

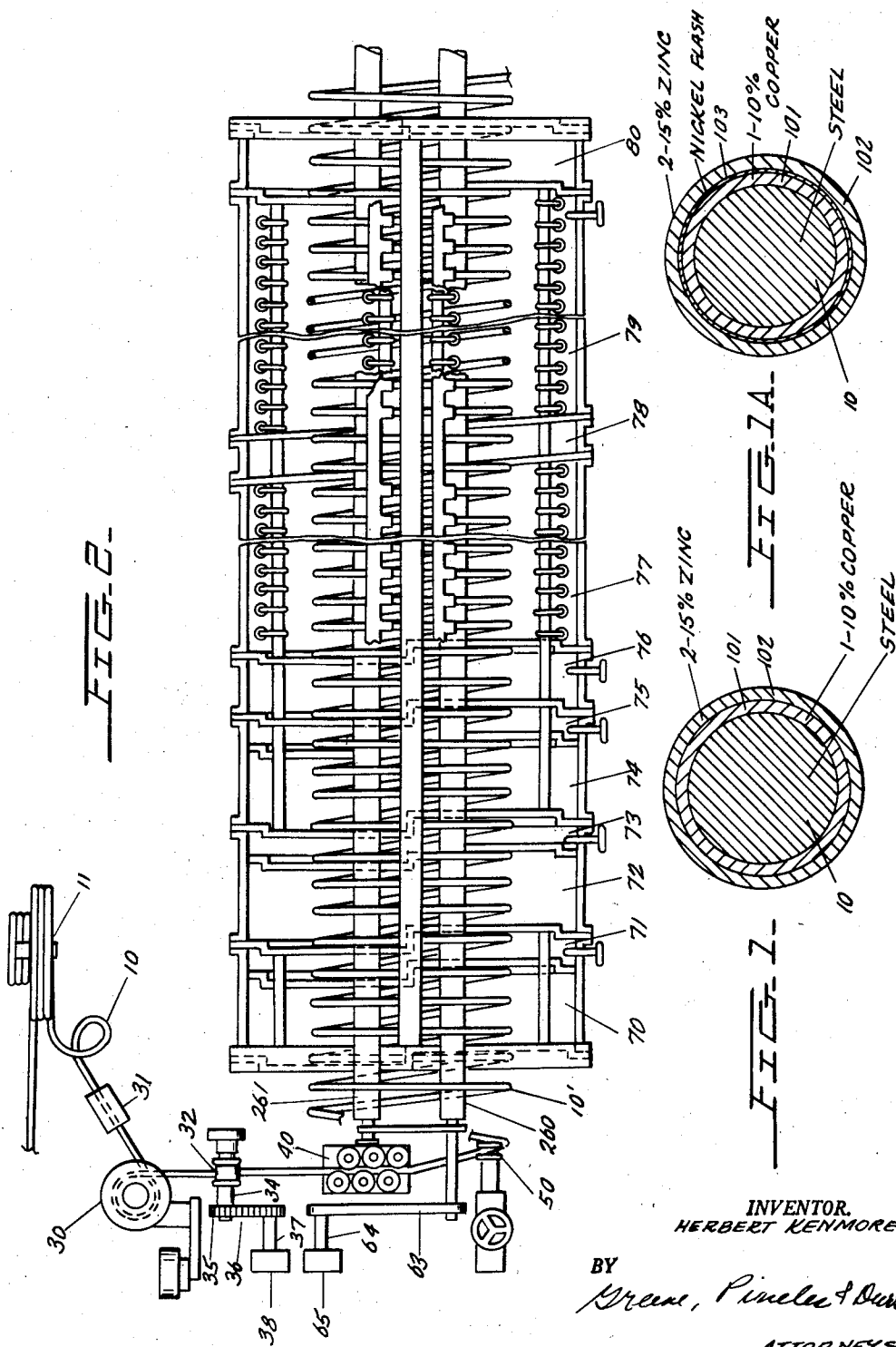
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H. KENMORE

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ELECTRICAL COMMUNICATION WIRE

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## ELECTRICAL COMMUNICATION WIRE

Herbert Kenmore, Jersey City, N.J., assignor, by mesne assignments, to National Standard Company, Niles, Mich., a corporation of Delaware

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This invention relates to a strong signal conducting wire.

Copper wire is ordinarily employed for conducting signals but in the case of long distance telephone or telegraph wires copper wire is no longer employed. It is desirable to support such wires on poles which are spaced as far apart as possible, and copper wire is not strong enough to be supported by widely spaced poles. As a result bronze wire, copper coated steel wire or galvanized steel wire has been substituted for copper wire.

