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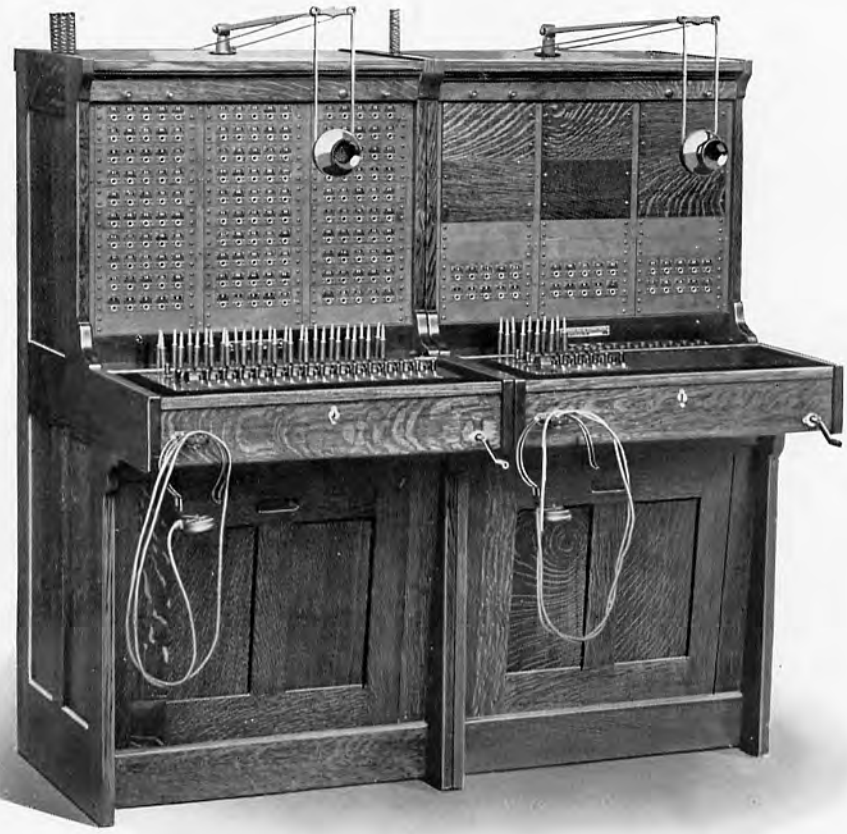
No. 105 High Efficiency Switchboard

For Magneto Telephone Systems



Two Sections No. 105 High Efficiency Switchboard

No. 105
High Efficiency Switchboard
For Magneto Systems

"The Switchboard that brings Metropolitan Telephone Service to the Town"

Stromberg-Carlson Telephone Mfg. Co.

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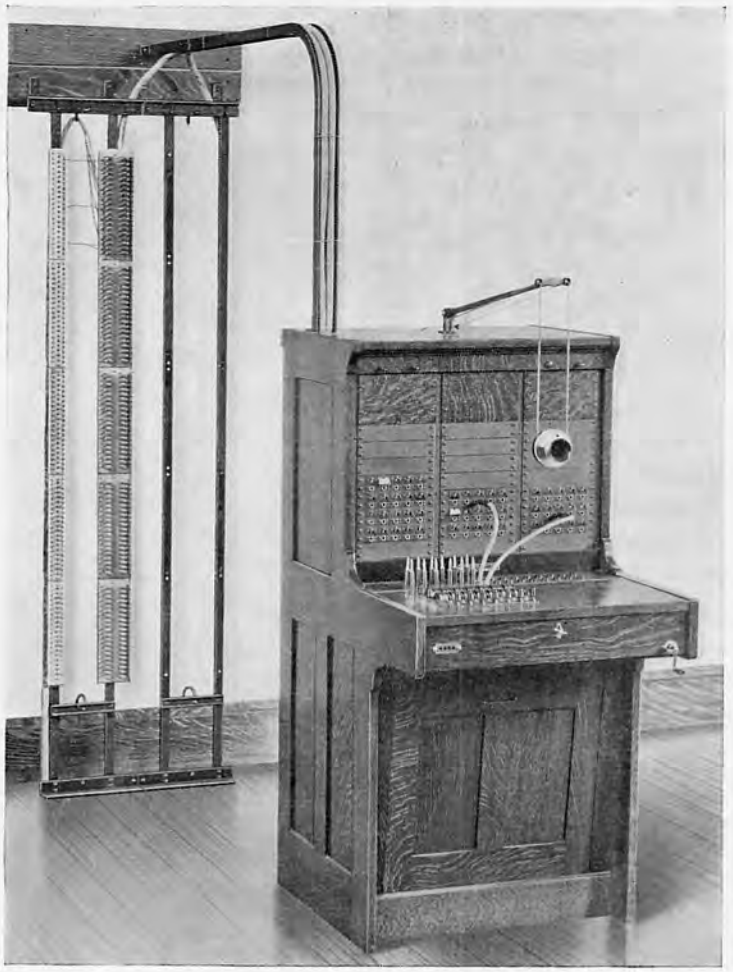

Fig. 1—The ideal magneto exchange equipment—No. 105-B High Efficiency Switchboard with two No. 1 Protector Frames and No. 1 Cable Rack

For many years a feeling has existed among telephone men that the magneto switchboard equipment in common use represented the peak of development in this class of telephone apparatus. The belief that the magneto system was bound by limitations which actually prevented further development confirmed this opinion, often, into a firm conviction. Such sentiments have never been shared by our Engineering Department, whose constant aim has been to bring metropolitan service to the town.

Long continued study of the operating company's problems proved that various departures from the well-beaten paths were absolutely essential to the production of an actual High Efficiency Magneto Switchboard. The innovations adopted by us have already demonstrated their superiority, under all manner of traffic conditions, and in exchanges of all sizes adapted to magneto service.

No. 105 Magneto Switchboard

The No. 105 Switchboard described in these pages is our positive answer to the rural exchange problem and marks the first really progressive step in magneto switchboard design that has been taken for many years. Efficiency is always the keynote in the development of our products and no effort has been spared to manufacture the No. 105 Switchboard with the most desirable and uniformly high grade characteristics which are commercially practicable. They are built throughout by workmen who are enthusiasts in producing "Quality Apparatus."

The equipment in the No. 105 Switchboard has been standardized so as to meet practically every magneto exchange requirement without alteration. Standardization has permitted us to manufacture these switchboards on a quantity production basis never conceived in the days when each equipment possessed its own distinctive features.

Production in large quantities has not only developed workmanship of particular skill but enables us to offer a superior product at a price which might otherwise stand beyond the reach of the smaller exchange. A standardized product offers a further strong appeal to the thoughtful manager. In time of emergency, be it addition or fire replacement, he can almost invariably secure immediate shipment from our stock of a board which will meet his particular requirements.

The No. 105 Switchboard is equipped with apparatus and circuits which facilitate fast, accurate service closely approximating that obtained through the central energy systems of our larger cities. These operating advantages have been secured, it will be noted, without sacrificing transmission (talking) efficiency in the least degree.

Magneto switchboards in the past possessed one great, common defect. Those which were designed to provide a high grade of transmission proved inadequate from an operating point of view. On the other hand, the switchboards having good operating facilities were enabled to possess these advantages only through great sacrifice of transmission qualities. No one type of magneto switchboard prior to the development of our No. 105 type possessed both essentials, namely, high transmission efficiency and wholly satisfactory operating facilities.

The No. 105 High Efficiency Switchboard has been designed in a manner that successfully corrects the conditions described in the preceding paragraph, and performances of the large number of No. 105 Switchboards that are in service today justify our statements in every particular. They are providing the highest quality of service ever obtained with magneto equipment, and are being maintained more economically than other equipments which they have replaced.

The No. 105 High Efficiency Magneto Switchboard

Fig. 2—No. 105-B High Efficiency Switchboard

The No. 105 Switchboard cabinet is made of thoroughly seasoned quarter-sawed oak, with the exception of the cord rack and the terminal board, where hard maple proves more suitable. All exposed woodwork is given our No. 20 dull golden oak finish, which cannot be surpassed for durability and pleasing appearance. Following modern preferences, the cabinet is made after a neat, simple design and is easily kept free from dust. The sides are so constructed that two or more cabinets may be lined up to form a multi-position switchboard of pleasing proportions. All of the principal dimensions are shown on page 25. Other features of the cabinet construction, as well as the method of mounting various apparatus, is indicated in the cross sectional view Fig. 21.

The keyboard of the No. 105 Switchboard, as will be noted, is the same height as the average desk. A chair of ordinary height may accordingly be used by the operator. Not only do these cabinet proportions insure comfort to the operator, but they also present an agreeable appearance when associated with the usual office furniture.

Keyshelf and Plugboard

As shown in Fig. 3, the keyshelf, plugboard and space between the line drops and keyshelf are covered with a tough, black insulating material resembling hard rubber. This material has a smooth finish, wears well without discoloring, and will not warp, crack nor chip off. It harmonizes with the golden oak finish and presents a background against which the various signals stand out in marked contrast.

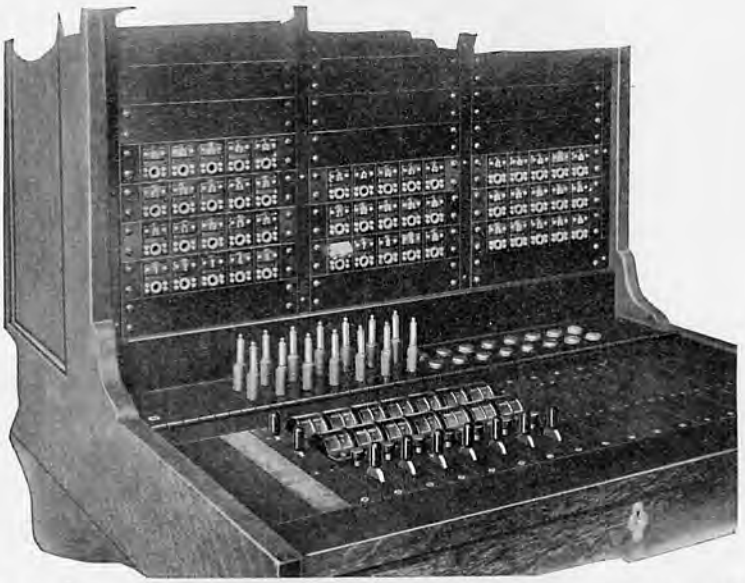

Fig. 3—Close-up view of keyshelf of No. 105-B High Efficiency Switchboard

The keyshelf is hinged with a strong piano hinge extending the full width of the cabinet. By raising the keyboard inspection is easily made of all key connections and other equipment mounted beneath.

