The present invention relates to the coiling of metal strip, on edge, for the purpose of producing helical forms of varying pitch and diameter. The invention contemplates the provision of instrumentalties particularly adapted for producing helical forms closely encircling a supporting member, or core, with the convolutions of the helix uniformly spaced and with the wound strip providing corrugations closely engaging the core.

As will hereinafter appear, a helical form produced by practice of the invention is particularly suited for use in connection with the radiation of heat from a rod or a pipe, around which the form is coiled. Due to the uniform spacing of the convolutions of the coil and the provision of corrugations, or fins, in the strip closely engaging the supporting rod or pipe, a maximum heat radiating effect is obtained, thereby adapting the product of the invention for use in heating or refrigerating installations, or for other analogous purposes.

In carrying out the coiling operation, crimped strip is fed on edge, at a predetermined rate, to coiling tools rotatable about the coiling axis, and as the strip is wound, the outer edge thereof is flattened. The increase in length of one edge of the strip, resulting from the flattening, not only assists in the coiling action, but also causes the crimping along the other edge, on the inside of the coil, to draw together and very closely engage a rod or pipe on which the helix is being wound.

Other and further objects and advantages of the invention will appear from the following detailed description, taken in connection with the accompanying drawings, in which:

Fig. 1 is a front elevation of a machine embodying the invention.

Fig. 2 is a side elevation of the machine of Fig. 1.

Fig. 3 is a fragmentary section through the flier substantially along the line 3—3 of Fig. 1.

Fig. 4 is a plan view showing the drive for the machine, parts being broken away.

Fig. 5 is an enlarged fragmentary section through the coiling rolls.

Fig. 6 is a horizontal section substantially along the line 6—6 of Fig. 1.

Fig. 7 is a perspective view of a coil formed by the machine.

Like reference characters refer to like parts throughout the drawings.

Referring to Figs. 1 and 3, the machine comprises a base 1 having spaced upwardly extending portions 2 in which a hollow sleeve 3 is rotatably supported by anti-friction bearings 4. The sleeve 3 is provided at its forward end with a radial flange 5 on which the flier, indicated generally at 6, Fig. 2, is mounted and said sleeve has secured thereto between the upwardly extending portions 2 a sprocket 7 by which the sleeve 3 is rotated as will hereinafter appear.

The flier 6, Fig. 3, comprises members 8 and 10, the former of which is secured to the radial flange 5 of the sleeve 3 by screws 11, and said members are suitably secured together for rotation, as a unit, with the drive for the mechanism which feeds the strip material 1 mounted in an opening 9 between said members. The strip material 1 is carried on a reel 12 supported on guide rolls, not shown, mounted on the flier 15 to permit rotation of said reel relative to the flier and the strip material is drawn from said reel 12 over guide rolls 13, carried on brackets 14 secured to the flier, by a feeding and forming mechanism 16 carried on the flier.

The feeding and forming mechanism turns the strip material 1 into a plane perpendicular to the axis of the coil and forms uniform transverse corrugations in the strip. This mechanism 16, which is best shown in Fig. 6, comprises a pair of guide rolls 16 mounted on parallel axes perpendicular to the axis of the flier, said rolls 16 twisting the strip material 1 as it passes between said rolls from the guide roll 13 into a plane perpendicular to the axis of the flier. From the guide rolls, the strip material passes between a pair of crimping and feeding rolls 17, the peripheries of which rolls are corrugated for crimping said strip, said rolls being driven in timed relation to the rotation of the flier to procure a positive feeding movement of the strip material as the flier rotates.

Referring now to Fig. 3, the sleeve 3 has a hollow sleeve 18 extending therethrough, said sleeve 18 being mounted for rotation within the sleeve 3 with the forward end of the sleeve 18 supported by an anti-friction bearing member 19, the outer race of which is mounted in the member 8 and with the rearward end of said sleeve 18 journalned in a bracket 20 carried by one of the upwarding portions 2. A spur gear 21 is secured to the sleeve 18 between the members 8 and 10 and meshes with a spur gear 22, Fig. 1, journalned on a stud 23 carried by said members. The gear 22 meshes with an idler gear 24 journalned on a stud 25, said idler gear being in engagement with a pinion gear 26 secured to a shaft 27 journalned in the member 10. A bevel gear 28 is secured to the forward end of the shaft 27 and meshes with a bevel gear 30 secured to
the lower end of a shaft 31 to the upper end of which one of the crimping rolls 17 is secured; see Fig. 6. Rotation of the crimping rolls 17 is thus procured in response to rotation of the sleeve 18 relative to the flier 5.

