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[54] **ALUMINUM ALLOY ELECTRICAL CONDUCTOR**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 54,563, July 13, 1970, abandoned.

[52] **U.S. Cl.** ..... **29/193,** 29/527.7, 75/138, 148/2, 148/11.5 A, 148/32, 164/76

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[58] **Field of Search** ..... 75/138–148; 148/32, 32.5, 2, 11.5 A; 29/193, 193.5, 527.7; 164/76

[56] **References Cited**

UNITED STATES PATENTS

3,160,513	12/1964	Westerveld et al.	117/35
1,579,481	4/1926	Hybinette	75/138
1,916,087	6/1933	Titus	75/147
1,945,297	1/1934	Sterner-Rainer	75/147
2,245,166	6/1941	Stroup	75/147

FOREIGN PATENTS OR APPLICATIONS

498,227	1/1939	Great Britain
706,721	6/1931	France

OTHER PUBLICATIONS

Krupotkin et al., The Mechanical Properties of AVOOO Aluminum with small additions of Different Elements, Metals Abstract, December, 1969, 312291.

Krupotkin, Influence of Small Additions of Iron, Nickel and Cobalt on Mechanical Properties and Conductivity of Aluminum, Slavic Library, Nov. 30, 1965, Battell Memorial Institute.

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[57] **ABSTRACT**

Aluminum alloy electrical conductors are produced from aluminum base alloys containing from about 0.20% to about 1.60% by weight cobalt, about 0.30% to about 1.30% nickel, optionally up to about 2.0% of additional alloying elements, and from about 97.0% to about 99.5% by weight aluminum. The alloy conductors have an electrical conductivity of at least 57%, based on the International Annealed Copper Standard (IACS), and improved properties of increased thermal stability, tensile strength, percent ultimate elongation, ductility, fatigue resistance and yield strength as compared to conventional aluminum alloys of similar electrical properties.

26 Claims, No Drawings

ALUMINUM ALLOY ELECTRICAL CONDUCTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our copending application Ser. No. 54,563, filed July 13, 1970, now abandoned.

The present invention concerns an aluminum base alloy especially suited for producing high strength lightweight electrical conductors including wire, rod and other such articles of manufacture. The present alloy is particularly well suited for use as a wire, rod, cable, bus bar, tube connector, termination, receptacle plug, or electrical contact device for conducting electricity.

Aluminum base alloys are finding wider acceptance in the marketplace of today because of their light weight and low cost. One area where aluminum alloys have found increasing acceptance is in the replacement of copper in the manufacture of electrically conductive wire. Conventional electrically conductive aluminum alloy wire (referred to as EC) contains a substantial amount of pure aluminum and trace amounts of impurities such as silicon, vanadium, iron, copper, manganese, magnesium, zinc, boron, and titanium.

Even though desirable in terms of weight and cost, aluminum alloys have received far less than complete acceptance in the electrical conductor marketplace. One of the chief reasons for the lack of complete acceptance is the range of physical properties available with conventional EC aluminum alloy conductors. If the physical properties, such as thermal stability, tensile strength, percent elongation, ductility and yield strength, could be improved significantly without substantially lessening the electrical conductivity of the finished product, a very desirable improvement would be achieved. It is accepted, however, that addition of alloying elements, as in other aluminum alloys, reduces conductivity while improving the physical properties. Consequently, only those additions of elements which improve physical properties without substantially lessening conductivity will yield an acceptable and useful product.

It is an object of the present invention, therefore, to provide a new aluminum alloy electrical conductor which combines improved physical properties with acceptable electrical conductivity. These and other objects, features and advantages of the present invention will be apparent from a consideration of the following detailed description of an embodiment of the invention.

In accordance with the invention, the present aluminum base alloy is prepared by mixing cobalt, nickel and optionally other alloying elements with aluminum in a furnace to obtain a melt having requisite percentages of elements. It has been found that suitable results are obtained with cobalt present in a weight percentage of about 0.20% to about 1.6%. Superior results are achieved when cobalt is present in a weight percentage of about 0.5% to about 1.0% and particularly superior and preferred results are obtained when cobalt is present in a percentage by weight of about 0.6% to about 0.8%.