Of these previously employed substitutes, steel wire is the most economical and has very wide usage. Such steel wire must have the lowest possible resistance to electric current and be as strong as possible. However, the best conducting steels are the steels which are purest and which have no substantial content of carbon or manganese. Such steels have the lowest strength. Manufacturing processes for providing steel wires with the ultimate of high strength and conductivity have been patented. The balance by which such steel wires are produced with high strength and relatively high conductivity is difficult to maintain and such wire conductors are therefore relatively costly to produce. These steel wires have to be galvanized to prevent them from corroding since they are always used without insulation and are therefore exposed to the elements.

An object of this invention is to provide a steel wire conductor having low electrical resistivity (compared with steel wire of the same size as now manufactured and used today, for example) and a very high breaking load.

One phase of this invention is based on the discovery that if a strong steel wire is first coated with 1–10% (10 to 100 g. per kilo) by weight of copper and then with 2–15% (20 to 150 g. per kilo) by weight of an adhering coating of zinc, a superior conductivity wire for such outdoor installations is provided. The 1–10% of copper is not thick enough by itself to act as a corrosion resistant layer. If copper alone is applied to obtain corrosion resistance a minimum of 10% by volume or 260 g. per kilo or 26% of copper is required. Such an amount of copper would raise the cost considerably. The added 2–15% of zinc produces corrosion resistance at moderate cost. Lead or aluminum may be substituted for the zinc. The steel core may be any high strength steel wire, since it is the copper layer which provides the desired conductivity. A strong steel with a carbon content of .05 to .70% is very satisfactory. Examples of such wire cores are wires made of steels known as C1040 to C1070 (ASTM). The copper is preferably plated onto the steel core. The type of plating process disclosed in U.S. Patent No. 2,680,710 is very satisfactory but it is preferred to complete the copper and zinc electroplating in one continuous operation. The zinc lead or aluminum layer is preferably electroplated on top of the copper layer but this layer can be applied by the hot dip method. The product may be produced in larger size than required in the final product and then drawn down to size after the plating is complete.

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A second phase of this invention is based on the discovery that the conductivity properties and other properties of the product of the invention can be prevented from deteriorating if a barrier layer of  $\frac{1}{2}$  to 5% by weight of nickel is deposited between the zinc layer and the copper layer. The barrier layer of nickel prevents the zinc from combining or alloying with the copper layer to produce a brass which has a lower conductivity than copper.

The invention both as to its organization and its method of operation together with additional objects and advantages thereof will best be understood from the following description of specific embodiments thereof when read in connection with the accompanying drawing in which

Fig. 1 shows a cross-sectional representation of the structure of the wire.

Fig. 1A is a cross sectional representation of the structure of a modified form of wire made according to the invention.

Fig. 2 shows a typical machine for the production of the product of the invention in one continuous operation.

In Figure 1, the core 10 is steel and is surrounded by a first concentric layer 101 of substantially pure copper comprising 1–10% by weight of the body. A concentric layer 102 of zinc, lead or aluminum comprising 2–10% by weight of the product surrounds the copper layer.

In producing such a wire the core wire 10 of steel, held on bundle 11, is passed from said bundle 11 and drawn through die 31 by drawing drum 30. Die 31 is slightly smaller than the smallest diameter of the wire in bundle 11. Die 31 gives the wire a work hardened surface. From drum 30 the wire 10 passes to the wire propelling rollers 32 which in this particular structure push the wire through straightening means 40 over curving or helix forming device 50 which forms the wire into a helix 10' with a horizontal axis. The helix 10' is stored in its horizontal form on the pair of rotating rollers 260, 261.

In this type of apparatus it is very important to maintain the size of the individual coils of the helix of uniform size all along the rollers 260 and 261. The wire helix is moved through the apparatus by the combination of the pushing force applied at roller 32 and the rotational force applied by rollers 260 and 261. It has been found necessary to separately regulate the speed of the propelling rollers 32 on the one hand and the forwarding rollers 260 and 261 on the other hand. Rollers 32 are rotated by shaft 34 driven by gear 35, chain 36, shaft 37 and speed regulating device 38. Roller 261 is driven by chain 265 from roller 260. Roller 260 is driven by chain 63, shaft 64 and speed regulating device 65. Speed regulating devices 38 and 65 are shown only diagrammatically. Many such devices, Reeves drives for example, are available commercially. The shafts which drive these devices 38 and 65 are not shown. The speed of the devices 38 and 65 are usually manually controlled and require adjustment from time to time.

