E. T. GREENFIELD.

TUBING.

APPLICATION FILED JAN. 25, 1906.

1,009,964.

Patented Nov. 28, 1911.

Fig. 4.

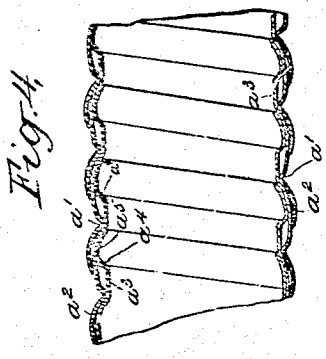


Fig. 1.

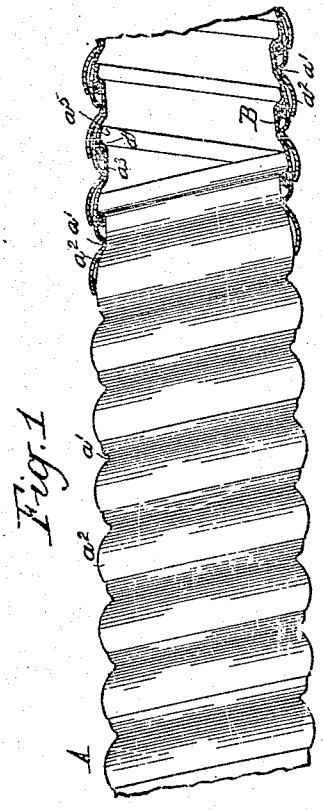


Fig. 2.

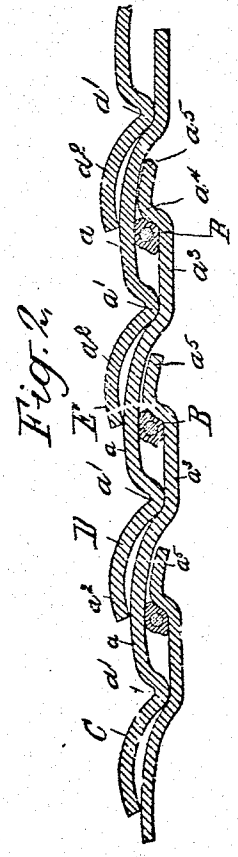
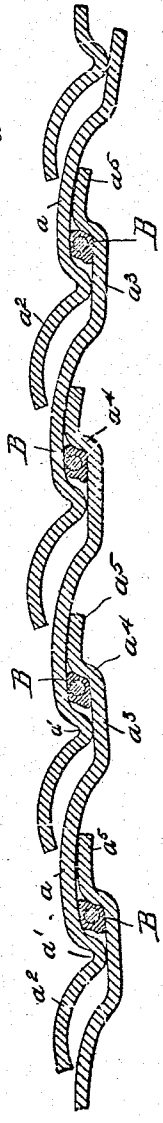


Fig. 3.



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TUBING.

1,009,964. Specification of Letters Patent. Patented Nov. 28, 1911.

Application filed January 25, 1906. Serial No. 297,912.

To all whom it may concern:

Be it known that I, EDWIN T. GREENFIELD, a citizen of the United States, and a resident of Kiamesha, in the county of Sullivan and State of New York, have invented certain new and useful Improvements in Tubing, of which the following is a specification.

The object of the invention is to produce a structure, suitable for use either as conduit or armor for electric conductors or cable or as hose for steam, water, air or other fluid agent, which may be inexpensively manufactured in large quantities and which shall be durable and efficient in operation.

A further object is to provide a structure of this character which shall be sufficiently flexible to meet the requirements of practical use and which shall amply protect the inclosed conductors or cable.

A further object is to provide a structure having maximum, and substantially uniform, strength throughout, whether the same be straight or bent.

In a preferred form of the invention, a single metallic strip is employed and this is given a peculiar lateral curvature by any suitable means, as, for instance, by passing such strip between suitable die-rolls as disclosed in Letters Patent No. 630,502 heretofore granted to me. After the strip has been so laterally curved, it is formed into successive spirals to form the tube, armor, hose, etc., each spiral interlocking with the next adjacent spiral but being movable relatively thereto. To accomplish this, the adjacent spirals have coacting portions permitting some freedom of relative movement but not actual separation. Additionally, each spiral overlaps the adjacent spiral on one side to a substantial extent and the extent of such overlap may be governed by the maximum permissible movement of said spiral relatively to said adjacent spiral. The overlap of the spirals is such that the edge of each spiral extends as far as the adjacent edge of the second spiral therefrom so that when the tube is straight there are at least two thicknesses of the metal from which the tube is made at all points throughout the length of the tube. In the preferred embodiment of the invention, the overlap is such that the edge of each spiral slightly overlaps the adjacent edge of the second spiral therefrom so that when the tubing is flexed as much as is permitted, these edges will not be separated lengthwise of the tubing and there will still be at least two thicknesses of the metal at all points. However, in view of the fact that the flexure permitted is usually very slight in these tubings and that when the tubing is in use it is curved only at widely separated points, it is frequently sufficient to have the edge of each spiral in substantial alinement transversely of the tube with the adjacent edge of the second spiral therefrom when the tube is straight; when such a tube is flexed there would be points on the outside of the curve where there would be but one thickness of the metal employed, but these points would be so narrow and of such small number compared to the full area of the tubing that they would not detract materially from the security afforded by the tubing and in many cases would not warrant the expense of the additional metal throughout the tube necessary to prevent the opening of these spaces of one thickness of metal on the curves.

