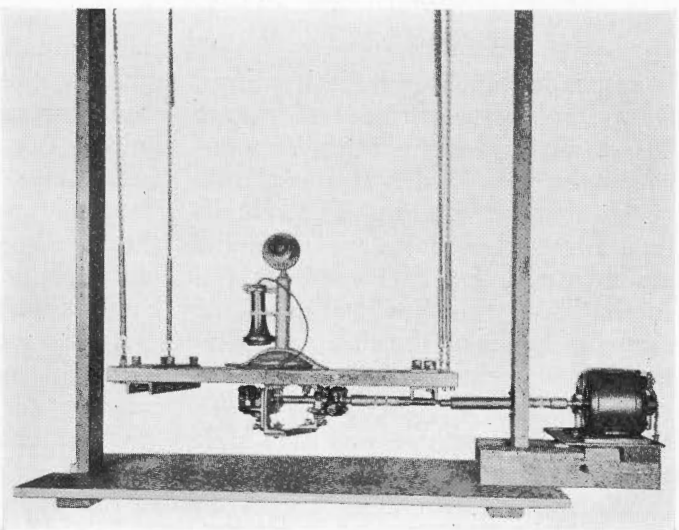
Accelerated Laboratory Tests

By E. MONTCHYK

PRIOR to the field trials which place the final hallmark on telephone apparatus of new design, laboratory investigations of important characteristics of the completed apparatus are undertaken. A thorough investigation is made of its physical characteristics, which in the majority of cases covers the dimensional correlation of the individual parts engaging with each other, and of the proper choice of materials. The latter study involves the consideration of such properties as strength, hardness, springiness, wear, resistance to atmospheric influences and insulating properties. Into this section of the testing pattern fit the accelerated laboratory tests, which aid in arriving at prompt decisions. Also, by bringing to light defects, these tests obviate the necessity of making field trials which are predestined to prove the apparatus faulty.

These rapid tests are somewhat exaggerated, but stimulate service conditions nearly enough to give quite accurate data provided the proper interpretation is given to the results. In this way certain engineers of the General Development Laboratory cooperate to the greatest extent with the engineers who design apparatus. With the results of these tests in mind, the designers can eliminate troublesome features which would not be discovered in a theoretical consideration. Almost indispensable in this work are several ingenious machines which add greatly to the rapidity and accuracy of the tests.

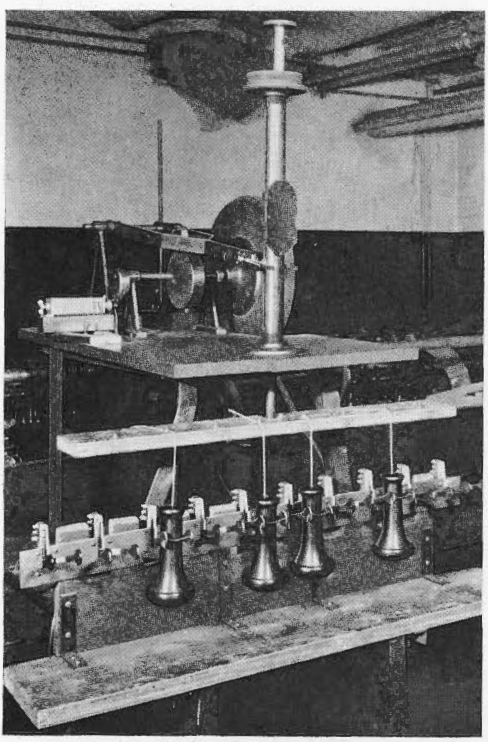
Vibration is the bane of many things besides slumber on a railroad train. When excessive vibration is applied to apparatus things begin to happen. Screws holding together individual parts tend to loosen; the welding in a vacuum tube may crack and render the tube inoperative; and even carbon grains have been shaken out of transmitter-buttons. For a



Testing a deskstand in the vibrating machine

rapid study of this condition a simple machine to force vibration was developed.

In this device the test pieces are placed on a wooden platform which



How receivers are tested in the dropping machine

is suspended on long helical springs. On the under side of this platform are two revolving weights in the form of cams which are driven at about 1800 revolutions per minute. The centrifugal force exerted by these weights tends to pull the platform back and forth, thus setting up vibrations. The cams can be set on the shaft at different angles, and thus the amplitude of vibration can be altered.

When the machine was first built the cam shaft was directly connected to the motor, with dire results—to the motor. The design was so efficient and the telephone apparatus was so comparatively strong that several motors broke down before any apparatus was damaged. A flexible shaft was then substituted, and the bearings, which had also proved unreliable, were changed. As it now stands, the mechanism wreaks damage upon the test pieces and not upon itself.

With all the care that, in general, is exercised in the use of telephone apparatus, desk-stands are often handled roughly, and receivers are slammed onto their hooks. Apparatus must also be shipped, and freight handlers are not receiving any palms for considerate treatment. These factors must be considered in design. To test the robustness of the product, a dropping machine was developed.