A switchboard keylock denies access to unauthorized persons and prevents tampering with the apparatus. This lock also prevents the key pocket from being used as a cash drawer, or as a catch-all for the operator's personal effects. Purses, combs and similar articles in the space beneath the keys have been a frequent source of trouble. This space must necessarily be kept free of all metallic substances, which could produce short circuits, or from other material which would interfere with the proper operation of the apparatus. A key to this lock in the manager's pocket insures absolute freedom from trouble of this character.

Removable Panels

The front panel below the keyshelf is made removable so that the cord compartment may be easily and quickly inspected. The entire back of the cabinet is made in the form of a removable panel that may likewise be lifted out, providing convenient access to the interior. Both of these panels are provided with hand grips cut flush into the woodwork.

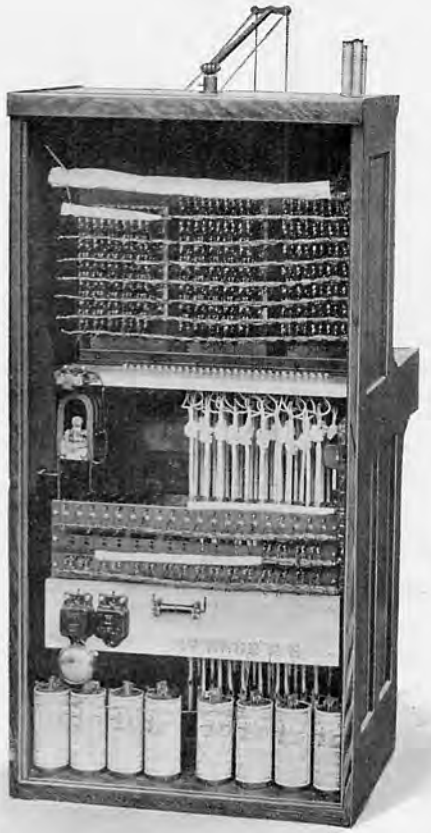

Fig. 4—Rear View No. 105-C High Efficiency Switchboard

Iron Framework

The plug-restoring drops in the face of the switchboard and the clearing-out signals on the keyshelf are mounted upon metal frames which in turn are secured to the framework of the cabinet. A rigid mounting for the apparatus is thus provided that prevents any possible variation in the woodwork from interfering with the alignment or adjustment of the signals. Whenever a switchboard is furnished with less than its full equipment the unequipped spaces are neatly filled with apparatus blanks. These blanks can readily be removed to permit the installation of additional apparatus as required.

All ironwork used in No. 105 Type Switchboard is designed to carry its full load of equipment with an ample margin of strength and rigidity to safeguard against possible damage during shipment. Large size machine screws are used for joining the framework and for attaching the apparatus so that the maximum holding power is secured.

The ironwork is protected against rust and corrosion by two coats of tough, black paint that will neither crack, chip nor peel off.

Wiring

All local wiring inside of the cabinet is formed in a hand-made cable consisting of No. 22 B. &. S. gauge tinned copper wires insulated with two reverse layers of silk and one layer of cotton. This cable is thoroughly boiled out in wax to insure a high grade of insulation. The outer cover of each wire has a distinctive color chosen in accordance with a definite color code. Any circuit may be traced with ease by referring to the colors indicated on the diagrams as found in the instruction book accompanying each switchboard. Operator's battery and alarm battery leads, together with power generator and switching key circuits, terminate on a conveniently located terminal board seen in Fig. 4.

All terminals for miscellaneous circuits are plainly numbered or lettered as an aid in installation or testing. An easily accessible space in the bottom of the switchboard cabinet is provided for the operator's and night alarm batteries. Attention is also directed to the conveniently placed cord terminals and other connections as shown in Fig. 4.

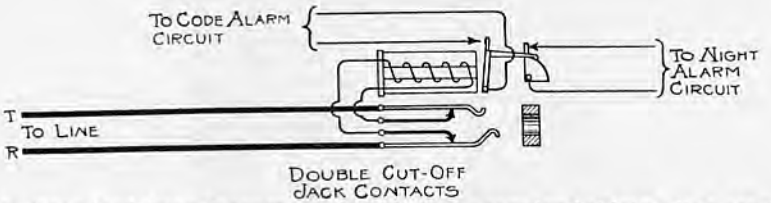

Fig. 5—Standard Line Circuit No. B-1840-A for regular bridging line service.

Line Circuit

Our standard magneto switchboard line circuit, illustrated in Fig. 5, is always wired for use in connection with full metallic lines. This type of line construction is recognized as absolutely essential to the highest grade of telephone service, and its use is urged in every case where local conditions permit. The same line circuit wiring is however adapted to use with grounded or common return lines by making the necessary connections at the cable terminals. The proper choice of cable terminals for these connections in an exchange operating grounded lines is vital to the quality of service, and is here considered worthy of special notice.

Operation of Grounded Lines

The greatest hindrance to the operation of grounded or common return lines is doubtless that of cross talk, or line noises arising from mutual induction. As is well known, talking currents in one circuit induce similar currents in neighboring parallel circuits. Moreover, the volume of the induced current is much greater when the conductors lie close together. On full metallic systems this difficulty is overcome by transposing the open line wires constituting each circuit. Wires in telephone cables are twisted together in pairs primarily for the same object.

In case one wire of a twisted cable pair serves a grounded line and its mate a second line, it will be seen that there is no transposition effect. The two conductors are in an inductive sense practically parallel, and besides, very close together. The inductive effect, both electro-magnetic and electro-static, between such conductors is of considerable proportions. Even a short length of cable connected in this manner and containing many

conductors will introduce a troublesome amount of noise on a system, while long cables magnify the disturbance many times.

More than one company, not fully appreciating the above principles, have carried grounded lines through cable to the central office, using but one conductor per circuit, and grounded the opposite side of each circuit at the exchange. The results, as may be readily understood, were far from satisfactory and became more aggravated as the traffic increased. In certain cases the resultant noise has even been attributed, of course unjustly, to the switchboards.

Stromberg-Carlson switchboards are always wired for full metallic service, with each circuit properly transposed by means of twisted pairs through the line cables to the protector frames. Should existing rate conditions actually prohibit full metallic line construction operating companies are earnestly urged to minimize inductive disturbances so far as possible by continuing the full metallic circuits from the protectors, through the outside cables,

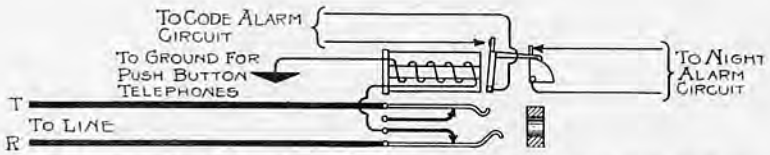

Fig. 6. Standard Line Circuit No. B-1840-B for non-interfering ringing on metallic bridging lines.

to each pole cable terminal using one twisted pair per circuit. Open wire leads beyond the cable terminal may then be employed, using but one wire per circuit. Under this method of operation one conductor of each cable pair must necessarily be grounded at the cable terminal where the open wire construction starts. This method of connection should be followed upon grounded lines, even in short cables extending to the office pole. While not offering the advantages of full metallic service, this method of connecting grounded lines is a long step in the proper direction and permits a switchboard to render a grade of service not otherwise possible. A uniform method of connecting cable pairs also renders the system more flexible, and future changes from grounded to metallic service may be more readily made.

Independent operating men have of late displayed great interest in all transmission problems and are making considerable expenditures to increase the efficiency of their exchanges. The best switchboard, however, will not eliminate transmission losses in the outside plant, and experience has demonstrated that uniformly good construction throughout the entire exchange returns the best dividends.

Line Jack Connections

Referring to Fig. 5 it will be noted that the drop is completely disconnected from the line circuit when a plug is inserted in the associated line jack. Switchboards having so-called "single cut-off" jacks leave one side of each drop winding permanently connected to the line and are often troubled with noises which may be traced directly to this unbalanced state. By employing a jack of the "double cut-off" type we entirely eliminate this unbalanced circuit condition.

Auxiliary Line Circuit Features

An excellent feature of our line signal circuit is the entire separation of the code ringing and the regular night alarms so that these auxiliary circuits may be operated independently of each other. The code-ringing alarm wiring is attached to all line drops in the switchboard, but if not required on any line or group of lines, this wiring can be easily disconnected.

All line circuits are arranged with a ground wire extending through the line cable form as may be seen in Fig. 6 so that they are available for use with non-interfering push button ringing telephones by simply changing the connections at the drop terminals.

Line Cables

The line circuits enter the switchboard through one or more lengths of standard 50 pair switchboard cable, which terminate in the line signals. The cables are brought out at the top of the cabinet and are almost invariably supported upon a cable rack that insures practical freedom from moisture or mechanical injury. Switchboard cables occasionally are run beneath a floor where they may become damp, and cause trouble. Cables furnished with a No. 105 Switchboard extend twelve feet from the top of the cabinet, a length sufficient to easily reach the usual protector frames. Descriptions of protector equipment and cable racks may be found upon pages 31 and 32.

The conductors in the line cables, as in the local forms, are No. 22 B. & S. gauge tinned copper, insulated with two layers of silk and one layer of cotton. The outer covering on each wire conforms with a standard color code by means of which a pair corresponding to any line signal on the switchboard may be readily located. Cores of the cables are saturated with a beeswax compound. They are then covered with a cotton braid, and treated with a fire repellent paint.

