The Switchboard Cord

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FROM the early days of the first crude telephone switchboard down to those of the great modern central office, the talking connection between subscribers has been completed by an indispensable piece of apparatus—the switchboard cord. Because of the important part which the switchboard cord has always played in the telephone plant, it has been subject to continual modifications of structure to improve its serviceability, ever since its humble beginning as a pair of twisted lamp cord conductors. To the casual observer, the switchboard cord is merely a flexible cotton-braided conductor having a plug attached to one end, and having the other end arranged for attachment to terminal punchings in the switchboard as shown on Figure 1. It is not so well appreciated, however, that this structure of textiles and conductors is composed of materials that are inherently variable in their character, size, and durability, and that it must not only meet close dimensional limits for attachment to the plugs and for satisfactory operation in the switchboard, but must be smooth and flexible, and able to withstand thousands of operations in service without breakage of the conductors or fraying of the outer covering.

The evolution of the switchboard cord is illustrated in Figure 2, which is a photograph of specially prepared samples including the more prominent types that have been developed for use during the past thirty years. Figure 3 is an X-ray photograph of these same samples, and illustrates clearly the various structures of these cords.

An early type, shown in the illustration as No. 2, had stranded copper wire conductors with rubber insulation. The extremely short service life of such conductors soon led to the investigation of other types of flexible conductors that might better withstand the conditions of use in a switchboard. As a matter of course, the use of tinsel, which for many centuries has been employed for decorative purposes, was proposed. It possessed the desired flexibility for use in cords, but the thin metal ribbon lacked the toughness required to produce long

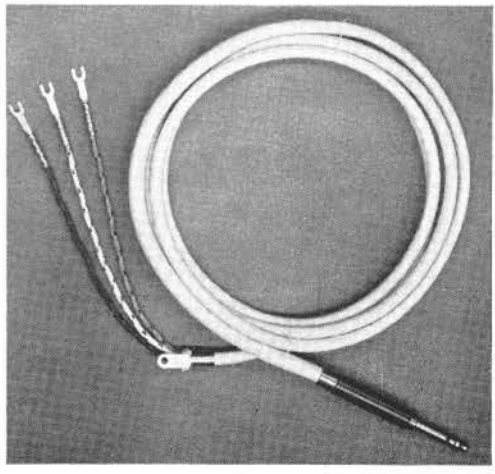


Fig. 1—The equipment end of the cord has a metal band with eyelet clamped around the braid which is used to suspend the switchboard end of the cord. On the band are stamped the cord identification marks

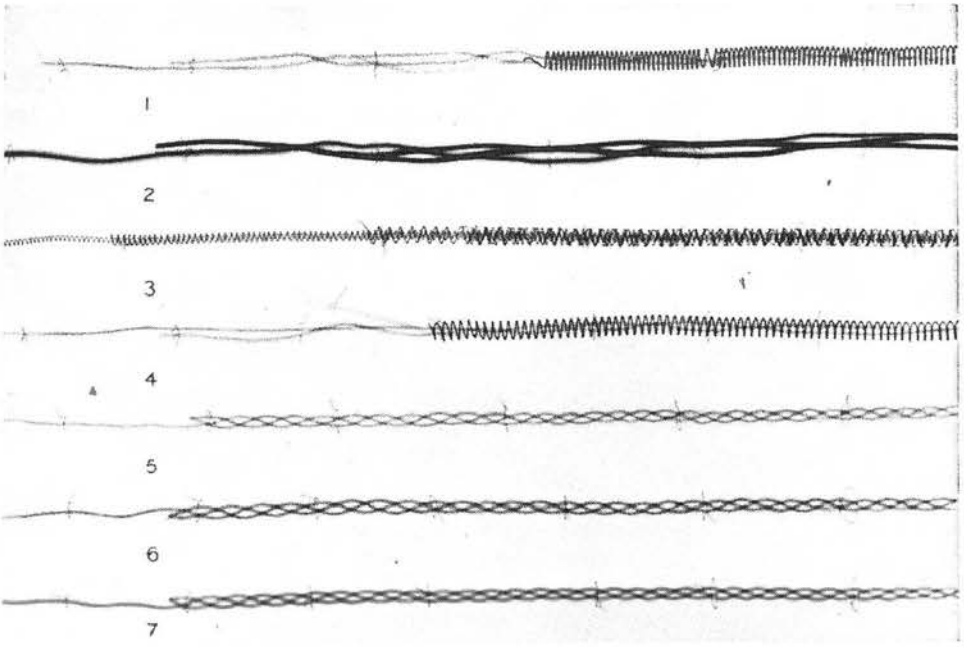


Fig. 3—An X-ray photograph reveals the arrangements of the conductors in the cords shown in Figure 2

spects as the tinsel cord because of its stiffness and higher resistance. Consequently, further consideration was given to the possibilities of tinsel for cord conductors.

