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MULTIFILAMENT CONDUCTOR

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No Drawing. Continuation-in-part of application Ser. No. 779,376, Nov. 27, 1968, which is a continuation-in-part of application Ser. No. 730,933, May 21, 1968. This application Apr. 7, 1969, Ser. No. 814,198

Int. Cl. B21c 1/00; C23f 1/04

U.S. Cl. 174—110 18 Claims

ABSTRACT OF THE DISCLOSURE

An insulated multifilament conductor prepared from aluminum alloy having an electrical conductivity of at least sixty-one percent (61%) based on the International Annealed Copper Standard and unexpected properties of increased ultimate elongation, bendability and fatigue resistance when compared to conventional EC wire of the same tensile strength. The aluminum alloy wires contain substantially evenly distributed iron aluminate inclusions in a concentration produced by the addition of more than about 0.30 weight percent iron to an alloy mass containing less than about 99.70 weight percent aluminum, no more than 0.15 weight percent silicon, and trace quantities of conventional impurities normally found within a commercial aluminum alloy. The substantially evenly distributed iron aluminate inclusions are obtained by continuously casting an alloy consisting essentially of less than about 99.70 weight percent aluminum, more than 0.30 weight percent iron, no more than 0.15 weight percent silicon and trace quantities of typical impurities to form a continuous aluminum alloy bar, hot-working the bar substantially immediately after casting in substantially that condition in which the bar is cast to form continuous rod which is subsequently drawn into wire without intermediate anneals and annealed after the final draw. After annealing, the wire has the aforementioned novel and unexpected properties of increased ultimate elongation, electrical conductivity of at least sixty-one percent (61%) of the International Annealed Copper Standard, and increased bendability and fatigue resistance.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Ser. No. 779,376, filed Nov. 27, 1968, which in turn is a continuation-in-part of my copending application Ser. No. 730,933, filed May 21, 1968, both now abandoned.

DISCLOSURE

This invention relates to an insulated multifilament electrical conductor and more particularly concerns a multifilament conductor which is prepared from aluminum alloy wires having an acceptable electrical conductivity and improved elongation and bendability at a standard tensile strength.

The use of various aluminum alloy wires (conventionally referred to as EC wire) as conductors of electricity is well established in the art. Such alloys characteristically have conductivities of at least sixty-one percent of the International Annealed Copper Standard (hereinafter sometimes referred to as IACS) and chemical constituents consisting of a substantial amount of pure aluminum and small amounts of conventional impurities such as silicon, vanadium, iron, copper, manganese, magnesium, zinc, boron and titanium. The physical properties of prior aluminum alloy wires have proven less than desirable in many applications. Generally desirable percent elongations have been obtainable only at less than desirable tensile strengths and desirable tensile strengths have been obtainable only at less than desirable percent elongations. In addition, the bendability and fatigue resistance of prior aluminum alloy wires has been so low that the prior wire has been generally unsuitable for many otherwise desirable applications.

Thus, it becomes apparent that a need has arisen within the industry for an insulated, multifilament aluminum alloy electrical conductor which has both relatively high tensile strength and acceptably high ultimate elongation, and also possesses an ability to withstand numerous bends at one point and to resist fatiguing during use of the conductor. Therefore, it is an object of the present invention to provide an insulated multifilament aluminum alloy electrical conductor of acceptable conductivity and improved physical properties. These and other objects, features and advantages of the present invention will become apparent to those skilled in the art from a consideration of the following detailed description of the invention.

