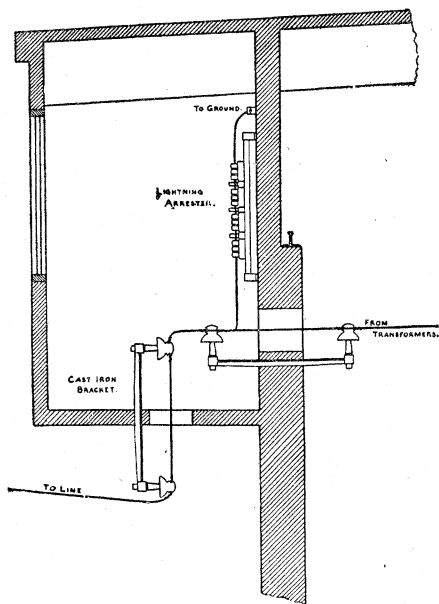


DISCUSSION OF MR. SKINNER'S PAPER.

MR. SKINNER:—I have here several communications which I will read.

MR. HENRY FLOY:—Because of its simplicity and reliability, the writer believes there is nothing quite equal to a plain but generous hole in the wall through which the wire rigidly supported, may pass. This form of construction modified as hereafter shown, is applicable to any voltage, and almost any climate.

I consider that the use of glass plates, as suggested by Mr. Skinner in Fig. I., or conductors insulated for a portion of their length as in Plan II., are more or less objectionable because of the constant menace of leakage and grounding of the system, through the wall of the building. The accumulation of dust or



moisture on the glass plates, or the deterioration of rubber or paper insulation due to exposure and weather will sooner or later end in a shut-down; glass tubes and plates are always breaking and never make a really good mechanical job.

If the station is provided with an overhead traveling crane, it will usually be found more convenient to bring the wires into the building through one of the walls rather than into a tower.

Having tried several different methods, none of which were wholly satisfactory, the writer devised the scheme shown in the accompanying sketch, which explains itself. This form of construction has been successfully used in a concrete-steel building, where the roof beams of concrete were carried beyond the walls

of the building and made to support a gallery, which serves as a lightning-arrester house; thus, the satisfactory introduction of the wires into the building and a proper fireproof room entirely separated from the station for the location of the lightning arresters, is provided. The iron brackets on which the wires are first supported, may be set either in the floor of the gallery or in the wall of the station. In either case all water drips from the wires before the latter turn vertically to pass through the floor of the gallery. At the same time any small amount of rain, snow or dust which may blow up into the gallery will not continue on through the second hole into the station. Moreover, the two apertures, one leading into the gallery and the other from there into the station, being at right angles to each other, prevent any large amount of cold air entering the station. One building provided with this form of admittance was not particularly uncomfortable though the outside temperature was as low as 27° Fahrenheit below zero. The maintenance of proper insulation is always insured; proper mechanical fastening of the line wires secured, and the reliability and simplicity is all that could be desired.

MR. SKINNER:—It should be noted that Mr. Floy's plan does not contemplate in any way taking up the end strains of the line wires. This must be done away from this point.

The other communication I have is from Mr. O. H. Ensign, Chief Electrical and Mechanical Engineer of the Edison Company of Los Angeles, California.

MR. O. H. ENSIGN:—We use, for 30,000 volts, plain 12-inch sewer-pipe wide open. Our temperature never goes to zero. It is cold only for short periods. I do not believe that unless considerable protection is given in the way of extension of the building, any sort of glass plate or marble supporting special insulators would be satisfactory, exposed to the weather.

MR. SKINNER:—Here is another discussion by A. L. Mudge.

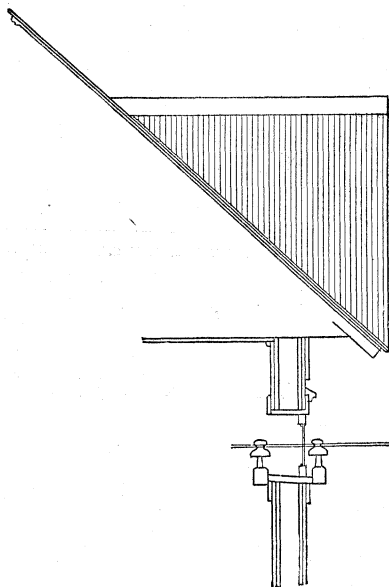
MR. MUDGE:—Would suggest that the terra cotta should be closed at outer end to prevent birds and insects getting into, or building nests in, the pipe. I find that a good ice and snow break on a sloping roof is V-shaped, and is much stronger than a single horizontal strip and also tends to let the roof free itself of snow. These strips can either be made of wood or of two lengths of angle iron bolted to the roof.

