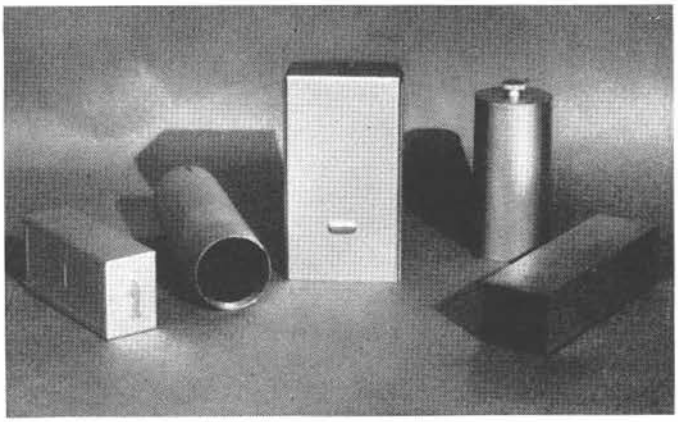

Finishes on the Metal Parts of Telephone Apparatus

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Telephone Apparatus Development

FINISHES are applied to metallic parts of telephone apparatus to obtain a uniform and pleasing appearance, and to protect against corrosion. These are the principal reasons, but finishes are also applied for specific purposes such as electrical insulation; heat or light reflection, or absorption; and to prevent sticking of parts.

At the present time some hundred standard metal finishes are being used on telephone apparatus parts. Paints, varnishes, enamels, baking japans, nitrocellulose lacquers and shellac solutions come within the grouping of organic coatings. The inorganic finishes consist of metallic coatings applied by various plating and dipping processes; and also several inert coatings such as the Bower-Barff and phosphate process finishes.

Paints are not used very extensively on metal parts owing to their softness. Paints consist of oxidizing oils, such as linseed oil, combined with suitable pigments and dryers, and employ turpentine or mineral spirits as thinners. Because of the slow oxidation of the linseed oil, paint films remain soft for a period so relatively long as to render them unsuitable for apparatus to be assembled within a short time after the finish is applied.

Clear air-drying varnishes made from bodied oils, dryers, gums, resins and thinners are used in metal finishes principally as vehicles for aluminum bronzing powder. A bright, light-colored finish for structural framework is produced in this way, which gives a pleasant appearance and due to its light color and reflecting power adds considerable to the effectiveness of central office illumination.* Clear baking varnishes are also used as vehicles for aluminum bronzing powder, the

* *For information on light-colored finishes for central offices see* BELL LABORATORIES RECORD, *Vol. IV, June,* 1927, *pp.* 353-358; 358-362.

finishes in this case being applied mainly to apparatus parts and covers subject to much handling. The baked aluminum finishes have a much higher resistance to wear and impact than the air-dried finishes.

Baking varnishes pigmented with aluminum powder offer the only means of obtaining a highly-baked finish of light color, as all other light-colored pigments darken with baking, the darkening becoming deeper as the baking temperature is raised. Baked aluminum finishes have replaced black Japan finishes on central office apparatus and have been in use for the past two years. They have given satisfactory service and in addition have materially brightened up the interior of central offices.