The preferred form of the invention here referred to is illustrated in the accompanying drawings, in which—

Figure 1 is a side view, partly in section of a structure employing my invention; Fig. 2 is an enlarged section of a portion thereof; Fig. 3 is a similar view showing a portion of the structure bent or curved; and Fig. 4 is a section, similar to the sectional portion of Fig. 1, illustrating the structure unprovided with a gasket between the several spirals.

Referring to these drawings, in which the structure selected for the purpose of disclosure is that form adapted for use, for example, as conduit for electric wires, it will be seen that the tube is formed of a single (preferably metallic) strip A. By suitable means, as for instance the die-rolls above referred to, this strip is curved laterally so as to present substantially the cross-sectional outline shown in the drawings, *i. e.*, the central, outwardly bowed portion a and the inturned rib or flange a' and overlap a^2 on one side and, on the other, the substantially flat portion a^3, the rib or flange a^4 and underlap a^5. After the strip, so curved, has been spiraled, by any known means, each spiral overlaps the next adjacent spiral to an extent predetermined with respect to the maximum permissible movement of such spirals relatively to each other. This move-

ment may be limited by the distance between the rib or flange a' of one spiral and the rib or flange a^4 of the next adjacent and underlying spiral, as in the structure shown in Fig. 4. Or, I may, as said strip is spiraled, run a gasket B, which may be of wire having a covering of rubber, fabric or other suitable material, between the spirals, the same resting, preferably, against the rib or flange a^4 and lying between the portion a of one spiral and the portion a^3 of the next adjacent and underlying spiral, all as illustrated in Figs. 1, 2 and 3. Whether such gasket be, or be not, employed, the movement between the rib or flange a' and the rib or flange a^4 will determine the extent of the overlap of the portions a^2 and a^5, the latter being, in the preferred embodiment now under discussion, substantially twice the former. Thus, for example, I have indicated, by the reference letters C, D, and E, three of the spirals shown in Fig. 2, these occupying normal position as when the tube is substantially straight. It will be seen that the ribs or flanges a' are at the limit of their movement away from the gaskets B. If now, as when bending the tubing at an angle, spiral C be moved relatively to spiral D so as to bring the rib or flange a' of the latter into contact with the gasket B between spirals C and D, the extent to which the portion a^5 of spiral C underlaps the portion a^2 of spiral E will be correspondingly decreased. If spiral D be similarly moved relatively to spiral E, so as to bring the rib or flange a' of the latter into contact with the gasket B between spirals D and E, the extent to which the portion a^5 of spiral C underlaps the portion a^2 of spiral E will be still further decreased. Under no condition, however, may the spirals be moved so far apart from each other as to result in leaving an open space (longitudinally of the tube) between the free end of the portion a^5 and that of the portion a^2. These portions overlap to substantial extent when the tube is straight. When the tube is bent to maximum extent, they still overlap or, at least, are not moved past each other so as to leave a part of the tube wall of a single thickness of metal represented by the spiral between them. Substantially the latter (bent) condition of the tube and the consequent relation between the spirals is illustrated in Fig. 3.

Having disclosed herein merely a preferred form in which the invention may be employed, I desire it to be understood that the exact curvatures shown and described are not essential to a realization of the advantages of the improvement. Furthermore, instead of the construction shown wherein the edge of each spiral overlaps the edge of the second spiral therefrom, I may use strip-metal of somewhat less width, such that the edge of each spiral is in substantial alinement transversely of the tube with the edge of the second spiral therefrom when the tube is straight. Such a tube would have two thicknesses of the metal employed at all points, but when bent there would be very narrow spaces on the outside of the bend where there would be but one thickness.

Having now described my invention, what I claim as new therein and desire to secure by Letters Patent is as follows:—

1. A tube formed of a series of overlapping metallic spirals each interlocked with and movable relatively to the spirals adjacent thereto, said interlocks limiting the extent of relative movement and preventing such movement as to leave any point in the walls formed by said spirals of less than double the thickness of the material employed, substantially as described.

2. A tube formed of a single metallic strip and consisting of a series of overlapping spirals each interlocked with and movable relatively to the spirals adjacent thereto, said interlocks limiting the extent of relative movement and preventing such movement as to leave any point in the walls formed by said spirals of less than double the thickness of the material employed, substantially as described.

