A Telephone for Use in Explosive Atmospheres

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Telephone Apparatus Development

A NUMBER of years ago a telephone set was developed for use in coal mines where explosive gases, such as methane or coal dust, might be present in dangerous proportions. It was designed not only to minimize the hazard of explosion but to withstand the rough usage it might encounter in narrow passages underground. More recently a need has appeared for a subscriber set for more general use in chemical factories, gas manufacturing plants, and other industrial establishments where explosive mixtures of gas may be present. The heavy mine set is unsuitable for such locations, and so the development of a new set for use in manual areas was undertaken based on experience gained from the earlier development.

Under normal use the only place where sparks are formed in a subscriber's set of the non-dial type is at the switchhook contacts. One of the chief objects of the design, therefore, is to prevent these small arcs at the switchhook from causing explosions. In addition, however, since a broken conductor, or loose contact might cause an arc, the set must be designed to prevent damage to any of the current-carrying parts, or the possible loosening of a contact. As a further precaution the set is locked so that only authorized persons may have access to it.

Either of two methods are possible for preventing arcs at the switchhook from causing explosions. The switchhook assembly could be mounted in an enclosure made absolutely gas tight—thus always insuring that no explosive gases would surround the contacts. Although this method is possible it requires a very expensive construction, and there is always the possibility that leaks may develop due to one cause or another. The other method, which was chosen for the new set, is to enclose the switchhook assembly in a small compartment,

Fig. 1—The locked case, internally mounted transmitter, and heavy receiver cord are the external features that differentiate the 629A subscriber set from the usual type

strong enough to withstand the explosion of the small amount of gas that it may contain, and to provide very long leakage paths to the outside of the compartment so that the escaping gases will be cooled below the ignition point before they reach the outside.

The desired seal could have been obtained in a number of different ways. The arrangement selected as being simple but yet effective is shown in Figure 2. The switchhook is fastened to a casting that forms the top of the compartment, and is surrounded by a heavy cylindrical container, which screws on the casting by a very long fine thread. The bottom of the cylinder is securely brazed and tested under air pressure to insure tightness. A plunger with a very long and closely fitting bearing surface is employed to operate the main contact spring. Connections to the contact springs are made with leads passing through a sealing chamber above the cylinder. To insure that there are no unfilled spaces, due to the wires being grouped together, the leads are spread at the top of the chamber so that each is surrounded by a minimum of 1/32 inch of sealing compound.

The interior arrangement of the set is shown in Figure 3. A standard ringer is employed except that a metallic shield, lined with bakelite, is placed around the coils to prevent their being accidentally damaged, which might occur when adjustments are being made. The leads, at the base of the ringer, are covered with sealing compound which prevents any possibility of short circuiting, and also holds them securely in place so that the soldered connections cannot be broken. In addition the leads are tied with twine to the bracket on which the ringer is mounted so that no movement can take place to crack the compound.

To avoid having soldered connections outside of the condenser, the leads are connected to the units inside the can, and are thus held in place when the can is filled with the regular compound. The can is made of brass to decrease the likelihood of corrosion,