In accordance with this invention, the present insulated, multifilament aluminum alloy electrical conductor is manufactured from solid wires which are prepared from an alloy comprising less than about 99.70 weight percent aluminum, more than about 0.30 weight percent iron, and no more than 0.15 weight percent silicon. Preferably, the aluminum content of the present alloy comprises from about 98.95 to less than about 99.45 weight percent with particularly superior results being achieved when from about 99.15 to about 99.40 weight percent aluminum is employed. Preferably, the iron content of the present alloy comprises about 0.45 weight percent to about 0.95 weight percent with particularly superior results being achieved when from about 0.50 weight percent to about 0.80 weight percent iron is employed. Preferably, no more than 0.07 weight percent silicon is employed in the present alloy. The ratio between the percentage iron and the percentage silicon must be 1.99:1 or greater. Preferably, the ratio between percentage iron and percentage silicon is 8:1 or greater. Thus, if the present aluminum alloy contains an amount of iron within the low area of the present range for iron content, the percentage of aluminum must be increased rather than increasing the percentage of silicon outside the ratio limitation previously specified. It has been found that a properly processed insulated multifilament conductor prepared from solid wires having aluminum alloy constituents which fall within the above-specified ranges possesses acceptable electrical conductivity and improved physical properties of tensile strength, ultimate elongation and fatigue resistance.

The solid wires of the aluminum alloy conductor are prepared by initially melting and alloying aluminum with the necessary amounts of iron or other constituents to provide the requisite alloy for processing. Normally, the content of silicon is maintained as low as possible without adding additional amounts to the melt. Typical impurities or trace elements are also present within the melt but only in trace quantities such as less than 0.05 weight percent each with a total content of trace impurities generally not exceeding 0.15 weight percent. Of course, when adjusting the amounts of trace elements due consideration must be given to the conductivity of the final alloy since some trace elements affect conductivity more severely than others. The typical trace elements include vanadium, copper, manganese, magnesium, zinc, boron and titanium. If the content of titanium is relatively high (but still quite low compared to the aluminum, iron and silicon content), small amounts of boron may be added to tie-up the excess titanium and keep it from reducing the conductivity of the wire. Iron is the major constituent added to the melt to produce the alloy of the

present invention. Normally, about 0.50 weight percent iron is added to the typical aluminum component used to prepare the present alloy. Of course, the scope of the present invention includes the addition of more or less iron together with the adjustment of the content of all alloying constituents.

After alloying, the melted aluminum composition is continuously cast into a continuous bar. The bar is then hot-worked in substantially that condition in which it is received from the casting machine. A typical hot-working operation comprises rolling the bar in a rolling mill substantially immediately after being cast into a bar.

One example of a continuous casting and rolling operation capable of producing continuous rod as specified in this application is as follows:

A continuous casting machine serves as a means for solidifying the molten aluminum alloy metal to provide a cast bar that is conveyed in substantially the condition in which it solidified from the continuous casting machine to the rolling mill, which serves as a means for hot-forming the cast bar into rod or another hot-formed product in a manner which imparts substantial movement to the cast bar along a plurality of angularly disposed axes.

The continuous casting machine is of conventional casting wheel type having a casting wheel with a casting groove partially closed by an endless belt supported by the casting wheel and an idler pulley. The casting wheel and the endless belt cooperate to provide a mold into one end of which molten metal is poured to solidify and from the other end of which the cast bar is emitted in substantially that condition in which it solidified.

The rolling mill is of conventional type having a plurality of roll stands arranged to hot-form the cast bar by a series of deformations. The continuous casting machine and the rolling mill are positioned relative to each other so that the cast bar enters the rolling mill substantially immediately after solidification and in substantially that condition in which it solidified. In this condition, the cast bar is at a hot-forming temperature within the range of temperatures for hot-forming the cast bar at the initiation of hot-forming without heating between the casting machine and the rolling mill. In the event that it is desired to closely control the hot-forming temperature of the cast bar within the conventional range of hot-forming temperatures, means for adjusting the temperature of the cast bar may be placed between the continuous casting machine and the rolling mill without departing from the inventive concept disclosed herein.