No. 11 Type Plug-Restoring Drop

Each equipped line circuit in a No. 105 Switchboard is supplied with one of our No. 11 Type Plug-Restoring Drops. This drop combines the line signal and its corresponding line jack in one unit as shown in Fig. 7. The drop and jack are mechanically inter-linked in such a manner that the insertion of a plug automatically restores a fallen shutter to its normal position when answering a call.

Plug-Restoring drops are preferable for use on all magneto switchboards as they permit the most rapid and positive operation; the operator does not waste valuable moments either in restoring shutters by hand or in hunting for the proper line jack when a call is received. As less movements are required in handling a call, it follows that a greater number of calls may be handled by one operator, and operating costs may be reduced, particularly on boards of two or more positions.

The Shutter

When in the operated position the shutter of the No. 11 Type Drop displays one curved and two plane surfaces as illustrated in Figures 10 and 11. This method of forming the shutter possesses particular merit. A fallen shutter exhibits a large and easily distinguished signal, regardless of its location in the switchboard, or the position assumed by the operator. Drops

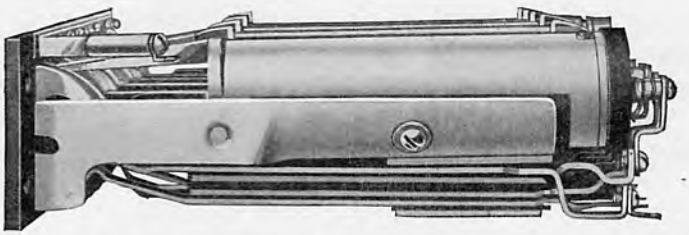

Fig. 7—Profile view of strip of five No. 11 Plug-Restoring Drops. Notice the extra long and heavy jack contact springs.

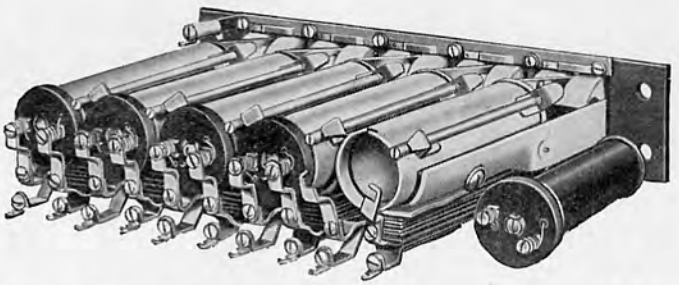

Fig. 8—Rear view of strip showing the convenient means provided for removing the drop coil without use of soldering iron.

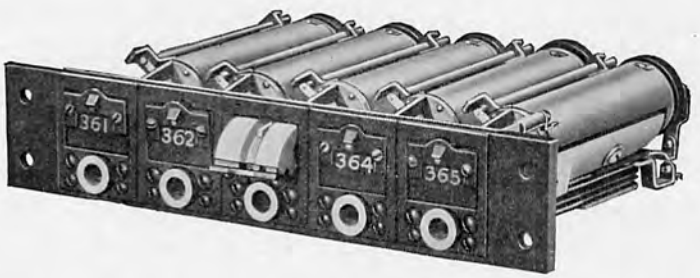

Fig. 9—Front view of strip with one drop operated to show segmental construction of the drop shutter. Code alarm contacts with screw adjustment rods show clearly in this illustration.

of this type prove of exceptional value at night, when a single operator is enabled to immediately recognize signals on a number of switchboard sections.

In its normal position each drop shutter rests nearly flush with its mounting plate. When all shutters are restored the face of a switchboard presents a relatively smooth surface, against which a fallen signal is readily distinguished. To compel the attention of the operator the indicating surfaces of the shutters are given an aluminum sand blast finish, causing them to stand out in striking contrast with the dead black finish of the surrounding switchboard face. Each shutter is provided with a removable and interchangeable embossed number plate.

Fig. 10—Appearance of No. 11 Type Drop shutter when viewed from above.

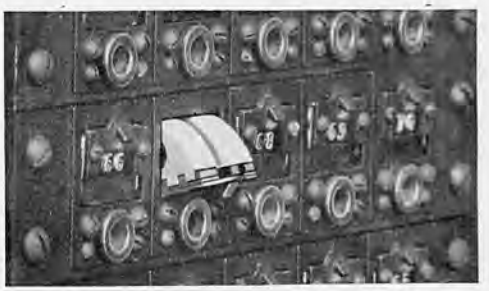

Fig. 11—Same drop shutter viewed from left side.

Damage to a shutter of the No. 11 Type Drop is exceedingly improbable. Resting, as it does, practically flush with the switchboard, and when actuated, displaying a solid semi-cylindrical surface, no projections are offered upon which dust cloths or other objects will catch. Contrasted with shutters of the leaf type, which are easily caught and bent out of shape, the No. 11 Type Drop shutter is particularly desirable.

The operation of the No. 11 Type Drop is not wholly dependent upon the force of gravity, as is the case with the majority of line signals. When its winding is energized by ringing current from the line the trip-rod not only releases the shutter, but strikes a bevelled projection on the shutter, impelling it downward with much more force than if actuated by gravity alone. So pronounced is this blow that the drop will operate satisfactorily, even though inclined at an angle of twenty-two (22) degrees.

Operating Characteristics

The No. 11 Type Drop is a rugged, permanently dependable piece of apparatus, with an ample margin of sensitiveness adapted to practical operating requirements. Drops are often seen with so sensitive an adjustment that a slight jar of the switchboard or a small static discharge of electricity on the lines will throw a number of signals. Super-sensitiveness is not required or even desirable in commercial work; such drops require frequent adjustment and are a continual source of annoyance both to operator and purchaser.

The No. 11 Type Drop operates positively either on short or on long and heavily loaded circuits. Each drop is given a rigid factory test which insures its reliable operation on any class of line over which commercial service is at all feasible.

Drop Spool

The spool of the No. 11 Type Drop has ample winding space, allowing the use of a large size of wire and a great number of turns in obtaining the required resistance. This drop is regularly furnished with a resistance of 500 ohms, which long experience has demonstrated to be most satisfactory for general use, whether on local, rural or toll lines. Pure copper magnet wire insulated with silk is used on all coils. The possibility of a burnout, due to static disturbances, is reduced by thoroughly insulating the winding from the core.

Correct proportions of the drop spool and its steel casing have produced a coil not only having a strong magnetic pull, but also a high impedance to voice currents, in comparison with its actual ohmic resistance. This construction minimizes the shunting of voice currents through an unconnected drop on party or toll lines. Appreciable loss in transmission would otherwise occur when parties on the same line converse without requiring a cord circuit connection through the central office. Cross-talk between lines in use under the above conditions is prevented from arising in the switchboard by the cross-talk proof casings surrounding each drop coil.

Reference to Fig. 8 shows how easily a coil may be replaced. Loosening two screws and giving the spool head a slight turn to the left allows the removal of the entire coil. When a coil is replaced the original adjustment is maintained, as all coils are interchangeable.

Line Jack Construction

The arrangement of the springs constituting the jack is indicated in Fig. 5. These springs are of the "double cut-off" type and provide for the entire disconnection of both leads to the drop coil when a plug is inserted. The springs are made of nickel silver and are sufficiently long to insure even tension under the most severe operating conditions. An extension on one jack spring used for restoring the shutter is entirely concealed, so that unauthorized persons cannot possibly change the adjustment from the face of the switchboard. The thimble of the jack, in order to resist continuous wear, is made of a special bronze. The screw terminals are provided with small, removable lugs in order that any wire may be readily disconnected without the use of a soldering copper. Connections between the inside springs of the jacks and the coil terminals are made by formed metal links. This construction simplifies the line cable wiring and facilitates testing.

Insulating separators between the jack springs are made from the highest grade of insulating material in order to prevent burnouts, or leakage, with the attendant transmission losses. This material will neither soften, warp nor crack when subjected to temperature changes.

Alarm Contacts

Separate sets of contacts are provided on each drop for the operation of a continuous ringing night alarm and for a code ringing night alarm. The contacts for the code ringing alarm cause an audible signal when operating so that an operator may distinguish party line rings from calls for the exchange. Further information regarding night alarm circuits and equipment will be found on page 22.

Method of Mounting Drops

Each No. 11 Type Drop and jack assembly constitutes an individual unit of apparatus complete in itself, and not dependent upon the front mounting strip for correct alignment of the associated parts. Any drop may, consequently, be readily removed for inspection or replaced on a mounting strip without disturbing adjacent apparatus or wiring.

No. 11 Drops mount in the switchboard upon rigid steel mounting plates, which insure an alignment of the signals in perfect rows not found with signals having wholly individual mountings. Front and rear perspective views of a bank of five drops assembled upon a mounting strip are shown in Figs. 8 and 9.

A strip of five drops constitutes a unit well adapted to small extensions. Such a unit is also more conveniently handled and offers a more flexible arrangement than strips mounting greater numbers of line signals. The No. 11 Type Drop is the only switchboard line signal possessing all the advantages of both individual and strip mountings.

Drop mounting strips as well as other exposed metal face details are given a durable, dull black finish which insures a pleasing appearance and freedom from rust.

Cord Circuit Equipment

Informed telephone men agree that magneto switchboard circuits should possess the following characteristics in order to assure greatest satisfaction alike to subscriber and to telephone company.

1st: The circuits should introduce the smallest possible loss in voice currents when two lines are connected together.

2nd: The circuits should be non-ring-through. In other words, when either of two connected parties signal for a "disconnect" by "ringing-off", the cord circuit should not permit passage of signalling current to the connected line in volume which would cause a false ring on that line.

3rd: The clearing-out signals in the cord circuits should respond positively under all operating conditions in order that subscribers' lines may be quickly released after finishing conversations.

