Nov. 11, 1958 H. L. DANIELS ET AL 2,860,314

CROSS-WIRED WHEEL

Filed Jan. 19, 1954

Fig. 1.

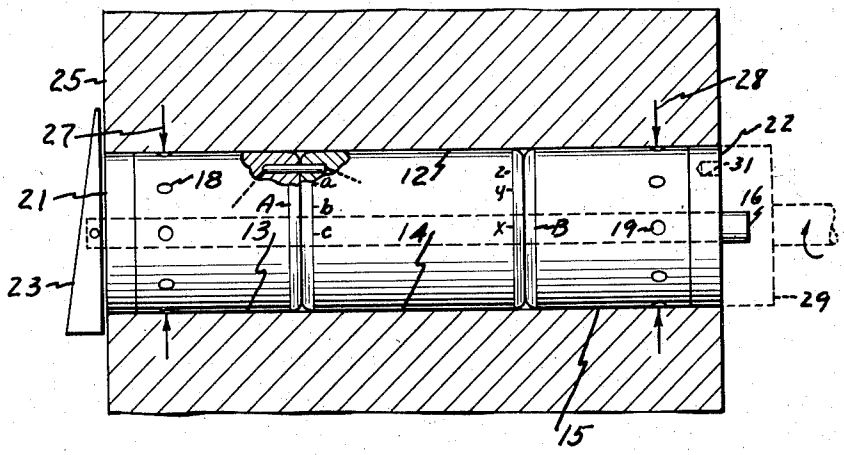


Fig. 2.

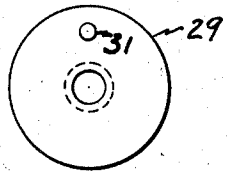


Fig. 3.

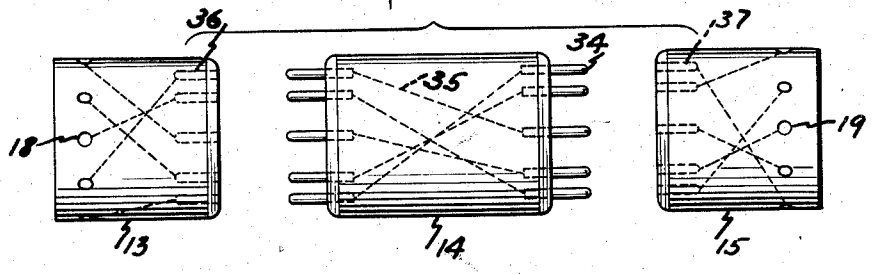
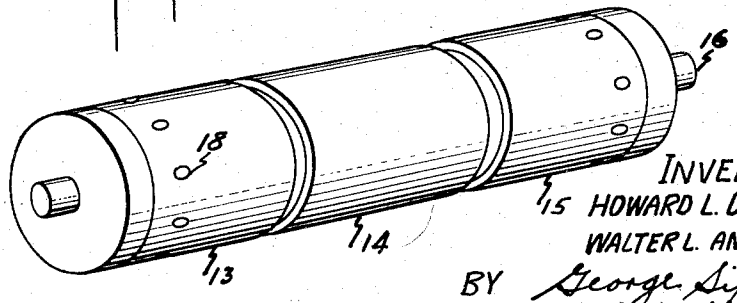


Fig. 4.



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CROSS-WIRED WHEEL

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Application January 19, 1954, Serial No. 405,056

7 Claims. (Cl. 339—18)

This invention pertains to an electric connector and in particular relates to a variable cross-wired wheel and which is capable of a large number of circuit permutations.

The connector described herein can be used in the equipment of patent application Serial No. 405,270, filed January 20, 1954, by Walter L. Anderson, Howard L. Daniels and Robert R. Reisinger for Time Delay Scramble Equipment.

Cross-wired wheels generally, are used in coding equipment. The wheel serves as a convenient means for scrambling speech into an unintelligible sequence of sounds. This is accomplished by feeding the original speech sequence into one end of a cross-wired wheel and deriving an output which is comprised of a disordered scrambling of the segments of the original input speech sequence. The wheel comprises a rotatable element being provided with a series of input contacts and a corresponding series of output contacts and having a series of electrical connections between the two sets of contacts such that the input contacts and the output contacts bear no definite ordered relationship. The cross-wired wheels in use do not provide for any change in the electrical relationship between the input contacts and the output contacts. In other words the wheel is intended for use in a coding equipment to provide one particular scrambling relationship between the input speech and the output signal.