The driving elements in this device are a motor and a cam-driven lever. A top view of this lever reveals its working end as a fork whose two prongs engage fingers projecting from a vertical rod which supports the objects under test. In operation, the lever lifts the rod until the prongs come into contact with a stationary plate and are forced apart. When the prongs no longer hold the fingers, the rod falls freely and the objects under test strike a platform of steel, wood, or stone, as the test may require. Some apparatus is handled differently; for instance receivers are dropped upon their switchhooks as they are in service. The violence of impact in any case depends upon the height adjustment of the release plate.

This same set-up is used to determine the resistance of stationary objects to abrasion. Suitable bundles of chain, or a metal ball, are attached to the moving rod and then allowed to fall upon the test piece. By comparing the result with the effect on standard articles are determined the

relative abilities of substances to withstand abrasion and impact.

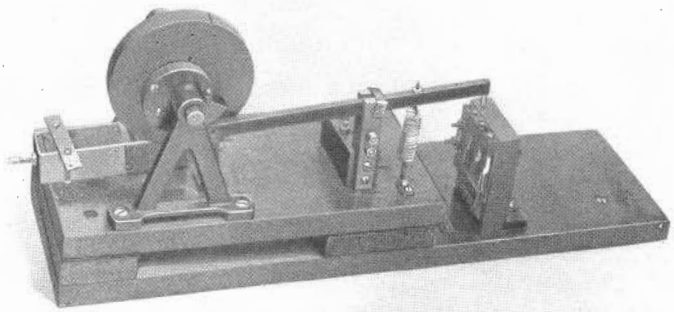
Number plates, which are associated with the jacks on a switchboard, are subject to blows from the plugs as the operators set up connections. Inferior finish on these plates soon deteriorates, with poor appearance and illegibility the results.

To ascertain the resisting qualities of various finishes, a "woodpecker" machine is employed. This resembles that industrious bird in action except that the man-made "woodpecker" works in a horizontal position. A pivoted metal arm carries at one end a portion of an ordinary plug. Operating this lever is a fairly high-speed cam. The force of impact is governed by a spiral spring which acts at a point between the pivot and the plug.

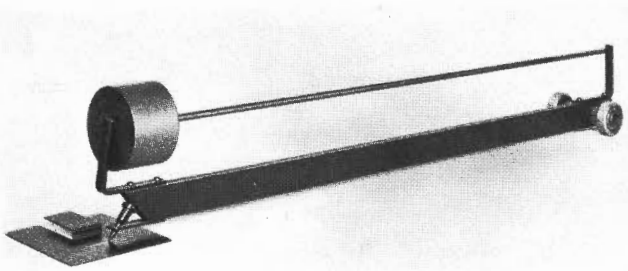
Usually these tests are comparative. A new finish is tested side by side with a standard. Thus direct evidence is obtained with a minimum of time expended. Special attention must be paid to the support of the test piece. Too rigid a support means fast wear; a resilient support—wood, for example—results in slower wear.

Finishes are also tested by a simple process for resistance to scratching. A sharp point is suspended in a frame which can be wheeled by hand along a table. The pressure exerted by the cutting edge is regulated by a weight which slides on the upper portion of the frame.

Another specially designed machine replaces the operator's finger as it tests the durability of push-button keys which must survive an extremely large number of operations. Associated with each key under test is a lever tipped with a soft rubber finger. An electromagnet operates the lever and forces the finger against the push button. Controlling the magnet is a sequence switch whose motor drive determines the speed of operation. An automatic register records the total number of pushes. Day and night the keys are kept in motion until the required number of operations is completed, or the keys fail. Fifteen years' service in the field is duplicated by the machine



The "woodpecker" machine



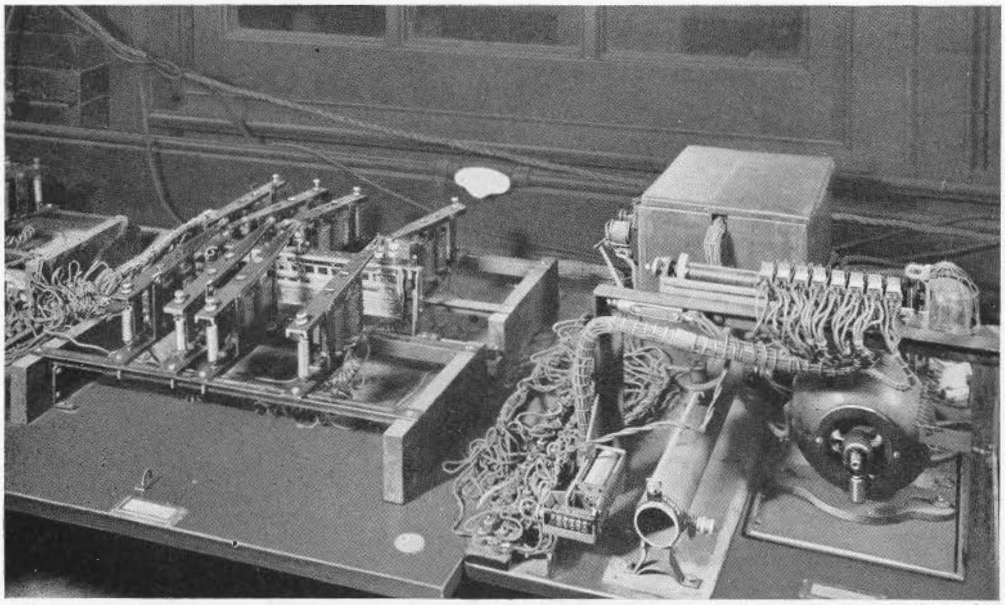
Testing a finish by moving the scratching point back and forth. The cylinder on the left is an adjustable weight

