Feb. 21, 1933. C. E. STURGIS 1,898,102

METHOD AND MACHINE FOR COILING SMALL WIRE

Filed Dec. 16, 1929 3 Sheets-Sheet 1

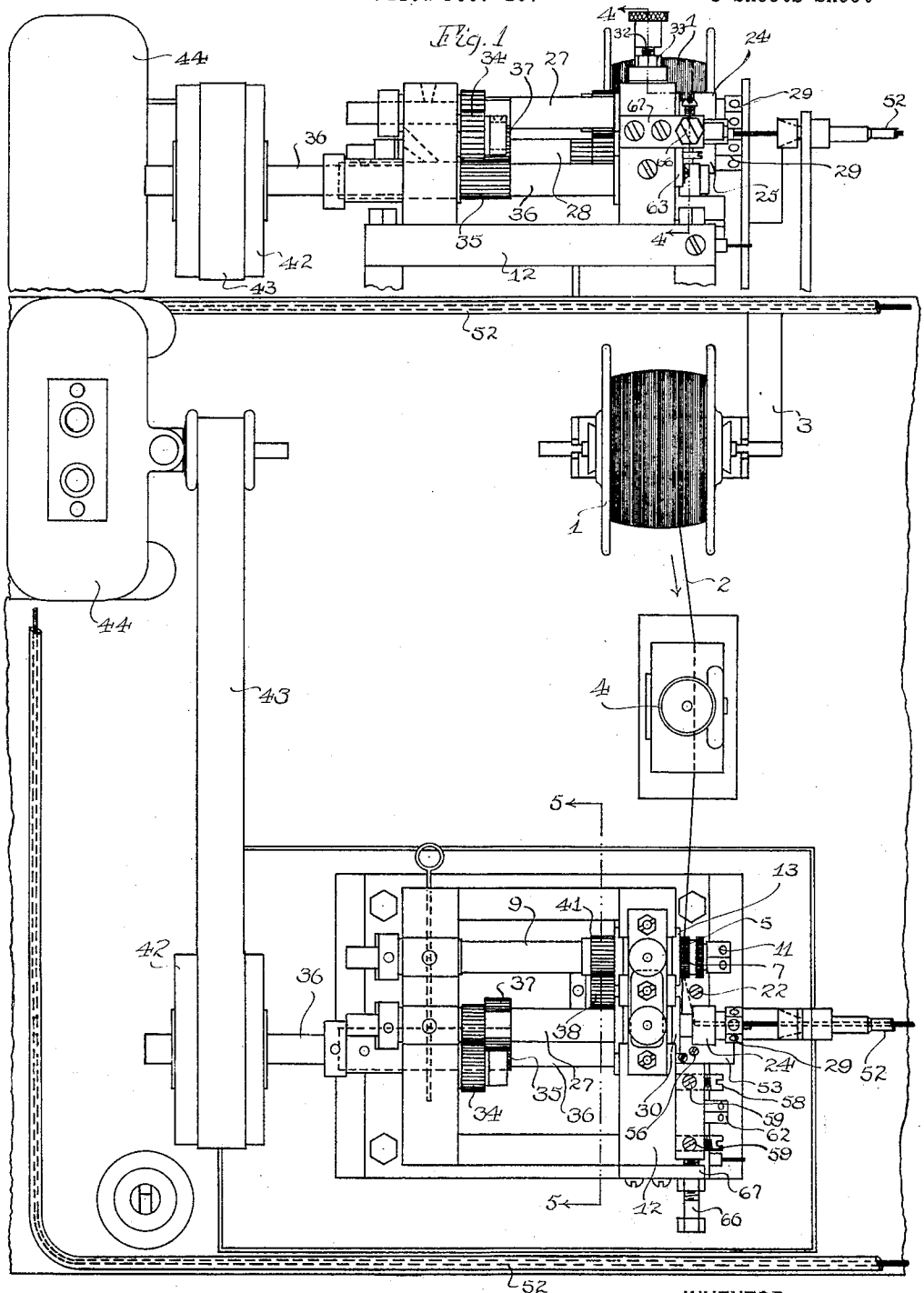


Fig. 2

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Filed Dec. 16, 1929 3 Sheets-Sheet 2

