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Automatic adjusting machine for C-type ringers

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A ringer must do more than just ring when 20-cycle ringing current comes over the line. It must not respond at all to signals connected with dialing, switching or party line identification. The correct sensitivity is secured by counterbalancing the magnetic forces on the armature with a spring tension.

At one time, ringers were adjusted by the installer who varied the tension on a bias spring in relation to signals from the central office. In the B-type ringer for the 302 combined set, the spring tension was adjusted at the factory to provide three tension settings one of which was selected by the installer to fit the service conditions.

In the C-type ringer for the new 500 type set, the number of settings has been reduced to two. In addition, the optimum balance is more closely approached by adjusting the magnetic forces as well as the spring tension and the entire adjustment is performed by the automatic machine shown in Figures 1 and 2.

As shown in Figure 3, the armature is held in its "non-operated" position near the left hand pole face by a mechanical force. This mechanical force is opposed by magnetic forces which tend to move the armature toward its "operated" position at the right hand pole face. The mechanical force must be large enough to prevent motion of the armature when non-ringing signals such as dial pulses flow through the coil, but it must not be so large as to prevent response to minimum ringing cur-

Fig. 1—A. F. Conk connects ringer to automatic adjusting set.

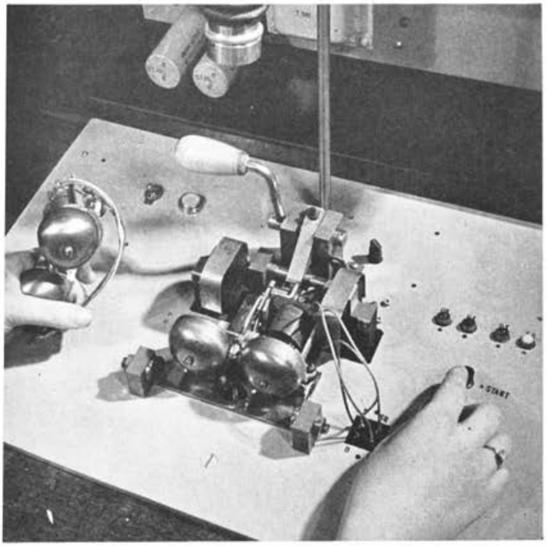

Fig. 2–C-type ringer in position for adjustment. Lights at right signal success or failure.

rents. Furthermore, the forces must be balanced so that the armature will be restored to its "non-operated" position on completion of ringing.

The situation is complicated by the fact that the mechanical force arises in part from the bias spring and in part from the armature reed spring, and the forces contributed by each are dependent upon the position of the armature. There is the added complication that the magnetic forces also vary with the armature's displacement. Because of the interrelation of these variables a virtually simultaneous adjustment of the mechanical force and the magnet strength is required to secure the combination of forces which will cause the armature to behave as required at both its operated and its non-operated positions. It is this combination which the mechanism, shown schematically in Figure 4, establishes.

Before adjustment, the magnet strength and mechanical force are purposely made greater than needed, and the adjusting process consists of reducing them alternately and in small amounts. By making each reduction sufficiently small a simultaneous adjustment of both is approached.

Reduction in magnet strength is accomplished with an external field obtained by discharging a capacitor through a pair of demagnetizing coils. To reduce the mechanical force, the bias spring is bent by rotating a forked shaft which projects upward through a hole in the ringer frame. When rotated, the two prongs of this shaft engage the bias spring making a small bend near the armature. After the shaft has bent the spring, it is rotated back to its rest position to free the spring and armature for subsequent tests.