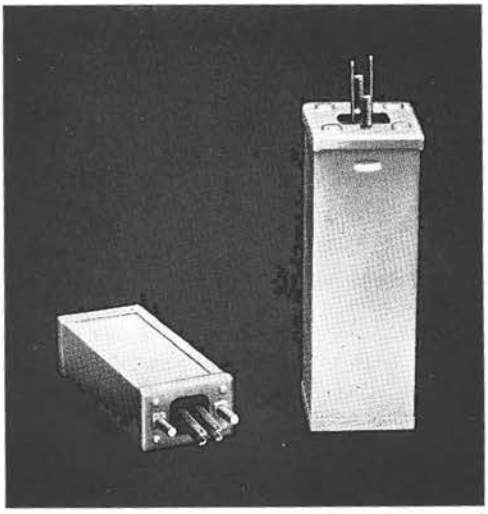

Fig. 1—Condensers finished with aluminum lacquer

Baking japans have been used on telephone apparatus for many years. Black is the usual color although some green and brown japans are being applied to telephone parts at the present time. The use of japans other than black leads to difficulties because of color differences resulting from variations in baking temperatures which occur in commercial practice. Their use therefore is discouraged. The japan used at the present time produces a semi-dull black finish having the appearance of a machined and polished piece of hard rubber from which it derives its name. The name—"rubber finish japan"—is somewhat misleading, however, in that the japan contains no rubber. This material, which is manufactured at the Hawthorne plant of the Western Electric Company is the result of several years cooperative effort of the Western Electric Company's and the Laboratories' engineers to develop a material suited to the specific needs of the Bell System. It produces a hard, though elastic, finish which has the strongest resistance to mechanical wear and impact of any of the numerous organic finishes tested up to the present time in the Laboratories. This japan also offers excellent resistance to deterioration from perspiration which was one of the most important considerations leading to its adoption. The asphaltic base japans used in the past on some telephone apparatus have been almost entirely replaced by the rubber finish japan in view of the superior mechanical characteristics and more pleasing appearance of the latter material.

The use of nitro-cellulose lacquers on telephone apparatus undoubtedly will become more and more extensive in the future as their development proceeds. Polished, brushed and grained nonferrous metals such as brass and copper are usually given a coat of transparent lacquer to retard tarnishing. Pigmented lacquers, commonly known as lacquer enamels, are used for producing finishes in color. These materials produce films

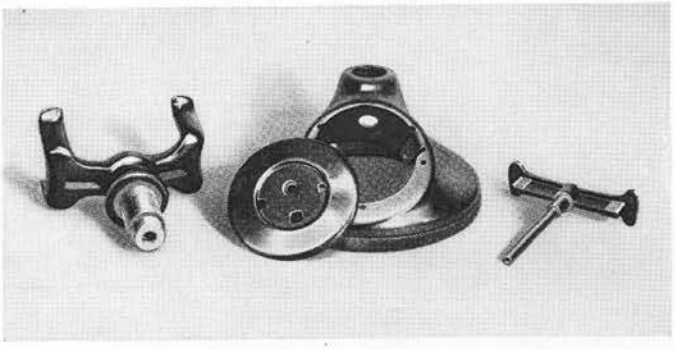

Fig. 2—Parts of B1-type handset mounting finished with two coats of rubber finish japan. Base and apparatus blank are of steel and have been phosphate-processed previous to japanning. The japan has been applied directly to the sand-blasted surfaces of the cradle and plunger, both die-cast of aluminum-base alloys

having the next best mechanical characteristics to baking japans.

Shellac solutions, which are used extensively for finishing wood, are seldom used on metal parts. Their only use on telephone metal work is for insulation on transformer laminations. Asphaltum paints and coal tar pitch also have insulation uses. The asphalt solutions applied as finishes produce soft electrical-insulating films and the coal tar pitch serves as an insulating corrosion preventive on loading coil cases which, when placed underground, are subject to considerable electrolytic corrosion due to stray ground currents. Rubber mixtures cured by heat alone are used to a limited extent to build up heavy electrical insulating coatings on irregular parts.

The organic finishes described above are applied principally by atomized spray, although some are applied by dipping, brushing and flow-coating.

Of the inorganic coatings applied to metal telephone parts, the metallic platings are by far the most important. Zinc, applied by electroplating, is the most widely used and has proved to be the most effectual of all platings in providing corrosion protection at reasonable cost for ferrous apparatus parts subject to normal indoor exposure. Nickel platings and composite finishes consisting of combinations of nickel and copper platings are used as rust preventives on parts on which the use of zinc is not advisable. Nickel is also applied for appearance reasons on non-ferrous parts subject to much handling. Electroplated tin is used primarily on parts which are to be soldered. Copper plating on telephone parts is not used very ex-

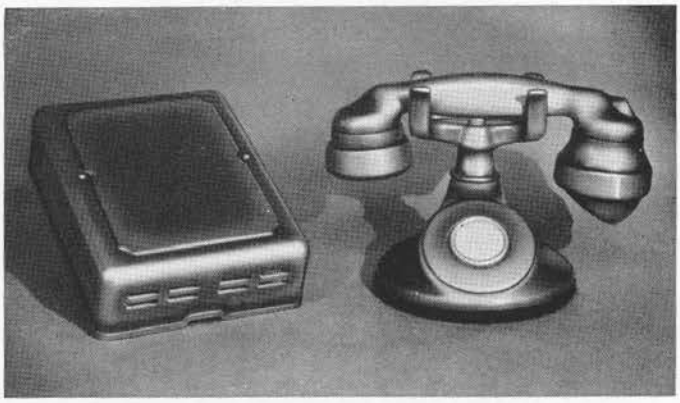

Fig. 3—Subscriber equipment finished in two-tone colors. Oxidized silver parts are shown which have a silver-base color over which a black shading has been applied

tensively at the present time. Gold is applied electrolytically on diaphragms and electrodes of transmitters to produce surfaces having low and uniform contact resistance. Chromium plating is used in several instances on small