in the space of two months. If the machine fails while the attendant is absent a circuit breaker shuts down the system.

Frequently an investigation of an entirely special nature is undertaken. In such cases existing facilities often do not suffice, and a new testing technique must be established. Such a situation arose in the investigation into the failure of the salt-water cooling tubes in radio transmitters similar to the installation on the S. S. *Leviathan*. To determine what material was least corrodible under the circumstances, several samples were made into coils of the form actually used. Since the materials did not react with one another they were connected by a rubber tubing. Hot salt water from an earthenware tank was circulated through the coils, and the reaction in each was observed.

To state that the faster a test, the sooner will apparatus deteriorate, seems a truism. Sometimes, however, the obvious concepts are false. It might seem reasonable to believe that a bearing which at low speed becomes unserviceable, will fail much faster at one hundred times that speed. Yet, some composition bearings operate satisfactorily at the high speeds for which they were designed, but at low speeds the opposite is true. The explanation is simple. At high speeds the lubricant becomes warm and acts very efficiently. At the low speed little heat is developed, the lubricant forms a thick paste with the powder produced by the wear of the bearing, and the shaft is seized. Thus, between test and service speeds a balance must always be struck, and an accurate determination of this relation is vital before a method of test is adopted.

As sentries guarding the far-flung lines of telephone design and developments stand the group concerned with "apparatus analysis." The machines, a few of which were described, form



To the left is the key testing machine; on the right are the drive motor and the sequence switch, which controls the operation of the electromagnets in the tester

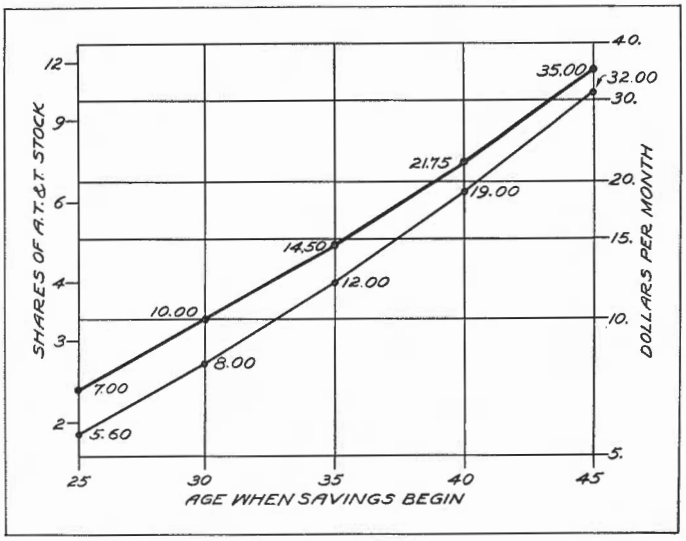
their first line of defense and assure telephone apparatus of highest quality—apparatus that will not falter in service; that reasonable abuse will not affect. It is true that only with large interests at stake can extensive tests be made. Yet it is easy to see the economy of such action when one stops to think that telephones are manufactured by the hundreds of thousands; and each little saving is magnified far beyond its face value.

The Price of Money

How much will each ten thousand dollars cost me?

An approximate answer is given in the two curves shown below, which indicate how much must be invested each month, at two different rates of interest, to give the investor ten thousand dollars when he is sixty years old. The upper and heavier curve is figured on an interest rate of six percent compounded semiannually; the lower and lighter, on a rate of seven percent compounded quarterly.

American Telephone and Telegraph stock is now being sold by the Employees' Purchase Plan at 130, which yields very close to seven percent in dividends. As payments deducted from salary are allowed interest at seven percent compounded quarterly, money systematically saved in accordance with this Plan will bring returns somewhat similar to those indicated by the lighter curve. Unfortunately, after each block of stock is paid for, it is extremely difficult safely to reinvest the dividends at this high rate of interest—presuming that the investor is already buying A. T. & T. stock up to the limit allowed for his salary. Six percent compounded semiannually is, however, possible to one who reinvests his dividends in A. T. & T. stock at its market price, through the Bell Telephone Securities Company.



How to have ten thousand dollars at sixty years of age