PRESIDENT SCOTT:—Another from Mr. F. C. Pierce.

MR. PIERCE:—Referring to the article: Page 314, Art. (5), (C), I do not believe in allowing the wall of the building to take the strain of the line, the last poles of the line should be braced or guyed; the number of poles guyed being determined by the number and weight of the line wires. In all cases I have seen, the wall, even if very heavy, will eventually come loose or bulge.

Where the strain is taken on the line; a X-arm just outside and one just inside the wall, fastened rigidly to the wall, will hold the wires in the centre of the slab of insulating material and exert no strain thereon.

I enclose rough sketch of our method of entering wires in the power house.



We found it necessary in cases where we enter under the eaves as in the sketch on p. 317, Fig. 2, to put a false dormer above the entrance, as otherwise the ice and snow slides down, catches on the wires and accumulates between the wires and eaves until the wires are either broken or pulled out of place.

The substation wires enter the gable ends. The slab of insulating material is 12" x 12" plate glass with 2" hole through center. Since putting the dormer on power house we have had no trouble whatever from our entrance wires.

[DISCUSSION CONTRIBUTED BY J. HARISBERGER.]

My experience has been with the construction as shown in sketches 1 and 2, pages 315 and 317. The Snoqualmie Power Company adopted at the very beginning the arrangement shown in Fig. 2, and with all of its high-tension troubles, it has yet to experience its first trouble with this style of construction for entering buildings. In some of the buildings the wires enter with the construction shown in Fig. 1 and in every instance when the high-tension lines became grounded for one reason or another, there was a discharge across the glass plate to the terra cotta pipe and which is evidence, in my opinion, that with a voltage as high as 30,000 it is not the best, unless a terra cotta pipe of an unpractical diameter is used.

[COMMUNICATED BY M. H. GERRY, JR.]

Mr. Skinner has stated the essential requirements for entering high-tension wires. There are a number of excellent methods in common use, all of which give good results when properly ap-

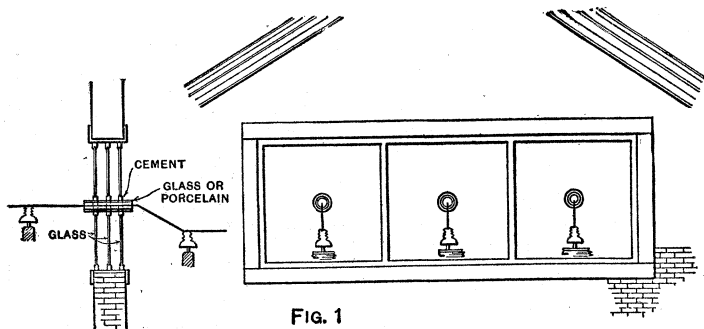


FIG. 1

plied. Fig. No. 1 is an excellent construction in use in several plants operating at 40,000 volts. This arrangement consists of a double, or triple, window sash set in an ordinary frame, the glass having openings in the centre in which are placed insulating bushings, or tubes. A water shed to keep the rain from the glass is sometimes added.

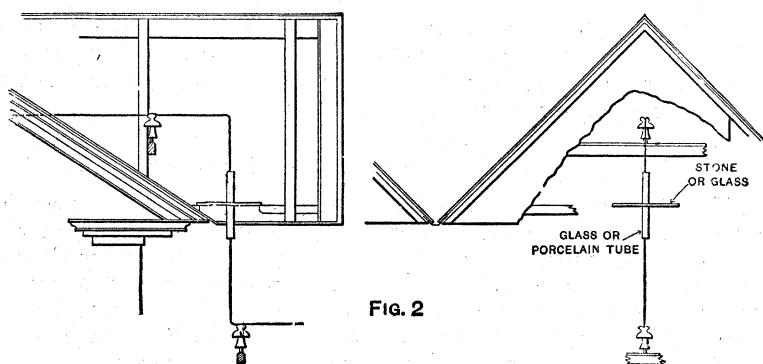


FIG. 2

Fig. No. 2 is a method frequently advocated, and in use for moderate pressures to a certain extent. It can be made to give good results, but involves special building construction.