The roll stands each include a plurality of rolls which engage the cast bar. The rolls of each roll stand may be two or more in number and arranged diametrically opposite from one another or arranged at equally spaced positions about the axis of movement of the cast bar through the rolling mill. The rolls of each roll stand of the rolling mill are rotated at a predetermined speed by a power means such as one or more electric motors and the casting wheel is rotated at a speed generally determined by its operating characteristics. The rolling mill serves to hot-form the cast bar into a rod of a cross-sectional area substantially less than that of the cast bar as it enters the rolling mill.

The peripheral surfaces of the rolls of adjacent roll stands in the rolling mill change in configuration; that is, the cast bar is engaged by the rolls of successive roll stands with surfaces of varying configuration, and from different directions. This varying surface engagement of the cast bar in the roll stands functions to knead or shape the metal in the cast bar in such a manner that it is worked at each roll stand and also to simultaneously reduce and change the cross-sectional area of the cast bar into that of the rod.

As each roll stand engages the cast bar, it is desirable that the cast bar be received with sufficient volume per unit of time at the roll stand for the cast bar to generally

fill the space defined by the rolls of the roll stand so that the rolls will be effective to work the metal in the cast bar. However, it is also desirable that the space defined by the rolls of each roll stand not be overfilled so that the cast bar will not be forced into the gaps between the rolls. Thus, it is desirable that the rod be fed toward each roll stand at a volume per unit of time which is sufficient to fill, but not overfill, the space defined by the rolls of the roll stand.

As the cast bar is received from the continuous casting machine, it usually has one large flat surface corresponding to the surface of the endless band and inwardly tapered side surface corresponding to the shape of the groove in the casting wheel. As the cast bar is compressed by the rolls of the roll stands, the cast bar is deformed so that it generally takes the cross-sectional shape defined by the adjacent peripheries of the rolls of each roll stand.

Thus, it will be understood that with this apparatus, cast aluminum alloy rod of an infinite number of different lengths is prepared by simultaneous casting of the molten aluminum alloy and hot-forming or rolling the cast aluminum bar.

The continuous rod produced by the casting and rolling operation is then processed in a reduction operation designed to produce continuous wire of various gauges between 0000 gauge AWG (cross-sectional diameter or greatest perpendicular distance between parallel faces of 0.460 inch) and 40 gauge AWG (cross-sectional diameter or greatest perpendicular distance between parallel faces of 0.0031 inch). The unannealed rod (i.e., as rolled to *f* temper) is cold-drawn through a series of progressively constricted dies, without intermediate anneals, to form a continuous wire of desired diameter. At the conclusion of this drawing operation, the alloy wire will have an excessively high tensile strength and an unacceptably low ultimate elongation, plus a conductivity below that which is industry accepted as the minimum for an electrical conductor, i.e., sixty one percent (61%) of IACS. The wide is then annealed or partially annealed to obtain a desired tensile strength and cooled. At the conclusion of the annealing operation, it is found that the annealed alloy wire has the properties of acceptable conductivity and improved tensile strength together with unexpectedly improved percent ultimate elongation and surprisingly increased bendability and fatigue resistance as specified previously in this application. The annealing operation may be continuous as in resistance annealing, induction annealing, convection annealing by continuous furnaces or radiation annealing by continuous furnaces, or, preferably may be batched annealed in a batch furnace. When continuously annealing, temperatures of about 450° F. to about 1200° F. may be employed with annealing times of about five minutes to about $\frac{1}{10,000}$ of a minute, of a minute. Generally, however, continuous annealing temperatures and times may be adjusted to meet the requirements of the particular over-all processing operation so long as the desired tensile strength is achieved. In a batch annealing operation, a temperature of approximately 400° F. to about 750° F. is employed with residence times of about thirty (30) minutes to about twenty-four (24) hours. As mentioned with respect to continuous annealing, in batch annealing the times and temperatures may be varied to suit the overall process so long as the desired tensile strength is obtained. Simply by example, it has been found that the following tensile strengths in individual aluminum alloy wires of the present conductor are achieved with the listed batch annealing temperatures and times.