4th: Each cord circuit should be equipped with two separate clearing-out signals so that the operator may know at a glance whether the parties are talking, whether both have finished talking, or when one has hung up and the other is awaiting further service.

Regular Cord Circuits

All of the above conditions are thoroughly satisfied by the High Efficiency cord circuits used in our No. 105 Switchboards and shown in Fig. 12. The transmission qualities of this circuit are the highest ever developed in any magneto cord circuit having both non-ring-through and double supervision features. It closely approximates in transmission efficiency the simple cord circuit having a single clearing-out drop. The total losses in the cord circuit as shown in Fig. 12 do not exceed 1.1 miles of standard cable. Transmission losses in many circuits designed to prevent ringing through, and employing ordinary apparatus, are frequently equivalent to four and even six miles of standard cable.

Our High Efficiency cord circuit will not permit rings from one line to pass through and signal telephones on a connected line. The repeating coil in this circuit, being of special design, will not permit the passage of ringing current in sufficient volume to even tap a telephone bell, when connected as shown in Fig. 12. This condition is met irrespective of the lengths and types of the lines connected.

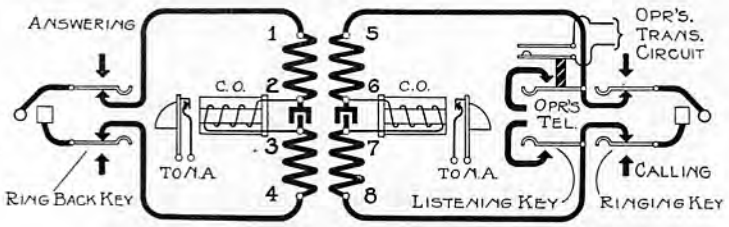

Fig. 12. Regular Cord Circuit No. B-1870

The clearing-out signals in this cord circuit operate positively and independently of each other, whenever either of two connected parties turn their hand generator, after talking. Current from a telephone ringing-off must traverse the winding of the clearing-out signal. It has no alternative path, often possible in other cord circuits through a low resistance connected line and telephone bell. The signals respond positively under all operating conditions regardless of the class of lines connected.

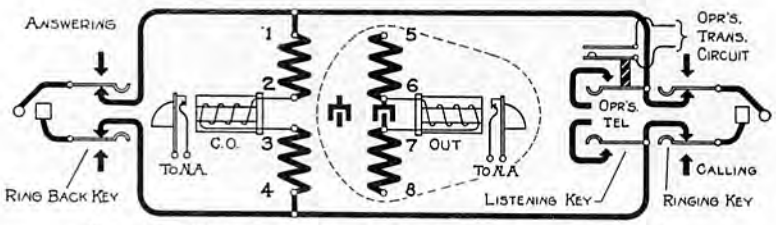

Fig. 13. Showing Circuit Conditions produced when zero-loss switching key is operated

Two separate clearing-out signals enable the operator to determine the exact condition of a connection in all its phases and enables either of two connected subscribers to regain the operator's attention quickly and easily, if making calls in rapid succession.

As is well known, the quieting effect of a repeating coil is desirable when connecting a noisy metallic line to a quiet metallic line; otherwise the noise on both connected circuits may be even greater than on the noisy circuit alone. When connecting metallic with grounded or common return lines a repeating coil is not only desirable, but is positively necessary for the same reason.

The use of a repeating coil in every cord circuit permits the inter-connection of grounded and metallic lines without requiring the operator to pre-select a particular cord circuit or to throw any extra keys.

When used to connect two such dissimilar lines all of the operating advantages of our circuit shown in Fig. 12 are retained. This arrangement is absolutely essential to fast service in exchanges operating both grounded and metallic lines.

"Zero-Loss" Cord Circuit

No. 105 Switchboard is equipped with switching keys wired into the first two pairs of cords on the left side of the keyboard. These keys switch the repeating coil connections in the first two circuits, and when thrown produce two so-called "Zero-Loss" circuits. The use of such a circuit is particularly desirable on long, or through toll connections that test quiet, in order to assure the highest possible grade of transmission. The wiring employed in these two cord pairs conforms with our circuit shown in Fig. 13.

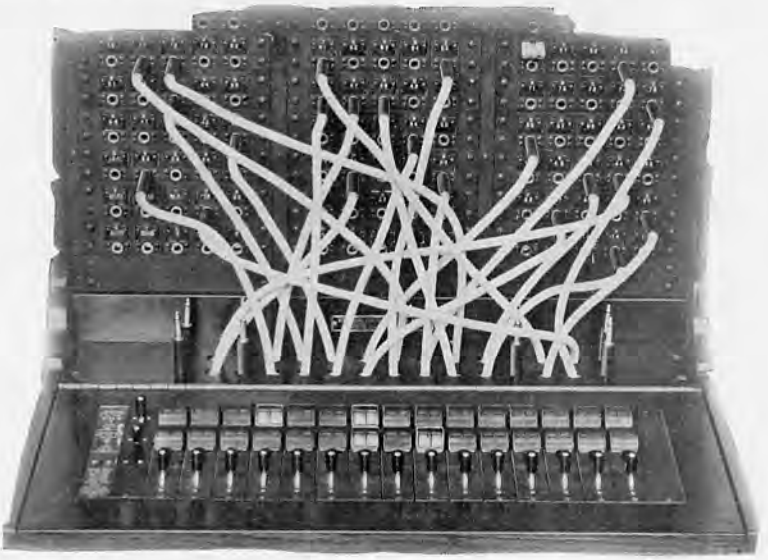

Fig. 14—Interlaced cords do not obscure clearing out signals.

The switching key, when normal, connects the talking circuit and clearing signals as in Fig. 12. After throwing the key however, the repeating coil is not cut out of the circuit in the customary way. Operation of the key entirely removes one side of the repeating coil with its associated clearing-out signal, and connects the other side in series with the winding of the remaining clearing-out signal, as shown in Fig. 13. The impedance remaining bridged across the cord is that of the clearing-out signal plus that of one side of the repeating coil.

Under standard testing conditions the remaining impedance produces a loss in the cord circuit of only .08 mile standard cable. In other words this condition entails a transmission loss only one quarter to one half as great as the simple bridged clearing-out drop circuit. Such a loss closely approximates that of a switchboard cord with a plug at each end. So small is this loss that it is well termed a "Zero-Loss" circuit. The combination of these two cord circuits in a switchboard is exceptionally good from an operating standpoint, as the operator may use all cords in the board for local connections, if needed, during busy hours.

The No. 169 Type Key

Two clearing-out signals, the ringing and listening key and the ring-back key, have been combined as a single apparatus unit in our No. 169 Type Key, illustrated in Fig. 15.

The shutters of the clearing-out signals in this key are seen through windows of two housings on the top of the mounting plate. These shutters are linked mechanically with the listening key lever so that they are automatically restored to their normal positions by throwing the key lever to the listening position.

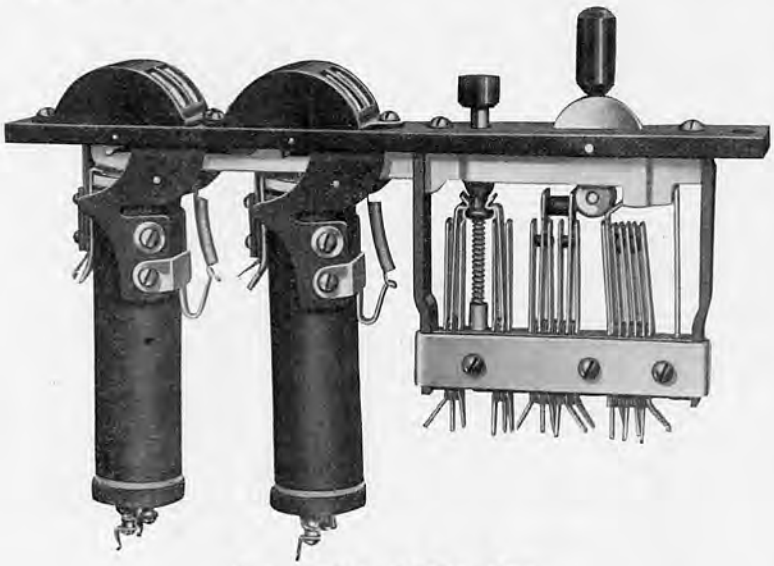

Fig. 15—No. 169 Type Key

The advantages realized through the use of this key in the No. 105 High Efficiency Switchboard are:

1. An increased number of line drops may be placed within easy reach of each operator, owing to the removal of the clearing-out signals from the face of the switchboard.
2. The clearing-out signals are placed in the keyshelf where they are at all times plainly visible (See Fig. 14.) They cannot be hidden nor obscured by a screen of interlaced cords during busy hours, when most needed, as with switchboards having the common form of clearing-out drops. Hand restored clearing-out drops are also inconvenient to reach when covered by a heavy lacing of cords.
3. The clearing-out signals are placed close to, and directly in line with the corresponding keys, cords and plugs. Operators consequently waste no time in associating cords with their signals, and are far less liable to make errors in disconnecting subscribers.
4. The automatic restoration of the clearing-out shutters eliminates two motions the operator would otherwise make in handling each call.
5. The supervision is raised to the same plane of efficiency as in lamp signal, central energy switchboards used in large cities.

6. Supervision is secured through the use of two mechanically restored drops which are simple and easy to maintain. No associated cord circuit relays, storage batteries to be kept at a uniform voltage, or other devices demanding the presence of an expert switchboard man are required, as on some types of magneto switchboards.

7. The wiring of the key cables is greatly simplified because a large portion of the wiring is localized on the key.

8. The ease and speed of operation resulting from the use of this key reduces the operator's fatigue and enables her to answer an increased number of calls per hour. The number of operators necessary on boards of two or more positions may consequently be reduced during certain hours of the day, with resultant operating economy.