Fig. 3

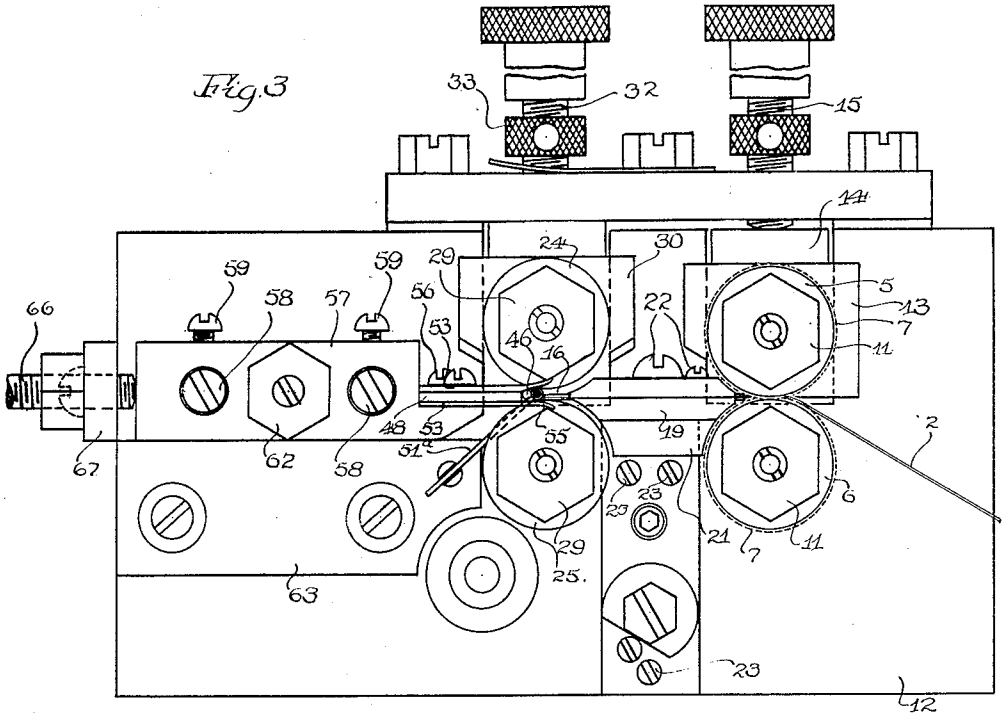
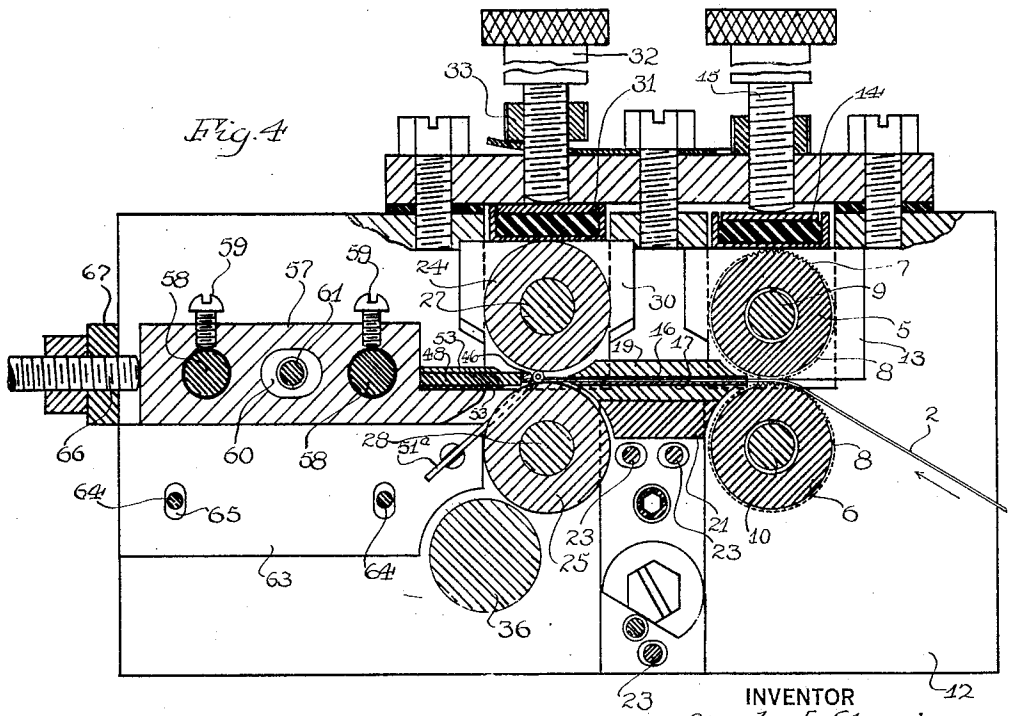