TABLE I

Tensile strength	Temperature (° F.)	TIME (hr.)
12,000–14,000	650	3
14,000–15,000	550	3
15,000–17,000	520	3
17,000–22,000	480	3

During the continuous casting of this alloy, a substantial portion of the iron present in the alloy precipitates out of solution as iron aluminate itermetallic compound ($FeAl_3$). Thus, after casting, the bar contains a dispersion of $FeAl_3$ in a supersaturated solid solution matrix. The supersaturated matrix may contain as much as 0.17 weight percent iron. As the bar is rolled in a hot-working operation immediately after casting, the $FeAl_3$ particles are broken-up and dispersed throughout the martix inhibiting large cell formation. When the rod is then drawn to its final gauge size without intermediate anneals and then aged in a final annealing operation, the tensile strength, elongation and bendability are increased due to the small cell size and the additional pinning of dislocations by preferential precipitation of $FeAl_3$ on the dislocation sites. Therefore, new dislocation sources must be activated under the applied stress of the drawing operation and this causes both the strength and the elongation to be further improved.

The properties of the present aluminum alloy wire are significantly affected by the size of the $FeAl_3$ particles in the matrix. Coarse precipitates reduce the percent elongation and bendability of the wire by enhancing nucleation and, thus, formation of large cells which, in turn, lowers the recrystallization temperature of the wire. Fine precipitates improve the percent elongation and bendability by reducing nucleation and increasing the recrystallization temperature. Grossly coarse precipitates of $FeAl_3$ cause the wire to become brittle and generally unusuable. Coarse precipitates have a particle size of above 2,000 angstrom units and fine precipitates have a particle size of below 2,000 angstrom units.

Following the annealing operation, the individual alloy wire is stranded with other similarly produced alloy wires to produce a multifilament stranded conductor. The stranded conductor is then continuously insulated in a standard continuous insulating operation. A typical insulating operation comprises passing the stranded conductor through an extrusion head. As the conductor passes through the head, a continuous thermoplastic coat of insulation is generated around the conductor. The coated conductor is then cooled in the air or by contact with a cooling bath. The insulating material should be one which is capable of insulating the multifilament conductor and the material should be of a thickness sufficient to insulate the conductor and withstand the physical hazards associated with stranded insulated conductors. Typical thicknesses of insulation are between about .001 of an inch and .400 of an inch. A preferred thermoplastic insulating material is poly (vinyl chloride), but other coatings such as neoprene, rubber, polyethylene, polypropylene and cross-linked polyethylene may be employed.

A typical individual No. 12 AWG solid insulated strand, which is subsequently grouped into a multifilament conductor, has physical properties of 16,000 p.s.i. tensile strength, ultimate elongation of 20%, conductivity of 61% IACS, and bendability of thirty bends to break. Ranges of physical properties generally provided by a suitable No. 12 AWG strand prepared from the present alloy include tensile strengths of about 13,000 to about 22,000 p.s.i., ultimate elongations of about 35% to about 5%, conductivities of about 61% to about 63%, and number of bends to break of about 45 to 10. Preferred strands for use in present conductor have a tensile strength of between 13,000 and 18,000 p.s.i., an ultimate elongation of between 30% and 15%, a conductivity of between 61% and 63%, and number of bends to break of between 40 and 15.

The individual strands of wire formed from the present alloy may be grouped together prior to the insulation thereof in several formations including concentric stranding, bunch stranding, parallel stranding and rope lay stranding. In concentric stranding, a strander conventionally strands in a helical fashion six or more wire strands about a central wire strand. The stranded unit is then passed through the extrusion head of an extruder where insulation is applied around the outer surfaces of the stranded unit.

In bunch stranding, individual wires are brought together with some twisting of the unit of wires and insulation is applied around the outer surfaces of the stranded unit.