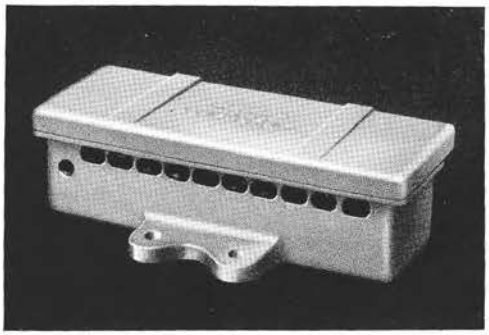

Fig. 4—83-type protector mounting finished with hot-dipped galvanizing

parts because of its wear resistance. As it also has prominent non-tarnishing qualities and extreme hardness, wider uses of chromium plating are being considered by the Laboratories at the present time.

Several metals, principally zinc, tin and solder, are applied to metallic telephone parts by hot dipping. To provide corrosion protection for ferrous parts exposed outdoors, hot galvanizing is employed. Tin finishes applied by hot dipping are particularly suitable in preventing season cracking of brass parts that are subject to outdoor exposure. These tin-dipped finishes constitute the first step in the production of the tin-coated sheet iron and steel which are extensively used in making sheet metal covers and containers for apparatus.

In addition to being applied by electroplating and hot dipping, zinc is applied to a large number of ferrous parts by the sherardizing process. In this process the parts are heated to approximately 850° F. for a suitable period of time in a closed rotating container partly filled with metallic zinc dust. The resulting finish consists of a closely cemented and even coating of zinc-iron alloys high in zinc content. This finish is particularly suitable where a zinc coating is desired on deeply recessed parts which cannot be evenly electroplated.

Several so-called oxide coatings are used for decorative purposes on copper, brass and bronze. Most of these coatings are relieved by scratchbrushing or buffing in spots and are then protected from further changes in color by transparent lacquer coatings.

A chemical scale finish which has been used widely on telephone set parts is the magnetic oxide of iron produced by the Bower-Barff process. By this process the oxide is produced

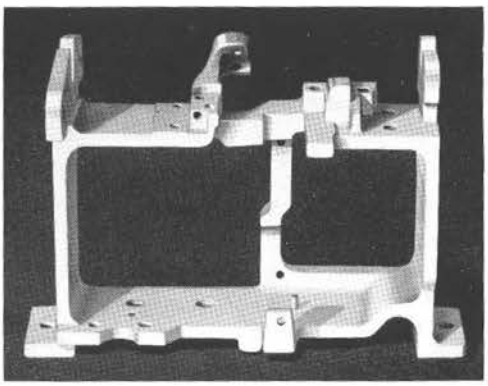

Fig. 5—Frame of step-by-step switch with sherardized finish

from the iron in the part itself by heating it to approximately 1400° F. in the presence of steam and a small amount of oil. This finish is then darkened by an application of linseed oil. Bower-Barffing produces a very hard, closely adherent finish having excellent corrosion resistant properties and pleasant dark gray appear-

ance but its use is limited somewhat due to its brittleness.

Another chemical scale finish, known as the phosphate process, is used extensively as an undercoating on ferrous parts to which a subsequent organic coating is to be applied. The process consists essentially of immersing the parts in a hot solution of phosphoric acid which results in a coating of iron phosphate being formed on the surface of the ferrous parts in the bath. The phosphate coating is a closely adherent crystalline deposit and has a slightly rough texture. It has given excellent results as a primer for organic coatings as its rough texture promotes very good adherence of the organic material to the phosphate crystals. In addition the excellent adherence of the phosphate to the base metal retards lifting of the organic coating after pin hole corrosion has started.

This brief summary of the metal finishes gives only a birds' eye view of one field of endeavor toward improved appearance and better functioning of telephone apparatus. New materials and methods of application are constantly being investigated and as a result the finishes in use are constantly undergoing revision and improvement.