Suitable results are obtained with nickel present in a weight percentage of about 0.3% to about 1.3%. Superior results are achieved when nickel is present in a weight percentage of 0.4% to about 0.8% and particularly superior and preferred results are obtained when nickel is present in a percentage by weight of about 0.45% to about 0.65%.

The aluminum content of the present alloy may vary from about 97.0% to about 99.5% by weight with superior results being obtained when the aluminum content varies between about 97.8% and 99.2% by weight. Since the percentages for maximum and minimum aluminum do not correspond with the maximums and minimums for alloying elements, it should be apparent that suitable results are not obtained if the maximum percentages for all alloying elements are employed. If commercial aluminum is employed in preparing the present melt, it is preferred that the aluminum, prior to adding to the melt in the furnace, contain no more 0.1% total of trace impurities.

Optionally the present alloy may contain an additional alloying element or group of alloying elements. The total concentration of the optional alloying elements may be up to 2.0% by weight; preferably from about 0.1% to about 1.5% by weight is employed. Particularly superior and preferred results are obtained when 0.1% to about 1.0% by weight of total additional alloying elements is employed.

Additional alloying elements include the following:

ADDITIONAL ALLOYING ELEMENTS

Magnesium	Scandium	Terbium
Iron	Thorium	Erbium
Copper	Tin	Neodymium
Silicon	Molybdenum	Indium
Zirconium	Zinc	Boron
Cerium	Tungsten	Thallium
Niobium	Chromium	Rubidium
Hafnium	Bismuth	Titanium
Lanthanum	Antimony	Carbon
Tantalum	Vanadium	
Cesium	Rhenium	
Yttrium	Dysprosium	

Superior results are obtained with the following additional alloying elements in the percentages, by weight, as shown:

PREFERRED ADDITIONAL ALLOYING ELEMENTS

Magnesium	0.001 to 1.0%
Iron	0.001 to 1.0%
Copper	0.05 to 1.0%
Silicon	0.05 to 1.0%
Zirconium	0.01 to 1.0%
Niobium	0.01 to 2.0%
Tantalum	0.01 to 2.0%
Yttrium	0.01 to 1.0%
Scandium	0.01 to 1.0%
Thorium	0.01 to 1.0%
Rare Earth Metals	0.01 to 2.0%
Carbon	0.01 to 1.0%

Particularly superior and preferred results are obtained with the use of iron or magnesium as the additional alloying element. Suitable results are obtained with magnesium or iron in a percentage range of about 0.001 to about 1.0% by weight with superior results being obtained when about 0.025% to about 0.5% by weight is used. Particularly superior and preferred results are obtained when about 0.03 to about 0.1% by weight of magnesium or iron is employed.

The rare earth metals may be present either individually within the percentage range stated or as a partial

or total group, the total percentage of the group being within the percentage range stated previously.

It should be understood that the additional alloying elements may be present either individually or as a group of two or more of the elements. It should be understood, however, that if two or more of the additional alloying elements are employed, the total concentration of additional alloying elements should not exceed 2.0% by weight.

After preparing the melt, the aluminum alloy is preferably continuously cast into a continuous bar by a continuous casting machine and then, substantially immediately thereafter, hot-worked in a rolling mill to yield a continuous aluminum alloy rod.

One example of a continuous casting and rolling operation capable of producing continuous rod as specified in this application is contained in the following paragraphs. It should be understood that other methods of preparation may be employed to obtain suitable results but that preferable results are obtained with continuous processing. Such other methods include conventional extrusion and hydrostatic extrusion to obtain rod or wire directly, sintering an aluminum alloy powder to obtain rod or wire directly, casting rod or wire directly from a molten aluminum alloy, and conventional casting of aluminum alloy billets which are subsequently hot-worked to rod and drawn with intermediate anneals into wire.

CONTINUOUS CASTING AND ROLLING OPERATION

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 in its periphery which is 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 surfaces 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 has a minimum electrical conductivity of 57% IACS and may be used in conducting electricity or it may be drawn to wire of a smaller cross-sectional diameter.