In parallel stranding, individual wires are brought together in parallel fashion with no twisting of the unit of wires and insulation is applied around the outer surfaces of the stranded unit.

In rope lay stranding, individual uninsulated concentrically stranded or bunched cables are concentrically stranded or bunched into a composite cable. Insulation is then applied to the outer surfaces of the composite cable as a whole.

It has been found that stranding and insulating wires of the present alloy yields a cable which has improved bandability over solid insulated conductors and in addition has improved bandability over stranded and insulated EC alloy wire.

A more complete understanding of the invention will be obtained from the following examples:

EXAMPLE NO. 1

A comparison between prior EC aluminum alloy wire and the present aluminum alloy wire suitable for use in the present conductor is provided by preparing an EC alloy with aluminum content of 99.73 weight percent, iron content of 0.18 weight percent, silicon content of 0.059 weight percent, and trace amounts of typical impurities. The present alloy is prepared with aluminum content of 99.45 weight percent, iron content of 0.34 weight percent, silicon content of 0.056 weight percent, and trace amounts of typical impurities. Both alloys are continuously cast into continuous bars and hot-rolled into continuous rod in similar fashion. The alloys are then cold-drawn through successively constricted dies to yield #12 AWG continuous wire. Sections of the wire are collected on separate bobbins and batch furnace-annealed at various temperatures and for various lengths of time to yield sections of the prior EC alloy and the present alloy of varying tensile strengths. Several samples of each section of wire are tested in a device designed to measure the number of bends required to break each sample at a particular flexure point. Through uniform force and tension, the device fatigues each sample through an arc of approximately 135°. The uninsulated wire is bent across a pair of spaced opposed mandrels having a diameter equal to that of the wire. The mandrels are spaced apart a distance of about 1½ times the diameter of the wire. One bend is recorded after the wire is deflected from a vertical disposition to one extreme of the arc, returned back to vertical, deflected to the opposite extreme of the arc, and returned back to the original vertical disposition. The speed of deflection, force and tension are substantially equal for all tested samples. The results are as follows:

TABLE II-A

EC alloy wire		Present alloy wire	
Tensile strength	No. of bends to break	Tensile strength	Average no. of bends to break
10,000	44	13,700	44
12,500	25	14,000	40
13,500	22	15,200	33
14,000	14½	16,000	30
15,000	14	17,000	23
16,200	11	17,200	20
17,000	10	18,200	15
18,000	8¾	19,575	13
23,000	6	25,000	6
29,000	4	35,900	3½

Several samples of the present alloy #12 AWG wire and EC alloy #12 AWG wire, processed as previously specified, are then tested for percent ultimate elongation

by standard testing procedures. At the instant of breakage, the increase in length of the individual wire strands is measured. The percent ultimate elongation is then figured by dividing the initial length of a wire strand sample into the increase in length of that wire strand sample. The tensile strength of the wire strand sample is recorded as the pounds per square inch of cross-sectional diameter required to break the wire strand during the percent ultimate elongation test. The results are as follows:

TABLE II-B

EC alloy wire		Present alloy wire	
Tensile strength	Percent ultimate elongation	Tensile strength	Percent ultimate elongation
		13,700	30.5
10,000	30.5	14,000	29.4
12,500	20	15,200	25
13,500	14	16,000	19.5
14,000	12	17,000	14
15,000	8	17,200	13.2
16,200	4	18,200	8.8
18,000	2.5	19,575	6.2

EXAMPLES 2 THROUGH 7

Six aluminum alloys are prepared with varying amounts of major constituents. The alloys are reported in the following table.