The No. 169 Type Key is strong, rugged and requires a minimum amount of attention. Each key is given a rigid factory test, assuring positive operation under the most severe line conditions practical for commercial operation. It is so simple that it cannot get out of order and cause trouble except through sheer abuse. The coils used in the clearing-out signals are wound to 1000 ohms resistance. These coils may be removed by a twist and downward pull, and can be replaced or exchanged without disturbing the adjustment of the signal. Each signal is provided with night alarm contacts and wiring so that an audible disconnect signal may be obtained in addition to the visual indication when required.

Two well-constructed cam type keys are mounted at the left of the keyboard for control of the repeating coils in the first two cord circuits. A printed designation instructing the operator as to the proper use of these keys is mounted under a transparent cover directly beside the keys. This designation may be plainly seen by referring to Fig. 14.

No. 13-A Repeating Coil

Each cord circuit in the No. 105 Switchboard contains one of our No. 13-A Repeating Coils, as shown in Fig. 16. This repeating coil is designed especially for the cord circuit conditions of the No. 105 Switchboard. When wired in connection with apparatus as shown in Fig. 12 it transforms the high frequency talking currents at maximum possible efficiency and at the same time bars the transformation of low frequency ringing currents. Because of these characteristics the No. 13-A Repeating Coil, when used under conditions shown in Fig. 12, is termed a "Talk-Thru and Non-Ring-Thru" repeating coil. The talking efficiency of the 13-A Repeating Coil, as previously stated, is unusually high under average circuit conditions when used on magneto cord circuits. When used on Magneto cord circuits the transmission loss of this repeating coil taken alone is approximately .5 mile of standard cable.

Fig. 16—No. 13-A Repeating Coil.

Repeating coils and their associated condensers are assembled on steel mounting plates in the back of the switchboard with their terminals projecting rearwardly so that all connections are in plain sight. The arrangement is such that any repeating coil or condenser may be removed or replaced as a unit without disturbing the adjoining apparatus or connections.

Plugs

Fig. 17 shows the general construction of our No. 42 Plug which is used with No. 11 Type Plug-Restoring Drops on all of our magneto switchboards. It is a two conductor plug made with a barrel, or body, of sufficiently large diameter to provide a roomy interior, with plenty of space to easily attach the cord terminals. Most plugs designed for similar purposes are so small that cords are changed or rebutted with difficulty. The large diameter of the No. 42 Plug also permits heavier reinforcement of the cord at the point of greatest wear, where it enters the plug body.

Fig. 17—No. 42 Plug

All plugs are turned in semi-automatic machines by skilled plug-makers and are gauged to 1/1000 of an inch. The tip and ring contacts are heavily insulated one from the other and the insulation in the terminal space is so arranged as to prevent short-circuits at this point. The shell practically covers the entire length of the body or "handle" of the plug, and is made from a tough, hard, insulating material of sufficient thickness to prevent warping due to excessive humidity or to moisture from the operator's hands.

Cords

"Duratex" moisture-proof cords are used exclusively in the No. 105 Switchboard. These cords are manufactured in our own plant with the same careful attention to detail that characterizes our other apparatus. Not only have we made a constant study of cord problems, but have developed much special machinery in order to assure a uniformly high standard of cords suitable for switchboards of our manufacture.

The "Duratex" cord used in the No. 105 Switchboard contains two conductors, and is built up in a manner similar to a manilla rope, which insures maximum wearing qualities. The several tinsel strands, composing each conductor, are first twisted together, served with two layers of tussah silk, treated with a special moisture-proof compound, and then covered with a braided sheath. Two conductors, together with dummy and filler threads, are finally twisted as a rope and covered with a heavy and closely woven glazed outer braid.

Fig. 18 clearly illustrates the method employed in building up this cord. Such construction produces a firm, round cord of low resistance, low transmission loss, impervious to moisture and long life. Cords made up in this manner will not

Fig. 18—Showing construction and finish of "Duratex" Switchboard Cord.

stretch, and the strain on the cord when returning to the plug seat comes on the cord body rather than on the tinsel conductors. In order to still further strengthen the cord a reinforcing braid extends eighteen inches from the plug end, where the flexure is greatest. The length of this reinforcing braid allows the cord to be re-butted a large number of times.

Operator's Circuit Equipment

The operator's circuit equipment of the No. 105 Switchboard includes our No. 8-L Transmitter, No. 20-A Operators Receiver with sanitary wire head band, No. 20-A Induction coil, N0. 23 Plug and minor associated equipment.

Fig. 19—No. 20-A Operator's Receiver with sanitary wire head band, cord and plug.

The suspended type of transmitter has been selected as best suited to the average small magneto switchboard, where the operator is not required to make long reaches, and where it would be inconvenient for the operator to wear a breast transmitter before her at all times. The transmitter employs the same active elements as are used on our No. 896 Type Magneto Telephones. So well and favorably known has this transmitter become that an extended description is here considered unnecessary. This highly important apparatus requires a very moderate amount of current in order to secure a high grade of transmission. As a further means of economizing battery current the transmitter circuit is carried through battery closing contacts on the listening keys. Current consequently can flow through the transmitter only when a key is thrown over for talking purposes.

The transmitter circuit contacts may be seen in the cord circuit diagrams Figs. 12 and 13. The contacts are arranged so that no click will be heard in the operator's receiver when a key is thrown. They also economize current to such a degree that dry cells may be successfully used on this intermittent service. Absence of wet cells, such as the gravity cell, will be appreciated by every telephone man. This operator's circuit requires for most efficient operation, four dry cells connected in series-multiple. The transmitter is suspended by flexible cords from an adjustable, telescopic transmitter arm. This method of mounting a switchboard transmitter prevents vibration of the building or vibrations caused by operation of the switchboard from reaching the transmitter, and introducing extraneous noises in the operator's circuit.

Receiver

The No. 20-A Operator's Receiver shown in Fig. 19 includes many features of practical value. The sanitary head band is made of flexible steel wire, having no sharp edges or projections to entangle the operator's hair. A highly polished black enamel which will

not chip or peel off covers the wires. This type of head-band can be readily cleaned and is more sanitary than other head-bands in common use. It may also be adjusted with ease to conform with the shape of the wearer's head. The receiver, together with head-band is extremely light weight. This, with its sensitive qualities, allows the operator to work with maximum comfort and efficiency. Each receiver is furnished with a six foot cord which terminates in a four pronged operator's plug. This plug is designed to engage the operator's jack mounted in the keyshelf rail.

Operator's Breast Plate Set

Although the No. 105 Switchboard is regularly furnished with a suspended type transmitter, a breast-plate type operator's set can be subsequently installed, if preferred, by disconnecting the suspended transmitter and short circuiting the transmitter terminal posts. A breast-plate operator's set may then be substituted in place of the head receiver equipment, as the operator's jack may be used for either equipment without modification. The breast plate operator's set will be substituted for the suspended transmitter set when required without extra charge, except for repacking expense as indicated on page 25.

Generator Circuit Equipment

The No. 105 Switchboard is regularly supplied with our No. 38 High Power Generator. This generator has five bars of selected magnet steel and furnishes current for ringing the most heavily loaded lines. Included in the wiring between the generator and ringing keys is a generator switching key. This key is of the plunger type and is located on the rail at the upper right side of the cabinet as seen in Fig. 2, and is engraved "GEN". When this plunger is pulled out the hand generator may be used, but when pushed in the leads from the ringing keys are switched into connection with the generator terminals located on the terminal board. From these terminals leads may be extended to a power ringing unit, if desired. Offices operating any considerable number of lines are urged to install a reliable source of power ringing supply, as the operators' efficiency will thereby be greatly increased. Bulletin No. 1019 describing our exchange ringing units or detailed information concerning other power ringing units will be gladly furnished upon request from our nearest branch office.

Buzzer

An operator can obviously handle calls most efficiently when she is enabled to recognize the presence of trouble. As an aid in this direction we have included a low resistance buzzer in the generator circuit. The operator soon becomes familiar with the intensity of sound from the buzzer on various types of lines under normal conditions and is often enabled to detect trouble, even before a patron has discovered its presence. Among the uses of this buzzer may be mentioned:—

1. Indication of open line or burnt-out fuse.
2. Absence of generator current.
3. Indication of short circuits.
4. Aid to operator in ringing code signals on party lines.

Continuous Ringing Night Alarm Circuit

Two distinct and independently controlled alarm circuits are furnished on each No. 105 Switchboard. The first, or regular night alarm, is arranged to give a continuous ring as long as a drop shutter remains displayed, and while the associated night bell key is depressed. The contacts for this alarm circuit are attached to the rear of the drop mounting as shown in Fig. 8.

Whenever a signal falls a small lug on the drop shutter engages one of the contact springs, carrying it forward into positive contact with the associated terminal beneath. These contacts, as will be seen, cannot be disturbed from the face of the board. They are reliable in action, yet easy of access for inspection purposes. The key controlling this circuit is similar in construction to the generator switching key, but is located in the upper left corner of the switchboard face and is engraved "N. A." A three-inch battery-operated vibrating bell gives a loud, clear signal on this circuit.

Code Alarm Circuit

The code alarm circuit is a particularly desirable feature for the switchboard attendant during either day or night hours, when her continuous presence is unnecessary. This feature permits a buzzer to accurately repeat each code ring on the rural or party lines, and the operator is required to go to the switchboard only when her particular call is rung. A small contact spring is attached to the armature of each drop, and is arranged to engage a contact rod while the armature is drawn forward, This rod, supported from the drop shell, extends to the rear of the drop and is so arranged that the code-ringing contact may be adjusted by a slight turn with a screw driver. Reference to Fig. 8 will show how easily this rod may be reached. Not only does the code alarm contact spring operate a buzzer signal; but it produces, also, a distinctly audible rattle, which aids greatly in the operation of party lines.

A slow acting relay is included in the code alarm circuit, which is constructed so as to pull up quickly, but fall away slowly. This relay holds the buzzer circuit positively closed during each ring and insures an accurate, distinctly repeating buzzer signal.

