Wires for Subscribers' Premises

By J. B. DIXON
Outside Plant Development

TO connect a subscriber's station to the terminating point of an outside line offers peculiar problems which have long justified the use of special wire known as "inside wire." Growth in the use of the telephone, developments in building construction and interior decorating, and improvements in the wire art have all led to periodic changes in the design of this wire, and recently to the additional development of "inside wiring cable," affording many conductors in a small space. Intended solely for interior use, where they are not exposed to excessive moisture, the newest wire and cable have been particularly adapted to the installation facilities and service conditions which modern buildings afford.

In general, inside wire consists of an annealed copper conductor insulated with rubber and covered with a braid of hard glazed cotton yarn. It is available as a single wire, and in twisted form in pair, triple and quad wires. All these forms of inside wire except the quad have been familiar in the plant for many years, and have met plant needs eminently satisfactorily. Continued development has resulted in a number of improvements.

Inside wiring cable has been developed recently for use in the installation of P.B.X. boards, monitors, wiring plans, and other equipment where groups of inside wire, or lead-covered textile-insulated cable, have been employed heretofore. In forming the new inside cable, annealed copper conductors are continuously coated with a varnish-type enamel. The enameled conductors are covered with washed cotton yarn, closely served twice in reverse directions, and this covering is coated with cellulose acetate lacquer. The insulated wires are twisted into pairs and formed into cables of 4, 6, 11, 12, 16 and 26 pairs. After stranding, the cable is bound with two spaced servings of cotton yarn and served with a layer of rubber-frictioned cotton tape. An outer covering, of closely braided unglazed cotton yarn, is finally applied.

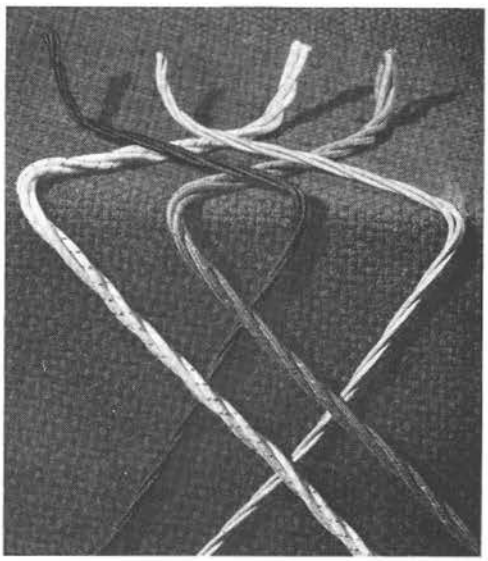

Fig. 1—The colored identification threads in the new inside wire are less conspicuous than in the old

The softness of the annealed copper used for the conductors in both wire and cable gives them maximum flexibility in handling. For many years it was necessary to employ conductors of No. 19 gauge in inside wire to secure adequate tensile strength and transmission efficiency. Improvements in installation methods, in braid strength, and in the efficiency of associated apparatus, have permitted a reduction in the size of the conductors to No. 22 gauge.

For insulating inside wire, rubber compounds are most satisfactory in both performance and cost. Recent advances in rubber chemistry, leading to the use of antioxidants and accelerators, have greatly improved the initial characteristics and increased the useful life of these compounds.

By adopting these more serviceable substances for the new wire, the nominal thickness of the rubber insulation has been reduced from 1/32 inch to 1/64 inch, with attendant savings in space and materials. The reduced cross-sectional area is particularly valuable in congested wiring spaces, where the problem of providing additional wiring facilities is often serious.

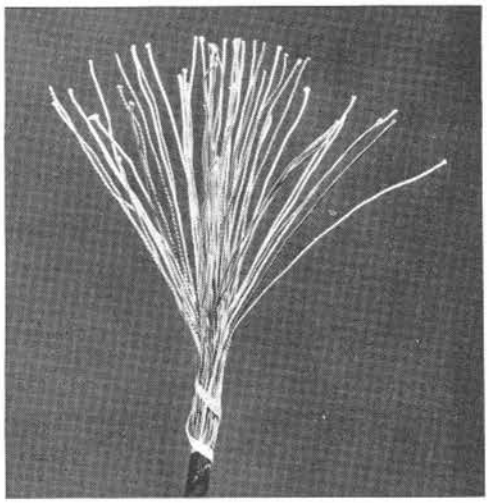

Fig. 2—Inside wiring cable affords many conductors in a small space

New methods of rating rubber compounds have also materially aided this development. Samples of the compounds used in the wire are given an accelerated aging test by exposure to oxygen under high pressure. The insulation is rated before and after aging by tests in a machine which records compression characteristics of the samples.*

In the development of the insulation for inside wiring cable, space considerations were of primary importance. The use of enamel, washed textiles†, and cellulose acetate, provides a cable whose diameter is only about half that of an equivalent number of braided, rubber-insulated wires. Conductors insulated in this newly developed way have shown adequate insulation even when immersed in water for long periods.