TABLE III

Example No.	Percent Al	Percent Fe	Percent S
2	99.73	0.180	0.059
3	99.52	0.385	0.063
4	99.46	0.450	0.056
5	99.36	0.540	0.064
6	99.275	0.680	0.015
7	99.20	0.750	0.030

The six alloys are then cast into six continuous bars and hot-rolled into six continuous rods. The rods are cold-drawn through successively constricted dies to yield #12 gauge wire. The wire produced from the alloys of examples Number 2 and 4 are resistance annealed and the remainder of the examples are batch furnace annealed to yield the tensile strengths reported in Table IV. Each of the uninsulated wires is tested for percent conductivity, tensile strength, percent ultimate elongation and average number of bends to break by standard testing procedures for each, except that the procedure specified in Example No. 1 is used for determining average number of bends to break. The results are reported in the following table:

TABLE IV

Example No.	conductivity in percent IACS	Tensile strength	Percent ultimate elongation	Average No. of bends to break
2	62.8	15,200	8.3	13
3	61.3	15,175	28.4	28
4	61.5	15,175	37.8	29
5	61.5	15,175	35.6	29½
6	61.25	14,400	28.9	33
7	61.2	15,875	26	29

From a review of these results it may be seen that Example No. 2 falls outside the scope of the present invention in percentage of components. In addition, it will be noted for Example No. 2 that the percentage of ultimate elongation is somewhat lower than desirable and the average number of bends to break the sample is lower than the remaining examples.

EXAMPLE NO. 8

An aluminum alloy is prepared with an aluminum content of 99.42 weight percent, iron content of 0.50 weight percent, silicon content of 0.055 weight percent and trace amounts of typical impurities. The alloy is cast into a continuous bar which is hot-rolled to yield a continuous rod. The rod is then cold-drawn through successively constricted dies to yield #12 AWG wire. The wire is collected on a 30 inch bobbin until the collected wire weighs approximately 250 pounds. The bobbin is then placed in a cold General Electric Bell Furnace and the temperature therein is raised to 480° F. The temperature of the furnace is held at 480° F. for 3 hours after which the heat is terminated and the furnace cools to 400° F. The annealed wire is then concentrically stranded by a tubular strander with six other wires produced in a similar fashion. The stranded unit is then passed through an extrusion head and insulated with poly (vinyl chloride). Under testing, it is found that the multifilament insulated alloy wire has a conductivity of 61.6% IACS and improved physical properties.

EXAMPLE NO. 9

Example 8 is repeated except the Bell Furnace temperature is raised to 500° F. and held 3 hours prior to cooling. The annealed and insulated multifilament alloy conductor has a conductivity of 61.4% IACS and improved physical properties.

EXAMPLE NO. 10

Example No. 8 is repeated except the Bell Furnace temperature is raised to 600° F. and held 3 hours prior to cooling. The annealed and insulated multifilament alloy conductor has a conductivity of 61.2% IACS and improved physical properties.

EXAMPLE NO. 11

Example No. 8 is repeated except the Bell Furnace temperature is raised to 600° F. and held 1½ hours prior to cooling. The annealed and insulated multifilament conductor has a conductivity of 61.5% IACS and improved physical properties.

EXAMPLE NO. 12

The alloy of Example No. 8 is cast into a continuous bar which is hot-rolled to yield a continuous *f* temper rod of ⅜ inch diameter. The rod is then cold-drawn through successively constricted dies to yield #14 AWG wire. The wire is then redrawn on a Synchro Model BG–16 wire drawing machine which includes a Synchro Resistoneal continuous in line annealer. The wire is drawn to #28 AWG at a finishing speed of 3,300 feet per minute and the in line annealer is operated at 52 volts with a transformer tap setting at No. 8. The annealed wire is then parallel stranded with five other wires produced in similar fashion. The stranded unit is then insulated by extruding poly (vinyl chloride) around the conductor unit. The annealed and insulated multifilament alloy conductor has a conductivity of 62% IACS and improved physical properties.