As above stated, the rolls 17 are driven in timed relation to the flier and this timed relation is variable to procure a faster or slower speed as desired. To this end, the sleeve 5 which carries the flier has a sprocket 32, Figs. 2 and 3, secured to the rearward end thereof, and said sprocket is connected by a chain 33 to a sprocket 34 of a reduction gear set 35 of the usual construction.

The driven sprocket 36 of said reduction gear set 35 engages a chain 37 which passes over a sprocket 38 secured to the rearward end of the sleeve 18. The reduction gear set 35 is adjustable to procure various speed ratios between the sprockets 34 and 38, thereby to vary the relative rates of rotation of the sleeve 5 and the sleeve 18. Thus the rate of movement of the strip material a between the rolls 17 may be varied by adjustment of said gear set 35 with said feed rolls 17 driven in timed relation to the sleeve 3.

Referring now to Fig. 3, a sleeve 40 is mounted on the forward end of said sleeve 18 and is supported therein at the forward end by anti-friction bearings 41 between said sleeve 40 and the member 10. The rearward end of said sleeve is mounted in the bracket 28 and secured against rotation therein by a key 42. An arbor 43 which is mounted in the forward end of said sleeve has an axial opening therethrough for the reception of a coiling core or pipe 44 which is fed through said arbor and upon which the strip material a is coiled as it is fed by the rolls 17, with coiling rolls 45 and 46 cooperating with said arbor in forming the strip into a helical coil about said pipe.

The coiling roll 45 is driven in timed relation to the flier and operates to iron out the crimps or corrugations in the outer periphery of the helix to form the structure of Fig. 7 which will be hereinafter more completely described. Referring to Fig. 3, the coiling roll 45 is carried by a bracket 47 mounted on the face of the flier member 10, said bracket having a shaft 48 journaled in anti-friction bearings 49 carried within the flier therein parallel to the axis of the flier to which said roll is secured. A pinion 51 is also secured against rotation on said shaft and engages with pinion teeth 52 formed on the periphery of the arbor 43. A thrust bearing 53 supports the shaft against sideward movement resulting from the action of clamping the strip material a between a shoulder 54 on the roll 45, and a corresponding shoulder 55 on the arbor 43, see Fig. 5. An adjusting nut 53a cooperating with the bearing 53 determines the position of the roll 45 with respect to the roll 46 and the flier rotator, pressure between the opposed shoulders 54 and 55 flattens the strip around the outer periphery of the coil being formed. The nut 53a permits the pressure exerted by the roll 45 to be varied in order to obtain the desired degree of flattening. Radial adjustment of the roll 45 is obtained by means of a screw 56 in threaded engagement with the bracket 47, the screw being turnable in a lug 56a provided by the flier portion 10.

The rolling coil 46 is arranged for free rotation and for holding the flattened periphery of the strip a against the shoulder 55 on the arbor in the formation of the helix. The roll 46 is journaled on anti-friction bearings 57 and is carried by a bracket 58 which is adjustable radially relative to the axis of the flier by an adjusting screw 59 to permit the formation of coils of varying diameters.

The opposite sides of the coiling rolls 45 and 46 adjacent the periphery converge to form a tapering edge on said rolls which extends between adjacent coils of the helix as it is formed on the core and the forward end of the arbor 43 is undercut as indicated at 60. Therefore, the spacing between the side faces of the rolls 45 and 46 and the end of the arbor 43 is great enough to accommodate the crimps in the strip material and to define the depth of said crimps which become substantially deeper adjacent the inner portion of the helix during the formation of the coil. Since the diameter of the arbor in the portion where the gear teeth 52 are formed corresponds to the diameter of the outer periphery of the coil being formed, the coiling roll 45 procures an ironing or rolling action on the periphery of said helix which procures the desired flattening effect without excessive frictional engagement between the coil being formed and the coiling roll. Varying diameters of coil may be accommodated by radial adjustment of the coiling rolls 45 and 46 and by an increase or decrease in the size of the arbor 43 by substitution of an arbor of the desired size, the annular shoulder 55 on the arbor corresponding in diameter to the outside diameter of the coil being formed. Obviously the diameter of the pinion gear teeth 52 on the periphery of the arbor 43 corresponds to the diameter of the annular shoulder 55.

