PROCESS OF PRODUCING A UNITARY MULTIPLE WIRE STRAND

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

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PROCESS OF PRODUCING A UNITARY MULTIPLE WIRE STRAND

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Filed Mar. 21, 1968, Ser. No. 16,398

3 Claims. (Cl. 29—470.5)

This application is a continuation-in-part of my co-pending application Serial No. 622,055, filed November 14, 1956, now abandoned.

This invention relates to the production of unitary multiple wire strand and particularly to extremely fine wire strand.

In industrial products, such as small diameter cables and various kinds of wire cloth, it is necessary that fine wire, having a diameter in the order of .01 inch, be employed, and because of the very fineness of such wire, difficulties are often encountered in satisfactorily meeting problems of wear, fatigue, corrosion and the like that are involved in the use of such products. One such situation is found in connection with Fourdrinier wire belts where repeated bending of the warp wires tend toward fatigue failure, while wear of the knuckles of the woven fabric produces weak points in the belt where fatigue failures may occur. The problem is accentuated by the fact that where the metal for a fine wire is selected to provide good fatigue characteristics, the selected metal invariably is one that possesses poor wear properties, and as a further complication, corrosion conditions that are to be encountered must be taken into consideration in the selection of the metal to be used.

In view of the foregoing it is the primary object of the present invention to provide a product which, in external characteristics and fineness, is comparable to fine wire of the general kind and site heretofore used in small cables, wire cloth and the like, but which possesses increased strength and better wear and fatigue characteristics. A further object related to the foregoing is to provide a fine metal strand which in workability is comparable to fine wire, but which combines the desirable properties of high fatigue resistance, good flexibility and high resistance to wear, abrasion, corrosion and corrosive-fatigue.

More specifically, it is an object of this invention to provide a fine or small diameter drawn wire strand having the transversely compacted individual wires thereof permanently united by an internal matrix having portions disposed as thin films between and brazed to adjacent faces of the individual wires of the strand.

Another specific object is to provide a unitary drawn wire strand of extremely small diameter wherein the outer wires are of stainless steel so as to possess high wear and corrosion resistance and in which the smallness or fineness of the wires enables the stainless steel of the wires to attain high fatigue resistance and good flexibility.

Other and further objects of the present invention will be apparent from the following description and claims, and are illustrated in the accompanying drawings, which, by way of illustration, show preferred embodiments of the present invention and the principles thereof, and what is now considered to be the best mode in which to apply these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the invention.

The drawings:

FIG. 1 is a cross sectional elevational view at a greatly enlarged scale of a drawn brazed strand embodying the invention;

FIG. 2 is a side elevational view of the strand in FIG. 1;

FIGS. 3 to 6 are side elevational views showing changes in form of the stranded material as the strand of FIGS. 1 and 2 is produced;

FIGS. 3A to 6A are cross sectional views of the structures shown in FIGS. 3 to 6 respectively;

FIGS. 7 and 8 are views similar to FIG. 3A and showing different initial strands that may be used;

FIG. 9 is a cross sectional view of an initial strand where the center wire has a sleeve-like covering of brazing material; and

FIG. 10 is a view similar to FIG. 9 wherein all of the wires have sleeve-like coverings of brazing material.

For purposes of disclosure the invention is herein illustrated in FIGS. 1 and 2 as embodied in a drawn brazed strand 20 which as under the present invention may be made in diameters such as .01 inch or smaller, so that it must be kept in mind that in FIGS. 1 and 2, as well as in all other figures, the structure has been shown at a greatly enlarged scale. The strand 20 of this invention comprises a core wire 21 and a plurality of outer wires 22 that have been stranded and then drawn and processed under the methods of this invention, as will be described, so that the core wire 21 assumes the general form of a regular polygon while the outer wires 22 each assume the general form of a truncated sector. In this form the side faces of the outer wires oppose each other in substantial radial planes while the short base of each truncated sector opposes the related side of the generally polygonal core wire 21.

As shown, particularly in FIG. 1 of the drawings, the core wire 21 and the several outer wires 22 are united by an internal metallic matrix 24 extended between the several opposed surfaces of these wires and brazed to such surfaces so as to secure the wires 21 and 22 together.