Fig. 4



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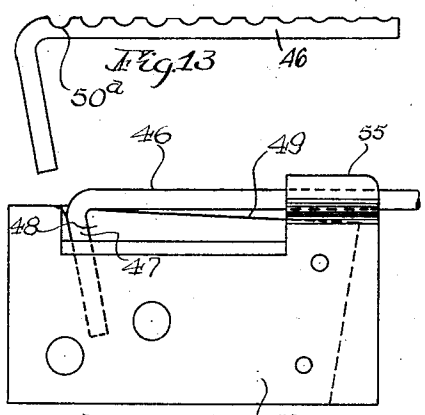
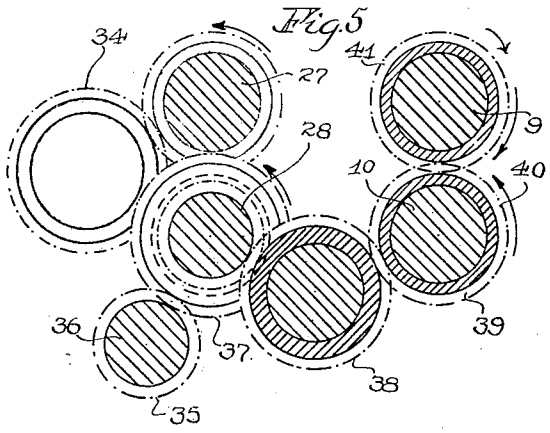
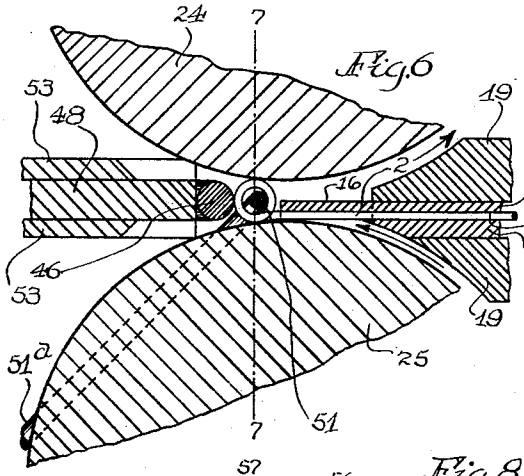
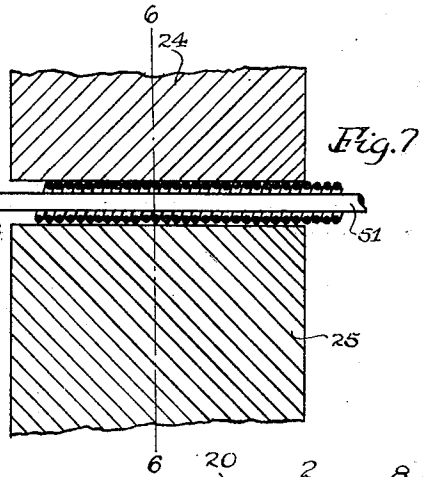
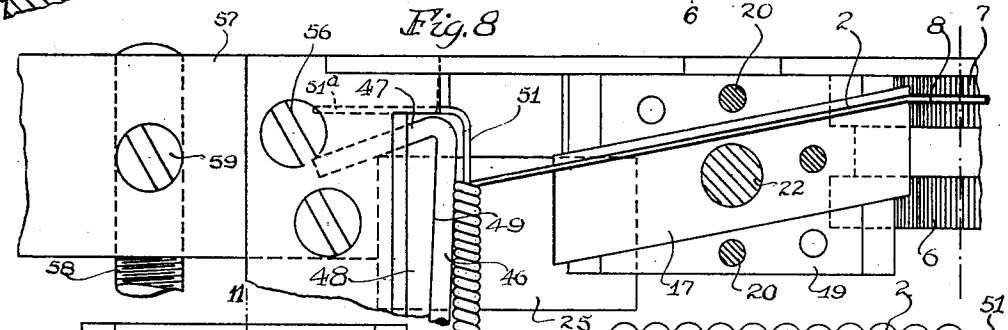


