TELEPHONE FACILITIES IN COUNTRY DISTRICTS

1951.

Suggestions to those who desire to obtain a Telephone Service

READ this booklet carefully. It has been compiled with the object of helping you.

Supply the Department with information, including a plan drawn approximately to scale, indicating clearly the number of your block on the parish map, the location of your premises and the nearest telephone exchange. This is most important.

Particulars of the main roads and the nearest point where Departmental poles are available would also be helpful.

Prompt replies to any inquiries made by the Department would be appreciated.

Do not hesitate to ask the Departmental Officers for advice. It will be given cheerfully, free of cost.

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COMMONWEALTH OF AUSTRALIA

TELEPHONE FACILITIES
IN
COUNTRY DISTRICTS.

Issued with the Compliments of the
POSTMASTER-GENERAL'S DEPARTMENT.

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TELEPHONE FACILITIES IN COUNTRY DISTRICTS.

INTRODUCTION.

Purpose of Booklet.

The intention of this booklet is to describe to country residents in simple language the manner of constructing lines and installing telephone instruments.

It is not practicable in all cases for the Department to erect the whole of the line, and consequently it is necessary to seek the co-operation of applicants. Without this co-operation the aim of the Department to provide service by the cheapest means compatible with satisfactory performance cannot be achieved, and prospective subscribers who are required to construct and maintain any part of their lines are earnestly requested to make themselves familiar with the contents of this booklet.

APPLICATIONS FOR SUBSCRIBERS' LINES.

Where to Apply.

Intending applicants are advised to write direct to the Director, Posts and Telegraphs, who will supply full details of the terms and conditions under which telephone services may be provided. It will greatly facilitate matters if the applicant furnishes particulars showing the location of his premises—that is, the exact point on the subdivision or block, and the position of the nearest telephone office or exchange. A parish map or hundred plan, or, failing this, a plan drawn approximately to scale showing the location numbers of the applicant and the position of the premises, will meet requirements. The map or sketch should show the probable route of the telephone line and all private and public lands and roads which the line would cross or traverse. The distance of the premises from the public road should also be stated.

Advantages of Party Lines.

Party-line services are those to which more than one telephone is connected. Where a number of persons desiring telephone service reside in the same locality, and particularly if that locality is remote from the exchange, a party-line service is much cheaper than exclusive services.

Agreements.

In the case of a party-line which is wholly or partly erected by the applicants an agreement must be completed by each person. The rental for the departmental section of the line will be divided equally between the parties concerned on a per telephone basis.

A separate account is issued to each subscriber to the service and will include—

(*a*) a proportion of the rental for the departmental section of the line, including the fee of £1 7s. 6d. per annum for each extra telephone connected, plus licence-fees;

(*b*) charges for local calls, trunk line calls, and phonograms originated from the particular telephone;

(*c*) extra rental for additional or special departmental apparatus appropriate to the telephone concerned; and

(*d*) any relevant miscellaneous charges.

It is desirable that the parties elect a "maintenance representative" to act on their behalf in all matters relating to the maintenance of the private sections of the circuit. Additional points will not be connected without the consent of the parties.

Number of Parties.

The number of telephones that can be connected to the same line with satisfactory results depends upon the length and type of the circuit, but if possible should not exceed six. The Department will furnish advice on this aspect.

Lines Erected by Subscribers'. Conditions.

Where the service is partly or wholly erected by the applicant, the conditions are made as simple as possible to obviate unnecessary expense. The Department, however, is continually improving the standard of efficiency and the range of communication, and in these circumstances it is essential that applicants who are required to erect their own lines should adopt sound constructional methods.

Well built lines give a more efficient service and result in lower maintenance costs. By adopting the suggestions made in this booklet, intending subscribers will ensure that faults are reduced to a minimum and that loss of time and expense on repair work are saved. A standard of construction as near as practicable to that of the Department is therefore desirable even though the first costs are a little higher.

It is also essential that the standard of construction be such that it will not cause interference with other lines, and where the line extends along public highways or crosses public roads, railway tracks or navigable waterways, due regard must be paid to public safety, and the type of construction adopted must conform to the requirements of local or controlling authorities, whose permission in writing must be obtained before the line is erected.

Information from Department.

The Department will furnish applicants with full details regarding the amount of construction to be undertaken by them and the point where their lines will junction with the departmental lines. The technical advice of departmental officers is available free of cost to intending subscribers.

Public Places.

Where the line passes along any road or track, the wire must be at least 12 feet from the surface, except where the line is erected close to a road fence and it is not possible for traffic to pass between the line and the fence, in which case the height of the wire above the surface may be reduced to 8 feet. In cases where the line crosses any road, track, public place, or vehicular gateway, the wire must be at least 18 feet above all portions of the road or track at the crossing and where the line crosses a railway track the wire must be at least 22 feet above the rails. The poles provided for carrying wires at crossings should be of a substantial character in order to stand the mechanical stresses to which they will be subjected.

An inspection of the construction crossing or traversing a public road or place will be made by a departmental officer, who will give advice if such construction does not conform to departmental requirements. The cost of such inspection must be borne by the applicant, but it will be kept as low as possible. The permission of the Railways Department must be obtained before erecting a line across a railway track, and the type of construction provided at the crossing must conform to the requirements of that Department.

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Private Property.

If the applicant can arrange to erect his line on private property—for instance, inside a fence paralleling a road or track—no conditions are imposed regarding the height of the wire from the surface of the ground, but the clearance should be sufficient to obviate interference by stock, crops or vegetation. The possibility of damage to wire (especially if copper wire is erected) from fire when burning off "thresh," "stubble," &c., should be borne in mind. The supports erected need not be as substantial as would be necessary on a public roadway, but they should be sufficiently stout and durable to ensure a minimum of line trouble and obviate frequent replacements.

If a line erected on private property parallels a departmental or other subscriber's line, it should be kept at a distance of at least 12 feet therefrom in the case of a metallic circuit, or double wire line, and 1 chain in the case of an earth circuit, or single wire line. The conditions enumerated in the paragraph headed "Parallel Lines" will also apply. This arrangement is necessary to prevent interference with departmental or other subscribers' lines. Where a line is erected on private property other than that owned by the applicant, it is necessary for him to obtain the permission in writing of the owners of the property.

"Parallel" Lines.

Where telephone lines are erected parallel for any distance, especially if close together, interference commonly known as "crosstalk" will result, i.e., one subscriber will be able to hear in his telephone receiver the conversations on the other line or lines. This interference will be particularly bad on single wire or earth circuit lines. It will also be considerable on double wire or metallic circuit lines where the parallel is very long and close, e.g., two lines in adjacent positions on the same poles for 2 or more miles.

A single wire circuit should be separated from all other single wire circuits by at least 1 chain, and if the "parallel" extends beyond 2 miles, the separating distance should, as far as possible,

be correspondingly increased as the length of the "parallel" increases. Metallic circuit or double-wire lines can, however, be erected on the same poles, or on separate pole routes closely adjacent for very long distances provided the wires of each circuit are reversed in position on the poles at intervals. This is arranged by inserting what is known as a "transposition" or "crossover." The Department will give advice on these points, and where the wires of the proposed line would be erected close to any other private or departmental line the work should not be commenced until particulars as to the separation or transpositions necessary have been received from the Department.

METHODS OF CONSTRUCTION.

Additional Information.

In order to assist subscribers in the erection of their telephone services the detailed information respecting the construction of lines and the installation of telephones is furnished in the following paragraphs in this section of the booklet. If further advice is required, the Department will gladly supply it free of charge.

Persons contemplating the erection of their own lines are invited to take advantage of the information concerning constructional details, which is available from the Department, and should apply for such details before actually commencing the work.

Lines in the Proximity of Electric Power Lines.

Telephone lines should not be placed on the same poles as electric power lines, and the further they are erected from power lines the better. As far as practicable they should not be erected any closer to an electric power line than the distance equal to the height of the power route poles.

Where it is not possible to completely avoid electric light and power lines, and it becomes necessary to erect a telephone line across or in close parallel to such a line certain conditions must be observed, and special precautions are necessary during the erection of the telephone line, to prevent contact between the telephone wire and the electric power wires. Unless these precautions are observed fatal accidents can result.

One of the important conditions which must be observed is that, according to the voltage of the electric power line, a minimum clearance must be provided between the completed telephone line and the electric power wires.

It is particularly important, therefore, under these circumstances, to seek the advice of a Departmental officer regarding the conditions and the precautions which should be observed when erecting the telephone line.

Similar precautions are necessary when any re-arrangements or repairs, including renewals of poles and other supports, or of wires, are carried out on an existing line in the vicinity of electric power wires, and it is important that subscribers seek Departmental advice regarding the precautions to be observed when undertaking such maintenance work. Even during the removal of certain types of fault from the line special precautions are necessary to guard against contact with the electric power wires. Subscribers are warned of the need for observing all necessary precautions where electric power routes are erected in the vicinity of the telephone line subsequent to its erection.

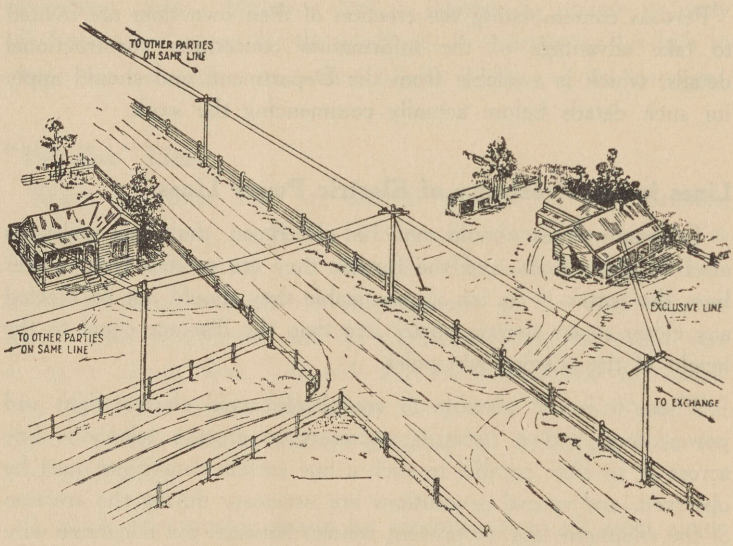


Figure 1—Showing a "Direct or Exclusive" Line, also Branches to the Subscribers on a Party Line turning off the Main Pole Line.

