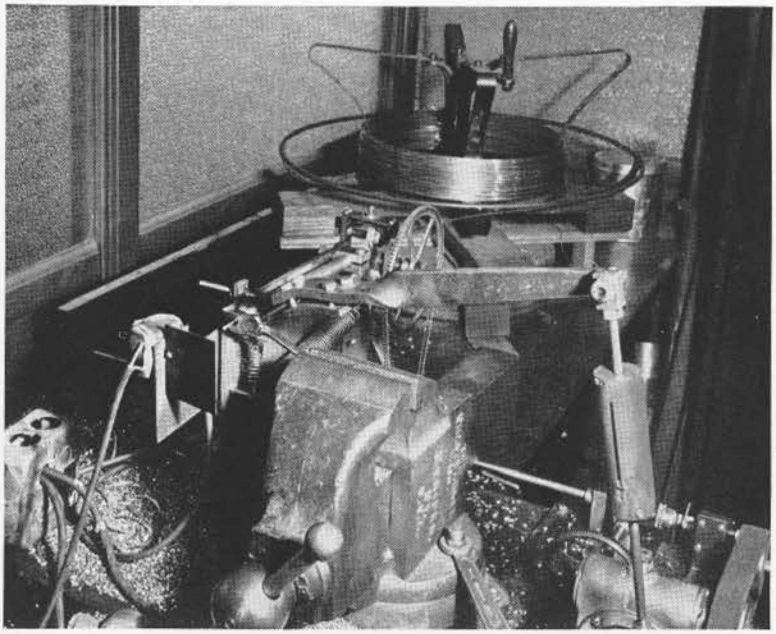

Telephone Hand Tools

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Outside Plant Development

TO build and keep in order a plant as complicated as that of the Bell System, a great variety of tools is required. For outside plant use alone, several hundred different hand tools are needed, not to mention automotive and power-driven tools, and the System's investment runs into large figures. Many of these hand tools are of familiar design but they differ from the ordinary commercial grades which can be bought in any hardware store, in being the result of careful study from the standpoint of serviceability and efficiency and with the needs of telephone work in mind. Laboratory tests are checked in most cases by field trials and the combined results are embodied in specification requirements of such a nature that they can be readily checked by inspection during or after manufacture. This procedure is justified from the point of view of efficiency and economy by the large investment of the Bell System in hand tools.

Pliers are representative examples of commercially available tools. In the development of specification requirements, samples are tested in our Outside Plant Laboratory for characteristics that have been found to be significant, such as hardness, ductility and service life. For the life test of side-cutting pliers, for example, the lower handle of the sample is clamped securely in a large vise and the upper end is attached to a long horizontal bar. A small motor is connected to this bar by a crank

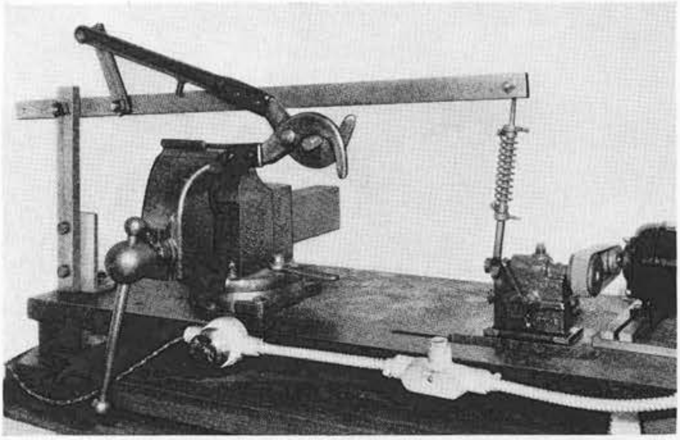

Fig. 1—Cable cutters are used to shear off lead cable. They are tested to destruction by making them bite repeatedly into a large brass rod at the rate of forty times a minute

mechanism which operates the plier handle about forty times per minute. Hard-drawn copper wire is fed automatically to the cutting edge of the pliers. When the plier breaks, or the cutting edges become dulled to the point where the wire is not cut through, the motor is automatically stopped. A counter indicates the number of operations.

The cable cutter, which is a shear used to cut lead cables ranging up to 2⅝ inches in diameter, is another instance of a tool that must be designed to withstand repeated severe stresses. To insure proper choice of materials and design, sample cutters are tested in the machine shown in Figure 1. In the test, the cutter is required to bite into a brass rod forty times per minute until failure of the cutting blade or other part occurs. With comparative results from such tests, suitable grades of steel and shapes of parts can be specified.

To obtain a measure of the service life of the leg iron of linemen's climbers, a special testing machine has been designed. It applies repeatedly a downward force to the stirrup, thus simulating the weight of the lineman, while the climber is supported at the top of the leg iron and the gaff. The machine is operated by a motor until the climber breaks, when the motor switch is automatically tripped. The number of repetitions is read on a counter. The leg iron is tested for ductility by bending it half-way around a cylinder two inches in diameter. This severe treatment must be withstood without fracture. The gaff also must be sufficiently ductile to permit hammering the point half an inch toward the leg iron without signs of breaking. The hardness of both the leg iron and gaff is determined by the Rockwell test. This consists of pressing a