The braid is an important factor in obtaining tensile strength in these wires and cables. In average installations, where attachments are provided at frequent intervals, the requirements on tensile strength are not severe.

Interesting considerations in the development of the braiding were those of appearance. On inside wire, which must sometimes be placed where it is exposed to view, hard glazed yarn is used. It affords economically a surface which is less subject to discoloration during installation and to the accumulation of dust and dirt than that of the less expensive soft yarns. Since inside wiring cable is more frequently concealed, and its appearance is therefore somewhat less critical, unglazed yarn is used for its outer covering. To select shades which would harmonize

*RECORD, *January*, 1928, *p.* 153.
†RECORD, *April*, 1929.

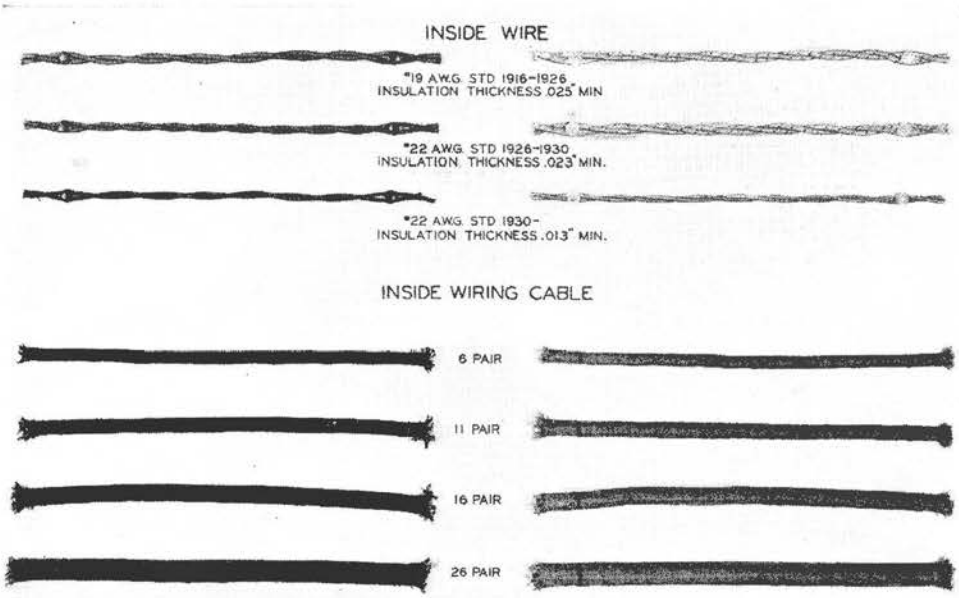

Fig. 3—Inside wire has been considerably reduced in thickness over a period of years, and the new inside wiring cable occupies far less space than an equivalent number of conductors in the form of inside wire

well with modern interior decorations, a number of trial installations were made. Ivory and brown were found to meet the field requirements best, and in the new wire and cable these tints have replaced the olive green and white previously employed.

Each of the conductors of inside wire and inside wiring cable is distinctively marked to permit ready identification by plant forces during installation. In inside wire, the marker is a strand of yellow, red, green or black thread woven into the braid about the individual conductors. The selection of the tracer shades is such that they are readily discernible at short distances, yet do not produce contrasts which are evident when the wire is observed at a distance of several feet. In the cable, the identification is obtained by coloring the second serving of yarn around each wire, in accordance with a standard code employed in other types of cable.

For appearance's sake, it is essential that the braid retain its original color as long as possible. Since the wires and cables are frequently installed in locations exposed directly to sunlight, fading requirements have been placed upon the dyed yarn. It has been found that exposure to light with the spectrum of sunlight affords a more satisfactory accelerated method of rating dyes for this purpose than exposures to the shorter wave-lengths which are not characteristic of service conditions. Although inside wiring is intended primarily for use in locations where it is not likely to be immersed in water, it may nevertheless be wetted in the course of household cleaning. The dyed yarns are therefore tested for reasonable insolubility of the dyes in water.