on a structure to which the disk **70** is attached receives signals through the leads **35** that are connected to the slip rings **31**, and through the brushes **39** and brush leads **39'**. As will be apparent, the brush assembly is fixed relative to a structure to which the disk **70** is secured.

In similar fashion, electrical apparatus on a structure to which the ring element **68** is secured is provided with signals through the slip rings **32**, the brushes **40** and the brush leads **40'**. Signals are supplied through the slip rings **33**, the brushes **41** and the leads **41'** to electrical apparatus on a structure to which the ring element **64** is fixed.

As will be apparent, the signal transfer system structure of FIGURE 3 is extremely compact, with the number of wires being kept to a minimum and arranged in the simplest manner to accomplish the desired result.

Although I have illustrated and described particular embodiments of my invention, it will be apparent that various modifications can be made therein without departing from the spirit and scope of my invention. Accordingly, I do not intend that my invention be limited except by the appended claims.

I claim:

1. Signal transfer apparatus comprising: spaced sets of coaxial slip rings, the slip rings in each set being spaced; a respective lead connected at one end to each slip ring, said leads extending from their slip rings toward one end of the assembly; a shaft including nonconductive material supporting said slip rings and embedding said leads therein; spaced sleeves including nonconductive material, said sleeves surrounding said shaft, each sleeve surrounding a set of slip rings; means supporting said sleeves and said shaft for relative angular movement; brush elements supported by said sleeves and engaging said slip rings; and leads extending through said sleeves to the brush elements.

2. The combination defined in claim 1, further including means to aid in securing each sleeve to a structure; and a disk element secured to said one end of the shaft, said leads from said slip rings extending through said disk element.

3. Apparatus for transferring signals from a control station to each of a number of controlled stations, wherein such stations are on structures that are subject to independent relative movement about a common axis, comprising: a shaft including nonconductive material on the axis to be secured at one end to the structure supporting the control station; a plurality of spaced slip ring elements supported in spaced sets on said shaft; respective leads extending from the slip ring elements and through said shaft to said one end of the shaft for connection to the control station; spaced sleeves including non-conductive material surrounding said shaft, each sleeve surrounding a set of slip rings; means supporting said sleeves and said shaft for relative angular movement; spaced brush elements supported by said sleeves extending generally transversely therethrough, said brush elements being arranged so as to be maintained in engagement with respective slip ring elements; and leads extending through said sleeves to the brush elements, the brush leads from each sleeve being adapted for connection to a respective controlled station.

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