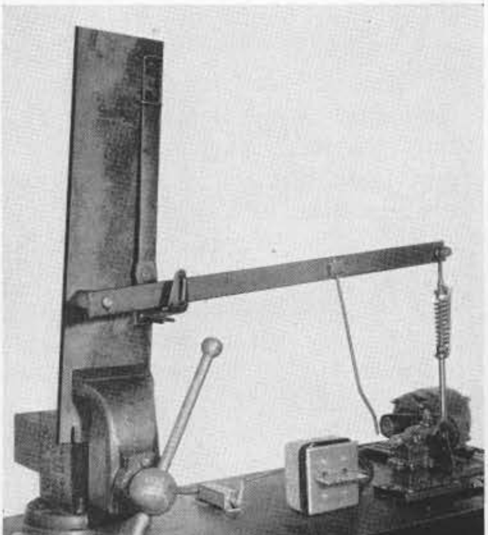

Fig. 2—Linemen's climbers are tested by subjecting the stirrup to a repeated downward thrust in this testing machine

diamond point of definite size and shape against the surface by a known force and measuring the depth of the depression which results.

Problems of a different character are encountered in the development of special tools to fulfill specific needs. The shunt dynamometer and the cable car fall in this category. The shunt dynamometer measures the tension in the stranded steel wire used for such purposes as guying poles and as a "messenger" to support telephone cables. It is important that the tension in this "messenger strand" be held between fairly definite limits. While the tension must be adequate to limit sag and maintain clearances, excessive tension would aggravate bowing of the cable caused by the difference in the expansion, with rising temperature, of the cable and the supporting strand. The dynamometer operates on the principle that the force required to thrust a given length of supporting strand aside may be used as a measure of the tension in the strand. The instrument consists of a rectangular steel bar split lengthwise to the center and provided with a hook at each end to fit over the strand. At the mid-point, there is a cam handle which operates a plunger. This applies lateral pressure and bows both the strand and the upper bar of the dynamometer an amount which depends on the tension of the strand. The bowing of the dynamometer bar is measured by the dial gauge attached to the lower bar. A calibration is made by noting the readings of the gauge for each size of strand under measured tensions. These data are plotted and supplied with the instrument to enable the operator to convert the dial readings into tension in pounds.

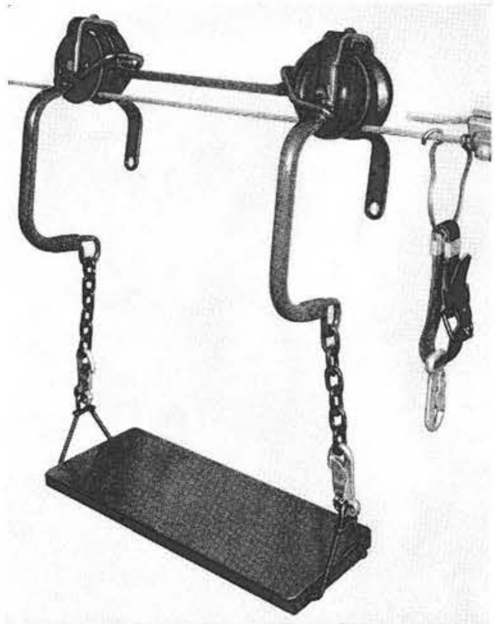

Fig. 4—The construction and maintenance of aerial cable frequently requires that workmen ride a cable car

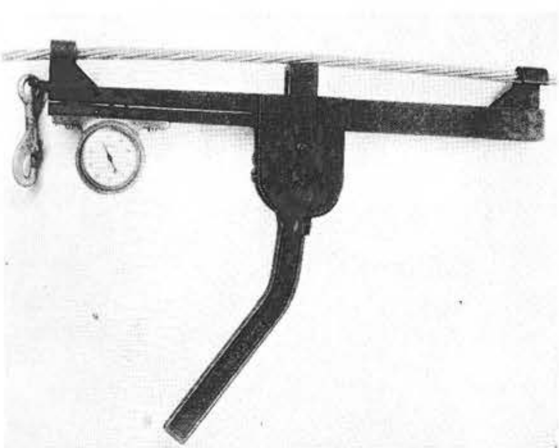

Fig. 3—The tension of the stranded steel wire used as a messenger to support aerial cable or for guying poles is measured with the strand dynamometer

In the construction and maintenance of aerial cable, it is necessary to work along the supporting strand. For this purpose, a small trolley-like vehicle called a "cable car" is provided. In its latest form, it consists of a light steel frame mounted on two rubber-tired wheels and supporting a wooden seat by means of short chains and snap hooks. The height of the seat may be adjusted to suit the workman and a strap which is threaded through the D ring in the workman's belt is attached to the eyelets below the wheels to protect him from falling. Rubber-tired wheels are provided so that the cable rings will not be pushed along the strand, experience having shown that the relatively soft rubber will yield to the ring and ride over it. In addition to these more obvious points, great care was exercised to embody in the design safety features that are only apparent on detailed study. For example, the snap hook had to be redesigned in relation to the chain link it engages so as to make it impossible for the chain to be accidentally disengaged from the hook. As the cable car must be manipulated aloft by the lineman, weight is an important consideration and every effort was made to reduce the weight to a minimum consistent with strength and safety.

The care taken in working out these details in special tools and the thoroughness of the tests made on commercial types is indicated by the few examples given here. That these efforts are justified is shown by the notable improvement in the efficiency and life of many telephone plant tools which have resulted from this work.

Fig. 5—Riding the strand