To produce wire of various gauges, the continuous rod produced by the casting and rolling operation is processed in a reduction operation. 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. It has been found that the elimination of intermediate anneals is preferable during the processing of the rod and improves the physical properties of the wire. Processing with intermediate anneals is acceptable when the requirements for physical properties of the wire permit reduced values. The conductivity of the hard-drawn wire is at least 58% IACS. If greater conductivity or increased elongation is desired, the wire may be annealed or partially annealed after the desired

wire size is obtained and cooled. Fully annealed wire has a conductivity of at least 59% IACS. At the conclusion of the drawing operation and optional annealing operation, it is found that the alloy wire has the properties of improved tensile strength and yield strength together with improved thermal stability, percent ultimate elongation and increased ductility 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 batch annealed in a batch furnace. When continuously annealing, temperatures of about 450° F to about 1,200° F may be employed with annealing times of about five minutes to about 1/10,000 of a minute. Generally, however, continuous annealing temperatures and times may be adjusted to meet the requirements of the particular overall processing operation so long as the desired physical properties are achieved. In a batch annealing operation, a temperature of approximately 400° F to about 750° F is employed with residence times of about 30 minutes to about 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 physical properties are obtained.

It has been found that the properties of a Number 10 gauge (American wire gauge) fully annealed soft wire of the present alloy vary between the following figures:

Conductivity	Tensile Strength, psi.	% Elongation	Yield Strength, psi.
59% - 63+%	12,000–24,000	12% - 30%	8,000–18,000

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

EXAMPLE NO. 1

Various melts are prepared by adding the required amount of alloying elements to 1,816 grams of molten aluminum, containing less than 0.1% trace element impurities, to achieve a percentage concentration of elements as shown in the accompanying table; the remainder being aluminum. Graphite crucibles are used except in those cases where the alloying elements are known carbide formers, in which cases aluminum oxide crucibles are used. The melts are held for sufficient times and at sufficient temperatures to allow complete solubility of the alloying elements with the base aluminum. An argon atmosphere is provided over the melt to prevent oxidation. Each melt is continuously cast on a continuous casting machine and immediately hot-rolled through a rolling mill to ⅜ inch continuous rod. Wire is then drawn from the rod in both the as-rolled condition (hard rod) and after being annealed for 5 hours at 650° F (soft rod). The final wire diameter obtained is 0.107 inches, 10 gauge AWG. Wire from each type rod is tested in both the as-drawn condition (hard wire) and after being annealed for 5 hours at 650° F (soft wire).

The types of alloys employed and the results of the tests performed thereon are as follows:

TABLE I

Co	Fe	Mg	Ni	HR	SR	HW-HR	HW-SR	SW-HR	SW-SR	Properties
.80		.08	.80	2.1	27.5		1.7		25.1	% Elong.
				29,400	15,900		34,700		15,870	UTS
				62.62	60.06		59.56		60.47	% IACS
.30		.10	.90	1.2	21.0	2.2	2.3	22.7	23.0	% Elong.
				29,400	16,040	40,530	33,300	17,450	16,700	UTS
				59.34	59.75	58.14	58.81	59.95	60.01	% IACS
.40	.80	.10	.40	2.8	20.0	2.0	2.5	22.9	24.5	% Elong.
				30,340	17,110	37,935	32,500	18,350	17,245	UTS
				59.19	60.65	58.64	59.66	60.65	60.72	% IACS

HR = Hard Rod
SR = Soft Rod
HW-HR = Hard wire drawn from Hard Rod
HW-SR = Hard Wire drawn from Soft Rod
SW-HR = Soft Wire drawn from Hard Rod
SW-SR = Soft Wire drawn from Soft Rod
% Elong. = Percent ultimate elongation
UTS = Ultimate Tensile Strength
% IACS = Conductivity in Percentage IACS

Soft wire and soft rod are the fully annealed forms of the products.

EXAMPLE NO. 2

An additional alloy melt is prepared according to Example No. 1 so that the composition is as follows in weight percent:

Cobalt	0.60%
Nickel	0.60%
Magnesium	0.07%
Aluminum	Remainder

The melt is processed to a No. 10 gauge soft wire from hard rod. The physical properties of the wire are as follows:

Ultimate Tensile Strength	18,800 psi
Percent Ultimate Elongation	21%
Conductivity	59.05% IACS

EXAMPLE NO. 3

An additional alloy melt is prepared according to Example No. 1 so that the composition is as follows in weight percent:

Cobalt	0.80%
Nickel	0.50%

-Continued

Misch Metal	1.0%
Aluminum	Remainder

Misch metal is a commercial designation for a blend of rare earth metals and Thorium obtained during the processing of Thorium metal.

