Oct. 22, 1935. O. SCHMIDT 2,018,324

HIGH FREQUENCY TRANSMISSION LINE

Filed March 6, 1931

Fig. 1

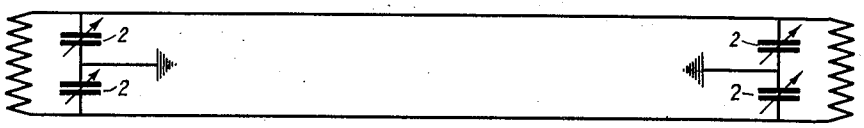


Fig. 2

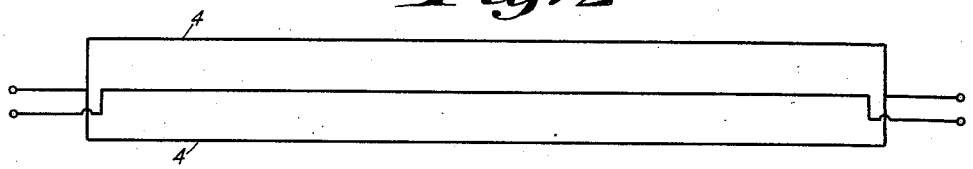


Fig. 3

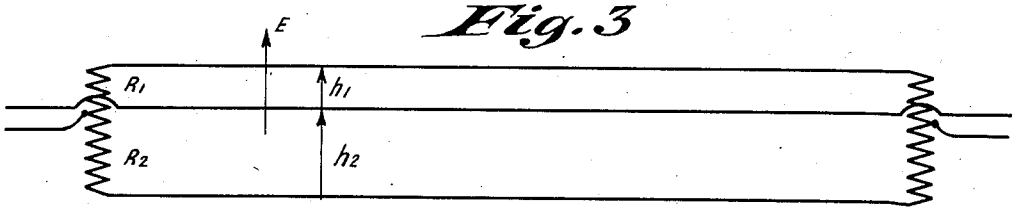


Fig. 4

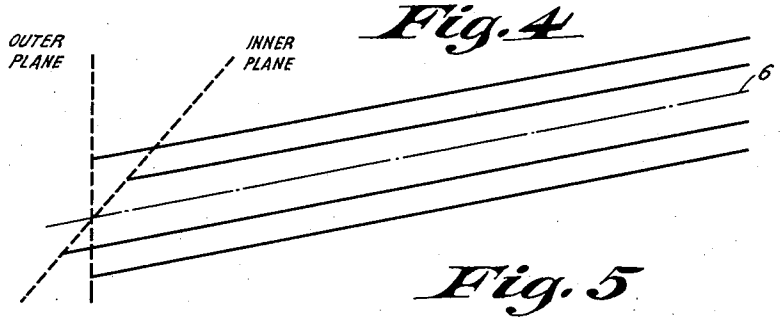


Fig. 5

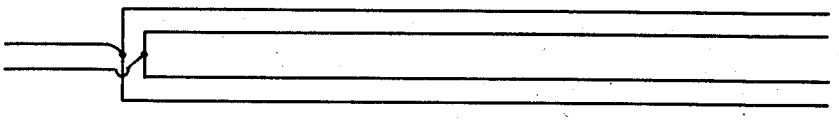
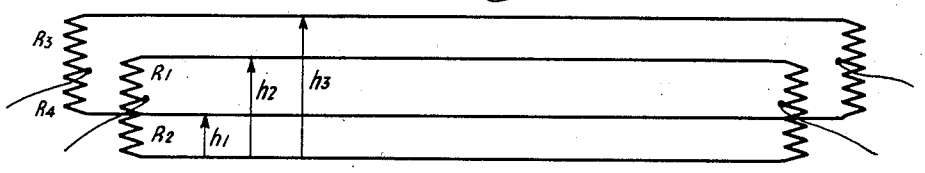


Fig. 6



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Patented Oct. 22, 1935 2,018,324

UNITED STATES PATENT OFFICE

2,018,324

HIGH FREQUENCY TRANSMISSION LINE

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Application March 6, 1931, Serial No. 520,737
In Germany April 3, 1930

3 Claims. (Cl. 178—44)

This invention relates to a transfer or transmission line for high frequency currents.

It has frequently been suggested to insure the transfer of high frequency energy by means of what is known as a Lecher wire-arrangement comprising a couple of parallel conductors, and wire arrangements of this kind have occasionally been used in practice. A disadvantage of this scheme compared with shielded concentric pipes used in the art is that slight self-radiation or self-absorption is hard to eliminate.

The present invention is more fully described hereinafter with the aid of the accompanying drawing, wherein

Figures 1 to 6 inclusive illustrate various embodiments of a transmission line incorporating various features of the present invention.

