# UNITED STATES PATENT OFFICE.

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## ALLOY FOR ELECTRICAL RESISTANCE.

943,066. Specification of Letters Patent. Patented Dec. 14, 1909.

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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 Alloys for Electrical Resistance, which improvement is fully set forth in the following specification.

This invention relates to alloys intended for electrical conductors.

The object of the invention is to provide a conductor having a very high melting-point as well as a very high electrical resistance, and that shall also be to a large extent non-corroding. It is quite desirable in a resistance-alloy for some lines of work to have a very high melting-point, as the material is often subjected to excessive temperatures.

I have discovered that alloys of nickel and manganese, especially where the nickel predominates, present the three qualities mentioned. Pure manganese is brittle and easily broken. An alloy consisting of nickel and manganese, in which the nickel predominates, is ductile and malleable, and is suitable for making into sheets or wires. Pure nickel has a comparatively low resistance, only about 12 microhms per cubic centimeter. A mixture of 95% of nickel with 5% of manganese gives a resistance of about 25 microhms per cubic centimeter, or twice that of pure nickel. 80% nickel with 20% manganese gives a resistance of about 70 microhms; while 70% nickel and 30% manganese has a resistance of about 100 microhms. The melting-point of these alloys is estimated to be in the neighborhood of 2500 F. These alloys all have the advantage of not corroding readily on exposure to the air. They have the further advantage of electric stability, differing in this respect from alloys of copper and manganese alone; copper-manganese alloys seem to require one or more additional ingredients, whereas these nickel-manganese alloys (where there is a high percentage of nickel) seem to require no third ingredient to "fix" their electrical properties.

The percentages given are merely for the sake of illustration, since I do not confine myself to any particular percentage, except that for mechanical reasons it is generally preferable that the nickel should be 50% or more of the mixture, in fact about 70%, since where there is more than 30% of manganese, there is strong tendency to brittleness, which is objectionable if the alloy has to be worked into wire or sheet form. Moreover, while I have spoken of a composition consisting of manganese and nickel, of course the presence of any other ingredient or ingredients would not be a departure from the spirit of my invention so long as such addition does not to a material extent interfere with or lessen the three desired qualities.

While as just said it is generally preferable that the nickel should preponderate over the manganese, yet an alloy in which the manganese preponderates will also give high resistance and high melting-point, and will be practically non-corrosive, but there should generally be not less than fifty per cent. (50%) of nickel and not less than five per cent. (5%) of manganese.

Having thus described my invention, I claim:

1. An alloy containing manganese, with sixty per cent. (60%) or more of nickel.

2. An electrical resistance element composed essentially of nickel and manganese.

3. An electrical resistance element composed of an alloy containing five per cent. to forty per cent. (5%–40%) of manganese, with fifty per cent. (50%) or more of nickel.

4. An alloy composed essentially of nickel and manganese, having ten per cent. to thirty per cent. (10%–30%) of manganese.

5. An alloy composed essentially of nickel and manganese, having ten per cent. to forty per cent. (10%–40%) of manganese.

6. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having five per cent. to thirty per cent. (5%–30%) of manganese.

7. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having ten per cent. to forty per cent. (10%–40%) of manganese.

8. An alloy composed essentially of nickel and manganese, having twenty per cent. to thirty per cent. (20%–30%) of manganese.

9. An alloy composed essentially of nickel and manganese, having twenty per cent. to forty per cent. (20%–40%) of manganese.

10. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having twenty per cent. to thirty per cent. (20%–30%) of manganese.

11. An electrical resistance element consisting of an alloy composed essentially of

nickel and manganese, having twenty per cent. to forty per cent. (20%–40%) of manganese.

12. An alloy composed essentially of nickel and manganese, having about thirty per cent. (30%) of manganese.

13. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having about thirty per cent. (30%) of manganese.

14. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having forty per cent. (40%) or more of nickel, and forty per cent. (40%) or more of manganese.