This invention represents a departure from the prior art by providing cross-wired wheels that are capable of providing a large number of possible scrambling relationships between the input speech and the output signal. To accomplish this there is provided a plurality of sections for the cross-wired wheel each of which are adapted to be connected in tandem to provide a single cross-wired wheel. Each of the sections of the wheel are separately cross-wired in an arbitrary manner which is not related to the wiring of any of the other sections. The contacts in each section are equal in number to the contacts of every other section of the wheel and are symmetrically disposed about each of the sections so as to permit relative displacement among the sections to accomplish a plurality of possible scrambling permutations. The sections plug into one another. Any of the other well known methods of physically connecting two electrical components may be readily used in this invention. The wiring scheme for each of the sections of the wheel may be the same; it may be different for each section if the degree of scrambling security requires the greater variety. Even in the case of the latter consideration is given to the interchangeability of parts whereby a spare section is adapted to replace a worn-out section of the wheel.

An object of this invention is to provide a variable cross-wired wheel.

A further object is to provide a variable cross-wired wheel which is adapted to provide a plurality of scrambling relationships between the input speech and the output signal.

A further object is to provide an improved cross-wired wheel that precludes the need for stocking a large number of differently wired cross-wired wheels.

A further object is to provide an improved cross-wired wheel that may be quickly and easily set in a particular scrambling relationship.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 shows a preferred embodiment of the cross-wired wheel, partly in plan, partly in section, and partly schematically,

Fig. 2 shows a preferred coupling arrangement for use between the cross-wired wheel and a driving motor,

Fig. 3 is an exploded view of the cross-wired wheel shown in Fig. 1, and

Fig. 4 is a perspective view of a cross-wired wheel.

There is shown in Fig. 1 an assembled cross-wired wheel **12**. The wheel **12** includes three longitudinally aligned sections **13**, **14** and **15** which sections are mounted on a common shaft **16**. The sections are circular and are of substantially the same diameter. The end sections **13** and **15** are provided with a plurality of equally spaced contacts **18** and **19** respectively, the contacts **18** and **19** being secured in each of the sections **13** and **15** adjacent one end thereof and in one transverse plane in each of said sections. The contacts **18** and **19** are arranged flush with the body of the sections **13** and **15**. A pair of collars **21** and **22** are provided for securing the cross-wired wheel sections **13**, **14**, **15** on the shaft **16** in conventional manner. Mounted on the front end of shaft **16** is an indicator pointer **23**. The indicator pointer **23** is adapted to cooperate with suitable indicia on the surface of supporting body **25**. Secured within the supporting body **25** are two circular series of brush contacts schematically indicated at **27** and **28**. The series of brushes **27** and **28** are spaced so as to cooperate with the series of contacts **18** and **19** of the cross-wired wheel **12**. The number of brushes in each of the circular series **27** and **28** and the number of contacts in each of the circular series **18** and **19** are equal and are spaced sufficiently from one another so that any one brush of a circular series can contact only one contact of the corresponding series of circularly arranged contacts. Therefore if a complete circuit exists between any one of the contacts in series **18** and any one of the contacts in series **19** the respective brushes that are in electrical contact with the two aforementioned contacts represent the terminals of a continuous electrical circuit. It will be shown hereinafter that a complete electrical circuit exists between each of the circular series of brushes **27** and one of the brushes in the circular series **28** so that if eight brushes are provided in each series there are eight complete circuits. It will be further shown that each of the aforesaid eight complete circuits are electrically separate from one another.

A coupling member **29** shown in phantom in Fig. 1 and in full line in Fig. 2 is adapted to transfer the driving torque from a motor (not shown) to the collar **22** and thereby to shaft **16**. The coupling member **29** includes a driving pin **31** which is adapted to cooperate with a suitable aperture or slot in the collar **22**. An end view of the coupling **29** is shown in Fig. 2.