Fig. No. 3 is a common method of entering high-tension wires through tile pipes. This method is an excellent one, and will give good results even up to pressures of 30,000 volts. Entrances of this design should always be made, if possible, through gable end of the building and not under the eaves, as shown by

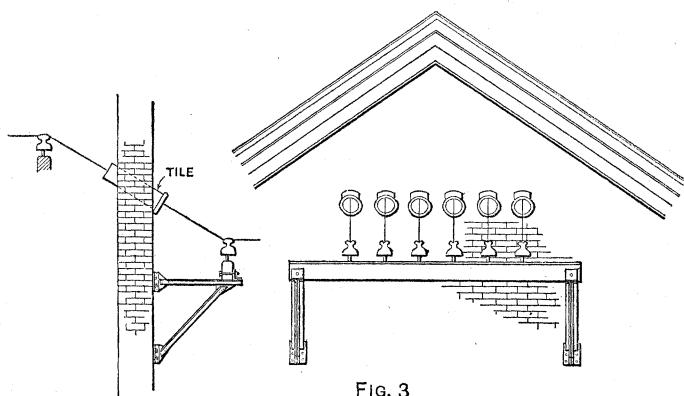


FIG. 3

Mr. Skinner. If impossible to enter at the end of the building, then a rain-shed should be provided over the wires, this being especially essential in cold climates, where ice forms readily.

Fig. No. 4 is a simple method of entering high-tension wires as applied to an iron building. The glass tubes shown are four feet in length two inches in diameter, and from five-eighths to three-fourths of an inch in thickness. This method is now in regular use at 50,000 volts.

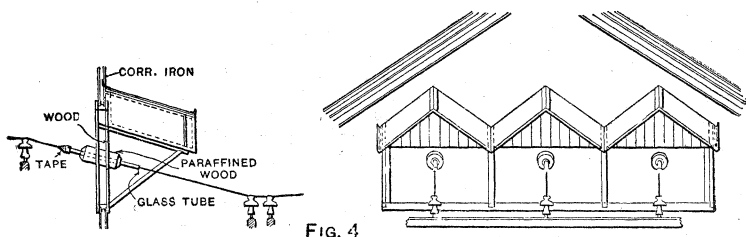
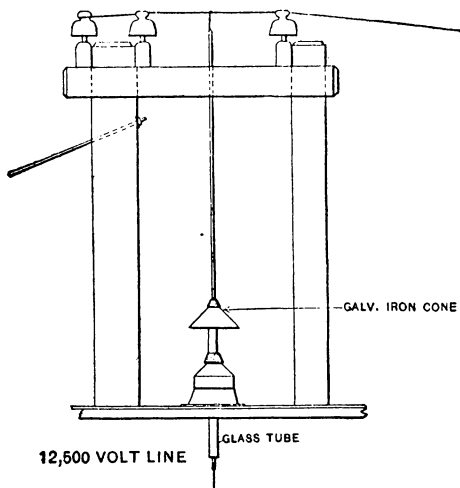


FIG. 4

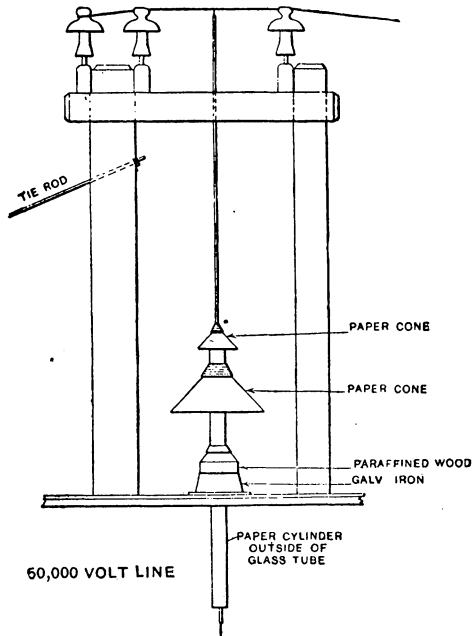
Figs. No. 5 and No. 6 are methods of entering wires vertically through the roof. Fig. 7 is a detail of the roof insulator, used in connection with the arrangement as shown in Fig. No. 6. The drawings show the construction clearly and require no explana-