The amount of rotation of the shaft is controlled by a potentiometer which forms two arms of a bridge circuit. The movable contact of the potentiometer rotates with the bending shaft. As the bridge approaches balance a thyratron fires, reversing the motor driving the shaft and returning it to

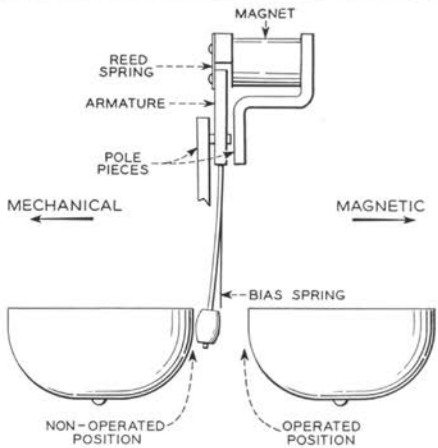

Fig. 3–Diagram showing forces acting on ringer armature at rest.

its rest position. The bridge circuit is arranged so that between bends the balance point shifts and each successive shaft rotation is slightly larger than the previous one. Thus, each time the shaft rotates it makes a slight increase in the total bend in the bias spring until the required curvature is reached.

At each stage of the process, the machine must decide whether the ringer has reached adjustment and, if not, whether the magnet strength or the spring force should

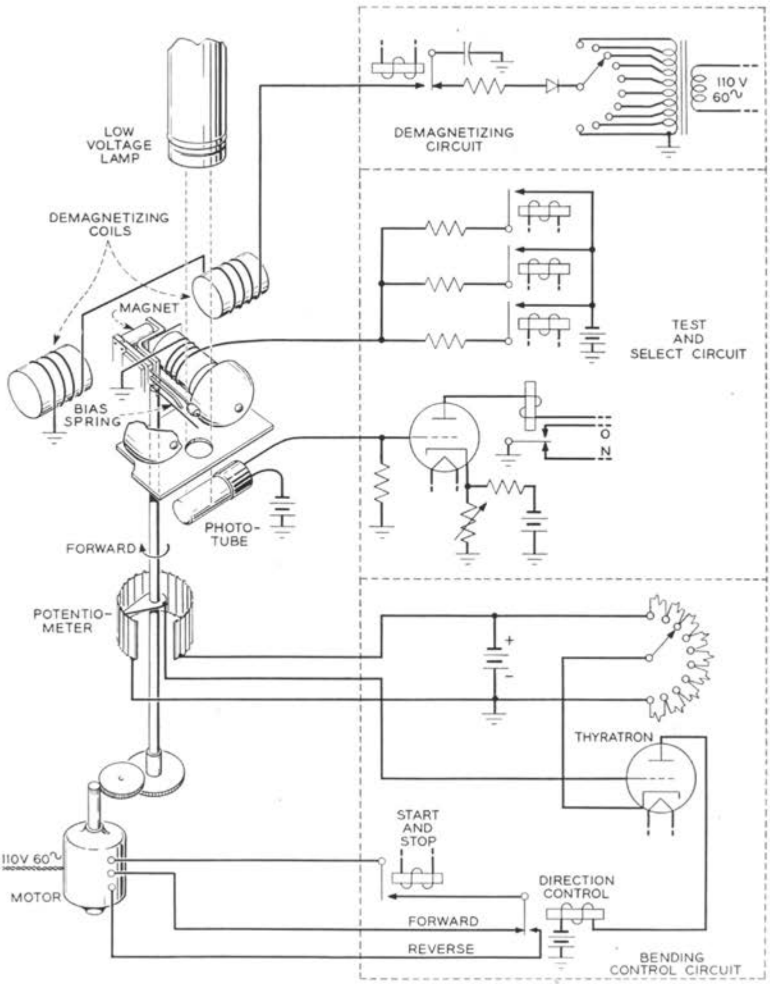

Fig. 4—Diagram showing operation of ringer adjuster.

next be reduced. To determine the condition of the ringer, the machine observes by means of a light and a photoelectric cell the response of the armature to test currents passed through the ringer coil. With the armature in its non-operated position the path of the light is interrupted by the clapper ball but is not interrupted when the armature is in its operated position. By this means the machine can determine, first, which of the two positions is occupied by the armature, and secondly, the change in position by comparing positions before and after application of the test current.