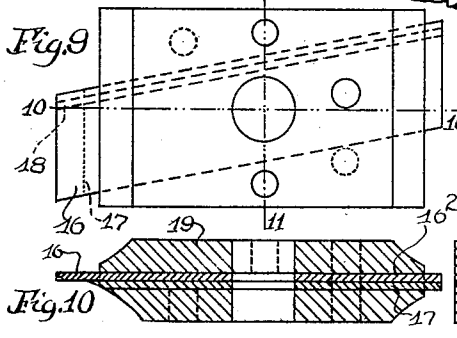
Fig.12

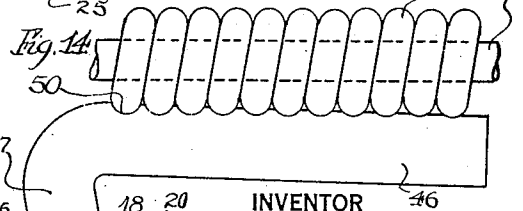












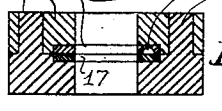


Fig.11

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UNITED STATES PATENT OFFICE

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METHOD AND MACHINE FOR COILING SMALL WIRE

Application filed December 16, 1929. Serial No. 414,317.

The present invention relates to a method of coiling small wire by a continuous action and to a machine employing such method. An object of the invention is to make it possible to coil a small wire so that the convolutions are set in abutment to obtain a coil which is not flimsy and will not buckle or bend readily. Another object of the invention is to insure the production of a coil having convolutions of uniform diameter with a uniform relationship between the convolutions. Still another object of the invention is to hold those convolutions of the coil in immediate proximity to the convolution being formed so that the convolutions maintain their relative positions for a time after formation to set the same. A still further object of the invention is to provide for resisting the movement of a number of convolutions in immediate proximity to the convolution being formed so as to cause the convolutions to hold their relative positions and form until they become set. Still another and further object of the invention is to gradually reduce the resistance on the convolutions as they proceed away from the convolution being formed.

To these and other ends, the invention consists of certain parts and combinations of parts all of which will be hereinafter described: the novel features being pointed out in the appended claims.

In the drawings;

Fig. 1 is an end view of a coiling machine constructed in accordance with this invention;

Fig. 2 is a plan view of the machine with parts broken away;

Fig. 3 is an enlarged side view of the feeding and coiling mechanisms;

Fig. 4 is a vertical section through the feeding and coiling mechanisms on the line 4—4, Fig. 1;

Fig. 5 is a sectional view showing gearing for driving the feeding and the coiling mechanisms on the line 5—5, Fig. 2;

Fig. 6 is a fragmentary section on the line 6—6, Fig. 7, showing the coil being formed;

Fig. 7 is a fragmentary section on the line 7—7, Fig. 6;

Fig. 8 is a fragmentary plan view showing the manner in which the wire is fed to the coiling mechanism;

Fig. 9 is a plan view of the guide;

Fig. 10 is a section on the line 10—10, Fig. 9;

Fig. 11 is a section on the line 11—11, Fig. 9;

Fig. 12 is a detail view of the die and its support before the depressions for the convolutions are formed therein;

Fig. 13 is a detail view of the die after the depressions for the convolutions are formed therein; and

Fig. 14 is an enlarged view showing the manner in which the coil convolutions contact with the die.

It has been known for years that a wire can be coiled from a long strand by forcing the wire against a curved die. So far as I know, however, no one prior to my invention has been able to form a coil for any considerable length in which the convolutions are uniformly held or set together in close or tight abutment while maintaining a uniform diameter in the coil, this type of coil being of considerable advantage in flexible controlling cables in which said coils are moved longitudinally to control different devices.

