A Wear Test for Finishes

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ONE of the difficulties in selecting proper finishes for use in the telephone plant has been the lack of suitable tests for determining their mechanical durability. Corrosion testing is well developed but for many applications of finishes, resistance to corrosion is not of any great concern; resistance to wear is far more important. The black japan finish on desk stands is a case in point. These are made of brass so corrosion would be negligible under any ordinary conditions. The real criterion of satisfactoriness of the finish is its resistance to ordinary usage which in a large majority of the cases consists mainly of mechanical rubbing or wear.

The need for a practical device to evaluate the wear resistance of finishes has been felt for some time and an apparatus has recently been developed to obtain it. The basic feature is rotation in sand of a disk of material coated with the finish to be tested. A photograph of six of the completed machines is shown in Figure 1, and of a single unit with sand chamber removed, in Figure 2. A four-inch specimen is fastened to the top of a vertical shaft coupled to a vertical motor. A chamber surrounding the upper end of the shaft and the sample is filled with a standard grade of sand to a depth of five inches over the finished surface. A compressed air injector arrangement circulates the sand while the test is under way by taking it from the bottom, and carrying it through an outside tube connection to the upper part of the sand chamber. A suction connection is also made to the upper part of the sand chamber and serves as a vacuum cleaner to remove light waste material. This circulating and cleaning arrangement acts also to cool the surface undergoing

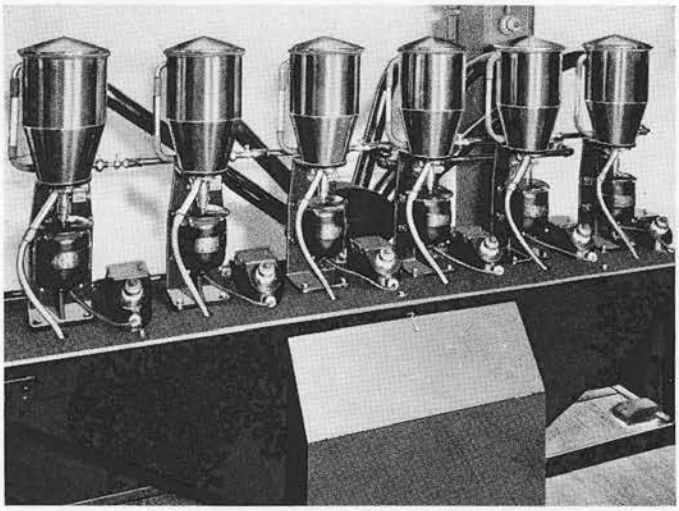

Fig. 1—In the arrangement adopted, six finish-testing machines are mounted as a unit. The large pipes connecting to the upper part of the sand chambers are the suction connections, and the smaller horizontal pipe at the rear carries the compressed air for sand circulation

wear. After each test, about a quarter of the sand is removed and replaced with new sand, which establishes a constant condition after about twenty tests.

The speed of the surface of the sample relative to the sand varies directly with the distance out from the center of the shaft. The wear, in other words, increases progressively toward the periphery of the disk. Under standard conditions of sand and speed, therefore, the distance from the center to the line of wear is a measure of the ability of the finish to withstand mechanical wear. By multiplying this distance by the number of thousands of revolutions that the sample made, a wear index is obtained which is a very satisfactory gauge of wear resistance. For metal samples, a speed of 1000 rpm has been found most satisfactory, while for wood, because of the difficulty of getting specimens sufficiently free from warping, 750 rpm has been found more satisfactory.

For accurate comparison, the thickness of the finish films should be alike to rather close limits. While accurate results may be obtained with other methods, it has been found that a little practice with a spray gun will produce results that are reasonably accurate, and this method is desirable as representing the more generally used method of application. This is particularly true of slow drying solutions which have a chance to level out before drying. The satisfactory application of lacquer films is more difficult. Due to their more rapid drying, a uniform thickness over the whole surface is difficult to obtain. The preparation of lacquer specimens, therefore, must be done with great care to get consistent wear results. Not only should the finish be of equal thickness over the surface but the specimen on which it is sprayed should have faces accurately parallel and the central hole should be precisely located, and perpendicular to the flat surfaces.