In Fig. 3 the sections **13**, **14** and **15** of the cross-wired wheel **12** are shown in disassembled relationship. Each of the sections **13**, **14** and **15** may be manufactured from an insulating plastic material. Each of the sections may be formed from either a continuous length of tubing or

as separately molded sections with all the electrical parts in place. The central section 14 includes eight equally spaced prongs 33 at one end and a corresponding set of equally spaced prongs 34 at the other end. Though any convenient number of prongs may be used eight has been selected arbitrarily as providing a sufficient number of permutations. Each of the prongs 33 is electrically connected to one of the prongs 34 by electrical connecting means 35. No one prong is connected to more than one prong of the opposite set. As has been shown the prongs 33 are randomly connected to the prongs 34. Each of the end sections 13 and 15 is provided with a socket having eight terminals at 36 and 37 respectively. Each of the series of terminals 36 and 37 includes spring-like elements similar to those found in a socket for a vacuum tube. The series of peripheral contacts 18 are connected to the terminals 36 and the series of peripheral contacts 19 are connected to the terminals 37. Though the electrical connections in the sections 13 and 15 are shown to have a different random pattern it is to be understood that this invention also contemplates the design wherein the electrical connections in each of the sections 13 and 15 are identical. The sections 13, 14 and 15 are adapted to be connected in tandem by forcing the central section 14 into each of the end sections 13 and 15. The central section 14 is provided with two peripheral series of indicia each one corresponding to a set of terminals 33 or 34 for cooperation with corresponding indicating marks on each of the sections 13 and 15. By means of the indicia and the indicating marks it is possible to arrange the sections of the cross-wired wheels into a desired relationship between the input at 27 and the output signal at 28. Though only three sections have been shown for a cross-wired wheel it is within the purview of this invention to use any convenient number of sections for the cross-wired wheel. The sections can have any convenient number of contacts in the several series.

In operation the cross-wired wheel described in an assembly made of two or more sections that are plugged together. Each section is separately cross-wired in a random manner and when the separate sections are plugged together they join to form a plurality of complete circuits through the cross-wired wheels. The number of separate circuits is equal in number to the input contacts and to the output contacts. The circuit elements in each of the sections 13, 14 and 15 of the cross-wired wheel 12 are evenly spaced so as to permit for connection of the sections in a variety of positions. The number of combinations of relative positions among the sections may be doubled simply by reversing the position of the central section 14 relative to the end sections 13 and 15. As a consequence many different resultant wheels may be derived from just a few components. The advantages of this arrangement are that only a small number of cross-wired wheel assemblies are required to accomplish the same scrambling function in a coding apparatus which would otherwise require a large number of cross-wired wheels with fixed circuitry. The cost is lower and a considerable space saving is effected.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

We claim:

1. An electrical connector for scrambling a plurality of circuits in which it may be included, comprising a member having therein a cylindrical recess, a center section and end sections of cylindrical shape, all individually rotatable in said recess about its axis and arranged in an end to end relation, the abutting end faces between said sections having attachably interengaging coupling contacts arranged in circular rows concentric with said axis, equally spaced apart in each row and of the same radial distance from said axis, and all of those

on one end of the center section being aligned with those on the other end thereof in a direction parallel to said axis, said coupling contacts physically coupling together the adjacent ends of said sections against unintentional angular displacement about said axis, a plurality of individual conductors in said center section, one for each contact at one end and each connecting one contact on one end of said center section with one contact on the other end of that center section in an irregular random pattern, each end section having a circular row of exposed contacts equally spaced apart, all concentric with said axis, and of the same radial distances from said axis, means within each end section individually connecting each of its said exposed contacts with one of the coupling contacts on the end adjacent said center section, but in an irregular, random pattern, a plurality of relatively stationary brush means spaced apart in the same manner and distances as said exposed contacts and engaging individually with said exposed contacts of each end section for connection to the circuits to be scrambled, and means for releaseably confining said sections in end to end engagement.

2. The connector as set forth in claim 1, wherein said brush means are carried by said member, and said exposed contacts are in rows on the peripheries of said end sections.

3. The connector as set forth in claim 1, wherein said coupling contacts on opposite ends of said center section are identical to enable selective reversal, end to end, of said center section between said end sections, with contacts established between the coupling contacts of the end sections with the adjacent ends of the center section.

4. The connector as set forth in claim 1, wherein said confining means includes a common shaft on which said sections are mounted, and collars on the end portions of the shaft that engage with the exposed ends of the end sections and confine them in end to end coupling relationships and with axially aligned ones of said abutting coupling contacts engaging one another, whereby said sections may be assembled in the desired relative angular positions on said shaft while outside of said member.