As above pointed out, the pipe or core 44 on which the coil is formed is moved in timed relation to the rotation of the flier. Referring to Fig. 4, the motor 51 carries a pinion 52 in mesh with a loose gear 53 on a drive shaft 54, the shaft carrying a sprocket 55 connected to the sprocket 7 on the sleeve 3 by a chain 66 to procure rotation of the flier. A sleeve 67 carrying the gear 63 is adapted to be connected to the shaft 64 by a clutch mechanism 68 of any suitable construction and the shaft 64 carries a worm, not shown, which meshes with a worm gear 69 on a shaft 70. A gear 71 which is also meshed to the shaft 70 meshes with a gear 72 on a countershaft 73, the latter carrying a gear 74 meshed with a gear 75 secured to the rearward end of a shaft 76 journaled in a housing 77 which carries the coiling rolls 45 and 46. The forward end of the shaft 76 carries the lower core feeding roll 78, Fig. 2, and has secured thereon a pinion, not shown, which meshes with a gear 80 on a shaft 81 also journaled in the housing 77. The forward end of the shaft 81 carries the upper feeding roll 82, the latter being adjustable vertically by a hand wheel 83 to procure a more or less positive clamping engagement between said rolls 78 and 82 to provide for a positive feeding movement of the core therebetween. Since the rotation of the rolls 78 and 82 is positively procured from the same shaft 84 which drives the flier and the associated mechanism, the core 44 is fed in timed relation to the rotation of the flier 5.

The helical form produced by operation of the above described mechanism is shown in Fig. 7, in which the pipe 44 has a helical groove thereon with elements of said coil substantially perpendicular to the axis of the pipe. The coil is provided with corrugations or crimps 85 which are of substantial depth adjacent the inner periphery of said coil and which gradually diminish toward the outer periphery 86 which is substantially flat. It will be noted that successive coils
of the helix are uniformly spaced apart on the core.

In the operation of the machine, the strip material, which is carried on the reel \(2 \) is drawn therefrom over the rolls \(3 \) by rotation of the crimping rolls \(7 \) in response to rotation of the sleeve \(18 \) which in turn is driven by rotation of the sleeve \(3 \). The crimping rolls \(7 \) form corrugations in the strip material \(a \) and feed it at a predetermined rate between the colling roll \(45 \) and the arbor \(43 \) which cooperate, as above pointed out, to iron out the corrugations in the outer edge of said strip, thereby lengthening said edge and causing the strip to coil around the pipe, this colling action being aided somewhat by the helix surface \(87 \) formed by the shoulder \(84 \). As the fier continues to rotate, the colling roll \(46 \) engages the strip material \(a \) and aids in the formation of the coil, said roll also maintaining consecutive coils spaced apart, as shown in Fig. 5. As the feeding action of the rolls \(17 \) is adjustable, as above pointed out, the length of strip material fed for each rotation of the fier may be accurately determined so that the strip material is collied on the pipe sufficiently tight to prevent subsequent shifting of the coils axial to the pipe. Furthermore, the elongation of the outer edge of the strip due to the flattening causes the crimps \(88 \) to be forced together to closely embrace the pipe. During the formation of the coils on the pipe, the latter is fed in predetermined timed relation to the rotation of the fier and accordingly determines the pitch of the helix since the core \(44 \) is fed forwardly a predetermined distance for each rotation of the fier.

In order to support the forward end of the core against vibratory movements as a result of the colling action, said end is carried by a horizontally movable carriage \(88 \) which is movable on a horizontal guideway \(90 \) supported by a stand \(91 \), the core being supported in a clamp \(92 \) on the carriage. As the core is fed and the strip collied thereon, the carriage moves away from the forming end. From the foregoing, it will be apparent that by the present invention there is provided an improved method and machine for colling helical forms from crimped metallic strip.

