

# UNITED STATES PATENT OFFICE.

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NICKEL ALLOY FOR HIGH RESISTANCES.

993,042.

Specification of Letters Patent.

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No Drawing.

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*To all whom it may concern:*

Be it known that I, WILBUR B. DRIVER, a citizen of the United States of America, and a resident of East Orange, State of New Jersey, have invented a new and useful Improvement in Nickel Alloys for High Resistances, which improvement is fully set forth in the following specification.

This invention relates to alloys intended especially for electrical resistances.

The object of the invention is to produce workable alloys which will have high electrical resistances, with high melting-points, and that will not deteriorate to any noticeable extent upon exposure to the atmosphere.

Various alloys have been known and used for electrical resistance, having more or less high electrical resistance, but as a rule the melting-points of these alloys are comparatively low, and many of them are not stable in their electrical properties and besides are liable to deteriorate from rust, etc.

Nickel is malleable, has a high melting-point, is practically non-corrosive, and is reasonably cheap. The alloys composed of nickel and manganese alone (disregarding any other substances that may be present as impurities) have quite a high electrical resistance, but one purpose of this invention is to increase the resistance of such alloys still further. In general also, by increasing the percentage of manganese in the alloy, the electrical resistance is increased; but there is a limit to the percentage of manganese that may be employed, because too much manganese will render the alloy unworkable. On the other hand, any increase of the percentage of nickel is the same as decreasing the percentage of manganese, and the resistance is thereby reduced.

Although copper, for instance, has a far lower specific electrical resistance than nickel and manganese, yet if a small proportion of copper (or, so far as I am aware, any other similar metal or combination of metals)—one per cent. or more—be added to the nickel and manganese, the resulting alloy has a higher electrical resistance than the alloy composed of nickel and manganese alone. For example, an alloy of 90 parts nickel and 10 parts manganese gives a specific resistance of about 36; if 10 parts of the nickel be displaced by 10 parts of copper, making an alloy of 80 parts nickel,

10 parts copper, and 10 parts manganese, a specific resistance of about 53 is obtained; where 20 parts of nickel are displaced by the same amount of copper, the resulting composition consisting of 70 parts nickel, 20 parts copper, and 10 parts manganese, has a specific resistance of about 60. Again, whereas a composition composed of 80 parts nickel and 20 parts manganese gives a specific resistance of about 65; I have found that the substitution of 10 parts of nickel by the same amount of copper, producing the alloy 70 parts nickel, 10 parts copper, and 20 parts manganese, gives a resistance of about 80; and an alloy consisting of 60 parts nickel, 20 parts copper, and 20 parts manganese, gives a resistance of about 90.

I am aware that alloys composed mainly of copper, with more or less manganese and a small amount of nickel, have been known and used. But these alloys are, from a physical standpoint, essentially copper alloys, that is, copper is the principal ingredient. On the other hand, my alloys are composed essentially of nickel (and manganese) in which the nickel largely predominates, to which is added a comparatively small amount of copper (or its equivalent); my alloys are not in this sense "copper alloys". My present alloys differ further from these copper alloys in having a high melting-point and in producing conductors that are stable in their electrical properties.

The proportions above given are for the sake of illustration only, since the spirit of my invention consists, in the first place, in employing a large part, say fifty per cent. or over of nickel; in the second place, in employing at least two other ingredients in addition to this excess of nickel; in the third place, specifically, in having a substantial amount of manganese as one of the other two or more ingredients; and, finally, more specific still, in having a small but appreciable amount of copper (or an equivalent) as a third ingredient in addition to the manganese with the excess of nickel (and any other ingredients that may be present, if any).

Having thus described my invention, I claim:

1. An alloy of nickel, manganese and copper, the content of nickel being not less than fifty per cent. by weight of the whole, said