EXAMPLE NO. 13

The alloy of Example No. 8 is cast into a continuous bar which is hot-rolled to yield a continuous *f* temper rod of ⅜ inch diameter. The rod is then cold-drawn on a Synchro Style No. FX 13 wire drawing machine which includes a continuous in line annealer. The rod is drawn to #12 AWG wire at a finishing speed of 2,000 feet per minute and the in line annealer voltage at preheater #1 is 35 volts, at preheater #2 is 35 volts, and at the annealer is 22 volts. The three transformer taps are set at #5. The annealed wire is bunch stranded with four other wires produced in similar fashion. The stranded unit is then continuously insulated by being passed through an extrusion head where poly (vinyl chloride) is applied around the outer surfaces thereof. The annealed and insulated multifilament alloy conductor has a conductivity of 62% IACS and improved physical properties.

EXAMPLE NO. 14

An aluminum alloy is prepared with an aluminum content of 99.42 weight percent, iron content of 0.50 weight percent, silicon content of 0.055 weight percent and trace amounts of typical impurities. The alloy is cast into a continuous bar which is immediately hot-rolled to yield a continuous rod. The rod is then cold-drawn through successively constricted dies, without intermediate anneals, to yield No. 12 AWG hard wire. The hard wire is then concentrically stranded by a tubular strander with six other wires produced in a similar fashion. The stranded unit is then collected on a thirty inch bobbin until the collected wire weighs approximately 250 pounds. The bobbin is then placed in a cold General Electric Bell Furnace and the temperature therein is raised to 480° F. The temperature of the furnace is held at 480° F. for three hours, after which the heat is terminated and the furnace cools and the bobbin is removed. The stranded unit is then fed from the bobbin to and through an extrusion head and insulated with polyvinyl chloride. Under testing, it is found that the multifilament insulated alloy wire has a conductivity of 61.6% IACS and improved physical properties.

It should be understood that the present invention concerns insulated aluminum alloy multifilament conductors. Particular examples of specific insulated multifilament conductors or cables formed therefrom as encompassed by the present invention include building cable, auto ignition and primary cable, underground building cable, battery cable and battery cable ground wire, aircraft cable, harness cable, neon sign cable, radio hookup cable, fire alarm and burglar alarm cable, fixture cable, control cable, machine tool cable, enunciator cable, heater cord, lamp cord, flexible electric cord, welding and mining cable, locomotive cable, armor cable, SEU cable with a flexible cross-link polyolefin insulation, service drop, braided cable, appliance cable, and composite cable of aluminum or copper strands about a steel or aluminum alloy core.

While this invention has been described in detail with particular reference to preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinbefore and as defined in the appended claims.

I claim:

1. Insulated multifilament aluminum alloy conductor including individual filaments which have a minimum conductivity of sixty-one percent IACS and a diameter or greatest perpendicular distance between parallel faces of between 0.460 inch end 0.0031 inch consisting essentially of from about 0.55 to about 0.95 weight percent iron; no more than about 0.15 weight percent silicon; less than 0.05 weight percent each of trace elements selected from the group consisting of vanadium, copper, manganese, magnesium, zinc, boron and titanium; and from about 98.95 to less than 99.45 weight percent aluminum, said alloy containing no more than 0.15 total weight percent trace elements and having an iron to silicon ratio of 8:1 or greater.

2. Insulated multifilament conductor of claim 1 consisting essentially of from about 0.80 to about 0.95 weight percent iron; from about 0.07 to about 0.15 weight percent silicon; and from about 98.95 to about 99.13 weight percent aluminum.

3. Insulated multifilament conductor of claim 1 consisting essentially of from about 0.55 to about 0.80 weight percent iron; from about 0.01 to about 0.07 weight percent silicon; and from about 99.15 to about 99.40 weight percent aluminum.

4. Insulated multifilament conductor of claim 1 consisting essentially of from about 0.55 to less than 0.60 weight percent iron; and from about 0.01 to about 0.15 weight percent silicon; and from about 99.10 to about 99.44 weight percent aluminum.