Even when the wire is work hardened or tempered there is a limit to the length of the horizontal supporting and storage roller which can be employed and still obtain a coil size at the end of the supporting roller which is the same as the coil size at the beginning of such rollers. For this reason where a plurality of coatings are to be applied the device shown with two horizontal supporting rollers 260 and 261 is better than a device with a single supporting roll as the two roller construction provides twice as much traction and twice as much strength. The coil diameter should not vary more than plus or minus one inch from that originally set by the coil forming roll 50.

An example of the treatments through which the coils of the helix pass according to Fig. 2 is the following. The first few coils coming from the helix forming device rotate outside the bath structure. Thence the coil passes

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through baths 70-80. Bath 70 is a cleaning bath containing, for example, an aqueous solution of sodium phosphate. Baths 71, 73, 75, 78 and 80 are water rinsing baths one occurring between each two consecutive chemical baths. Bath 72 may be hot sulfuric acid bath. Bath 74 is another cleaning bath and bath 76 may be a polarizing or flash plating bath. The copper is plated in bath 77, then after rinsing in bath 78 the zinc is continuously plated onto the copper plated wire. The product thus produced may be drawn down to the size desired with conventional wire drawing devices.

Fig. 1A shows a core wire 10 similar to that shown in Fig. 1 but having a nickel layer 103 of  $\frac{1}{2}$  to 5% by weight between the copper layer 101 and the zinc layer 102.

#### Example 1

A steel wire core of  $\frac{1}{4}$ " diameter, for example, having a carbon content of .10 to .60% is provided. Such a wire has a conductivity of 9-11% of the conductivity of pure copper wire of the same size. This wire is treated and electroplated by the process described above with 1-10% (10 to 100 g. per kilo) by weight of pure copper. This layer of copper increases the conductivity of the steel wire by 1-10% to provide a wire with a resultant conductivity of 11-20% of a pure copper wire of the same size. A relatively thick layer of zinc is then electroplated onto the copper coated wire. Approximately 0.80 oz. (which represents about 5% by weight) to 2.4 oz. (which represents about 15% by weight) of zinc per square inch of surface are deposited into the copper plated wire. In a typical process a  $\frac{1}{4}$  inch wire is passed at a speed of 30 to 50 feet per minute in and out of a copper plating bath 100 to 150 times and in and out of a zinc plating bath 100 to 150 times. The resultant wire is drawn down to the size desired by a series of drawing steps without any annealing.

A standard telephone wire of B.W. gauge has a standard breaking strength of 1213 lbs. and a maximum resistance per mile of 39.23 ohms. Wire of 12 B.W. gauge made by the above process containing 50 g. per kilo of copper has the same minimum breaking strength but has a resistance per mile of only 34.12 ohms. Similar improved results are noted with other gauges of wire. For wires of the same resistance it is obvious that the product of the present invention is stronger than the prior art products and with stronger wires, fewer poles and less hardware are required and fewer holes for telephone poles have to be dug.

#### Example 2

The wire is made as described in Example 1 except that a layer of about  $\frac{1}{2}$ % to 5% by weight of nickel is deposited between the zinc layer and the copper layer.

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This proportion of nickel forms a barrier layer which prevents alloying of the copper with the zinc during drawing, annealing, heat treating or aging of the wire product.

This application is a continuation-in-part of my U.S. application Serial No. 484,405, filed January 27, 1955, now abandoned. The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific feature or details thereof.

I claim:

1. An electrical conductor wire for communication installations comprising a composite wire with a steel core, a substantially pure copper layer of 10 to 100 g. per kilo of the product next to said steel core, and a layer of substantially pure zinc comprising 20 to 150 g. per kilo of the product over said copper coating.

2. The product as set forth in claim 1 in which the steel core has a carbon content of .05 to .70% by weight.

3. A process of producing a steel cored conductivity wire comprising providing a steel core, plating a multiplicity of concentric layers of copper thereon to provide 20-100 g. per kilo of said copper, plating a multiplicity of concentric layers of zinc on the copper to provide 20-150 g. per kilo of zinc over the copper.

4. An electrical conductor wire for communication installations comprising a composite wire with a steel core of high tensile strength, a layer of substantially pure, unalloyed, copper concentrically deposited around said core and comprising 10-100 g. per kilo of the two layers, a concentric layer of nickel covering the copper layer and comprising  $\frac{1}{2}$  to 5% by weight of the product, and a layer of unalloyed zinc covering the nickel layer and comprising 20-130 g. per kilo of the product.

5. A process as claimed in claim 3 comprising plating a thin barrier layer consisting of about  $\frac{1}{2}$  to 5% by weight of nickel between the copper layer and the zinc layer, and thereafter drawing the plated wire.

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