The melt is processed to a No. 10 gauge soft wire from hard rod. The physical properties of the wire are as follows:

Ultimate Tensile Strength	18,500 psi
Percent Ultimate Elongation	19%
Conductivity	59.2% IACS

EXAMPLE NO. 4

An additional alloy melt is prepared according to Example No. 1 so that the composition is as follows in weight percent:

Cobalt	0.80%
Nickel	0.40%
Niobium	0.20%
Tantalum	0.20%
Aluminum	Remainder

The melt is processed to a No. 10 gauge soft wire from hard rod. The physical properties of the wire are as follows:

Ultimate Tensile Strength	19,380 psi
Percent Ultimate Elongation	19.5%
Conductivity	59.1% IACS

EXAMPLE NO. 5

An additional alloy melt is prepared according to Example No. 1 so that the composition is as follows in weight percent:

Cobalt	0.60%
Nickel	0.35%
Copper	0.20%
Silicon	0.18%
Aluminum	Remainder

The melt is processed to a No. 10 gauge soft wire from hard rod. The physical properties of the wire are as follows:

Ultimate Tensile Strength	17,000 psi
Percent Ultimate Elongation	19.5%
Conductivity	59.7% IACS

EXAMPLE NO. 6

An additional alloy melt is prepared according to Example No. 1 so that the composition is as follows in weight percent:

Cobalt	0.80%
Nickel	0.45%
Zirconium	0.30%
Aluminum	Remainder

The melt is processed to a No. 10 gauge soft wire from hard rod. The physical properties of the wire are as follows:

Ultimate Tensile Strength	18,600 psi
Percent Ultimate Elongation	18.5%
Conductivity	59.3% IACS

ADDITIONAL EXAMPLES

Additional alloy melts are prepared according to Example No. 1. The composition and the physical properties of No. 10 gauge soft wire from hard rod of the alloy melts are as follows:

TABLE 2

Example No.	Co	Ni	Mg	UTS in psi	% Elongation	% IACS Conductivity
1193	.2	.6		15,400	21.9	61.55
1194	.2	.8		15,625	27.8	61.23
1195	.8	.6	.1	18,200	27.0	59.50

Through testing and analysis of an alloy containing 0.80 weight percent cobalt, 0.30 weight percent nickel, and the remainder aluminum, it has been found that the present aluminum base alloy after cold working includes an intermetallic compound precipitate. The compound is identified as cobalt aluminate (Co_2Al_9). The cobalt intermetallic compound is found to be very stable and especially so at high temperatures. The compound also has a low tendency to coalesce during annealing of products formed from the alloy and the compound is generally incoherent with the aluminum matrix. The mechanism of strengthening for this alloy is in part due to the dispersion of the cobalt intermetallic compound as a precipitate throughout the aluminum matrix. The precipitate tends to pin dislocation sites which are created during cold working of the wire formed from the alloy. Upon examination of the cobalt intermetallic compound precipitate in a cold drawn wire, it is found that the precipitates are oriented in the direction of drawing. In addition, it is found that the precipitates are rod-like or plate-like in configuration and a majority are less than 2 microns in length and less than ½ micron in width.

A characteristic of high conductivity aluminum alloy wires which is not indicated by the historical tests for tensile strength, percent elongation and electrical conductivity is the possible change in properties as a result of increases, decreases or fluctuations of the temperature of the strands. It is apparent that the maximum operating temperature of a strand or series of strands will be affected by this temperature characteristic. The characteristic is also quite significant from a manufacturing viewpoint since many insulation processes require high temperature thermal cures.