5. Insulated multifilament conductor of claim 1 wherein the insulation material is selected from the group consisting of poly(vinyl chloride), neoprene, rubber, polyethylene, polypropylene and cross-linked polyethylene.

6. Insulated multifilament conductor of claim 5 wherein the insulation has a thickness of between 0.001 inch and 0.400 inch.

7. Insulated multifilament conductor of claim 1 wherein the individual filaments are grouped together in a formation selected from the group consisting of concentric stranded; bunch stranded, parallel stranded, and rope lay stranded.

8. Insulated multifilament aluminum alloy conductor including individual filaments which have a minimum conductivity of sixty-one percent IACS, and a diameter or greatest perpendicular distance between parallel faces of between 0.460 inch and 0.0031 inch and contain substantially evenly distributed iron aluminate inclusions in a concentration produced by the presence of about 0.45 to about 0.95 weight percent iron in an alloy mass consisting essentially of about 98.95 to less than 99.45 weight percent aluminum; no more than about 0.15 weight percent silicon; and less than 0.05 weight percent each of trace elements selected from the group consisting of vanadium, copper, manganese, magnesium, zinc, boron, and titanium, said iron aluminate inclusions having a particle size of less than 2,000 angstrom units.

9. Insulated multifilament conductor of claim 8 wherein iron is present in a concentration of about 0.55 to about 0.95 weight percent; silicon is present in a concentration of about 0.01 to about 0.15 weight percent; and aluminum is present in a concentration of about 98.95 to about 99.44 weight percent.

10. Insulated multifilament conductor of claim 8 wherein iron is present in a concentration of about 0.80 to about 0.95 weight percent; silicon is present in a concentration of about 0.07 to about 0.15 weight percent; and aluminum is present in a concentration of about 98.95 to about 99.13 weight percent.

11. Insulated multifilament conductor of claim 8 wherein iron is present in a concentration of about 0.50 to about 0.80 weight percent; silicon is present in a concentration of about 0.01 to about 0.07 weight percent; aluminum is present in a concentration of about 99.15 to about 99.40 weight percent.

12. Insulated multifilament conductor of claim 8 wherein iron is present in a concentration of about 0.45 to less than 0.60 weight percent; silicon is present in a concentration of about 0.01 to about 0.15 weight percent; and aluminum is present in a concentration of about 99.10 to about 99.54 weight percent.

13. Insulated multifilament conductor of claim 8 wherein iron is present in a concentration of about 0.55 to less than 0.60 weight percent; silicon is present in a concentration of about 0.01 to about 0.15 weight percent; and aluminum is present in a concentration of about 99.10 to about 99.44 weight percent.

14. Insulated multifilament conductor of claim 8 wherein the insulation material is selected from the group consisting of poly(vinyl chloride), neoprene, polyethylene, polypropylene and cross-linked polyethylene.

15. Insulated multifilament conductor of claim 14 wherein the insulation has a thickness of between 0.001 inch and 0.400 inch.

16. Insulated multifilament conductor of claim 8 wherein the individual filaments are grouped together in a formation selected from the group consisting of concentric stranded; bunch stranded, parallel stranded, and rope lay stranded.

17. Insulated multifilament conductor of claim 1 wherein the silicon content is from 0.01 to 0.15 weight percent, the individual trace element content is from 0.0001 to 0.05 weight percent, and the total trace element content is from 0.004 to 0.15 weight percent.

18. Insulated multifilament conductor of claim 8 wherein the silicon content is from 0.01 to 0.15 weight percent, the individual trace element content is from 0.0001 to 0.05 and the total trace element content is from 0.004 to 0.15 weight percent.

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RICHARD O. DEAN, Primary Examiner

U.S. Cl. X.R.

29—191.6; 148—2; 174—126

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,513,251 Dated May 19, 1970

Inventor(s) Roger J. Schoerner

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Under "References Cited" add:
United States Patents

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(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

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