These results are secured in this invention by forcing the wire against a die to produce the convolutions and then imposing a resistance on the convolutions in immediate proximity to the convolution being formed to hold them against relative movement until the convolutions are set, this resistance preferably gradually decreasing as the convolutions move away from their point of formation.

The drawings illustrate a machine for carrying out the method, and this machine comprises, in this instance, a reel 1 on which the wire 2 to be coiled is wound, this reel being mounted to turn on a base frame 3. The wire 2, which, in this instance, is piano wire, leads to an oiler 4 which coats the wire with oil.

From the oiler, the wire leads to a forcing or pushing mechanism comprising, in this instance, a pair of rolls, 5 and 6. Each of these two rolls has two transversely milled surfaces 7, each milled surface having a peripheral or

circumferential groove 8 of less depth than the transverse grooves of the milled surface. These rolls, 5 and 6, are detachably secured on two projecting shafts 9 and 10, respectively by nuts 11. The lower shaft is mounted in a frame 12, whereas, the upper shaft 9 is mounted in adjustable bearing blocks 13 slidable vertically on the frame 12, the block 13 adjacent the roll 5 being engaged by a plate 14 which is acted upon by a pressure screw 15 so as to create the desired pressure on the wire passing between the rolls 5 and 6 in the opposed grooves 8.

From the forcing or pushing mechanism, the wire passes to a guide comprising, in this instance, two parallel abutting plates 16 and 17, one of which is formed with a groove 18 in its face opposed to the other plate. The plates are held between two clamping blocks 19, one of which has positioning pins 20 passing through the other, and both blocks being removably held to a bracket 21 by means of screws 22. It is apparent that the guide clamps may be readily removed and separated for the purpose of repairing or replacing the guide plates 16 and 17. The guide groove 18 is at an angle to the line of travel of the wire and this angle corresponds to the pitch of the convolutions to be formed from the wire.

The bracket 21 is adjustably supported on the frame 12 by screws 23 so that its position may be changed to agree with the diameter of the wire and also to correctly position the guide with reference to the feeding mechanism and the coiling mechanism.

The coiling mechanism, in this instance, embodies cylindrical rolls 24 and 25 having smooth peripheries, and between which the wire travels. The rolls do not press hard on the wire between them but merely guide the same to the coiling chamber 26 on the other side of the nearest portions of such rolls. The rolls 24 and 25 are detachably mounted on projecting end shafts 27 and 28 respectively being removably held on the shafts by nuts 29. The lower shaft 28 is journalled in the frame 12 while the upper shaft 27 is journalled in sliding bearing blocks 30, one of which is engaged by a wear plate 31 which in turn is engaged by an adjusting screw 32 held in adjusted position by a lock-nut 33. The shafts 27 and 28 are connected by a gear 34 while a gear 35 on a drive shaft 36 meshes with the gear 37 on the shaft 28. An idler gear 38 is geared to the shaft 28 and also to a gear 39 on the shaft 10 which by a gear 40 thereon is geared directly to a gear 41 on the shaft 9. On the shaft 36 is a pulley 42 which by a belt 43 connects with the shaft of an electric motor 44 so that the latter serves as a common means for operating the wire coiling rolls 24 and 25 and the feeding or pushing rolls 5 and 6.