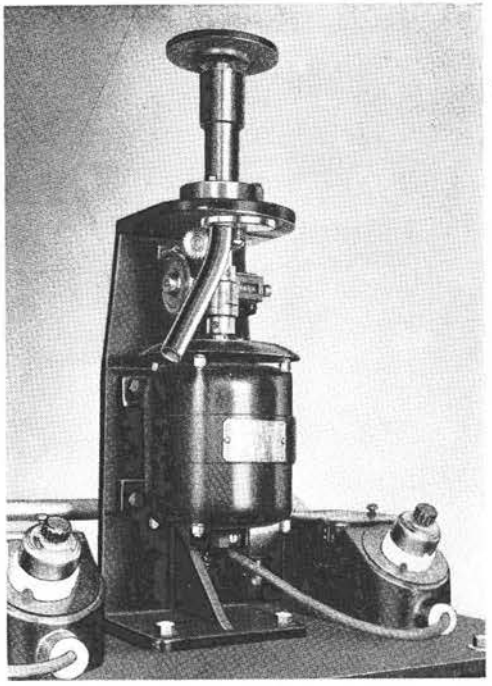

Fig. 2—A single finish-tester with sand chamber removed but with a specimen in place. A revolution counter geared to the driving shaft forms part of each unit

The usual practice in the preparation of samples is to spray the desired number of test disks, among which have been placed promiscuously several disks which have been previously measured for thickness. After the finishing processes have been completed the special disks are remeasured and the film thickness determined. Extreme care in obtaining equal thickness of film is desirable for all samples but is particularly so in comparing finishes of the same type, since for them the wear varies considerably with thickness. For finishes of different types,

however, thickness is not quite so important. A good baked japan, for example, no matter how thin so long as it "covers", will outwear a cheap bronzing liquid even if made of maximum commercial thickness.

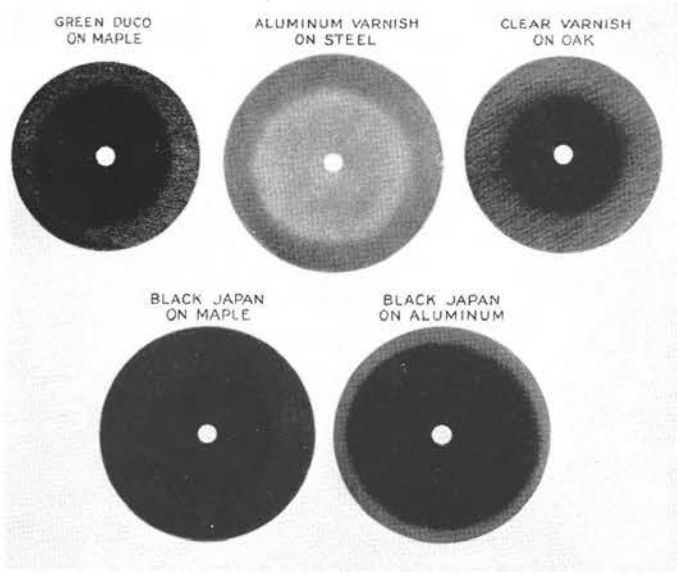

Fig. 3 — The distance of the wear line from the center can easily be measured from these tested specimens but the determination of the wear index requires that readings of the revolution counter be made at the beginning and end of test as well

Typical specimens that have undergone test are shown in Figure 3. The standard four-inch disk run at 1000 rpm will serve for a wide range of finishing materials. Inexpensive bronzing liquids carrying aluminum powder as a pigment will wear off rather rapidly. After a thousand revolutions — one minute's run — the wear line will be about half way out to the periphery of the disk so that the wear index is about one. A two-coat japan finish, on the other hand, of approximately .0005 inch in thickness, will normally run about 15 minutes before the wear line reaches the same point so that its wear index is in the neighborhood of 15.

The design of the apparatus involved some interesting problems. The specimen must be rotated with a minimum of eccentricity and this seemed to require a bearing directly beneath the specimen. Since the chamber is filled with sand from several inches below the specimen to five inches above it, this requirement necessitated that the bearing run continuously immersed in sand — a rather difficult requirement for a bearing to meet.

Another difficulty due to the use of sand was the selection of material for the outside connection through which the sand is circulated. In the experimental models this was made of rubber hose and gave very good service. In the refined design, however, metal tubing was employed which soon blasted through at the corners. In the final machines the corners are made of rubber and the straight section of metal, which has proved a very satisfactory combination in service.

To remove the specimen after testing it is necessary to partially empty the sand chamber. For this purpose a quick-opening slide valve was designed, which was gasketed with felt. The pipe shown in Figure 2, bending out diagonally from the bottom of the chamber, is the outlet from this valve and may be extended with hose to con-

duct the sand to a chamber below the apparatus, or any convenient place.

This apparatus furnishes means whereby the resistance of finishes to mechanical wear can be evaluated on a commercial basis. No feature in its operation is critical, and the apparatus can be used successfully under ordinary shop or laboratory conditions although it is always better, whenever practicable, to make the tests in conditioned rooms.

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