5. An electrical scrambling connector comprising a center section including a body, a plurality of circularly-arranged equally-spaced prongs projecting axially from one end of said body, a corresponding plurality of circularly-arranged equally-spaced prongs projecting from the opposite end of said body and axially aligned with those at said one end of said body, all of said prongs being identical, a corresponding plurality of independent conducting means separately connecting each prong at one end of said body in a completely random irregular pattern to an individual prong at the other end of said body; a pair of end sections for connection axially to respective ends of said center section, and abutting endwise with said center section, each end section including a cylindrical peripheral wall, a corresponding plurality of evenly-spaced apart conductive sockets recessed axially into that end of each of the bodies of said end sections, which abuts the center section arranged in a circular row about the same axis as said prongs and at the same radial distance from that axis as said prongs, a corresponding plurality of evenly-spaced contacts recessed into the peripheral wall of each of the bodies of said end sections and symmetrically disposed relative to a common transverse plane through each body adjacent the other ends thereof, said contacts being approximately flush with the cylindrical wall of each of said end sections, individual brushes bearing on the end sections and the contacts thereon and establishing circuit connections thereto, a corresponding plurality of independent conducting means in each of the bodies of said end sections and separately connecting in a completely random and irregular pattern each recessed socket to an individual contact on the periphery of the respective end sections, the prongs of said center sections being detachably plugged into the sockets

of said end sections in any one of a plurality of different possible angular relationships, whereby when said electrical connector is arranged as a switch part in an external circuit, detachment of one of the sections from the others, rotation of it on its axis relatively to the other sections into any one of a corresponding plurality of angular orientations and recoupling to the other sections, will produce a change in the connection pattern between the brushes bearing on the end sections.

6. An electrical connector for variably scrambling circuit connections in which it may be included, comprising a member having a cylindrical recess, a center section including a cylindrical body disposed within and rotatable in said member about the axis of said recess, a plurality of circularly-arranged equally-spaced prongs projecting axially from one end of said body at equal radial distances from said axis, a corresponding plurality of circularly-arranged equally-spaced prongs projecting from the opposite end of said body at equal radial distances from said axis, which radial distances are the same for the prongs at both ends of the body, all of said prongs being identical, a corresponding plurality of independent conducting means separately connecting each prong at one end of said body in a completely and irregular random pattern to an individual prong at the other end of said body; a pair of end sections having cylindrical peripheries also rotatable in said recess about the same said axis, and abutting endwise with respective ends of said center section, a plurality of evenly-spaced apart conductive sockets recesesd axially into that end of each of the bodies of said end sections which abuts the center section and arranged in a row concentrically with said axis, a plurality of evenly-spaced apart contacts secured to the other end portion of each of the bodies of said end sections and arranged concentrically of said axis, a corresponding plurality of independent conducting means in each of the bodies of said end sections and separately connecting in a completely random and irregular pattern each recessed socket to each contact of the respective end sections, the prongs of said center sections being plugged into the sockets of said end sections in any one of a plurality of different possible angular relationships, whereby when said electrical connector is connected as a switch part in circuits to be scrambled, detachment of one section from another section to which it is coupled, rotation of it axially into any one of a corresponding plurality of angular orientations, and recoupling it to that other section, will vary the connections between said brushes.

7. An electrical connector for variably scrambling circuit connections in which it may be included, comprising a member having a cylindrical recess, a center section including a cylindrical body rotatably supported

in said recess, a plurality of circularly-arranged equally-spaced electrical terminals secured to one end of said body at the same radial distances from the axis of that body, a corresponding plurality of circularly-arranged equally-spaced electrical terminals secured to the opposite end of said body at the same radial distances from the axis of said body as at said one end, a corresponding plurality of independent conducting means separately connecting each electrical terminal at one end of said body in a completely random and irregular pattern to each electrical terminal at the other end of said body; a pair of end sections also rotatably supported in said recess, one at each end of said body, for coupling connection axially to respective ends of said center section, each end section including a cylindrical body of the same diameter as said center section, whereby the sections can be moved end to end into and out of said recess, a corresponding plurality of evenly-spaced apart electrical terminals secured to one end of each of the bodies of said end sections and having the same radial distance from said axis and the same spacing about said axis as do said terminals on said center body section, a corresponding plurality of contacts recessed into the peripheral surface of each of the bodies of said end sections, evenly spaced apart in a direction peripherally of said end sections and symmetrically disposed relative to a common transverse plane through each body adjacent the other ends thereof, said contacts being flush with the cylindrical surface of each of the bodies of said end sections, a corresponding plurality of independent conducting means in each of the bodies of said end sections and separately connecting in a completely random and irregular pattern each of said electrical terminals to one of said contacts of the respective end sections, the electrical terminals of said center sections being detachably securable to the electrical terminals of said end sections in any one of a plurality of angular relationships, whereby when said electrical connector is included as a switch part in circuits to be scrambled, relative rotation in said member of any of said sections relatively to the other sections, will produce a scrambling of said circuits.

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