Route of Lines.

Telephone lines should follow the shortest possible route, having regard to the avoidance of obstructions or difficult country. Where several telephones are to be connected, it is not necessary to run the main line past each building, as short and light branch lines can be run from the main line in order to save wire and simplify construction as shown in Figure 1.

Types of Circuits.

Telephone lines may be of two classes—

"Single-wire lines" commonly referred to as "earth circuit" lines. See Figure 2.

"Double-wire lines," commonly referred to as "metallic circuit" lines. See Figure 3.

Single-wire Lines.

In the case of single-wire lines, the current travels in one direction via the wire and in the other via the earth. Since it is necessary to erect only one wire it is the cheaper arrangement, but has the disadvantages referred to in the paragraph dealing with "Parallel Lines". Generally a certain amount of noise is always prevalent on single-wire lines, and under certain conditions, e.g., on long lines in hot weather, the noise will be great enough to cause very considerable interference with conversations. Single-wire lines will not operate satisfactorily if erected in close proximity to an electric power line. For these reasons it is in the best interests of intending subscribers to construct double-wire lines wherever possible.

Where a single-wire line is to be connected to the departmental telephone system, such connexion can be made only through a piece of electrical apparatus, termed a transformer. Transformers are supplied, installed, and maintained by the Department, and a rental of 10s. per annum is charged. To reduce cross talk where more than one single wire line connects to the Department's wires at a transformer pole a separate earth for each line must be provided at least one pole span distant from any other

earth. A subscriber in these circumstances must erect a second wire from the transformer pole along his route until he has reached a point at least one span beyond or distant from the earth or any other line. This separation of earths is also necessary to assist in avoiding inductive noises in the telephone circuits due to the presence of electric power circuits in the area. For further information regarding the method of providing an efficient earth see later paragraph headed " Earth Connexion ".

Not more than one single-wire line will be allowed on any one pole route, and where earth circuit lines are placed on separate pole routes running parallel they must be kept well apart as explained in the paragraph dealing with " Parallel Lines ".

At the subscriber's premises, the telephone speaking circuit must not be connected to the same earth as used for an electric power circuit or its protective device. Usually the electric authority will require to use the water reticulation pipe system in which case the telephone earth should be installed preferably near a dam or other moist place by running an aerial wire on insulators at least ten chains from the house. Frequently it may be practicable to run this earth wire for 3 or 4 spans on the same poles as the line wire to the exchange. However the protector earth wire for the telephone lightning arrester should be as short as practicable.

Where the applicant will be connected to an automatic exchange, single-wire lines are to be avoided, if possible, and will not be allowed if more than one telephone is to be connected to the line.

Double-wire Lines.

In this class of line, the current travels via one wire in one direction and via the second wire in the other direction. For the reasons previously mentioned, they give more efficient service than single-wire lines. Moreover, it is not necessary to install a transformer at the junction point with the departmental construction and this facilitates the testing of the line for faults and removes a possible source of trouble.

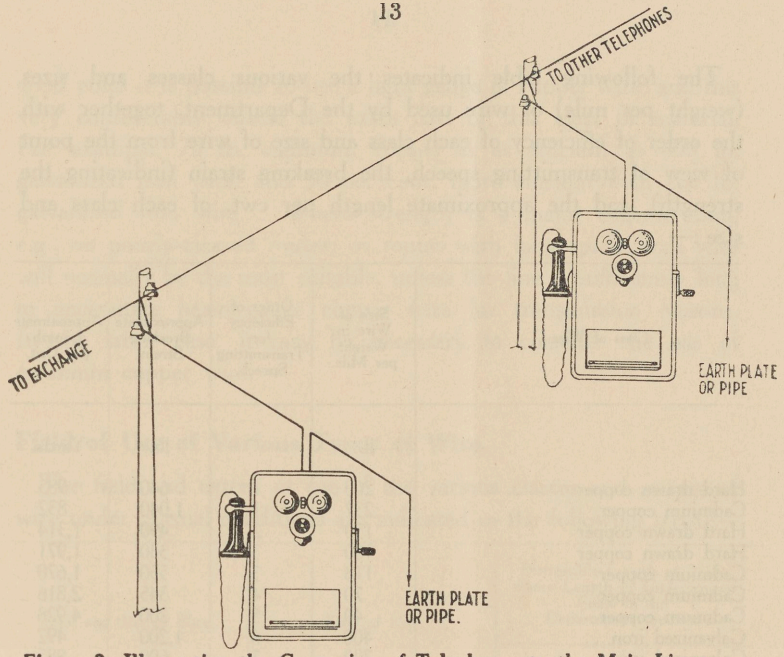


Figure 2—Illustrating the Connexion of Telephones to the Main Line on an "Earth Circuit" or "Single-Wire" Line.

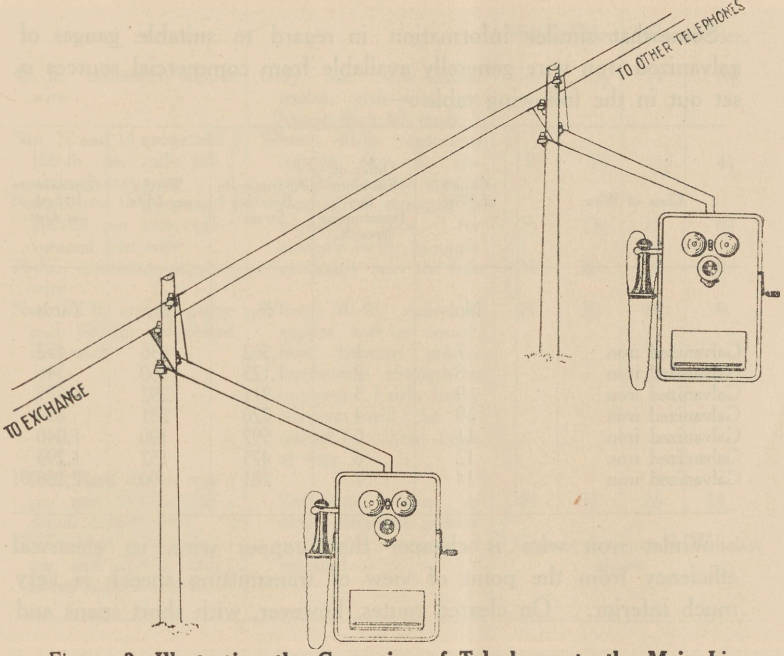


Figure 3—Illustrating the Connexion of Telephones to the Main Line on a "Metallic Circuit" or "Double-Wire" Line.

The following table indicates the various classes and sizes (weight per mile) of wire used by the Department, together with the order of efficiency of each class and size of wire from the point of view of transmitting speech, the breaking strain (indicating the strength), and the approximate length per cwt. of each class and size :—

Class of Wire.	Size of Wire in Weight per Mile.	Order of Efficiency for Transmitting Speech.	Approximate Breaking Strain.	Approximate Length per Cwt.
	lb.		lb.	Yards.
Hard drawn copper	200	1	640	985
Cadmium copper	237	1	1,040	832
Hard drawn copper	150	2	490	1,314
Hard drawn copper	100	3	330	1,971
Cadmium copper	118	3	550	1,670
Cadmium copper	70	4	345	2,816
Cadmium copper	40	5	200	4,928
Galvanized iron	400	6	1,200	492
Galvanized iron	200	7	600	985

Somewhat similar information in regard to suitable gauges of galvanized iron wire generally available from commercial sources is set out in the following table :—

Class of Wire.	Gauge of Wire.	Order of Efficiency for Transmitting Speech.	Approximate Breaking Strain.	Weight per Mile.	Approximate Length per Cwt.
	No.		lb.	lb.	Yards.
Galvanized iron ..	7	1	1,362	436	452
Galvanized iron ..	8	2	1,125	360	546
Galvanized iron ..	9	3	911	292	675
Galvanized iron ..	10	4	720	231	854
Galvanized iron ..	11	5	597	190	1,040
Galvanized iron ..	12	6	475	152	1,293
Galvanized iron ..	14	7	281	90	2,186

Whilst iron wire is cheaper than copper wire, its electrical efficiency from the point of view of transmitting speech is very much inferior. On cleared routes, however, with short spans and

good poles it is possible to use a light gauge of copper wire, and this very considerably offsets the extra cost of this class of material. For example, 70 lb. cadmium copper is as efficient as 400 lb. galvanized iron wire, and 50 per cent. more efficient than 200 lb. galvanized iron wire. Where strength is a major consideration, e.g., on poorly-cleared routes, or routes with long spans, iron wire will normally be the most suitable, unless the line is sufficiently long to necessitate heavy-gauge copper wire for transmission reasons. In the latter case, it may be necessary to consider the use of cadmium copper wire.

Field of Use of Various Types of Wire.

The field and extent of use of the various classes and gauges of wire under normal conditions are indicated in the following table :—

Class and Size of Wire.	Field of Use.	Permissible Length of Route where Length of Underground Cable in the Departmental Section is—			
		Nil.	½ Mile.	1 Mile.	2 Miles.
		Miles.	Miles.	Miles.	Miles.
40 lb. cadmium copper wire	Only on well-cleared routes, with spans no longer than 60 yards	16	13½	11	6½
Nos. 12 and 14 gauge and 100-lb. per mile galvanized iron wire	Where 40-lb. cadmium copper wire is unsuitable because greater mechanical strength is required, due, for example to the presence of timber near the line	9	7½	6½	4½
Nos. 10 and 11 gauge and 200-lb. per mile galvanized iron wire		16	13½	11	6½
70-lb. cadmium copper wire		24	20	16	9
Nos. 7, 8, and 9 gauge and 400-lb. galvanized iron wire	Where 70-lb. cadmium copper wire is unsuitable because greater mechanical strength is required. Fairly heavy supports will be required for these types of wire	24	20	16	9
100-lb. hard drawn copper and 118-lb. cadmium copper wire	Cadmium copper is used where still greater mechanical strength is required	40	32	26	14
200-lb. hard drawn copper and 237-lb. cadmium copper wire		Greater distances than shown above			

The lengths of line set out in the foregoing table include the length of the departmental section. The maximum lengths indicated are based approximately on departmental standards and, if exceeded, will result in reduced efficiency of speech transmission. It is recommended that these maximum lengths be adhered to where possible. In certain cases, these maximum lengths do not apply to a line which will be connected to an automatic exchange, and, to enable satisfactory working over such a line, shorter limits than those given in the table must be observed.