Two types of test are used to determine the condition of the ringer. One is a "release test" in which the machine applies a current large enough to move the armature to its operated position; it then reduces this current to a small value and observes whether the armature falls back to its non-operated position. Failure to fall back indicates that the magnet is too

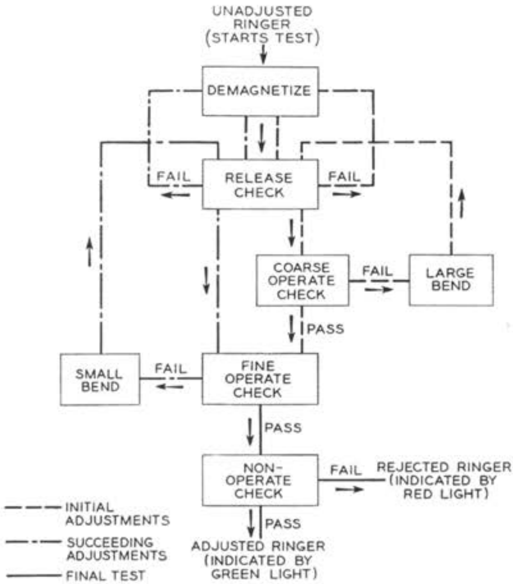

Fig. 5—Flow chart of ringer adjustment process.

strong. The other is the "operate test" in which the machine observes whether the armature moves in response to a certain minimum ringing current. Failure to respond indicates that the mechanical force on the armature is too high.

The accuracy with which the force on the armature can be set depends on the increment by which the bias spring is bent. If small changes are made, the required value can be more closely approached than if large changes are made; but the smaller the change, the greater the number and so the longer the time required to complete the adjustment. Without sacrificing accuracy the machine was made to work faster by having it make coarse adjustments at first and then fine ones as the desired optimum is approached.

The sequence of operations is shown in the flow chart in Figure 5. First of all the magnet is demagnetized by a predetermined and relatively large amount in order to stabilize its magnetization, rendering it invulnerable to line surges passing through the ringer winding or to the effect of nearby magnetic objects. Next a release test is made. Whenever a release test is not met, the magnet strength is further reduced by applying a slightly greater demagnetizing field to the ringer. As soon as the release test is satisfied, an operate test is made. If this is not met, a relatively large reduction in the mechanical force is made by bending the bias spring. After each change in the bias spring another release test is made since the force may have been reduced so much that the armature will no longer return to its non-operated position. Once the coarse operate test has been passed, a fine operate test is made. If the test is not met a small reduction in bias spring force is made and the release test is repeated. After the fine operate test has been met, a non-operate test is made and, if this is satisfied, the machine signals the fact by lighting a lamp and makes itself ready for another ringer. When a ringer proves unadjustable the machine automatically stops trying after a predetermined number of operations and signals accordingly. Also, the machine

Fig. 6—To insure prescribed magnetization and to avoid the picking up of ferrous particles, ringer magnets are magnetized after assembly.

immediately recognizes a ringer with an open or reversed winding and makes no attempt to adjust it.

An average adjustment cycle involves eight to ten demagnetizing operations, eight to ten coarse tests, six fine tests and the complete cycle takes about 30 seconds.

The nature and number of the operations automatically reflect the character of the unadjusted ringers presented to the machines, and thus provide a measure thereof which could be conveniently summarized by automatic registering equipment. Data on trends in the averages could be used to monitor the assemblies before adjustment. For example, lower numbers of demagnetizing operations indicate weak magnets, and higher numbers of coarse operate tests indicate excessive mechanical forces.

This article has described a machine developed by the Laboratories, and the Western Electric Company is now employing several machines, adapted from this design, on their assembly lines. In addition to incorporating a winding insulation breakdown test and providing a semi-automatic loading carriage the machine has been arranged so that the control circuits may be located at some distance from the assembly line to conserve space and facilitate maintenance. Currently, each operator is operating three machines since they require no attention other than loading, unloading, and operating a start key.

THE AUTHOR: M. S. Richardson joined the Laboratories in 1937 following graduation with a B.S. in physics from Iowa State College. Until 1943 he made field and laboratory studies on the 300-type telephone set, including coin collectors and ringers, then took military leave to work with the Airborne Instruments Laboratory at Columbia. Since 1944 his chief responsibility has been ringer design for the 500-type set.