This work on the tinsel conductor resulted first in the development of an entirely new type of cord structure having the so-called "rope core" construction as illustrated by No. 5 in the photographs. In service trials cords using this new construction compared favorably in life with the efficient steel conductor cord, but further improvement in the tinsel conductor was found to be needed. The final development of the modern long-life tinsel conductor for use in station and switchboard cords is described in a previous issue of the RECORD* and need not be discussed in detail here. It should be noted, however, that the fundamental improvements in the tinsel consisted in the replacement of the copper ribbon by one of tough bronze alloy which was better able to withstand the repeated bending which the conductors received in service; the later use of two tinsel ribbons of larger size on each thread; and the reduction in the number of tinsel threads to six from the eighteen formerly used. Also, to render the cords suitable for use throughout the country, a moisture-proofing treatment was applied, so that a satisfactory insulation level would be obtained when the cords were subjected to the extremely humid climatic conditions which are encountered frequently during the summer months along the seaboard localities.

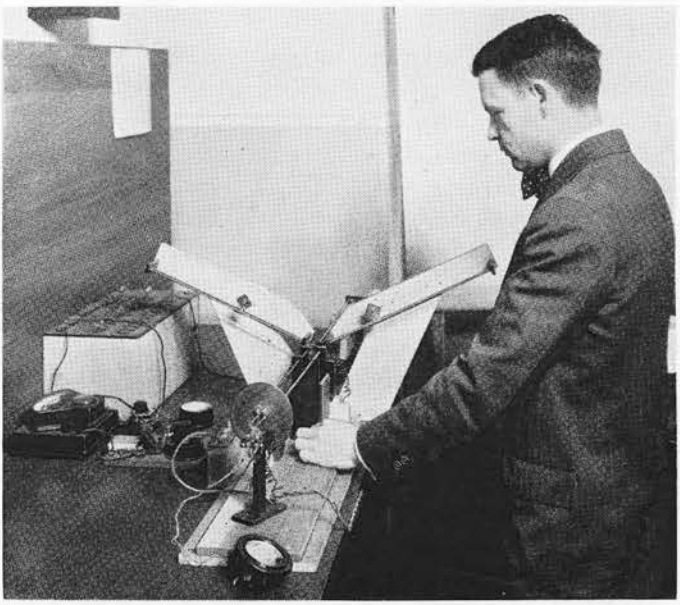
This new cord came into general use in 1925. While it completely fulfilled all expectations in serviceability, other improvements were still to follow. The first of these was the adop-

*RECORD, *July*, 1926, *p.* 196.

tion of solderless cord tips for the conductors, which reduced the contact resistance between the tip and the tinsel, and virtually eliminated troubles in service from variable resistance at the tips, and from tips pulling off the conductors.

Since the adoption of the rope-twisted conductor, with two tinsel ribbons on each core thread, practically eliminated the failure of the conductor before the braid began to fray, it was evident that the life of the cord could be further increased by making improvements in the braid. Braid-life improvement was brought about through the development of better glazed cotton and its more uniform application through the use of automatic braiding machines developed by the Western Electric Company. These improvements were accompanied by other structural changes in the design of the cords and these final improvements have recently been embodied in the commercial product and thus are now coming into use in the telephone plant. Their useful service life is approximately ten times the life of the earlier types of tinsel switchboard cords used in toll switchboards, and two to three times the life of the steel cords formerly standard for local central offices.

General studies of the materials and manufacturing processes involved are being continued with the expectation that this work will be productive of further improvements in switchboard cords in the future.



Experimental circuits for 60 cm. radio waves take some unusual forms. Four tuned circuits are present in this detector circuit being tested by J. G. Chaffee of the Research Department.