Supports for Wires.

The selection of supports for the wires is a matter which is determined largely by the local circumstances. The purposes of the supports are, first, to keep the wire off the ground or from contacting with any other wires, trees, undergrowth, long grass, or herbage, so that the current may not be diverted from its proper path, and, secondly, to keep the wire from being damaged by, or injuring, pedestrians, stock or traffic.

Poles most Satisfactory.

Poles are recommended as providing the best supports. They should be strong and firmly set in the ground so that they will be safe for climbing to attend to faults. The heavier the gauge of wire used the more substantial the supports should be, but even with light wire they should be sufficiently substantial to prevent any considerable sway in the head of the pole when shaken at a short distance from the ground. Wooden poles should be straight, sound, and well proportioned, and of a class of timber which is durable both above and in the ground. The use of timber which does not comply with these conditions will result in heavy costs for renewals. The length of the poles must be sufficient to carry the lowest wire at a safe height. When selecting poles to obtain the requisite height of the wires, allowance must be made for the depth to which the pole will be sunk in the ground and the sag of the wire between poles. In districts where durable sound timber is not available, or where white ants are particularly bad, iron poles are preferable. Old railway rails or iron piping make suitable poles in such places.

Where lines are erected along fences on private property, 4-in. x 4-in. sawn hardwood supports bolted to the fence may be used in lieu of poles, provided they will have only one or two wires attached. In this case, it is desirable that the length of the spans should be about 2 chains.

The following table indicates the minimum dimensions of wooden poles which should be used on the various classes of privately-maintained lines and the depth to which they should be placed in the ground :—

Length.	Depth in Ground.	Diameter at the top (sapwood to be not more than 1 inch thick).		
		Routes carrying up to Two Light or One Heavy Wire.	Routes carrying Three to Six Light Wires or Two to Three Heavy Wires.	Routes carrying more than Six Light or Three Heavy Wires.
feet	ft. in.	inches.	inches	inches
12 and 14	2 6	4½	5½	6½
16	3 0	4½	5½	6½
18	3 6	5	6	7
20	4 0	5	6	7
22	4 0	5	6½	7½
24	4 0	5½	7	8
26	4 6	5½	7	8
28	4 6	5½	7½	8½
30	5 0	6	8	9

From the aspect of stability and future maintenance poles heavier than those specified above are considered desirable. For this reason poles which are supplied and erected by a subscriber to carry wires departmentally maintained must comply with Departmental Specification 55E, which covers the normal standard of departmental construction.

Poles should be tapering in shape so that the diameter at the butt is at least 33 per cent. larger than at the top. Where the sapwood is more than 1 inch thick, the diameter of the poles should be correspondingly increased. The depths in the ground may be reduced by approximately 20 per cent. where rock holes are encountered.

Distance between Poles.

The length of the span between poles is governed by the number of wires attached to the poles, the separation between the wires, the class and the size of wire used, and the amount of sag which can be allowed to ensure necessary clearances from

the ground. Where more than a small number of wires are carried on the poles, shorter spans are necessary to ensure stability of the pole line, and greater separation between the wires is necessary for long spans to guard against the wires becoming crossed.

For light gauges of copper wire, spans should not be more than 50 to 60 yards long, but for other sizes and classes of wire, where the wires are given a wide separation, spans up to 80 yards can be used for routes carrying up to four wires.

Sinking Post Holes.

Figure 4 shows the method of sinking holes for poles. It should be the aim in making the excavation that, when filled in, the pole will, as far as is possible, stand against firm earth.

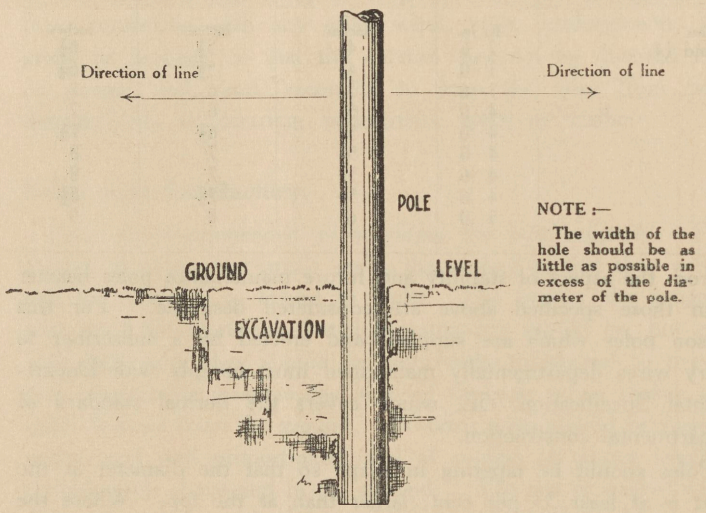


Figure 4—Method of Sinking Holes for Poles.

Staying Poles.

Figures 5 and 6 show the methods of holding poles by a stay where the line makes a sharp turn or angle, and consequently the stress in the wires tends to pull the pole over. When any stay wire used for this purpose is within reach of traffic or stock, a piece of timber or light sapling should be lashed to it to serve

as a guard. It is essential that the angle pole should be well stayed or secured to keep it upright, so as to maintain even regulation of wires on both sides of the angle.

It is also advisable to provide stays in each direction parallel with the wires at intervals in long straights and against the pull of the wires where any are terminated on a pole.

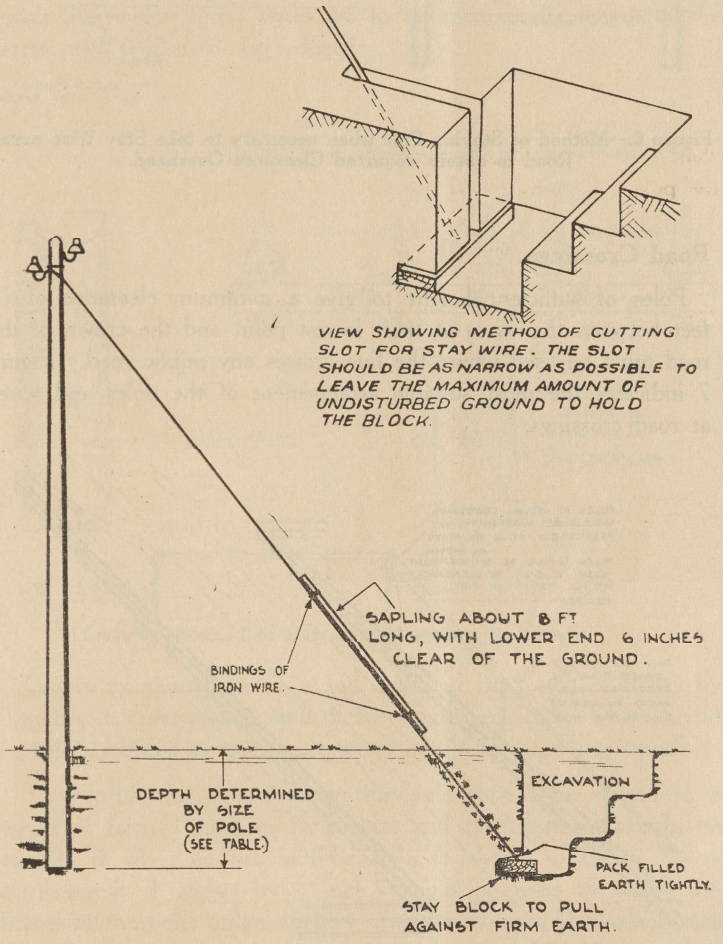


Figure 5.—Method of Staying Pole, using Block as Anchor and Sapling as Guard for Stay Wire.

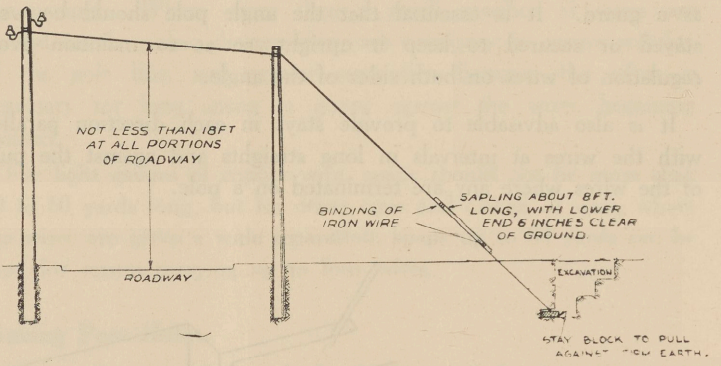


Figure 6.—Method of Staying Pole when necessary to take Stay Wire across Road to obtain required Clearance Overhead.

Road Crossings.

Poles of sufficient height to give a minimum clearance of 18 feet between the wires at their lowest point and the crown of the road must be used where the line crosses any public road. Figure 7 indicates the most suitable arrangement of the poles and wires at road crossings.