Although each drop is wired ready for code alarm service these contacts on any individual drop or group of drops may be disconnected when desired. Operating companies usually find it preferable to leave only individual lines connected to the regular night alarm circuit, and only toll and rural lines to the code alarm circuit. With this arrangement any operator, who has retired for the night, will hear all signals, and may readily distinguish each one that requires attention. The code alarm circuit is controlled by its individual key, marked "C. A." and mounted beside the regular night alarm key. The code alarm buzzer is operated from four cells of dry battery, the same battery also serving the regular night alarm circuit.

Static disturbances, such as occur during thunder showers, occasionally throw a number of drops and cause more or less inconvenience by ringing a night bell after an operator has retired. This difficulty is usually most pronounced on long rural and toll lines. When lines of this class are connected to drops with a code-ringing alarm the static discharge causes only a short, easily distinguished ring, and much annoyance is averted.

In addition to the above alarm circuit features, terminals are provided to which extension night alarm or code alarm signals in a distant room may be wired when desirable.

Position Switching Key

A switchboard consisting of two or more positions requires facilities in order that an operator on any position may handle the cords in adjacent positions, as well as her own, during periods of light load. Operators' circuits on adjacent positions of a No. 105 Switchboard may be inter-connected or rendered independent by means of position switching keys. Switchboards are not regularly carried in stock with this key equipped, although cable wiring and neatly blanked drillings are provided so that the keys may be easily added at any time. This switching key is similar in appearance to the generator switching key, and mounts directly beside it. Position switching keys may be added in accordance with information on Page 25.

Transfer Circuit

On switchboards consisting of three or more positions it is obviously impossible for each individual operator to reach all line jacks with a single pair of cords. Under such conditions it becomes necessary to install transfer circuits which serve as extension links from each position to other points on the switchboard where the connections can be completed. The standard transfer circuit terminates in two jacks installed in widely separated positions.

In handling a transferred connection, an operator receives and answers a signal in the usual manner. Learning that the line requested is located beyond her reach she inserts the associated calling plug into a transfer jack giving access to the operator before whom the desired line appears. She then requests that operator to connect the specified transfer circuit with the desired party. A regular cord circuit is used by the second operator to complete the connection. Instructions for completing transferred connections are most satisfactorily passed between operators in a verbal manner on boards not exceeding three or four sections.

The presence of two cord circuits in a transferred toll to local connection has heretofore been considered particularly undesirable, due to the high transmission losses. Many complicated transfer circuits have been developed in an effort to avoid introducing more than one cord circuit in such connections. The presence of either one or two of our "Zero-Loss" cord circuits on such toll connections insures excellent service and allows the use of an extremely simple and flexible transfer system. For local to local transferred connections the use of the Zero-Loss cord circuits are not necessary as the presence of two regular cord circuits in such connections will not cut down the transmission perceptibly.

Transfer circuit wiring is not included in stock switchboards, but may be easily added at any time. Jacks for transfer purposes are mounted in strips of five, and occupy the same space in the switchboard as five line drops. Space for fifteen transfer circuits is regularly provided directly below the line drops in each No. 105 Switchboard. Transfer jacks may be most conveniently connected by short lengths of switchboard cable, one end of such cable coming already attached to one of the strips of jacks.

The remaining end is furnished formed out so as to be easily attached to the second strip of transfer jacks after mounting in the switchboard sections. Information with regard to ordering transfer equipment will be found on page 25.

Party Line Ringing Key

Keys for selective party line ringing are not regularly furnished on the No. 105 Switchboard. Master Keys, with attached cable and connecting rack terminals, however, can be supplied for mounting in these switchboards to such companies as are at present operating harmonic, pulsating, or line to ground party line ringing. Purchasers desiring No. 105 Switchboards with provision for party line ringing are requested to outline their requirements to our nearest branch office.

Instruction Book

Furnished with each No. 105 Switchboard is an instruction book, known as Bulletin 1025, which gives practical directions covering its installation and operation. This volume is in fact a switchboard text book, written in an interesting manner, and readily understood by the average reader. Numerous cuts clearly illustrate the circuit operations, as well as the instructions for most efficient manner of installing the equipment. Wiring diagrams and lists of apparatus contained in the No. 105 Switchboard are included in this volume, eliminating the use of easily lost blue prints and typewritten lists.

Switchboard Tools

The following set of switchboard tools is regularly furnished with each No. 105 Switchboard. These tools have been carefully designed to aid in the switchboard maintenance and are construted of the best materials.

No. 42 Screw Driver for changing cords in plugs.
No. 7 Spring adjuster for jack springs.
No. 38 Wrench for jack sleeves.
No. 52 Screw Driver

Service Department

The Stromberg-Carlson Tel. Mfg. Co. maintains a Service Department where bulletins are prepared on various phases of maintainance, and on operating problems met in exchanges of a size using the No. 105 Switchboard. These bulletins contain many helpful hints both to the manager, wire chief and operator, and will be mailed as issued to all purchasers of our No. 105 Switchboard Equipments.

Dimensions and Prices No. 105 High Efficiency Magneto Switchboard

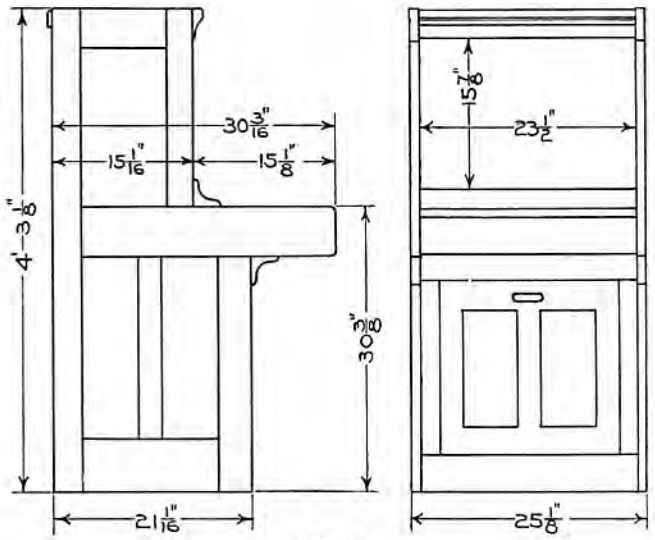

Fig. 20

To place an order for any of the following standard stock switchboards it is only necessary to specify the code number of the switchboard desired. To order a No. 105 Magneto Switchboard with 50 lines and 7 cord circuits equipped, simply specify "1 No. 105-B Switchboard". Should the same switchboard be required with 10 cord circuits equipped, the order should read "1 No. 105-B Switchboard plus 3 cord circuit equipments".

Code	Wired for Lines	Wired for Cords	Equipped with Lines	Equipped with Cords	Shipping Weight	Net Price
105-A	50	15	30	5	360 lbs.	$425.00
105-B	100	15	50	7	400 "	530.00
105-C	150	15	100	10	450 "	748.75

(See pages 28, 29 and 30 for equipment diagrams)

When specially equipped switchboards are required, apparatus will not be removed from any standard switchboard listed above with the exception of Switchboard No. 105-A. Additional apparatus, will however, be placed in any of the above standard equipments when desired. Additions or deductions to switchboard prices should be figured in a corresponding manner, and in accordance with prices listed below. These switchboards are carried in stock packed for shipment. An extra charge of $5.00 will be made in addition to the prices given above when it is necessary to unpack a switchboard for the purpose of making changes from these standards.

Line equipments (500 ohm signals), each	$ 3.85
Line equipment (1000 ohm signals), each	3.95
Cord equipments, each	18.00

Other additions in equipment can be made at the following prices:

Position switching circuit No. 301 key marked "SW" CKT. B-3430 each	3.00
Transfer Circuit No. 140 Jack on No. 85 Mtg. (5 per) CKT. B-3290 per jack	2.75
5 CKT. Transfer jack unit. Consisting of No. 70-B (8 pair cable) with 5 No. 140 jacks (5 per strip) at each end, one strip attached	29.15
Order Wire Circuit No. 300 Key, per circuit B-3300 each	1.25
Master Key either pulsating or harmonic ringing	10.00

Protector Equipment and Standard Cable Rack Code No. 1 listed on Page 32

Changes in standard stock switchboards extend the delivery date from ten days to three weeks.