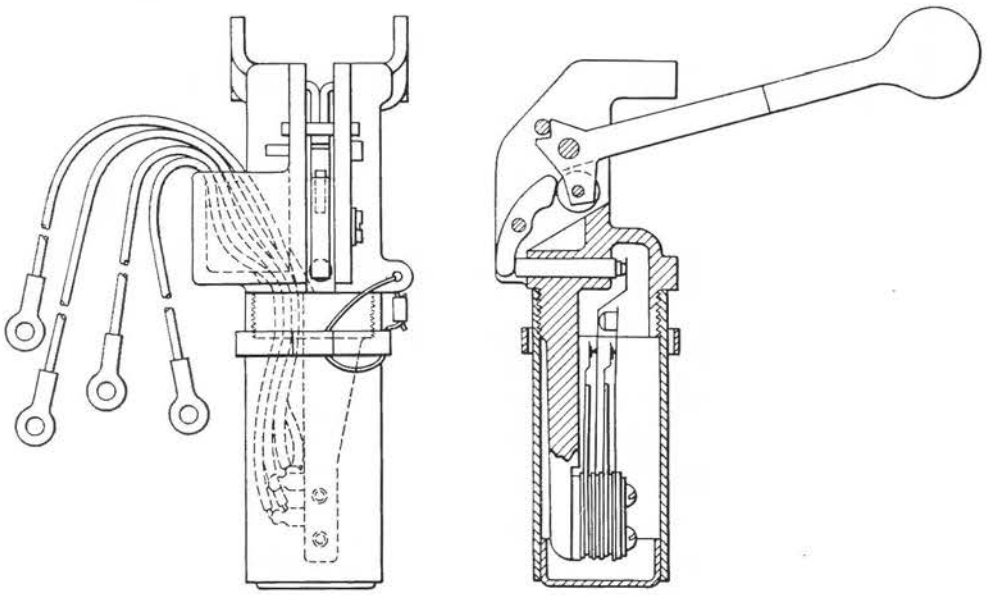

Fig. 2—Switchhook assembly and enclosing cover with the new subscriber sets

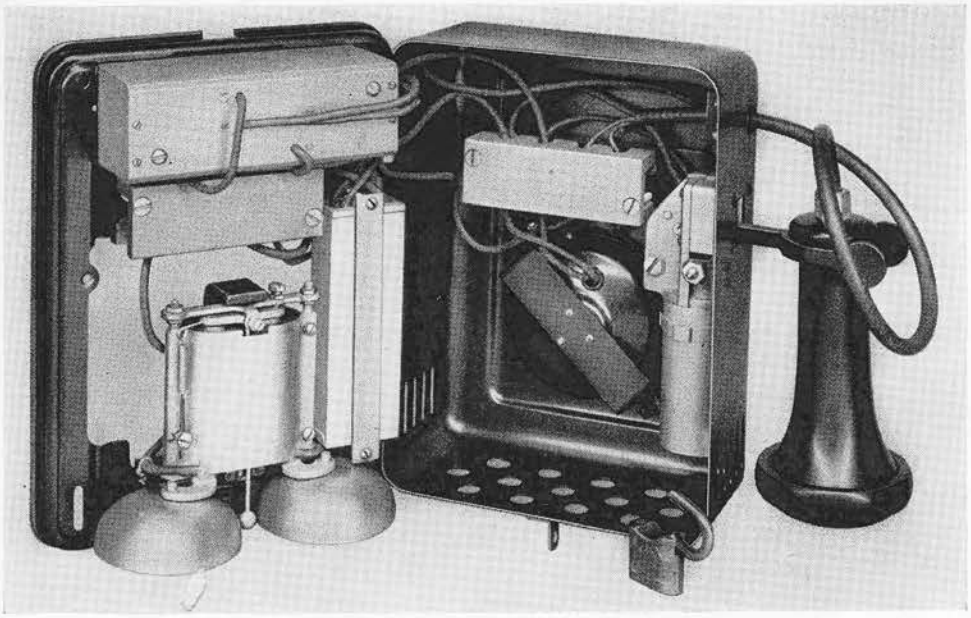

Fig. 3—No exposed or unprotected conducting parts are permitted within the set and all leads are short, and securely fastened

but except for these modifications the condensers are of the standard type. The induction coil is of the moisture proof type and is mounted in a wooden box which is then filled with sealing compound. Before the box is filled with compound the leads are connected to the terminals on the spoolheads and tied to the coil winding so that strains on the wires will not be taken by the terminals.

Each piece of apparatus is equipped with leads of just the right length for connecting to the proper terminal blocks. Four of the leads which run from the base to the cover are necessarily long enough to permit opening the cover, but they are clamped to the side of the induction coil to prevent their getting between the edge of the cover and the base when the cover is closed. The free ends of the leads have closed eye-type cord tips, and lock washers are employed to insure a permanently tight connection. Particular attention has been given to the materials and finishes of every part of the set to prevent corrosion either from moisture or from various gases such as carbon disulphide, acetone, or ammonia.

The transmitter, which normally is mounted on an adjustable bracket on the cover of wall-type telephone sets, is located within the locked housing, and only the mouthpiece projects through the housing. With a fixed transmitter there is no movement of the connecting leads as there would be with the bracket mounting, and there is no access to the transmitter except after the set has been unlocked. The only exposed apparatus is the receiver and its cord. The receiver is adequately protected by its hard rubber case and cap, and the cord is of the heavy-duty type clamped firmly both to the case of the receiver and to the cover of the set.

As part of the development a series

of tests were carried on to determine whether explosions could occur with the set as designed. How successfully the set met the tests for a large variety of explosive mixtures is described in the following article.

An important factor in the attenuation of speech currents on open-wire lines is the leakage between the wires of each pair by way of the insulators, pins, and cross-arms. Persistent study of the nature of this leakage has steadily reduced its amount and its variability. In studies conducted in our Chemical Laboratories, many insulators have been so connected that the leakage paths across them are in parallel. The current leaking through and around the insulator to the pin has been measured at various frequencies and humidities, and after the insulators have been given various aging treatments. From these and other tests it seems probable that the leakage permitted by an insulator at carrier frequencies is largely due to a condenser action. One "plate" of the "condenser" is formed by the mounting pin, the other by the wire and a conducting film of high resistance on the surface of the insulator.