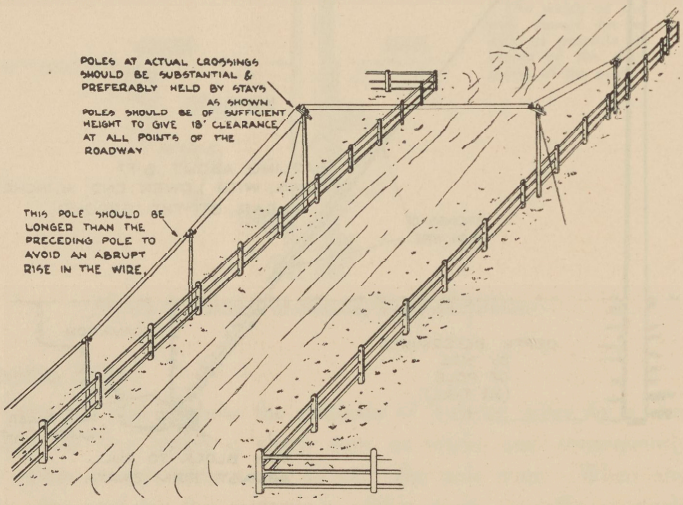


Figure 7.—Method of crossing road.

Crossarms.

If more than four wires are to be erected, crossarms should be fitted to the poles and straight spindles used to support the insulators. Figure 8 shows the method of attaching crossarms to poles. Crossarms may be of various lengths from 3 feet to 9 feet, to take from two to fourteen wires. For uniformity and good appearance, crossarms on the same pole and on the same line of poles should all be of the same length, but, on branches from the main line where fewer wires are to be carried, the length of the arms may, if desired, be reduced.

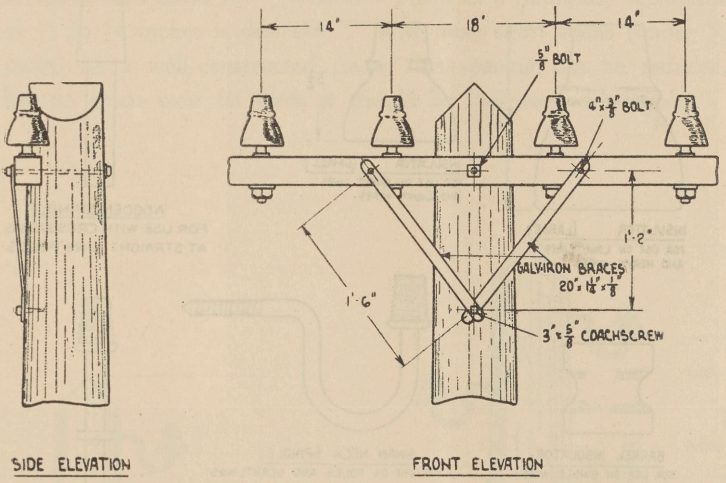


Figure 8.—Method of attaching Crossarms to Poles.

Crossarms should be of sound seasoned hardwood 3 inches by 3 inches in cross-section, and of the length required. They should be suitably bored to take the required number of insulator spindles.

To provide for the crossarm the pole should be slotted to a depth of from 1 inch to 1½ inches, and the crossarm should be secured to the pole with a ⅝-in. bolt, as shown in Figure 8. A coach-screw, 3 inches by ⅝ inch, should be used to attach the braces to the pole, unless there is a second crossarm, in which case the bolt of the bottom crossarm can be used for the braces attached to the upper crossarm.

Insulators and Spindles.

Figure 9 shows the different types of insulators and spindles used. The large insulator, which is $5\frac{1}{8}$ inches in height, is used on the Department's trunk lines but, except in the case of very long lines, is not generally required on private country telephone lines.

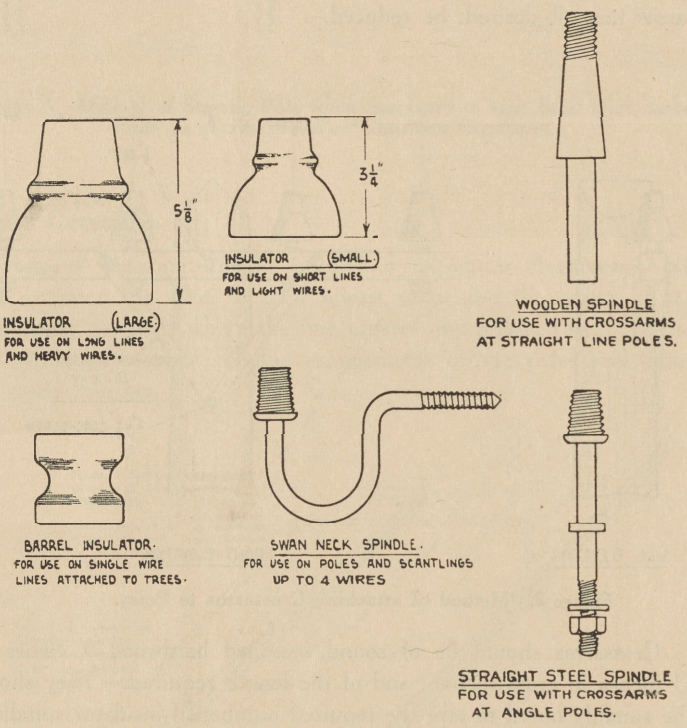


Figure 9.—Standard Insulators and Spindles.

The small insulator, which is $3\frac{1}{4}$ inches in height will prove quite satisfactory on any line up to 50 miles in length. Swan-neck spindles fitted as shown in Figure 10 will be most suitable for pole line carrying up to four wires.

Spacing of Wires.

The spacing of the wires should be such that the possibility of faults due to contacts and crosses caused by the wind, or by birds alighting on or leaving the wires is reduced to a minimum. When lines are to be connected to automatic exchanges it is especially desirable that there should be little chance of momentary contacts between the wires. These objectives can be achieved by evenly and correctly tensioning the wires (see table of sags, page 25) and giving them as wide a separation as possible, or by staggering the wires on opposite sides of the pole (with a good separation), as shown in Figure 10. Wherever possible, a minimum separation of 12 to 14 inches is desirable. With very short spans (under 50 yards) on a well-constructed route, this spacing can be reduced, but on spans over 60 yards it should be increased if possible.

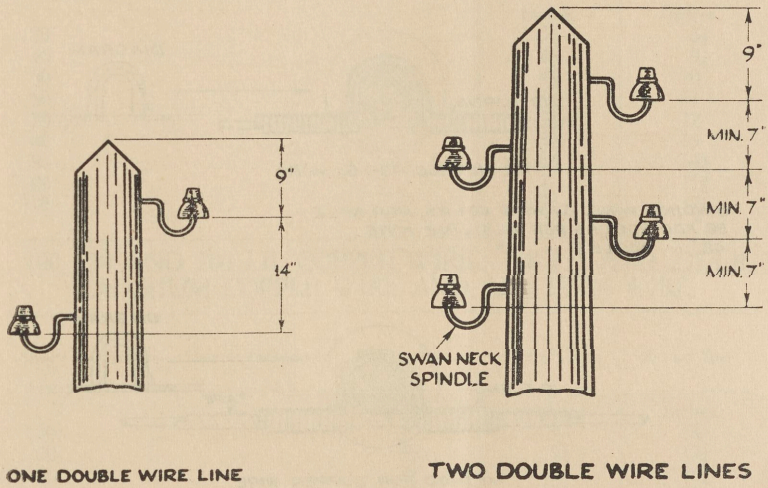
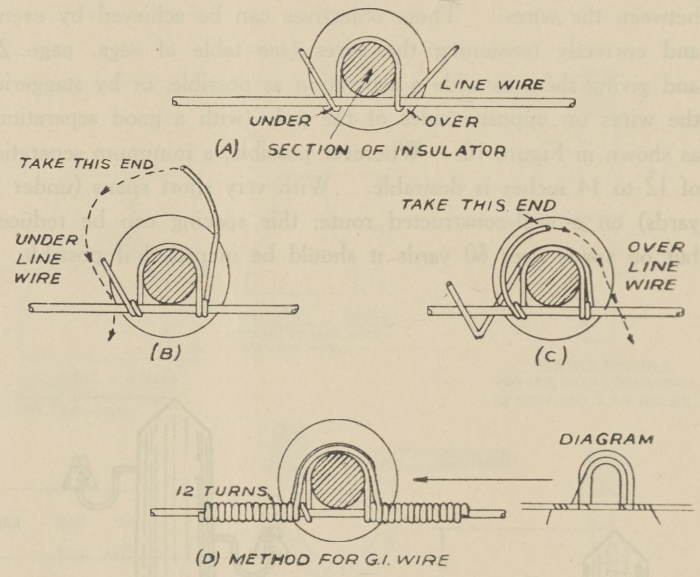


Figure 10.—Fitting Swan Neck Spindles.

Attaching Wires.

Figures 11 and 12 indicate methods of attaching wire to insulators. When dealing with copper wire, extra care must be taken to ensure that it is carefully handled to prevent damage to the skin of the wire and to ensure that it is correctly tied in and terminated, otherwise trouble may be experienced later from broken wires where the skin is nicked or at faulty ties.



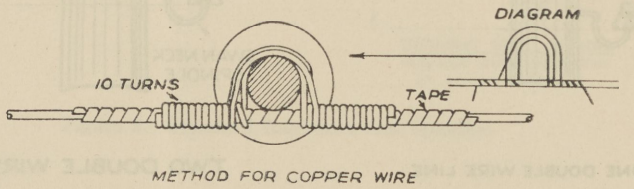


Figure 11.—Method of attaching Wires to Insulators.

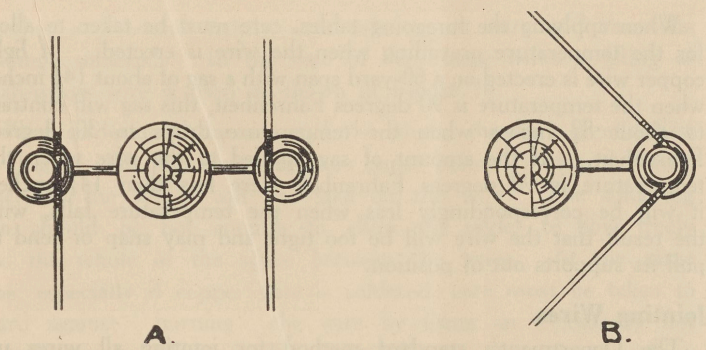


Figure 12.—Showing the correct side of Insulators to which Wires should be fastened. (A) on Straight Lines, and (B) at Angles.