Prices are F. O. B. **Rochester, N. Y. or Chicago, Ill.**

Typical Cross Section Drawing No. 105 High Efficiency Magneto Switchboard

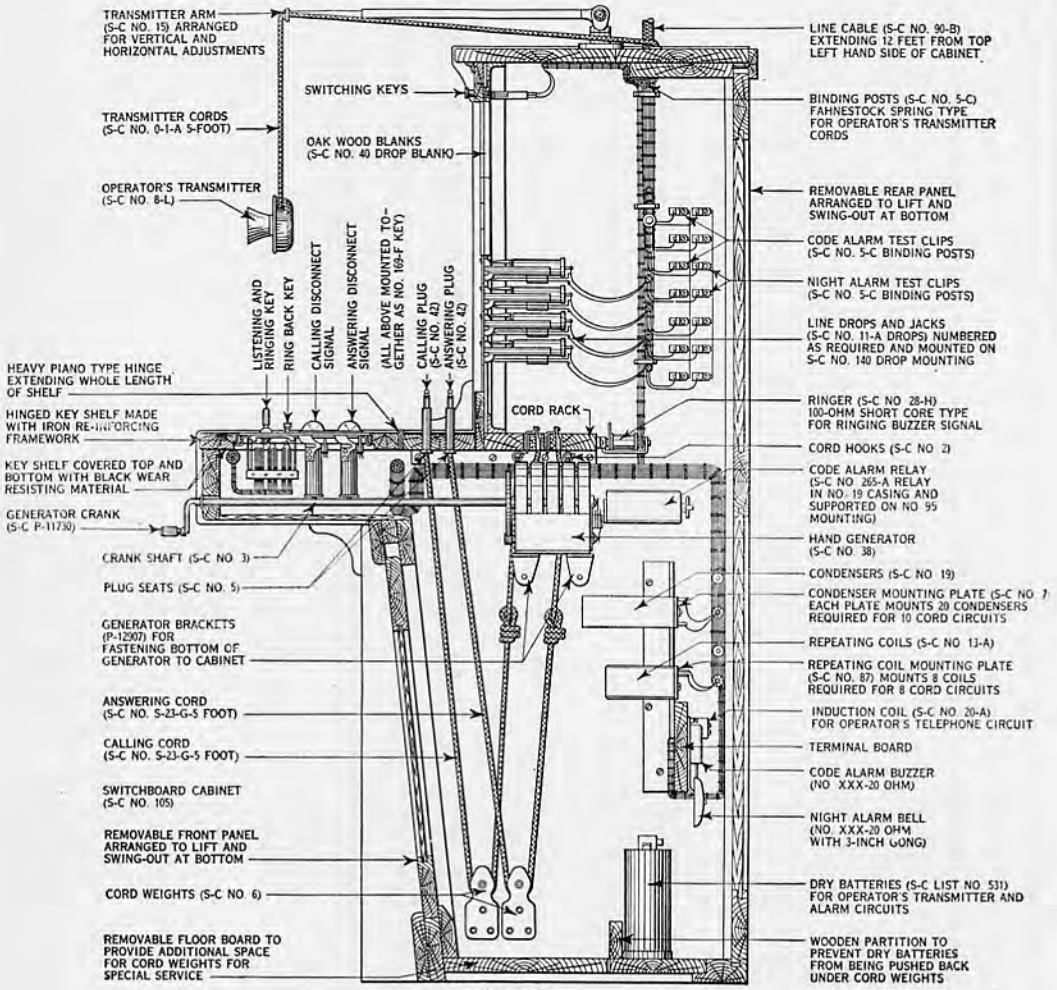

Fig. 21

Typical Rear Equipment Drawing No. 105 High Efficiency Magneto Switchboard

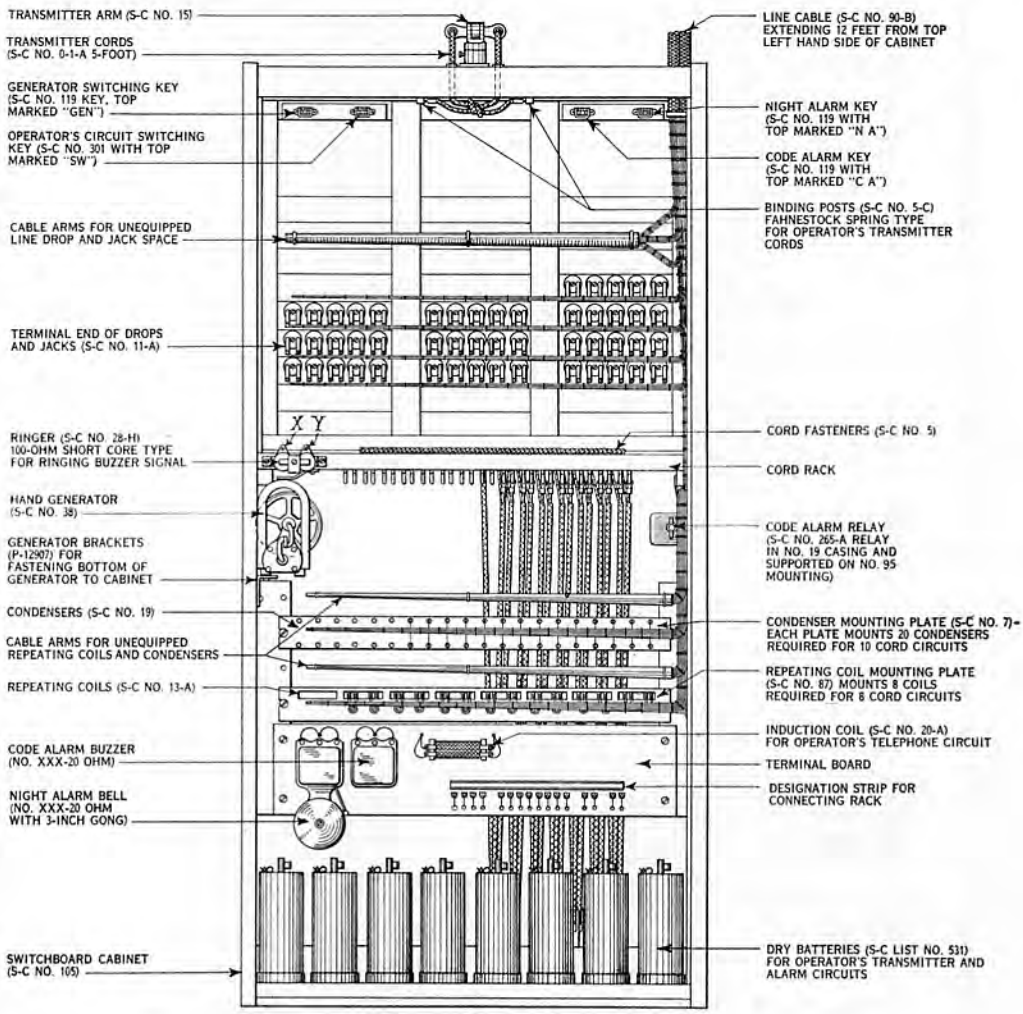

Figure 22

Equipment Drawing
No. 105-A High Efficiency Magneto Switchboard

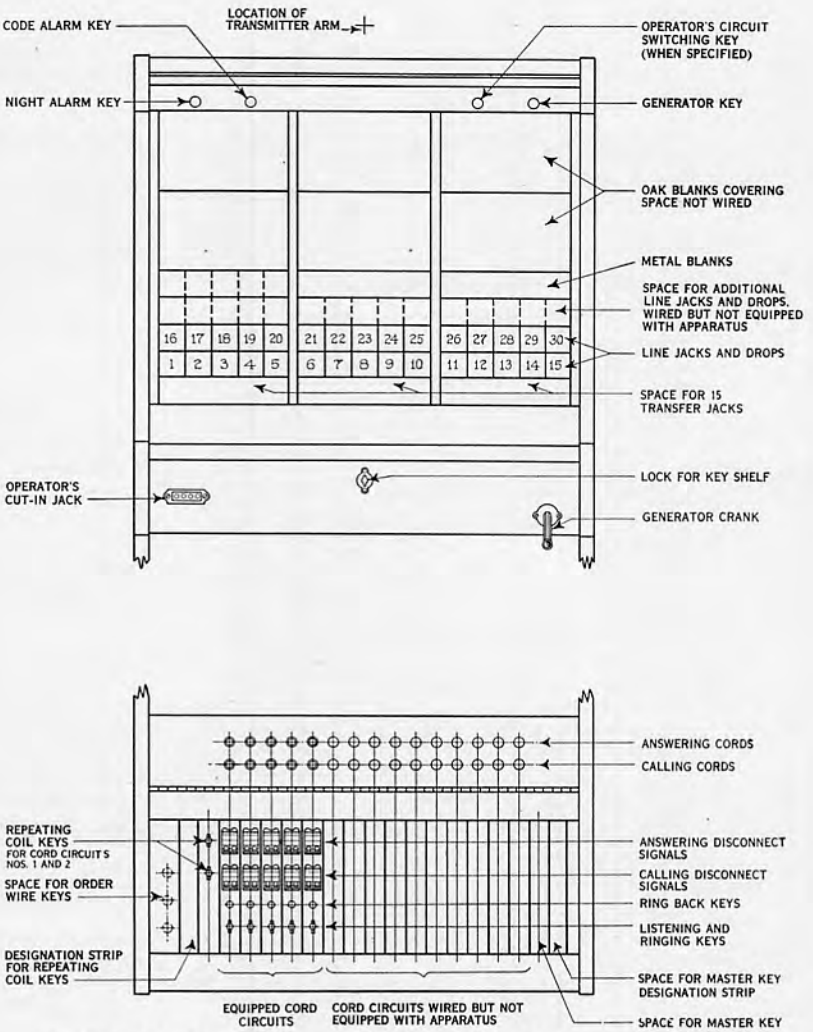

Fig. 23—Standard Equipment of No. 105-A Magneto Switchboard.

	Wired for	Equipped with
Line Equipments	50	30
Cord Pair Equipments	15	5

Shipping weight approximately 360 lbs.

Equipment Drawing
No. 105-B High Efficiency Magneto Switchboard

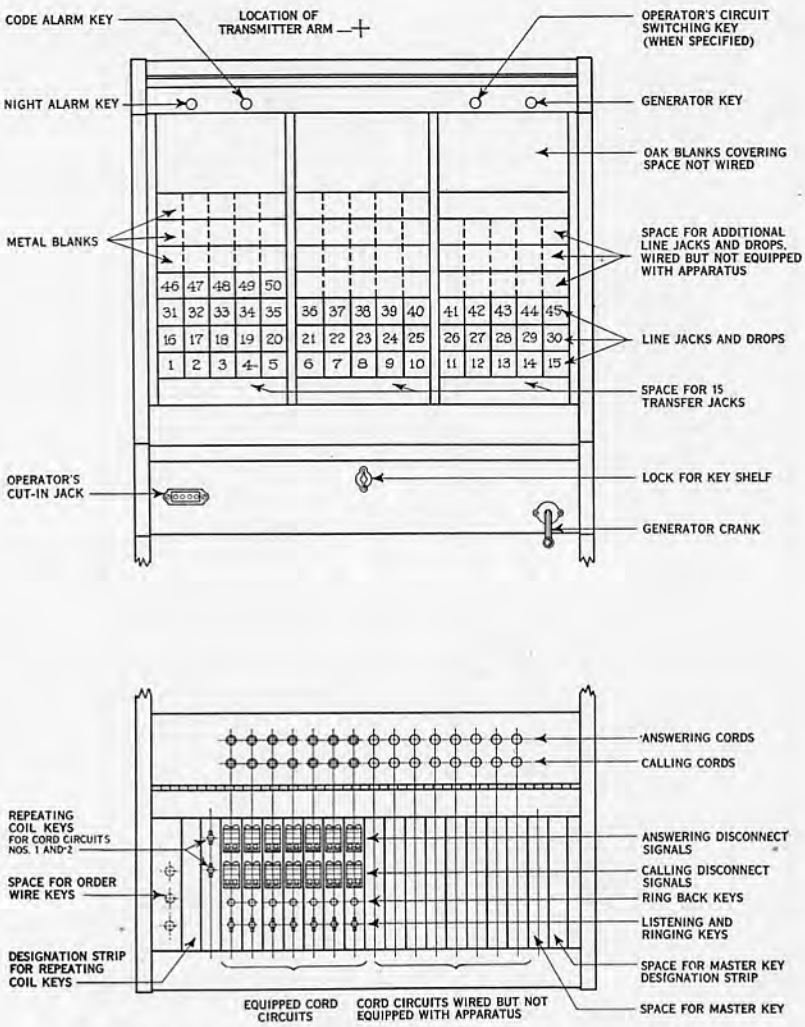

Fig. 24—Standard Equipment of No. 105-B Magneto Switchboard.