3. A tube formed of a series of interlocking relatively-movable metallic spirals, each spiral overlapping a substantial portion of the next adjacent spiral and a smaller portion of the second spiral therefrom, substantially as described.

4. A metallic strip having a central portion and, on each side thereof, a rib or flange and an outwardly extending portion beyond such rib or flange, one of said outwardly extending portions constituting an overlap and the other an underlap, said strip being formed into a series of interlocking spirals with each spiral overlapping portions of the next two adjacent spirals, substantially as described.

5. A metallic strip having a central portion and, on one side thereof, a rib or flange and on the other a depression and a rib or flange and integral, outwardly extending portions, one constituting an overlap and the other an underlap, said strip being formed into a series of interlocking spirals, a rib or flange on one spiral coacting with a rib or flange on the next adjacent spiral, and each spiral overlapping portions of the two next adjacent spirals, substantially as described.

6. A metallic strip having a central portion and, on each side thereof, a rib or flange and an outwardly extending portion, one of said outwardly extending portions forming an overlap and the other an underlap, and a gasket between said overlapping and under-

lapping portions, said strip being formed into a series of interlocking spirals, a rib or flange on one spiral coacting with a rib or flange on the other, with each spiral overlapping portions of the next two adjacent spirals, substantially as described.

7. A flexible tube consisting of a series of interlocking spirals formed of substantially flat metallic strip bent laterally to provide a central portion bounded on one side by a depressed portion and a rib or flange and on the other side by a rib or flange and a convexly curved portion extending outwardly from the axis of the tube and overlying the central portion of the next adjacent spiral, substantially as described.

8. A series of interlocking spirals each having a central portion bounded on one side by a rib or flange and an outwardly extending overlapping portion and on the other side by a depressed portion and a rib or flange and an underlapping portion, each of said spirals overlapping portions of the next two adjacent spirals, substantially as described.

9. A series of interlocking spirals each having a central portion bounded on one side by a rib or flange and on the other side by a depressed portion, a rib or flange and an extension, each of said spirals overlapping portions of the next two adjacent spirals, substantially as described.

10. A series of interlocking spirals formed of laterally curved metal, said spirals being relatively movable, and means combined with said spirals for preventing the edge of one spiral and the adjacent edge of the second spiral therefrom from separating beyond the point of substantial alinement, substantially as described.

11. A flexible metal tube comprising a metal strip wound spirally, the overlapping and underlying convolutions coöperating to form a double wall at every point throughout the length of the tube.

12. A flexible metal tube comprising a metal strip wound spirally, the overlapping and underlying convolutions coöperating to form a double wall at every point throughout the length of the tube, the metal of the strip being bent laterally to form longitudinally disposed outward projections which coöperate to lock the overlapping and underlying convolutions of the tube.

13. A flexible metal tube comprising a metal strip having an outwardly projecting flange at one edge, and bent laterally to form a longitudinal outwardly curved portion at its opposite edge, and an intermediate curved portion, said strip would spirally, the overlapping and underlying convolutions of the strip coöperating to form a tube having a double wall at every point, with the flanged edge of the strip constituting a portion of each underlying convolution and engaging the intermediate curved portion of the strip, and the outwardly curved edge portion of the strip constituting a portion of each overlapping convolution.

14. A flexible metal tube comprising a metal strip bent laterally to form a series of longtudinal outwardly projecting portions, said strip wound spirally and the overlapping and underlying convolutions cooperating to form a double wall at every point throughout the length of the tube.

15. A tube consisting of a series of interlocking spirals formed of a substantially flat metallic strip bent laterally to provide a central portion bounded on one side by a rib or flange and an outwardly extending overlapping portion and on the other side by a depressed portion, a rib or flange and an underlapping portion, substantially as described.

16. A tube consisting of a series of interlocking spirals formed of substantially flat, metallic strip bent laterally to provide a central portion bounded on one side by a rib or flange and on the other by a depressed portion and a rib or flange and having an extension beyond one of said ribs, the edge of each of said spirals being in alinement transversely of the tube with the adjacent edge of the second spiral therefrom, substantially as described.

17. A flexible tube formed of a single metallic strip and consisting of a series of interlocking spirals, each spiral overlapping a substantial portion of the next adjacent spiral and being of sufficient width to extend as far as the adjacent edge of the second spiral therefrom, so that when the tube is straight there are at least two thicknesses of the metal employed at all points in the wall of the tube, substantially as described.

18. A flexible tube formed of a single metallic strip and consisting of a series of interlocking spirals and a gasket between said spirals, each spiral overlapping a substantial portion of the next adjacent spiral and being of sufficient width to extend as far as the adjacent edge of the second spiral therefrom, so that when the tube is straight there are at least two thicknesses of the metal employed at all points in the wall of the tube, substantially as described.

This specification signed and witnessed this 15th day of January, 1906.

EDWIN T. GREENFIELD.

Witnesses:

I. McINTOSH,

D. S. EDMONDS.