Sag of Wire.

The following table of sags will serve as a guide to suitable tensions for the various classes of wire :—

LIGHT (40 LB. AND 70 LB.) CADMIUM COPPER WIRE.

Shade Temperature in Degrees Fahrenheit.	40-yard Span.	60-yard Span.
	Inches.	Inches.
30	3¾	8¾
40	4¼	9¼
50	4½	10
60	4¾	11
70	5¼	12
80	5¾	13
90	6¼	14¼
100	7	15¾
110	7¾	17½

100, 150, AND 200 LB. COPPER WIRE; 118 LB. AND 237 LB. CADMIUM COPPER WIRE AND ALL IRON WIRE.

Shade Temperature in Degrees Fahrenheit.	40-yard Span.	60-yard Span.	80-yard Span.
	Inches.	Inches.	Inches.
30	4	9	16
40	4¼	9¾	17¼
50	4¾	10½	18¾
60	5¼	11½	20½
70	5¾	12½	22½
80	6¼	13¾	24½
90	7	15¼	27
100	7¾	16¾	30
110	8¾	18½	33

When applying the foregoing tables, care must be taken to allow for the temperature prevailing when the wire is erected. If light copper wire is erected on a 60-yard span with a sag of about $14\frac{1}{4}$ inches when the temperature is 90 degrees Fahrenheit, this sag will contract to about $8\frac{3}{4}$ inches when the temperature drops to 30 degrees Fahrenheit. If the amount of sag applied to the wire when the temperature is 90 degrees Fahrenheit were less than $14\frac{1}{4}$ inches, it will be correspondingly less when the temperature falls, with the result that the wire will be too tight and may snap or tend to pull its supports out of position.

Jointing Wires.

The Department's standard method for jointing all wires up to gauge 300 lb. per mile is the press type sleeve joint, and, for all wires larger than this, the twist-type sleeve joint. These are the most suitable types of joints.

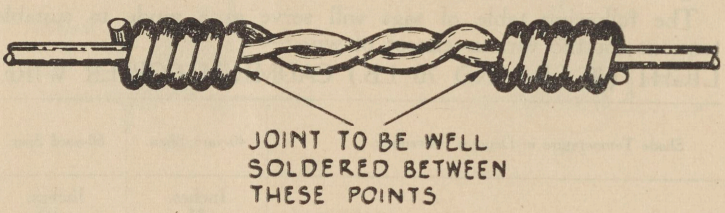


Figure 13.—Showing method of making a Twist Joint.

Where the necessary equipment for making sleeve joints is not available, an ordinary twist joint (Figure 13) is effective in the case of iron wires, but the joint must be soldered throughout to ensure electrical continuity. Where copper or cadmium copper wires are used the most effective alternative to the sleeve joint is the Brittania joint. In this joint the two ends of the wire are laid

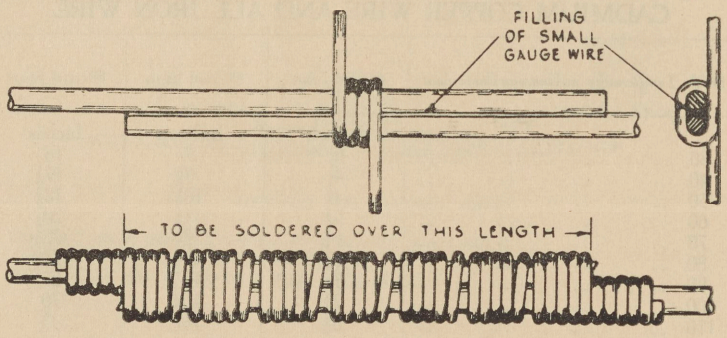


Figure 14.—Showing method of making a Brittania Joint.

together and bound tightly with soft copper wire and then the bindings soldered. In the case of very large wires a filling of small-gauge wire is used as shown in Figure 14.

When soldering Britannia or Twist joints, the wire should first be cleaned with fine emery or glass paper before jointing the wire, otherwise the solder will not take on the wire. The soldering iron should be hot enough to allow the solder to flow freely into the whole of the space between the wires. At the same time, especially if copper wire is soldered, care must be taken to guard against "burning" the wire by using an excessively hot soldering iron. This weakens the wire at the joint, resulting later in a broken wire. If the wires are not clean and the soldering not properly performed, it may mean that the outside only is covered with solder and that there is no firm metallic connexion between the two wires, in which case the joint will only be equal to an unsoldered or dry joint.

Unsoldered Joints.

Defective joints constitute one of the most frequent causes of unsatisfactory telephone service. An unsoldered or badly soldered joint will cause troubles of many kinds, e.g., if the joint is loose and swings with the wind the electrical circuit may become broken, the result being that conversation is heard only intermittently. Such joints will also cause high resistance faults in the circuit and on a double-wire circuit these will have the effect of causing noises. They reduce the voice volume on all circuits.

Tree Lines.

Where the line will pass through forest and timbered country and it is not practicable to erect pole lines, a single wire line attached to trees only or to trees and poles can be used. If such a line is erected, **the applicant must be prepared to accept a service confined to a limited area and one which even then may not always be entirely satisfactory.** Iron wire, not lighter than No. 11 gauge, or 237-lb. cadmium copper wire in the case of longer lines, should be used on these circuits, together with barrel insulators (see Figure 9) attached to the trees by means of wire slings as shown in Figure 15.

The tree attachments should be so arranged that the pull of the line wire is away from the tree. The trees chosen should be of

substantial size. Light timber, which has considerable movement in wind, is unsuitable. Where practicable, the trees should be lopped to minimize the swaying of the tree and so chafing the line wire or working it loose at adjacent supports. Any branches or shoots which might foul the wire should be removed.

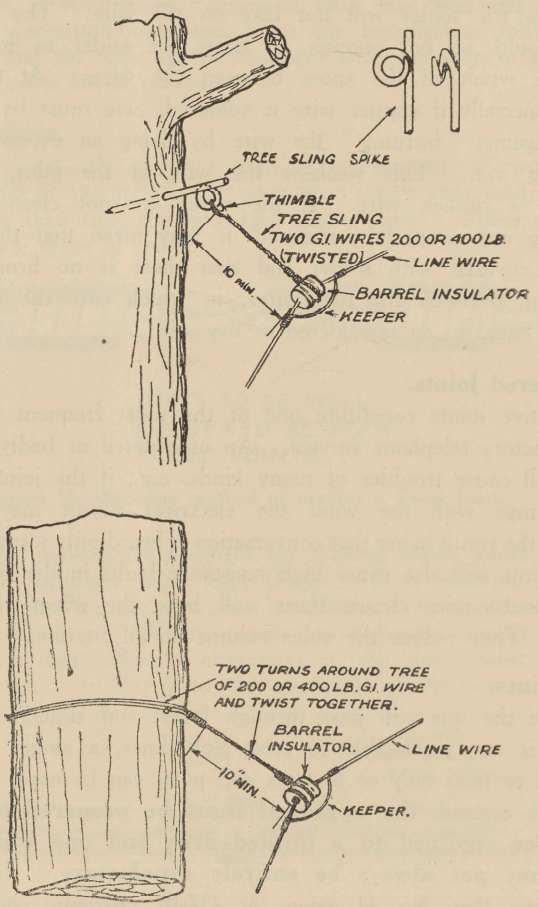


Figure 15.—Method of attaching Tree Slings.

As shown in Figure 15, the line wire should pass through the centre hole of the insulator and the wire sling which holds the insulator to the tree should be taken around the barrel of the insulator. To prevent the wire pulling through any distance

should it break, and to prevent it sagging down too much in one span, a keeper wire (as shown) should be provided on at least every fifth tree. Any joints in the line wire should be at least 15 feet from any sling not provided with a keeper.

The advice of the Department should be sought before any tree line is erected. **Tree lines will not be permitted when the applicant's telephone will be connected to an automatic exchange.**

Leading in Wires.

Figure 16 shows the method of leading the wires into the building. The span from the last pole into the building should be as short as possible and the spindles on the building should be affixed securely to solid timber or masonry. The point of entry to the building should be as close as convenient to the point where the telephone is to be installed. Wherever possible, the point of entry should also be immediately adjacent to a suitable position for the protector.

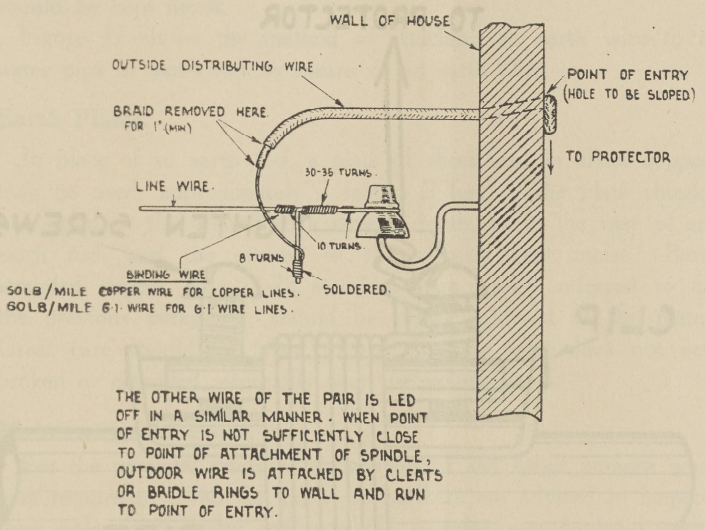


Figure 16.—Showing Lead-in Connexions.

Earth Connexion.

One of the most important parts of the telephone installation is the connexion to the earth. On it depends the proper operation of the protector, and on a single-wire circuit the efficiency of the speaking and ringing depends much upon it as well. Cases of unsatisfactory service can frequently be traced to poor earth connexions. Short pieces of wire seldom make good earth connexions.