FIG. 5



END ELEVATION

FIG. 6



END ELEVATION

tion. These vertical entrances are in use at the Canyon Ferry Plant of the Missouri River Power Company, and give good satisfaction. The above methods are selected as representing current practices. There can be no one method of entering high-

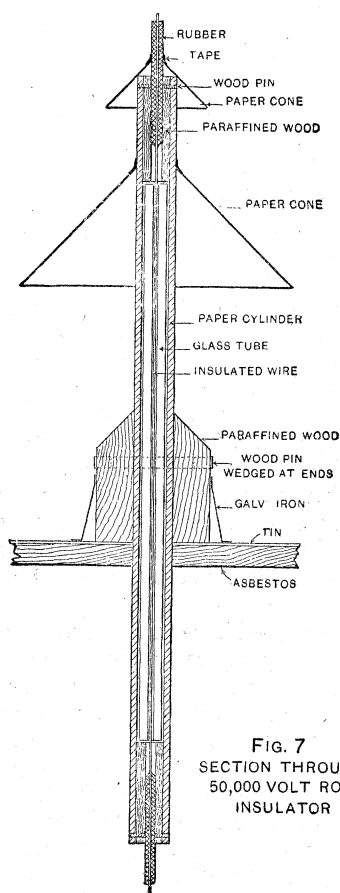


FIG. 7
SECTION THROUGH
50,000 VOLT ROOF
INSULATOR

tension wires. It is always a question of engineering detail, which should receive special treatment in each particular case.

PRESIDENT SCOTT:—Mr. Skinner's paper, on the "Methods of Bringing High-Tension Conductors into Buildings," is open for discussion.

MR. MERSHON:—I have used a number of different methods of bringing wires into buildings, some of which have already

been described. The method of a tile and a flat glass plate, has been used, I think, quite a long while; also that of a glass tube in a wooden bushing going through the wall, for voltages of 25,000 or 30,000. The latter is a good method of bringing wires into buildings except for the difficulty of getting glass tubes. Some times I have had no difficulty in getting satisfactory glass tubes; at other times tubes obtained from the same manufacturer will all go to pieces if, being warm, they are subjected to a blast or draft of cold air, such as would result from opening the door of the station. So I have come to feel a little bit afraid of the use of glass tubes.

Now, as to the size of the glass plate and the distance which the voltage will go over it. Some time ago I had occasion to install a tile and a glass plate arrangement because there was not time to get anything else, and the largest tile obtainable was 24 inches. That size was put in on a 50,000 volt line, which has been in operation in all kinds of weather for four or five months without any trouble. At times the frost gets so thick on the glass that you cannot see through it and, if the line has been shut down for a little while and a great deal of frost has collected, there is a discharge over the glass until the frost is melted; but after it is melted near the wire the discharge stops almost altogether. Although we have had no trouble at all in this case, I think a greater distance than 12 inches over the surface of the glass plate from the wire to the tile in a brick wall is advisable for this voltage. I think this question of entering buildings is a good deal like the question of insulators, in that it depends somewhat on the climate. There are places where the climate is such that the method I have just described for a 50,000 volt circuit would undoubtedly give trouble.

MR. R. F. HAYWARD:—There is no doubt that the question of climate cuts a very big figure in the selection of the methods for entering buildings with high-tension wires. I think this method of using a tile is open to objection, and a good deal of trouble comes from it. I do not think that any outlet which has for its protection a covering for building outside the power house where the wire comes in, then up and then through, is very nice, for the reason that birds do get in. The most successful outlet that I know of is one that was put in at the Murphy mill and has been running on 40,000 volts for, I think, four years. There is a brick wall in the gable end. The outlets are, I think, four feet apart. The holes in the brick are, I think, 18 inches. They may not be more than 14 inches. In those are set two plates of glass, each plate of glass flush with the outside, then another flush with the inside, of the brick; a hole about $2\frac{1}{2}$ inches in diameter drilled through this and another glass tube placed in it. There was great difficulty, as Mr. Mershon has mentioned, in getting good glass, but they have got it, and that glass has never broken. There has never been a short-circuit or a breakdown, and that gable end faces the southwest storms, where all the