It has been found that the aluminum alloy wire of the present invention has a characteristic of thermal stability which exceeds the thermal stability of other aluminum alloy wires. In order to demonstrate this feature a group of wires is prepared for testing decrease in tensile and yield strength in response to ageing at established temperatures and times. The samples have composi-

tions and are processed as shown in the following table:

TABLE III

Sample	Co	Fe	Si	Al	Processing
No. 1	—	0.60	0.05	Remainder	Continuous casting and immediate hot rolling; drawing to flat magnet wire with no intermediate anneals and then partially annealed.
No. 2	—	0.47	0.045	Remainder	Billet casting; homogenization and rolling; drawing with intermediate anneals to flat magnet wire and then partially annealed.
No. 3	—	0.60	0.045	Remainder	Billet casting; homogenization and rolling; drawing with intermediate anneals to form flat magnet wire and then partially annealed.
No. 4	0.80	Ni 0.60	—	Remainder	Continuous casting and immediate hot rolling; drawing to flat magnet wire with no intermediate anneals and then partially annealed.

The results of the test are reproduced in the following table:

TABLE IV

SAMPLE	160°C-AGEING TEMP. TIME	DECREASE IN YS	DECREASE IN UTS	TIME	190–200°C AGEING TEMP. DECREASE IN YS	DECREASE IN UTS
No. 1	100 hrs.	0	0	100 hrs.	600 psi	1200 psi
	500 hrs.	1,800 psi	0	670 hrs.	4,200 psi	1200 psi
No. 2	100 hrs.	0	0	100 hrs.	2,700 psi	2300 psi
	500 hrs.	1,800 psi	0	550 hrs.	9,300 psi	5000 psi
No. 3	100 hrs.	1,400 psi	0			
				NO	TEST	
	480 hrs.	2,800 psi	0			
No. 4	100 hrs.	0	0			
	500 hrs.	0	0	550 hrs.	0	0

YS = Yield Strength
UTS = Ultimate Tensile Strength

A significant aspect shown by the results of these tests is the lack of thermal stability obtainable with several aluminum alloys. The test sample wires identified as No. 2 and 3 show a significant decrease in thermal stability in the yield and tensile strength tests and alloy No. 2 has almost completely softened after a 550 hour soak period at 190°–200° C. On the other hand, the wire fabricated from the present alloy demonstrates a high degree of thermal stability by exhibiting zero decreases in yield and tensile strength.

For the purpose of clarity, the following terminology used in this application is explained as follows:

Aluminum alloy rod — A solid product that is long in relation to its cross-section. Rod normally has a cross-section of between 3 inches and 0.375 inches.

Aluminum alloy wire — A solid wrought product that is long in relation to its cross-section, which is square or rectangular with sharp or rounded corners or edges, or is round, a regular hexagon or a regular octagon, and whose diameter or greatest perpendicular distance between parallel faces is between 0.374 inches and 0.0031 inches.

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.

We claim:

1. Aluminum alloy electrical conductor having a minimum conductivity of 57% IACS consisting essentially of from about 0.20 to about 1.60 weight percent cobalt, from about 0.30 to about 1.30 weight percent nickel, the remainder being aluminum with associated trace elements, said aluminum alloy electrical conductor having the following properties when measured as a No. 10 A.W.G. fully annealed wire:

Tensile strength	12,000 - 24,000 psi
Elongation	12% - 30%
Yield strength	8,000 - 18,000 psi

2. Aluminum alloy electrical conductor of claim 1, further including an additional alloying element selected from the group consisting of magnesium and iron, in an amount ranging from 0.001 to 1.0 weight percent.

3. Aluminum alloy electrical conductor of claim 1, further including iron as an additional alloying element in an amount ranging from about 0.1% to about 0.5%.

4. Aluminum alloy electrical conductor of claim 1, further including magnesium as an additional alloying element in an amount ranging from about 0.1% to about 0.5%.

5. Aluminum alloy electrical conductor according to claim 1, wherein the weight percentages of the constituents are as follows:

Cobalt	0.80%
Nickel	0.50%
Misch Metal	1.0%
Aluminum	remainder

6. Aluminum alloy electrical conductor according to claim 1 wherein the weight percentages of the constituents are as follows:

Cobalt	0.80%
Nickel	0.40%
Niobium	0.20%
Tantalum	0.20%
Aluminum	remainder

7. Aluminum alloy electrical conductor according to claim 1 wherein the weight percentages of the constituents are as follows:

Cobalt	0.60%
Nickel	0.35%
Copper	0.20%
Silicon	0.18%
Aluminum	remainder

8. Aluminum alloy electrical conductor according to claim 1 wherein the weight percentages of the constituents are as follows:

Cobalt	0.80%
Nickel	0.45%
Zirconium	0.30%
Aluminum	remainder

9. The aluminum alloy electrical conductor of claim 1 wherein said conductor is in the form of a rod.

10. The aluminum alloy electrical conductor according to claim 1 wherein said conductor is in the form of a wire.

11. Method of preparing an aluminum alloy conductor having a minimum conductivity of at least 57% IACS comprising the steps of:

A. alloying from about 0.20 to about 1.60 weight percent cobalt with about 0.30 to about 1.30 weight percent nickel, the remainder being aluminum with associated trace elements;

B. casting the alloy in a moving mold formed between a groove in the periphery of a rotating casting wheel and a metal belt lying adjacent said groove for a portion of its length;

C. hot rolling the cast alloy substantially immediately after casting while the cast alloy is in substantially that condition as cast to form a continuous rod;

said aluminum alloy conductor having the following properties when measured as No. 10 A.W.G. fully annealed wire:

Tensile strength	12,000 – 24,000 psi
Elongation	12% – 30%
Yield strength	8,000 – 18,000 psi

12. Method of preparing an aluminum alloy conductor in accordance with claim 11 including the further step of drawing said conductor through wire-drawing dies, without annealing the conductor between drawing dies, to form wire.

13. The method according to claim 11 wherein the alloying step also includes the addition of alloying agents taken from the group consisting of iron and magnesium, in an amount ranging from 0.001 to 1.0%, by weight.

14. The method according to claim 13 wherein said additional alloying element is iron in an amount ranging from about 0.1% to about 0.5%, by weight.

15. The method according to claim 13 wherein said additional alloying element is magnesium in an amount ranging from about 0.1% to about 0.5%, by weight.

16. The method according to claim 11 wherein the alloying step also includes the addition of magnesium in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Magnesium	0.03% to 0.10%
Aluminum	97.8% to 99.20%

17. The method according to claim 11 wherein the alloying step also includes the addition of iron in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Iron	0.03% to 0.10%
Aluminum	97.8% to 99.20%

18. The method according to claim 11 wherein the alloying step also includes the addition of misch metal in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.80%
Nickel	0.50%
Misch metal	1.0%
Aluminum	remainder

19. The method according to claim 11 wherein the alloying step also includes the addition of niobium and tantalum in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.80%
Nickel	0.40%
Niobium	0.20%
Tantalum	0.20%
Aluminum	remainder

20. The method according to claim 11 wherein the alloying step also includes the addition of copper and silicon in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.60%
Nickel	0.35%
Copper	0.20%
Silicon	0.18%
Aluminum	remainder

21. The method according to claim 11 wherein the alloying step also includes the addition of zirconium in an amount sufficient to yield an alloy having the following weight percentages:

Cobalt	0.80%
Nickel	0.45%
Zirconium	0.30%
Aluminum	remainder

22. Aluminum alloy electrical conductor of claim 1 wherein the weight percentage of the constituents are as follows:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Magnesium	0.03% to 0.10%
Aluminum	97.8% to 99.20%

23. Aluminum alloy electrical conductor of claim 1 wherein the weight percentages of the constituents are as follows:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Iron	0.03% to 0.10%
Aluminum	97.8% to 99.20%

24. Aluminum alloy rod of claim 9 wherein the weight percentages of the constituents are as follows:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Magnesium	0.03% to 0.10%
Aluminum	97.8% to 99.20%

25. Aluminum alloy rod of claim 9 wherein the weight percentages of the constituents are as follows:

Cobalt	0.60% to 0.80%
Nickel	0.45% to 0.65%
Iron	0.03% to 0.10%
Aluminum	97.8% to 99.20%

26. Aluminum alloy electrical conductor having a minimum conductivity of 57% IACS consisting essentially of from about 0.20 to about 1.60 weight percent cobalt, from about 0.30 to about 1.30 weight percent nickel, the remainder being aluminum with associated trace elements, said aluminum alloy electrical conductor having the following properties when measured a a fully annealed wire:

Tensile strength: at least 12,000 psi

Yield strength: at least 8,000 psi.

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