Water Pipes.

The best earth connexions are those attached to the pipes of a water supply system where the pipes are laid underground for a considerable distance, or where they actually connect to a dam or into an underground well with earth sides. Connexions to water pipes from house tanks erected above ground are useless. **It is essential that the water pipe make an efficient connexion with the earth in a moist locality.**

As indicated under the paragraph on single wire lines, a water pipe system should not be used for both a power protective or neutral earth and a single wire telephone speaking earth even though the points of connexion to the water pipe system be separated.

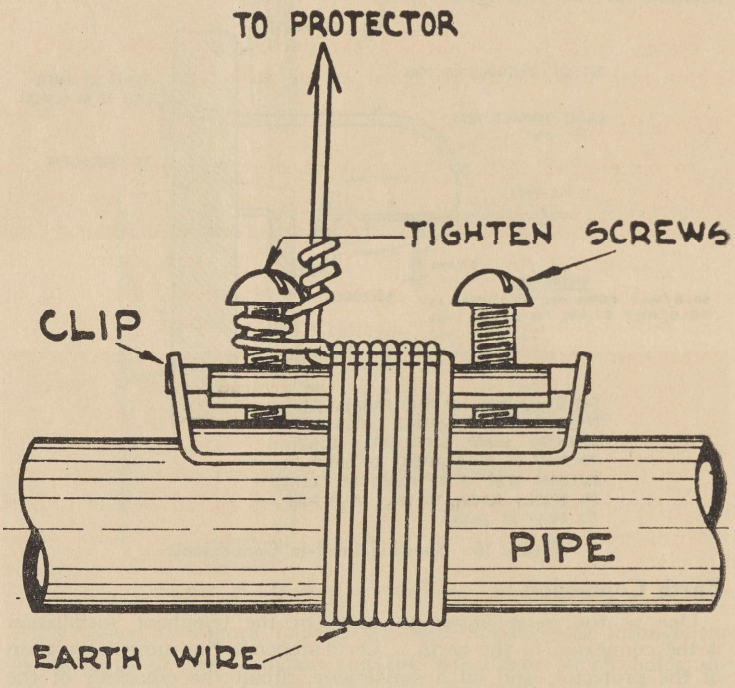


Figure 17.—Method of fitting Earth Clip.

Earth Rods.

If an underground water supply with pipes therefrom is not available, the next best arrangement is an earth rod. The rod may be made from lengths of 1 inch, ¾ inch, or ½ inch galvanized iron pipe or ½ inch solid rod, and should be from 4 feet to 6 feet long, the length being determined by the depth necessary to secure connexion with moist earth. The rod should be driven vertically into the earth to within 3 or 4 inches of its length, and the earth wire attached to the head of the pipe above ground. An earth clip, which will be supplied by the Department, should be used for this purpose (see Figure 17), but if this is not available three or four turns of the earth wire should be taken round, and soldered to, the head of the pipe. Bare stranded copper wire 3-22 standard wire gauge, one end of which has been tinned, should be used for making the earth connexion to the pipe or the rod. The ground in the vicinity of the earth rod should be kept moist.

Figure 17 shows the method of attaching an earth wire to a water pipe or earth rod by means of an earth clip.

Earth Plates.

In place of an earth rod, a plate of sheet lead or sheet copper may be used, approximately 2 feet x 2 feet. The plate should be buried in the ground to a similar depth, as in the case of an earth rod, and the ground in the vicinity kept moist. Bare stranded copper wire, 3-22 standard wire gauge, referred to in the previous paragraph, should be firmly soldered to the plate. Great care should be taken to see that the wire does not get broken or corroded, especially near the ground level.

Maintenance of Poles.

For the personal safety of themselves or any other persons who may require to climb the poles, subscribers are advised to inspect their poles periodically and carefully examine any doubtful ones. If any are badly decayed or eaten by white ants or have become seriously weakened in any other way, they should be replaced as soon as possible. If it is not convenient to replace a faulty pole immediately, it should be marked with a cross as a warning to any one who may be attending to faults or defects on the line that the pole is dangerous to climb. To assist in preserving poles as

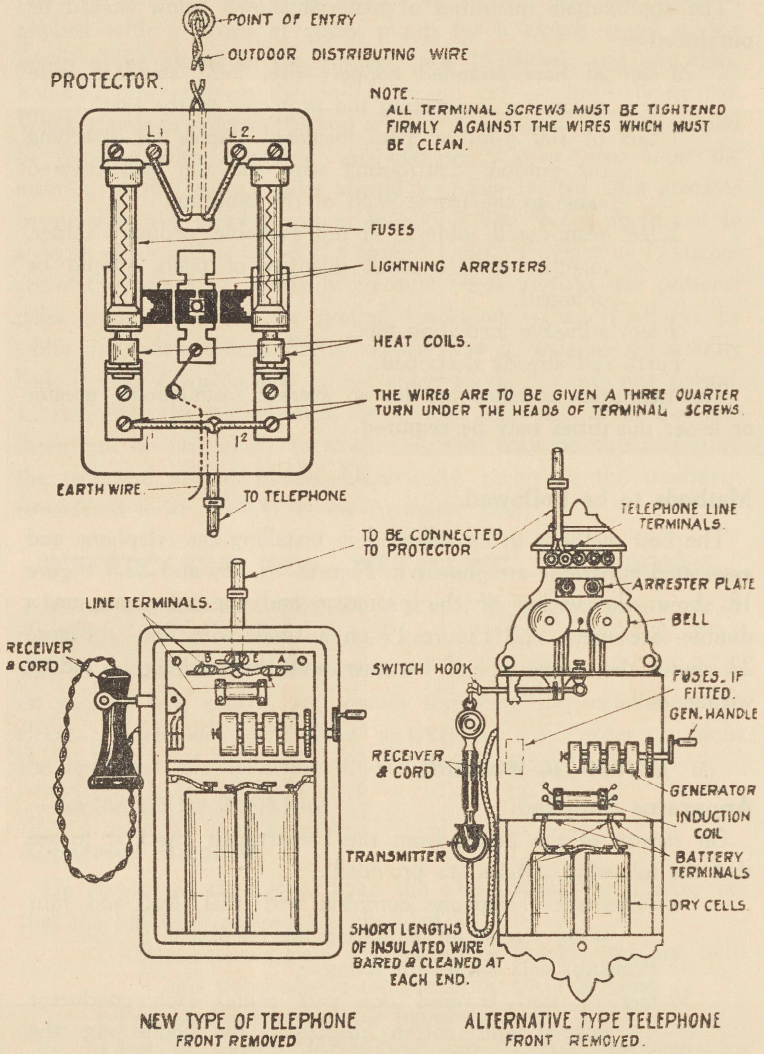


Figure 18.—Method of Installing Protector and Magneto Telephone Double Wire Circuit.

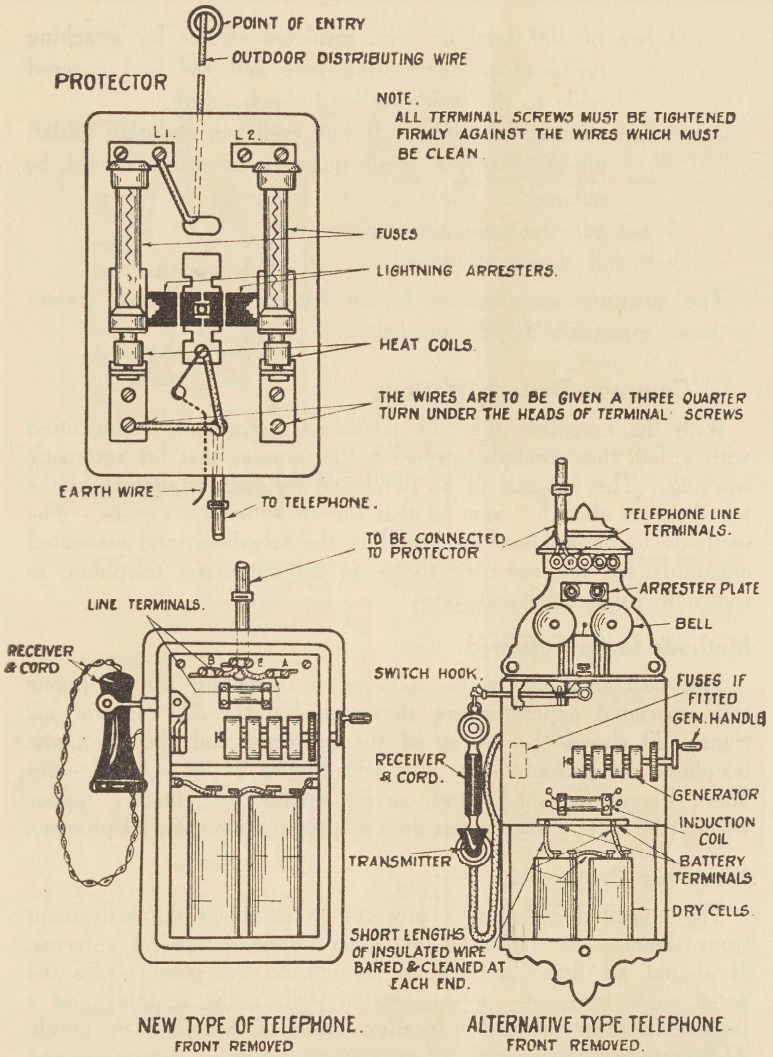


Figure 19.—Method of Installing Protector and Magneto Telephone Single Wire Circuit.

Material Required.