According to this invention, in order to avoid antenna effects in the parallel wire arrangement recourse has been had to symmetrizing methods, say, of the nature illustrated in Figure 1, wherein by low parallel connected capacities 2 slight lack of symmetry to ground may be compensated.

However, even if perfect symmetry be assumed, there still remains one effect, i. e., the Beverage effect known in the art. As an antenna system comprising a horizontal antenna extending in a direction parallel to the direction of transmission of the signals to be received this antenna is arranged so that its distributed capacity inductance and resistance is of such values that the currents produced therein by the desired signals increase progressively from the end of the antenna nearest the transmitting station becoming a maximum value at the end furthest from the transmitting station. A more complete description of this effect will be found in the U. S. patent to Beverage, No. 1,381,089. Checking the situation up by calculation it is found that the ultimate end strength of field due to this effect is not inconsiderable, and that under certain circumstances it may occasion serious disturbances in the reflection action of a connected antenna system. To be sure, in case the Lecher arrangement is connected at both ends by antenna and receiver in a way to preclude reflection action, there results a unilateral directional effect of the Lecher wire arrangement which, if conditions happen to be favorable, may coincide with the directive effects of the aerial system, though the situation might also be reversed when the Lecher circuit will oppose the aerial action.

To decrease or eliminate entirely the Beverage effect, recourse may be had to two schemes:

1. By well-known means, for instance, by a continual insertion of condensers, it is feasible to so alter the rate of speed of propagation so that the ensuing end potential at the receiver will become very low due to the departure from the speed of light.

2. By continual turning of the parallel wire system or circuit about the axis of symmetry, it is further feasible to make conditions so that the Beverage effect will disappear. However, this holds good only of a homogeneous unilaterally polarized field subjected to known polarization. But since what is dealt with here, is a circularly polarized field, or, to be more precise, a field, presenting local intensity fluctuations, the energy absorption in the end effect, as mentioned above under (1) will be diminished, though not be caused to disappear.

3. By insuring energy transfer by the aid of three, or generally speaking any desired odd number of wires disposed in one plane, it is possible to make conditions so that no energy at all is absorbed by making the outer wires or outers 4 (Figure 2) of the same potential. It will be easily understood that energy absorption disappears if the outers at the beginning and end are symmetrically combined or united. For in that case the charges occasioned by an extraneous field become equalized, and there will be no residual E. M. F. with reference to the inner conductor.

Fundamentally speaking, it is not necessary for the middle wire to be laid symmetrically with reference to the outer wire. In an arrangement as shown in Figure 3 where the middle wire is disposed dissymmetrically with reference to the outer wire, the outers, to be sure, must be at a potential of like polarity, but of different value. Potential division at the beginning and end must be made by a real, complex or imaginary resistance so that the potential caused by virtue of the Beverage effect will be so compensated that no residual end potential against the middle wire will persist. The ratio of resistance must be thus:

$$R1:R2=h1:h2$$

Fundamentally speaking, it is moreover not necessary that there should be just one middle wire. Indeed, the middle wires may be subdivided, and such a system may be disposed either in such a way that the plane of or laid through the middle wires, which are of like potential, is perpendicular or at an angle to the plane of the outers. The median axis 6 of the

middle wires must, however, at all events be in the plane of the outers, (Figure 4).

Or else the middle wires should be positioned in the plane laid through the outers, the preferable plan being to place the two middle wires inside the outers, most suitably symmetrically in reference to the outer wires as shown in Figure 5.

However, even if the arrangement is chosen quite arbitrarily and without plan or method (Figure 6), complete compensation of the Beverage effect is realizable, the presupposition here being only that the median axis of one pair of the wires comes to lie inside the two other wires. The basic condition upon which the compensation of the Beverage effect is predicated is

$$h_1+\frac{(h3-h1)}{R3+R4}\cdot R4=\frac{h2\cdot R2}{R1+r2}$$

or, since $R3+R2=R1+R2$ may be made equal to R, there may be put:

$$h1\cdot R3+h3\cdot R4=h2\cdot R2$$

I claim:

1. A transmission line for high frequency currents comprising three long parallel conductors, a connection at each far end of the outer conductors to maintain each of said outer conductors at the same potential, the inner conductors having terminals located at each end and having a different potential than said outer conductors and centrally disposed with respect to said outer conductors.

2. A transmission line for high frequency currents comprising three long parallel conductors, a resistance connected at each far end of the outer conductors, the inner conductors unsymmetrically disposed with respect to said outer conductors, a terminal connected to each of said resistances at a point intermediate the outside conductors so that the potential caused by virtue of the Beverage effect will be compensated so that no residual end potential against said inner conductors will exist.

3. A transmission line for high frequency currents comprising a plurality of long parallel conductors, one group of which comprises outer conductors, and the other group of which comprises central conductors, a resistance connected at each far end of both groups, a terminal connected to said resistance at a point intermediate the outer portion of each group of conductors for compensation of the Beverage effect.

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