After the wire passes from the rolls 24 and 25 it enters into the coiling chamber 26 where it is confined against the periphery of the upper one of two rolls by a die. This die, in this instance, is in the form of an elongated rod 46 of small diameter resiliently mounted preferably being supported at one end only by an arm 47 which is removably fitted in a slot in a plate 48, one edge 49 of the plate being at a slight angle to the coil to be formed, its portion nearest the center of the coil being nearest the point forming point of the coil. The die when first used has a smooth cylindrical surface, but after the coil starts to form, the coil wears concave grooves or notches 50 in the die, and owing to the fact that the pressure of the coil tends to move the die against the inclined edge 48, these curved notches or grooves gradually decrease in depth as shown in Figs. 13 and 14. Before the coiling on the machine is started, a small coil is formed on the end of the wire independently of the machine, of the diameter desired and also having the coils formed the desired distance apart. The machine is then adjusted to provide a coiling chamber which will correspond to the diameter of the selected coil. After this coil is introduced into the coiling chamber, it cuts its own concave grooves in the die member and the distances between the grooves formed by the coil and the distances between convolutions of the coil will correspond. This makes it possible to provide what has heretofore been impossible, a coil from a long strip of wire having its convolutions set or fixed in abutment. The cutting of the grooves in the die rod 46 tends to resist the movement of the coil adjacent the point of the coil formation. This resistance decreases gradually as the coil proceeds from its formation point due to the fact that the die lies at an angle to the coil axis so that eventually the coils pass out of engagement with the die. While not necessary, it is preferred to arrange in the coiling chamber 26, a coil support 51 which is not a forming rod but merely acts as a centering device for the coil after it is formed to prevent sidewise movement of the latter until it enters the discharge tube 52 which thereafter holds the coil against lateral movement and which is of such a length that it will hold a long coil, being continued by bends around the machine. The coil is arranged loosely about the support 51 which is mounted by an arm 51^a to one side of the rolls 24 and 25.

It will be noted that the guide plate 16 projects between the two rollers 24 and 25 substantially to the common vertical plane of the two axes of the rollers, and that the guide groove 18 is exposed on its under side so that the roller 25 can cooperate with the wire in the guide groove and hold it until it passes beyond the end of the plate 16. The end of the plate serves as an abutment to confine the coil against displacement from the coiling

chamber. The die 46 has the center of its curved face so situated that the axis of the coil while it is being formed lies on that side of the common plane of the two axes of the rollers 24 and 25 opposite the side on which the forcing means is arranged. It will thus be seen that the coil is confined by the two rollers 24 and 25, the abutment formed by the end of the plate 16 and the coiling die. By adjusting the distances betwen the rollers and the position of the coiling die the diameter of the coiling chamber may be changed and coils of different diameters may be produced.

The plate 48 is secured between two plates 53 by screws 56 holding said plates together. Each of these plates has a lip 55 lying to one side of the rolls 24 and 25 in diverging relation and serving to act as guides for the free end of the die 46. The three plates 48 and 53 are held by screws 56 to an adjustable carrier 57 having two transversely extending openings with screw-threaded walls engaged by two adjusting screws 58 which bear at their inner ends against the frame 12. Set-screws 59 serve to lock the screws 58 in their adjusted positions. The carrier 57 also has an elongated opening 60 through which a screw 61 projecting from the frame 12 loosely projects. a nut 62 on this screw serving to draw the two screws 58 in firm abutment with the frame 12.

The carrier 57 is preferably supported by a rest 63 which by screws 64 and slots 65 is adjustably secured to the frame 12. Also supporting the carrier 57 against movement away from the coil-forming rolls 24 and 25 is a screw abutment 66 adjustable in an arm 67 supported on the frame 12.

In operation, the machine is adjusted so as to operate upon a wire of a given diameter and to produce a coil of a given diameter. A few coils are made in the free end of the wire by hand to form coils of the desired diameter and having their convolutions arranged either spaced or in abutment. This small coil is then fitted on the centering device 51 and placed within the coil-forming chamber 26 against the die 46. The machine being started the coil starts to form. The coil gradually forms a line of grooves or recesses 50 in the die 46 and owing to the resilient mounting of the abutment the free end of the latter yields under the action of the coil so that the grooves decrease in depth from the forming end of the coil. These grooves will be spaced apart a distance corresponding to the distances between the convolutions of the coils and will therefore make a uniform coil. Furthermore, the friction produced, in the first instance, in wearing the grooves in the die of different depths as well as the resilient mounting of the abutment serves to retard the movement of the coil and in this way a coil can be made in which its convolutions are in set abutment, a result which, so far as I am aware, has not heretofore been accomplished in coiling fine piano wire by continuous action. Instead of making the coil form its own way in the die, the die may be made as shown in Fig. 13 where the grooves 50a are formed independently of the coil. This construction is more particularly designed for forming a coil in which a given spacing is desired between the convolutions.