The approximate quantities of material shown below should be purchased :—

20 feet of bare stranded copper wire, 3–22 standard wire gauge for connecting the protector to the earth.

long as possible, the free use of creosote is recommended. Before poles are erected, the butts should be treated with hot creosote, applied with a brush or spray pump for a length equal to the depth to be placed in the ground, plus 15 inches, and any slots, holes or other cuts in the timber should also be similarly treated. When a pole is erected the soil around the base of the pole should be puddled with creosote. At intervals of two years after the erection of the line all poles should be again treated with creosote by opening the ground around each pole and freely treating it to a depth of 15 inches below the ground and to a height of 15 inches above the ground. Normally creosote freely applied will preserve poles from rotting at the ground level and ward off attacks by white ants, but if the locality is one where white ants are persistently bad, it may be necessary to use some form of white ant poison. In this case the poison must be applied carefully to ensure that there will be no danger to stock. Advice may be obtained from the technical officers of the Department regarding the treatment considered most suitable in any particular case.

INSTRUCTIONS FOR INSTALLING TELEPHONES.

In cases where a telephone line is partly or wholly erected by the applicant, he is also required to install the telephone, which will be supplied by the Department. The departmental technician on request will explain any points regarding the installation not clearly understood from these instructions. In order to assist the applicant the following simple directions are offered :—

(*a*) MAGNETO WORKING.

Apparatus Supplied.

On receipt of the parcel from the Department check it to see that the following articles are provided :—

1 Telephone complete with generator handle, two dry cells, and wood screws for mounting the telephone.

1 Protector and screws for fixing.

30 feet of indoor distributing wire, 1 pair insulated, for connecting the telephone to the protector.

15 feet of outdoor distributing wire, 1 pair insulated for connecting the protector to the aerial wires (see Fig. 16).

1 Earth clip.

Material Required.

The approximate quantities of material shown below should be purchased :—

20 feet of bare stranded copper wire, 3–22 standard wire gauge, for connecting the protector to the earth.

1 box of 100 $\frac{1}{2}$-in. or $\frac{3}{4}$-in. insulated staples for attaching the outdoor distributing wire and the lead covered cable to the inside walls of the building.

3 feet resin-cored solder. If not available, ordinary solder, together with a small quantity of resin, should be obtained.

9 feet adhesive insulating tape.

Earth rod already described.

The quantities specified are for an average installation ; greater or lesser quantities may be required.

Methods to be Followed.

The best methods to be followed in installing the telephone and associated apparatus are shown in Figures 18, 19, and 22. Figure 18 shows the wiring of the protector and the telephone on a double-wire line ; and Figure 19 on a single-wire line. Figure 22 shows the connexion of batteries and the running of indoor wiring.

(*b*) **AUTOMATIC WORKING.**

Apparatus Supplied.

On receipt of the parcel from the Department check it to see that the following articles are provided :—

1 Automatic Telephone complete with dial, &c., and four wood screws for mounting the telephone.

1 Protector and screws for fixing.

50 feet of lead covered one pair cable, each conductor enamel and cotton insulated, for connecting the telephone to the protector.

15 feet of outdoor distributing wire, rubber insulated and cotton braided, for connecting the protector to the aerial wires (see Figure 16).

1 Earth clip.

1 box of 100 $\frac{1}{2}$-in. or $\frac{3}{4}$-in. insulated staples for attaching the outdoor distributing wire and the lead covered cable to the inside walls of the building.

3 feet resin-cored solder. If not available, ordinary solder, together with a small quantity of resin, should be obtained.

9 feet adhesive insulating tape.

Earth rod already described.

The quantities specified are for an average installation; greater or lesser quantities may be needed.

(*c*) Common Battery Working.

With the exception that the telephone instrument is not fitted with a dial, the material supplied is the same as that for automatic working. The material to be purchased for the installation of the telephone is also the same as that for an automatic service. The methods to be followed in installing the telephone and associated apparatus are the same as those for an automatic telephone as shown in Figures 20 and 21.

Methods to be Followed.

The best methods to be followed in installing the telephone and associated apparatus are shown in Figures 20, 21, and 22. Figure 20 shows the wiring of the protector and the automatic telephone on a double-wire line and Figure 21 on a single-wire line. Figure 22 shows the correct method of running indoor wiring (the battery connexions do not apply to automatic telephones).

Mounting Protector.

The object of installing a protector is to shield the instrument from damage by lightning or other foreign electrical currents. It should be fitted as near as possible to the point where the aerial wires terminate on the outside wall of the building and a suitable position is a dry location under a verandah or porch. The protector should not be exposed to water or dampness, and on no account should it be installed in close proximity to any inflammable material, such as window curtains.

The method of installing the protector on a double-wire line is shown in Figures 18 and 20, and on a single-wire line in Figures 19 and 21. The position in which the protector is fitted should also be such that it can be readily reached for inspection or repairs as required.

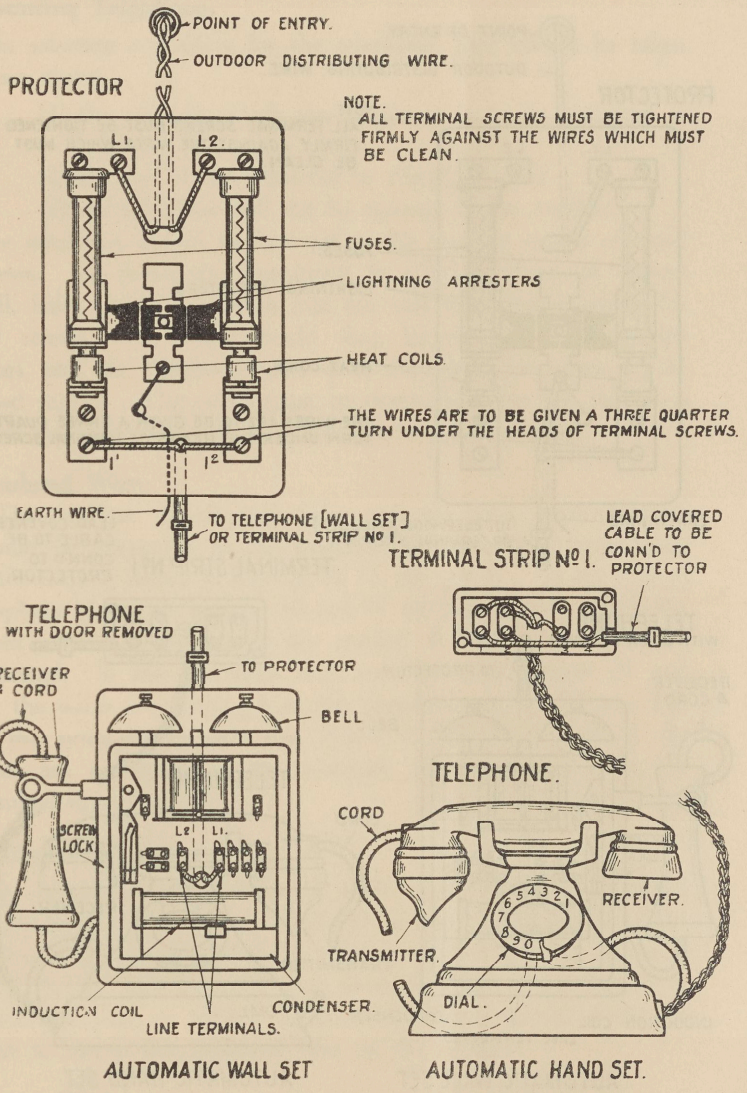


Figure 20.—Method of Installing Protector and Automatic Telephone Double Wire Circuit.

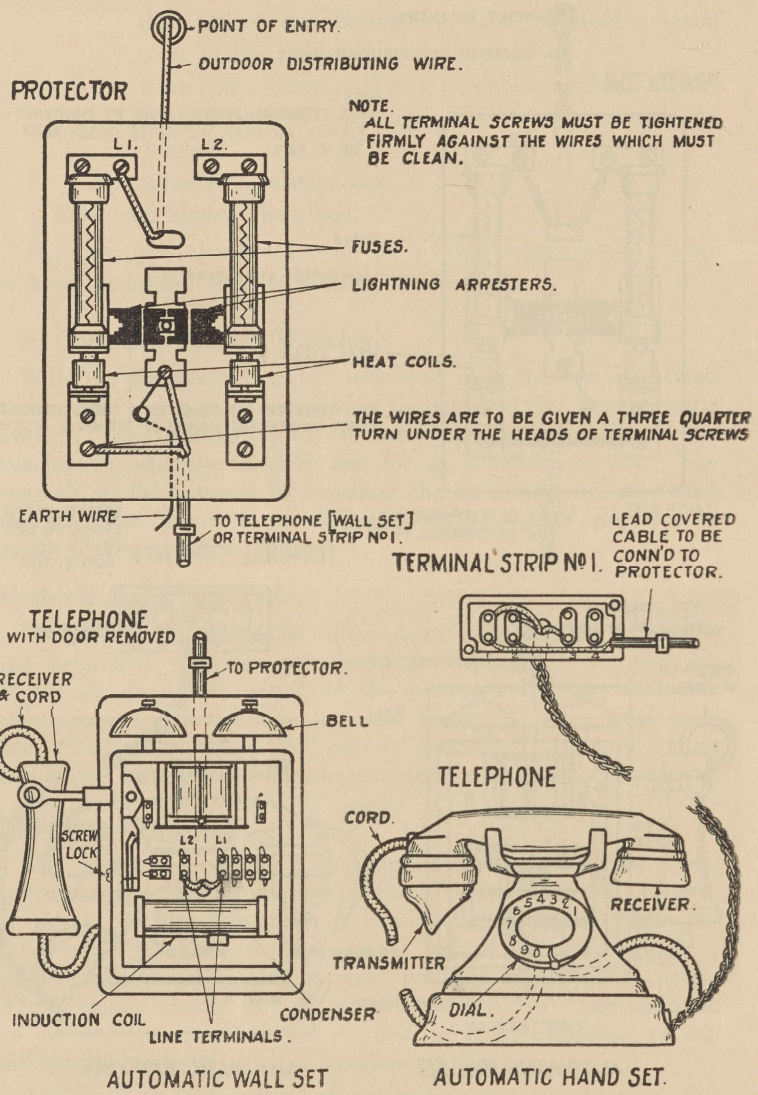


Figure 21.—Method of Installing Protector and Automatic Telephone Single Wire Circuit.

Mounting Telephone.