In FIGS. 3 to 6 and 3A to 6A, the method of producing the stranded wire 20 is illustrated at an enlarged scale, such scale being somewhat smaller than the scale at which the strand has been shown in FIGS. 1 and 2. To illustrate the extent of the enlargement that has been employed, it may be observed that the strand 20, when it is to be used as the warp of a Fourdrinier wire cloth, may in many instances be less than .01 inch in diameter. Thus the drawn brazed strand from which the present illustrations were made had a diameter of .0093 inch so that the illustration included in FIGS. 1 and 2 is at about three hundred and twenty-five times the actual size. The drawn strand 20, particularly when used as the warp of a Fourdrinier belt, is made basically from stainless steel wire so that it may be used in those paper making machines where an acid condition of the pulp materially reduces the life of the belts made from other materials or metals.

Thus the drawn strand 20 of FIGS. 1 and 2 is produced from a seven wire strand 220 that is shown in FIGS. 3 and 3A and the outer wires 222 are of the normal circular cross section and are stranded in surrounding relation to a core wire 221. The outer wires 222 used for producing a final drawn strand having a diameter of .0093 inch, the initial diameter of the strand made up of seven wires may be substantially .0115 inch, and may be made up from outer wires 222 and core wire 221 having diameters of substantially .0105 inch.

In the production of drawn brazed strand of this invention as shown in FIGS. 3 to 6, for use in making a Fourdrinier belt, the outer wires 222 of the strand 220 are made from stainless steel, and the core wire 221 is made from a wire that is at least in part made up of a brazing material such as 22% nickel, 78% copper, or phosphor bronze brazing alloy that may be melted and brazed at a temperature of about 2200° F. or below. The initial
strand 220 is formed through the usual stranding processes so as to have the usual twist that is afforded by the helical winding of the outer wires 221, 222, and 223 of FIGS. 3 and 3A, the strand 220 has relatively wide and deep helical grooves 222G formed in its outer surface of the adjacent outer wires 222, and in addition, helical internal passages 222S of a modified triangular cross sectional form are present between the core wire 321 and the adjacent pairs of outer wires 222.

Starting with the strand 220 that is shown in FIGS. 3 and 3A, the strand is subjected to a plurality of successive drawing and brazing-annelling operations, the number and sequence of which is determined by the importance of the strand and the degree of final twist to be attained. The combination of the drawing operations followed by brazing-annelling operation so as to obtain the desired twist that is afforded by the usual stranding processes is followed by a brazing-annelling operation, so that the strand is successively modified as to its diameter, cross sectional form, and relation of the several wires of the strand. The successive changes in form that are caused in a typical sequence of drawing operations is illustrated in FIGS. 3A to 6A. FIG. 3A illustrates the forming of the strand 220 into a form with a flat helical groove that is formed by the brazing operation, preferably at about 1860° F. in a protective atmosphere, and this restores the softness of the various wires and causes additional flow of the brazing material of the center wire 421 onto the surfaces of the outer wires 420.

The strand 420 of FIGS. 5 and 5A is then subjected to a further drawing operation through a series of dies having diameters of .0150 inch, .0132 inch, .0118 inch, .0105 inch, and .0093 inch to produce the final strand that is shown in FIGS. 6 and 6A.

In this final forming operation the outer grooves between the outer wires 522 are eliminated so that they appear merely as fine lines 522G, and the sides of the outer wires 522 are quite flat and are disposed in substantially radial planes with respect to the center of the core wire 521. In the final drawing operation the outer wires 522 are pressed inwardly against the core wire 521 so that a core wire 521 is changed to a substantially regular polygonal form with substantially flat surfaces of the outer wires 522 engaging the respective sides of the core wire 521. In their final forming the several outer wires 522 have the general form of truncated sectors, the outer surfaces of which form parts of a generally cylindrical surface of the strand.

After the third drawing operation as above described, the drawn strand 520 is subjected to a third and final annealing-brazing operation at about 1850° F. in a protective atmosphere, this restores the desired degree of softness to the metals of the several wires, and completes the flow of the brazing material into the spaces between the several wires of the strand, and the flow of the brazing material thus forms the matrix 24 that is illustrated in FIG. 1 of the drawings. This matrix 24 has a somewhat spider-web-like form so that adjacent outer wires 22 are brazed together, and each of the outer wires 22 has its innermost surfaces brazed to the core wire 21. It will be recognized that temperature of the brazing-annelling operations may be varied depending upon the material of the several wires of the strand and depending at least in part upon the severity of the successive drawing operations.