15. An alloy composed essentially of nickel and manganese, having sixty per cent. (60%) or more of nickel.

16. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having sixty per cent. (60%) or more of nickel, and ten per cent. (10%) or more of manganese.

17. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having sixty per cent. (60%) or more of nickel.

18. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having sixty per cent. (60%) or more of nickel, and five per cent. (5%) or more of manganese.

19. An electrical resistance element consisting of an alloy having sixty per cent. (60%) or more of nickel, and five per cent. (5%) or more of manganese.

20. An alloy composed essentially of nickel and manganese, having seventy per cent. (70%) or more of nickel.

21. An alloy composed essentially of nickel and manganese, having seventy per cent. (70%) or more of nickel, and ten per cent. (10%) or more of manganese.

22. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having seventy per cent. (70%) or more of nickel.

23. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having seventy per cent. (70%) or more of nickel, and ten per cent. (10%) or more of manganese.

24. An alloy composed essentially of nickel and manganese, having eighty per cent. (80%) or more of nickel.

25. An alloy composed essentially of nickel and manganese, having eighty per cent. (80%) or more of nickel, and ten per cent. (10%) or more of manganese.

26. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having eighty per cent. (80%) or more of nickel.

27. An electrical resistance element consisting of an alloy composed essentially of nickel and manganese, having eighty per cent. (80%) or more of nickel, and ten per cent. (10%) or more of manganese.

28. An alloy containing sixty per cent. (60%) or more of nickel, and five per cent. (5%) or more of manganese.

29. An alloy containing sixty per cent. (60%) or more of nickel, and ten per cent. (10%) or more of manganese.

30. An electrical resistance element consisting of an alloy containing sixty per cent. (60%) or more of nickel, and ten per cent. to thirty per cent. (10%–30%) of manganese.

31. An alloy containing sixty per cent. (60%) or more of nickel, and fifteen per cent. to thirty per cent. (15%–30%) of manganese.

32. An electrical resistance element consisting of an alloy containing sixty per cent. (60%) or more of nickel, and fifteen per cent. to thirty per cent. (15%–30%) of manganese.

33. An alloy containing sixty per cent. (60%) or more of nickel, and twenty per cent. to thirty per cent. (20%–30%) of manganese.

34. An electrical resistance element consisting of an alloy containing sixty per cent. (60%) or more of nickel, and twenty per cent. to thirty per cent. (20%–30%) of manganese.

35. An alloy containing seventy per cent. (70%) or more of nickel, and five per cent. to thirty per cent. (5%–30%) of manganese.

36. An electrical resistance element consisting of an alloy containing seventy per cent. (70%) or more of nickel, and five per cent. to thirty per cent. (5%–30%) of manganese.

37. An alloy containing seventy per cent. (70%) or more of nickel, and ten per cent. to thirty per cent. (10%–30%) of manganese.

38. An electrical resistance element consisting of an alloy containing seventy per cent. (70%) or more of nickel, and ten per cent. to thirty per cent. (10%–30%) of manganese.

39. An alloy containing seventy per cent. (70%) or more of nickel, and ten per cent. to twenty per cent. (10%–20%) of manganese.

40. An electrical resistance element consisting of an alloy containing seventy per cent. (70%) or more of nickel, and ten per cent. to twenty per cent. (10%–20%) of manganese.

41. An alloy containing eighty per cent. (80%) or more of nickel, and five per cent. to twenty per cent. (5%–20%) of manganese.

42. An electrical resistance element consisting of an alloy containing eighty per cent. (80%) or more of nickel, and five per

cent. to twenty per cent. (5%–20%) of manganese.

43. An alloy containing eighty per cent. (80%) or more of nickel, and ten per cent. to twenty per cent. (10%–20%) of manganese.

44. An electrical resistance element consisting of an alloy containing eighty per cent. (80%) or more of nickel, and ten per cent. to twenty per cent. (10%–20%) of manganese.

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.