	Wired for	Equipped with
Line Equipments	100	50
Cord Pair Equipments	15	7

Shipping weight approximately 400 lbs.

Equipment Drawing
No. 105-C High Efficiency Magneto Switchboard

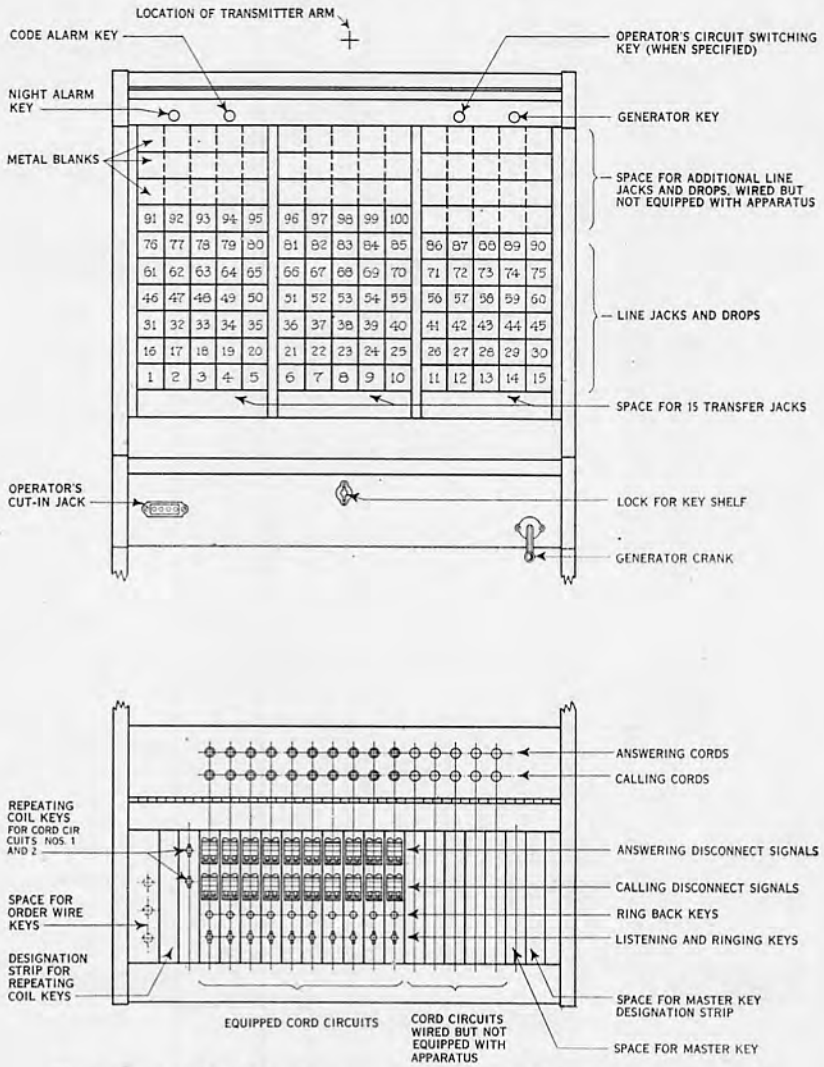

Fig. 25—Standard Equipment of No. 105-C Magneto Switchboard.

	Wired for	Equipped with
Line Equipments	150	100
Cord Pair Equipments	15	10

Shipping weight approximately 450 lbs.

Switchboard Protective Apparatus

Every central office should be adequately protected from damage due to crosses with power or lighting circuits and from high potential discharges due to lightning. Such protection is not only desirable as a precaution against interrupted service, but is absolutely essential in minimizing the exchange fire hazard. Our No. 69-A Protector has been especially designed to meet the requirements of the average exchange, unless exposed to unusual conditions. It will of course be understood that outside cables entering the exchange should also be equipped at their outer ends with protective devices suited to the local conditions.

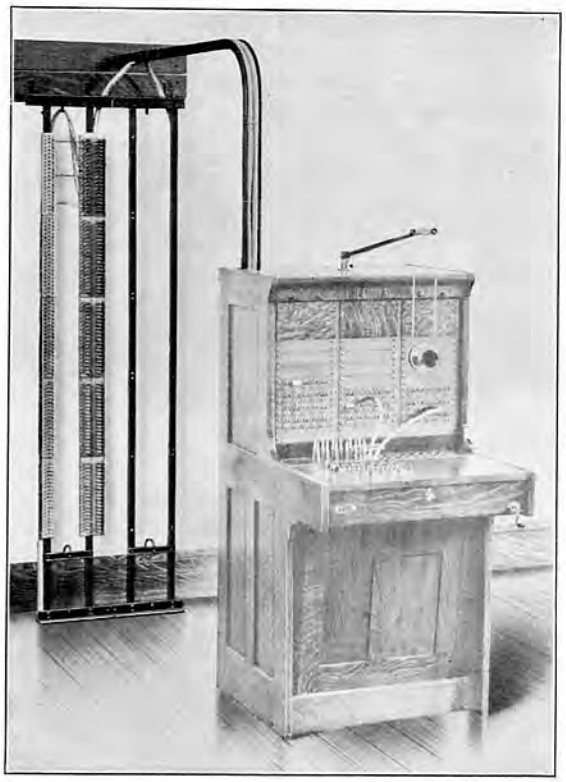

Fig. 26—Two No. 1 Protector Frames and No. 1 Cable Rack installed with No. 105 Switchboard

The No. 69-A Protector comprises two distinct units, one unit mounting the protective apparatus proper, and the other mounting terminals only, to which jumpers may be run from the protector strip.

The protector strip is illustrated in Fig. 27. Each protector strip is made up of fuse clips, mica enclosed fuses, carbon block lightning arresters, and screw terminals, all rigidly mounted on a maple block in a manner easy to wire and maintain. The fuse clips are designed to mount Western Union Fuses of a standard size. Positive contact at the fuse terminals is always assured through the constant tension of the spring mountings. A ground plate extends the full length of the strip and is equipped with a lug for soldered ground connections at each end.

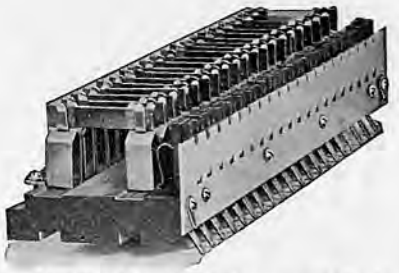

Fig. 27—Pc. No. 12606 Protector Strip

Fig. 28 shows the associated jumper or terminal strip. This strip is equipped with terminals to which the outside cables may be soldered, and to which the jumpers are attached by means of binding head screws.

Use of screw terminals eliminates the constant use of a soldering iron, and insures positive connections. All terminal screws are reached from the front of the protectors, and may be turned without danger of loosening any nuts or bolts.

The No. 69-A Protectors are assembled in groups of ten pairs each. Units of this size enable extensions to be made which will meet only existing requirements, and will not necessitate an investment in unused apparatus. They are thoroughly practical, efficient in operation, and the cost is well within the reach of every purchaser.

No. 69-A Protectors are almost invariably mounted on the Stromberg-Carlson No. 1 Protector Frame, which has been developed particularly for this use. The No. 1 Protector Frame is made up of steel channels and angles, and is arranged to mount against the wall directly back of the switchboard as seen in Fig. 26. Each unit of this frame is arranged to mount 50 pairs of No. 69-A Protectors, and accordingly, provides the proper terminal equipment for one of the 50 pair switchboard cables extending from the top of the switchboard. These frame units are designed in such a manner that a number of frames may be lined up and fastened together in a row presenting a continuous appearance. Fig. 26 indicates two such frames, which would be necessary for the ultimate capacity of one No. 105-B Switchboard. Jumper rings are provided at the top and bottom of each unit, that contribute to the ease of running and tracing jumpers.

Fig. 28—Pc. No. 12607 Jumper Strip

Cable Rack

Cables may be run from the switchboard to the protector frame in a most convenient and sightly manner by using our No. 1 Cable Rack which is also illustrated in Fig. 26. This rack is formed of channel iron and has dimensions which allow proper working space between the protectors and switchboard cabinet.

Protector Equipment Prices

	Net Prices
No. 69-A Protectors, including mounting bolts, nuts, washers and fuses. Price per 10 pair strip	$ 6.00
Pc. No. 12606 Protector Strip (10 Pairs of Protectors less jumper strip)	4.50
Pc. No. 12607 Jumper Strip (10 Pairs Terminals)	1.75
Pc. No. 12614 Carbon Blocks, per hundred	1.50
Pc. No. 12625 Dielectrics, per hundred	1.00
List No. 568 ¼ Ampere Fuses, per hundred	2.70
No. 1 Cable Rack, for carrying cables from No. 105 Switchboard to protectors	7.00
No. 1 Protector Frame arranged for 50 pairs of No. 69-A Protectors	6.00

Above prices are F. O. B. Rochester, N.Y. or Chicago, Ill.