In producing the drawn brazed strand as above described, the brazing material is uniformly distributed longitudinally of strand and this is achieved by forming the core wire 221 at least in part from a brazing metal. The desired uniformity of distribution of the brazing material in the strand may also be attained in other ways as illustrated in FIGS. 7 to 10 of the drawings. Thus, in FIG. 7 a preliminary strand is shown that is similar to that shown in FIGS. 3 and 3A, but in this instance both the core wire 221 and the outer wires 222 are made from stainless steel in a protective atmosphere, and in the brazing operation, the stainless steel of the outer wires is softened so as to prepare the same for further drawing operations, and a similar softening of the brazing material of the center wire 321 also takes place, coupled with a flowing of the material of the center wire to a limited degree onto the adjacent surface of the outer wires 322.

The strand 320 of FIGS. 4 and 4A is then subjected to a further drawing operation through a series of dies having diameters of .0234 inch, .021 inch, .0188 inch and .0168 inch, and this produces a further modified strand 420, FIGS. 5 and 5A, having a further modified core 421, and outer wires 422 that are modified as compared to the wires 322 of FIG. 4A. Here again the pitch of the helical grooves 422G has been increased and the grooves 422G have narrowed somewhat and reduced in depth. Further, there is a marked tendency shown in FIG. 5A for the engulfed areas of the outer wires 422 to assume a flattened form. At this stage in the processing of the strand, the inner surfaces of the outer wires 422 have undergone a flattening action on and with respect to the core wire 421.

At the conclusion of the second drawing operation, the strand 420 is subjected to a second brazing-annelling operation, preferably at about 1860° F. in a protective atmosphere, and this restores the softness of the various grooves 222G of FIGS. 3 and 3A.

In FIG. 9 a preliminary strand is illustrated in which all of the outer wires 222 and the inner wire 221 are made from stainless steel, and the brazing material that is required in producing the brazed strand is provided as an outer coating 228 that is secured as a sleeve about the inner wire 221. This may be done by winding or folding a flat thin ribbon of brazing material about the center wire 221 before the brazing operation or electroplating.

In FIG. 10 of the drawings a preliminary strand is shown in which all of the outer wires 222 and the inner wire 221 are formed from stainless steel, and the center wire 221 and all of the outer wires 222 are provided with a covering or coating 229 of a brazing material in the form of a sleeve as described in connection with FIG. 9. The preliminary strand of FIGS. 7 to 10 may be drawn and brazed in the manner hereinbefore described to pro-
duce a drawn brazed strand like that of FIGS. 1 and 2, but the strands produced in this instance have the core wire formed from stainless steel so as to embody added strength in the product.

From the foregoing description it will be apparent that the present invention provides a product which in external characteristics and fineness is comparable to the fine wire of the general kind heretofore used in small cables, wire cloth and the like. The product that is produced under the present invention has greatly improved strength and better wear and fatigue characteristics. Moreover, it will be evident that the fine metal strand that is provided under this invention has extremely high workability, and in addition it may be made primarily from a corrosive resistant and wear resistant material such as stainless steel, while at the same time attaining high fatigue resistance and good flexibility which has heretofore been unattainable where stainless steel has formed the major component of a wire or strand.

It will also be evident that the small diameter drawn strand of the present invention has the individual wires or filaments permanently united by an internal matrix so that this internal matrix, while holding the individual wires or filaments together as a unit, is at the same time protected against abrasive wear.

Thus while preferred embodiments of the invention have been illustrated herein, it is to be understood that changes and variations may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim:

1. The process of producing a unitary multiple wire strand which includes the steps of stranding a plurality of main wires as a core wire and spirally related outer wires with a plurality of smaller wires of brazing material in the spaces between the outer wires and the core wire, subjecting the assembly to a series of drawing operations, and subjecting the drawn product to a brazing temperature to braze the main wires to each other throughout the length of the strand.

2. The process of producing an elongated multifilament strand which includes the steps of arranging wires of brazing material extended along spaces between the main wires, drawing the assembled wires through a drawing die to compact the wires laterally and at the same time elongate the wires, and subjecting the drawn product to brazing temperature to braze the main wires to each other throughout the length of the strand.

3. The process of producing a unitary multiple wire strand which includes the steps of stranding a plurality of wires at least one of which includes brazing material in or on its surface, subjecting the assembly to a series of drawing operations, and subjecting the drawn product to a brazing temperature to braze the wires to each other throughout the length of the strand.

References Cited in the file of this patent

UNITED STATES PATENTS
1,943,087 Potter ..................... Jan. 9, 1934
2,050,298 Everett ..................... Aug. 11, 1936
2,066,525 Gilbert ..................... Jan. 5, 1937
2,132,235 Green ..................... Oct. 4, 1938
2,207,090 Edwards .................... July 9, 1940

FOREIGN PATENTS
140,154 Germany .................... Jan. 1, 1903