In selecting a position for the telephone, care should be taken to see that—

(1) the wall on which the telephone is to be mounted is dry;

(2) the wall is not subjected to vibration; and

(3) the telephone will not be exposed to the weather.

The telephone should be fastened to the wall by means of wood screws. To fasten the instrument to a brick, stone, or cement wall, holes should be driven into the wall at proper positions for the screws. The holes should then be plugged with wooden plugs, and the telephone screwed to the plugs by means of the wood screws. The wood must be thoroughly dry and the plugs must be sufficiently large to hold the screws securely.

Insulated Wire.

The outdoor distributing wire and the lead covered cable should be connected to the protector and telephone respectively in the manner shown in Figures 18, 19, 20, and 21. In the type of telephone shown in Figures 18 and 19 the terminals to which the wires are to be connected are marked A and B or otherwise indicated. In the automatic wall set shown in Figures 20 and 21, the wires are connected to the terminals marked L1 and L2. In the automatic handset also shown in Figures 20 and 21 the wires are connected to the terminals marked 1 and 2 in the terminal strip No. 1.

Insulated Staples.

In attaching the wires to the walls of the building, insulated staples as shown in Figure 22 should be used. The spikes of the staples must not pierce the insulation of the wire or the lead cable sheath, and a staple must never be driven down so as to crush the wire or cable. Uninsulated staples should never be used to attach the insulated wire to the walls.

Indoor Wiring.

(*a*) The outdoor distributing wire should be run between the protector and the aerial wire termination (Figure 16). From the point of entry to the protector the wire should be stapled to the walls as indicated in Figure 22.

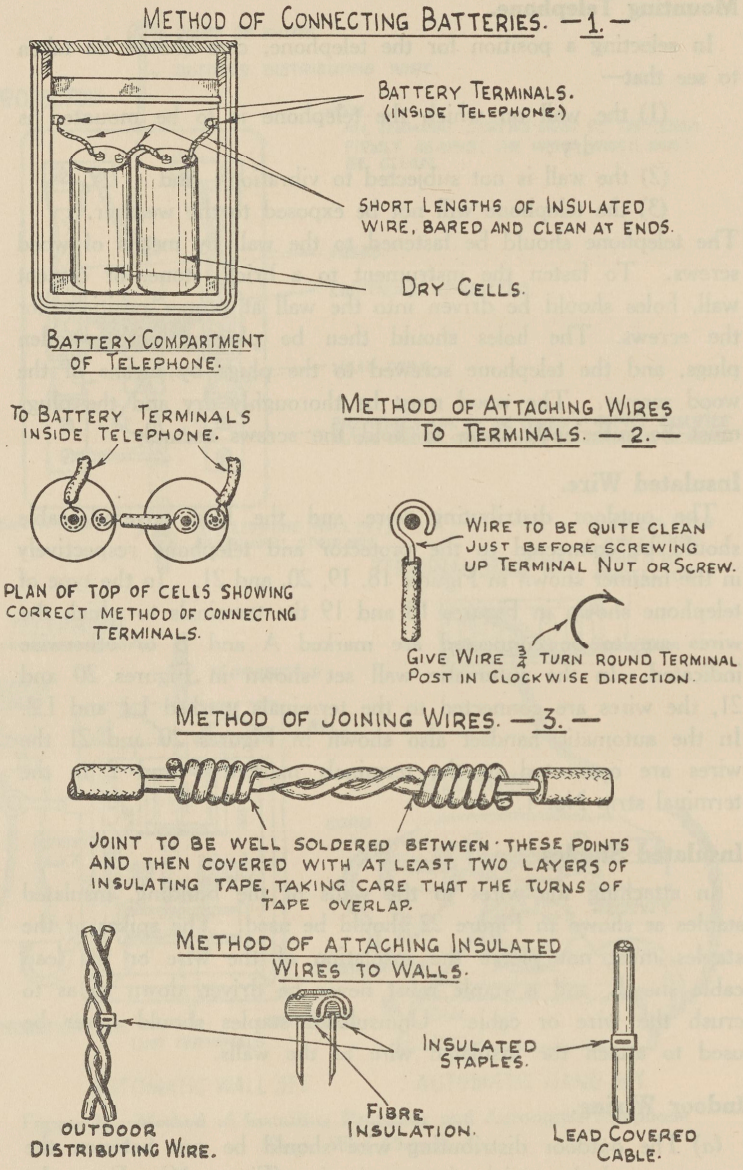


Figure 22.—Method of Connecting Batteries and Running Indoor Wiring.

(*b*) The lead covered cable should be run between the protector and the telephone or the terminal strip No. 1 as the case may be, and stapled to the wall as indicated in Figure 22. Sufficient length of the cable should be left at each end for connexion to the terminals.

(*c*) The wires and cable should be run in such positions that the possibility of damage will be prevented. Wet and damp localities should be avoided for all wiring inside the building. Do not allow the lead sheath or wires to lie in contact with metal pipes such as water or gas pipes. When these must be crossed, the cable or wires should be looped over them, leaving a clear area space of say $\frac{1}{2}$ inch over the pipe.

Connexion of Outdoor Distributing Wire.

(*a*) To attach the outdoor distributing wire to the protector, remove the cotton braiding and rubber insulation for about 1 inch at the end of the wire and clean the wire thoroughly with the back of a knife. The copper wire must not be nicked when cleaning off the insulation, as the wire will be weakened thereby and it may in time break and cause a fault.

(*b*) Place the bared end of the wire around and underneath the head of the terminal screws as indicated in Figure 22 and screw tight.

Connexion of Lead Covered Cable.

(*a*) To attach the lead covered cable to the protector and telephone or terminal strip No. 1, as the case may be, remove the lead sheath to within about $\frac{1}{2}$ inch inside the wiring entry hole of the apparatus. To do this lightly nick the lead all round with a knife and then bend it backward and forward until it breaks through. The sheath can then be pulled off the wires. About 6 inches of wire is required for connexion at the telephone, and about 4 inches at the protector, or the terminal strip.

(*b*) Remove about 1 inch of the cotton lapping and enamel insulation from the end of the wire. The enamel, the colour of which varies in cables of different manufacture from black to a dark golden brown, can be removed by scraping with the back of a knife blade or with a piece of emery paper. Avoid nicking the wire.

(c) When the end of the wire has been properly cleaned, connect it to the terminal screw as indicated in Figure 22, and screw tight. Where washers are supplied on the connecting terminals, place the wires between the washers.

Jointing Wires.

Avoid joints in wires if at all possible. If it is necessary to joint wires within a building, such wires should be soldered. After soldering, all sharp points of solder should be removed, and the whole joint carefully wrapped with adhesive insulating tape. Resin should be used as a flux for the solder when joining copper wires together.

Earth Wire for Protector.

An earth wire is required for the purpose of enabling the protector to operate satisfactorily and should be connected to the protector as shown in Figures 18, 19, 20, and 21. This earth wire should be led directly, and with as few bends as possible, to the earth connexion. There should be no spirals, coils, kinks, or sharp bends in the earth wire, and it should never be enclosed in an iron pipe. A suitable place for an earth connexion has already been explained (see page 29).

Connecting Batteries.

The two dry cells supplied with each magneto telephone should be connected as shown in Figure 22. Generally speaking, dry cells should give satisfactory service for about eighteen months, but under suitable conditions they last upwards of three years.

Telephone Receiver.

The receiver should always be placed on the switch hook or cradle after the telephone is used, otherwise the cells will soon become exhausted. **While the receiver is off the telephone cannot be called.**

MAINTENANCE OF LINES AND INSTRUMENTS BY SUBSCRIBERS.

Hints to Subscribers.

It is necessary in some cases for subscribers to maintain portion or the whole of the telephone line, including the instrument. With the object of assisting rural subscribers to locate and remedy simple apparatus and line faults, a booklet, entitled The Use and Care of the Telephone, is issued by the Department.

Efficient Maintenance Essential.

The importance of maintaining a telephone service in good order cannot be emphasized too greatly, and each subscriber is urged to inspect his portion of the line regularly and to co-operate with the Department by keeping the service in proper condition. The Department will gladly furnish free of cost any advice desired regarding the erection and maintenance of telephone services.

Faulty Maintenance.

When a line which is partly or wholly maintained by a subscriber becomes faulty, the Department is anxious that the trouble should be removed as quickly as possible and the co-operation of the subscriber (or the "maintenance representative") is invited in order to ensure a speedy restoration of service. The subscriber or maintenance representative is required to examine, or have examined, the privately maintained portions and the instruments and to give an assurance that no fault exists thereon before the departmental section is examined. If, after receiving this assurance, the fault is found to be on the subscriber's portion, the cost of examining the departmental portion will be charged to the service.

Much inconvenience is avoided if a general authority in writing is given by the subscriber to the Postmaster for the removal of faults immediately they are detected. This will obviate the necessity of a prior inspection of the private portion and so avoid delay in the restoration of the service.

Faults which develop in telephones will be rectified free of cost if the telephones are taken to the exchange. Suitable arrangements can be made through the Postmaster at the exchange to which the service connects.

By Authority: J. J. GOURLEY, Government Printer, Melbourne.

A few words to those who are connected by Telephone

THE telephone system, of which your service forms part, extends to 6,720 exchanges and more than 1,200,000 telephones.

It is the aim of the Department to provide an efficient service at a reasonable cost, and the tariff, including both rentals and fees for calls, compares favorably with that charged in other countries.

A dependable trunk line service is available between all States of the Commonwealth (including Tasmania), and calls may be made also to many overseas countries.

To maintain a satisfactory service the active co-operation of subscribers is essential, and the following suggestions are offered for general observance:—

- Read carefully the information at the front of your Telephone Directory and observe the general rules laid down for making and answering calls.
- Speak close to the transmitter in a clear even tone.
- If you are required to maintain portion of your service, see that it is kept in good working order. If you are in doubt regarding any matter, ask the departmental officers for advice which will be given free.
- If you are required to maintain the telephone ask for a helpful booklet explaining the procedure to be followed in locating simple faults.