- alloy being characterized by having a specific resistance greater than an alloy of the first-named ingredients.
2. An alloy consisting of nickel not less than fifty per cent., manganese from ten to thirty per cent., and the remainder of copper, said alloy having the characteristics specified.
  3. An alloy containing copper and manganese with fifty per cent. (50%) or over of nickel.
  4. An alloy containing fifty per cent. (50%) or more of nickel, ten per cent. (10%) or more of manganese, and forty per cent. (40%) or less of copper.
  5. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel with more than one other ingredient.
  6. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel with more than one other ingredient in substantial amounts.
  7. An electrical resistance consisting of an alloy containing copper and manganese with fifty per cent. (50%) or over of nickel.
  8. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel, an appreciable amount of manganese, and a small but appreciable amount of copper, substantially as described.
  9. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel, an appreciable amount of manganese, and at least one other ingredient.
  10. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel, about from ten per cent. to thirty per cent. (10%-30%) of manganese, and at least one other ingredient.
  11. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel, about from ten per cent. to thirty per cent. (10%-30%) of manganese, and copper.
  12. An electrical resistance consisting of an alloy containing fifty per cent. (50%) or over of nickel, about from ten per cent. to thirty per cent. (10%-30%) of manganese, and not more than forty per cent. (40%) of copper.
  13. An alloy containing sixty per cent. (60%) or more of nickel and manganese, with copper.
  14. An electrical resistance consisting of an alloy containing 70% or more of nickel, with more than one other ingredient.
  15. An electrical resistance consisting of an alloy containing 80% or more of nickel, with more than one other ingredient.
  16. An electrical resistance consisting of an alloy containing 60% or more of nickel, with more than one other ingredient.
  17. An electrical resistance consisting of an alloy containing 60% or more of nickel, with more than one other ingredient, in substantial amounts.
  18. An electrical resistance consisting of an alloy containing 70% or more of nickel, with more than one other ingredient.
  19. An electrical resistance consisting of an alloy containing 70% or more of nickel, with more than one other ingredient, in substantial amounts.
  20. An electrical resistance consisting of an alloy containing 80% or more of nickel, with more than one other ingredient.
  21. An electrical resistance consisting of an alloy containing 80% or more of nickel, with more than one other ingredient in substantial amounts.
  22. An alloy containing 60% or more of nickel, with copper and manganese.
  23. An alloy containing 70% or more of nickel, with copper and manganese.
  24. An alloy containing 80% or more of nickel, with copper and manganese.
  25. An alloy containing 60 or more parts of nickel, about 10 to 30 parts of manganese, and about 5 to 30 parts of copper.
  26. An alloy containing 70 or more parts of nickel, about 5 to 25 parts of manganese, and about 5 to 20 parts of copper.
  27. An alloy containing 80 or more parts of nickel, about 5 to 15 parts of manganese, and about 5 to 15 parts of copper.
  28. An alloy containing fifty per cent. (50%) or more of nickel, an appreciable amount of manganese, and at least one other ingredient.
  29. An alloy containing eighty per cent. (80%) or more of nickel, with more than one other ingredient in substantial amounts.
  30. An alloy containing fifty per cent. (50%) or more of nickel, an appreciable amount of manganese, and a small but appreciable amount of copper.
  31. An alloy containing fifty per cent. (50%) or more of nickel, about from ten per cent. to thirty per cent. (10%-30%) of manganese, and at least one other ingredient.
  32. An alloy containing fifty per cent. (50%) or more of nickel, about from ten per cent. to thirty per cent. (10%-30%) of manganese, and copper.
  33. An alloy containing sixty per cent. (60%) or more of nickel, an appreciable amount of manganese, and at least one other ingredient.
  34. An electrical resistance element consisting of an alloy containing sixty per cent. (60%) or more of nickel, an appreciable amount of manganese, and at least one other ingredient.
  35. An electrical resistance consisting of an alloy containing sixty per cent. (60%) or more of nickel, with copper and manganese.
  36. An electrical resistance consisting of an alloy containing seventy per cent. (70%)

or more of nickel, with copper and manganese.

37. An electrical resistance consisting of an alloy containing eighty per cent. (80%) or more of nickel, with copper and manganese.

38. An electrical resistance consisting of an alloy containing sixty or more parts of nickel, about from ten to thirty parts of manganese, and about from five to thirty parts of copper.

39. An electrical resistance consisting of an alloy containing seventy or more parts of nickel, about from five to twenty-five

parts of manganese, and about from five to 15 twenty parts of copper.

40. An electrical resistance consisting of an alloy containing eighty or more parts of nickel, about from five to fifteen parts of manganese, and about from five to fifteen 20 parts of copper.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILBUR B. DRIVER.

Witnesses:

C. A. L. MASSIE,

R. L. SCOTT.