I claim:

1. A machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip feeding and crimping means carried by said fier, of a positively driven colling roll on said fier arranged to flatten out the corrugations along one edge of said strip.

2. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip feeding and crimping means carried by said fier, of a colling roll driven in timed relation to the fier, said roll operating to flatten out the corrugations in one edge of said strip.

3. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip feeding and crimping means carried by said fier, of a colling roll driven in timed relation to the fier, said roll operating to flatten out the corrugations in one edge of said strip, and means for controlling the degree of the flattening of said strip by said roll.

4. In a machine for colling strip material on a core, the combination with \( \bar{L} \) rotatable fier for carrying a supply of strip material, of strip feeding and crimping rolls carried by said fier and driven in timed relation thereto and positively driven colling means carried by said fier and operating to flatten out the crimps in one edge of the strip for forming said strip into a coil with crimps in said strip extending at right angles to the axis of the core.

5. In a machine for colling strip material on a core, the combination with a rotatable fier for carrying a supply of strip material, of strip feeding and crimping rolls carried by said fier and driven in timed relation thereto and positively driven colling means carried by said fier for forming said strip into a coil with crimps in said strip extending at right angles to the axis of the core, and means for feeding the core in timed relation to the rotation of the fier.

6. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material and strip crimping means carried by said fier, of a positively driven colling roll on said fier operating to flatten out the corrugations in one edge of said strip.

7. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip crimping means carried by said fier, of a colling roll driven in timed relation to the fier and operating to flatten out the corrugations in one edge of said strip.

8. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip crimping means carried by said fier, of positively driven means on the fier for flattening out the corrugations in one edge only of said strip.

9. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, and strip crimping means carried by said fier, of a colling roll driven in timed relation to the fier and operating to flatten out the corrugations in one edge of said strip, and means for controlling the degree of flattening of said strip by said roll.

10. In a machine for colling strip material, the combination with a rotatable fier for carrying a supply of strip material, of strip feeding and crimping rolls carried by said fier and driven in timed relation thereto and positively driven colling means carried by said fier and operating to flatten out the crumps in one edge of the strip for forming said strip into a coil with the crumps therein extending at right angles to the axis of the coil.

11. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, a tubular guide extending axially through said fier, means for feeding a tube through said guide and means for driving said fier, of a colling roll rotatably mounted on said fier with its periphery overlapping the adjacent end of said guide, and means carried by the fier to positively feed, for each revolution of the fier, a predetermined length of strip material between opposed surfaces of said colling roll and of said guide to wind the strip in spiral form on said tube.

12. In a machine of the class described, the combination with a rotatable fier for carrying a supply of strip material, a tubular guide extending axially through said fier, means for feeding a tube through said guide and means for driving said fier, of a colling roll carried by said fier with its periphery overlapping the adjacent end of said guide, means for rotatably driving said colling roll from said fier, a pair of feeding rolls mounted on said fier, and means for variably driving said feeding rolls in unison with said fier to cause said rolls to positively feed, for each
revolution of the flier, a predetermined length of strip between opposed surfaces of said colling roll and of said guide.

13. In a machine of the class described, the combination with a rotatable flier for carrying a supply of strip material, a tubular guide extending axially through said flier, means for feeding a tube through said guide and means for driving said flier, of a colling roll carried by said flier with its periphery overlapping the adjacent end of said guide, means for rotatably driving said colling roll from said flier, a pair of corrugated rolls rotatably mounted on said flier, and means for driving said rolls in timed relation with said flier for causing said rolls to crimp the strip material and positively feed, for each revolution of the flier, a predetermined length of crimped strip between opposed faces of said colling roll and said guide.

14. In a machine of the class described, the combination with a rotatable flier for carrying a supply of strip material, a tubular guide extending axially through said flier, means for feeding a tube through said guide and means for driving said flier, of a colling roll carried by said flier with its periphery overlapping the adjacent end of said guide, means for rotatably driving said colling roll from said flier, a pair of corrugated rolls rotatably mounted on said flier, and means for driving said rolls in timed relation with said flier for causing said rolls to crimp the strip material and positively feed, for each revolution of the flier, a predetermined length of crimped strip between opposed faces of said colling roll and said guide to wind the strip in spiral form on said tube, with its outer edge flattened by passage between said colling roll and guide.

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