The tile shown in Fig. 1, seems to me to possess a very bad feature in being left open on the exposed side. This construction may suffice, and I know of several cases where it is in use, but it certainly is open to the objection of being free to receive anything that may lodge in it. I think that Fig. 2 is a much better construction, but it could be improved upon by using several tubes, rested one within the other. Mr. Mershon has stated the objection to glass tubes, and I would recommend the substitution of porcelain. I do not think that porcelain is always a good article to use, but it is in this case. Suitable glass tubes are not made in this country and are very difficult to get anywhere, while porcelain tubes are a standard article of manufacture and they can be gotten in lengths up to three feet, I believe, and in a variety of diameters, which will nest very satisfactorily. I would make the further suggestion with reference to Fig. 2, that instead of one glass plate, there be two glass plates, spaced some five or six inches apart. This will give additional support, and afford an inside space which should tend to prevent the accumulation of frost. As to the point of the extension of the gable, as first mentioned, I think that there is the insulation of the whole structure. To my mind, the most uncertain point of the insulation in Mr. Skinner's second figure is the surface distance from the outer end of the tube over the glass plate. This cannot be very many inches and should be protected. I would advise that the gable be extended down to a point considerably below the wall insulation. The line wires should be carried from the anchor pole to a point several feet below this gable, and up to the tube insulators and into the building. The lines may be held in this position by a bracket supported on the wall, below the gable. If the lines are heavy they may be further supported by line insulators within the gable, so that there will be no strain on the tubes or glass plates. I furnish a sketch embodying my ideas.

MR. P. H. THOMAS:—To my mind Mr. Converse's suggestion of a rain-shed is an excellent one. By extending the roof a considerable distance from the wall and running it low down, building a baffle-plate from the ground up, leaving just sufficient opening to carry the wires in, and carrying the wires down and up as he suggests, you get the conditions of an indoor inlet at the main wall, where the plate glass and tubes are used. With the possible exception of the temperature outside, the conditions of interior construction will be admitted to be very much superior to those out of doors. Now, by changing the usual out-door inlet to an indoor inlet nine-tenths of the trouble would be avoided, and this can be easily done by the rain-shed spoken of. Sometimes it might be more convenient to obtain the protection by bringing the the rain-shed inside the building; that is, have a large opening in the wall and building a small room or large box up near the top, for bringing in the wires and then putting the true inlet on the farther wall, where it would be thoroughly protected from the weather.

There is one other point; ordinarily, I think a great deal will be gained in the long run by mounting the true high insulating inlet in an insulating panel, made as nearly fireproof as possible—something of the nature of marble would of course be the best—but with a large number of substations this would be too expensive. For a great many climates, it would be wise to use a wooden panel in which to mount the glass or porcelain inlet. This panel in such a case should if possible be made of a number of different pieces of wood with the grain running in different directions, and should of course be as well treated and prepared as possible. There is a certain danger of fire, but this is a minimum, I think, with good construction, and with the rain-shed of which we have spoken.

MR. P. M. LINCOLN:—There is just one point in the scheme mentioned by Mr. Converse that I would like to bring up, and that is the matter of taking up end strain. If you adopt that scheme, you have got to take up your end strain on the line outside of the building. That means taking it up on the standard insulators with the usual pins. Unless there is a special construction it is difficult to take up the strain on a heavy line in that manner. The end strain should be taken up by a strain insulator inside, as represented in Mr. Skinner's sketch No. 1. The great advantage of that to my mind is that the end strain of the line is taken by the insulators mounted inside the building, and you can put your insulator in any position, without having petticoats in such a position as to fill up with water and become useless.

[COMMUNICATED AFTER ADJOURNMENT BY DR. LOUIS BELL.]

For all high voltages, I prefer the arrangement shown in Fig. 2 in Mr. Skinner's paper. It is thoroughly effective and has the great merit of demanding ample space between wires. A mania for compactness has been responsible for more trouble in high voltage systems than any other one cause with which I am acquainted.

Wire towers for high potential lines should be avoided, first, last and always, together with tunnels, conduits and every other device for getting high-tension wires compactly stowed away out of sight. My own personal rule is to use wide spacing and to carry all wires in obtrusively plain sight until they get out of the building and go upon the line proper.

The high voltage wires themselves and all their connections should be so placed that their whole arrangement is evident from a cursory glance, and the higher the voltage the more need for caution in this respect.