It is apparent that the elongated die 46 with its line of curved grooves of different depths lies at a slight angle to a line at right angles to the axis of the formed coil so that as each convolution is formed it enters the deepest groove where it mets the most resistance and then successively enters the grooves of the die 46 each time meeting with less resistance until it passes from the die. Each groove is a short arc and the side walls of the grooves tend to hold the convolutions against sidewise or lateral movement, thus acting to set the convolutions into their proper relationship and preventing expansion in any direction. This is assisted by the smooth-faced upper roller 24 with which the coil also engages.

What I claim as my invention and desire to secure by Letters Patent is:

1. The method of coiling wire which consists in forcing straight wire over a concave surface while holding the portion engaging the surface against sidewise movement and causing the convolutions thus formed thereafter to travel over a plurality of concave faces while holding the portions engaging such surfaces against sidewise movement.

2. The method of coiling wire which comprises forcing the wire over a concave surface while holding the portion engaging the surface against sidewise movement and retarding the movement of those convolutions of the coil adjacent the portion being coiled by said concave surface and gradually decreasing the retarding movement on the convolutions as the latter pass away from said concave surface.

3. The combination of a die for wire coiling machines having a plurality of separated concave faces arranged in a line and gradually decreasing in depth, and each concave face having sides for confining the convolutions of a coil against sidewise movement, with means for forcing a wire against one of said faces to produce convolutions in the wire, the remaining curved faces being arranged to be engaged successively by the convolutions after the initial coiling.

4. The combination with means for forcing a wire in the direction of its length, of a die having a plurality of grooves arranged in a line, the grooves having curved bottoms and gradually decreasing in depth, the forcing means directing the wire against the bottom of the groove of greatest depth to produce the

initial coiling and the convolutions then successively traveling to a groove of less depth.

5. The combination with means for forcing a wire in the direction of its length, of a die having a plurality of grooves arranged in a line, the grooves having curved bottoms and gradually decreasing in depth, the forcing means directing the wire against the bottom of the groove of greatest depth to produce the initial coiling and the convolutions then successively traveling to a groove of less depth, and means supporting the die so that the grooved portions gradually increase in resiliency with their decrease in depth.

6. The method of coiling wire which comprises forming initial convolutions in a wire, bringing such convolutions in contact with a die having an ungrooved contact surface engaging a plurality of convolutions and forcing the wire in the direction of its length to cause the convolutions to form a plurality of grooves in said ungrooved surface of the die.

7. The method of coiling wire which comprises forming initial convolutions in a wire, bringing such convolutions in contact with an elongated convex surface to engage a plurality of convolutions and forcing the wire in the direction of its length to cause the convolutions to form a plurality of grooves in said elongated convex surface.

8. The method of coiling wire which comprises providing an initial coil in the wire, bringing a plurality of convolutions of the coil in contact with an elongated ungrooved surface which is supported to yield more at one end than the other, and forcing the wire in the direction of its length to continue the coiling of the wire adjacent the other end of the ungrooved surface and cause the convolutions to travel over the elongated surface toward its greatest yielding portion and produce grooves in the elongated surface gradually decreasing in depth toward the greatest yielding portion of said surface.

9. The combination with a die having a plurality of curved grooves arranged in a line, the grooves gradually decreasing in depth from one end of the line to the other, of means for resiliently supporting said die so that it yields more at the shallowest groove, and means for forcing a wire in the direction of its length into the deepest groove to produce convolutions which successively travel in the other grooves.

10. In a wire coiling machine, the combination with a forcing means, of two smooth-faced rollers between which the forced wire travels, and a die having a curved groove receiving the wire from the rolls and directing the coil against one of said smooth rolls the axis of the coil formed by the die being situated on that side of a plane intersecting the axes of the two rollers opposite the side on which the forcing means is arranged.

11. In a wire coiling machine, the combination with means for forcing a wire in the direction of its length, of a die having a plurality of grooves arranged in a line transversely of the line of movement of the wire, and means for adjustably supporting said die so as to shift the angle of the line of grooves to the line of travel of the wire.

12. In a wire coiling machine, the combination with means for forcing a wire in the direction of its length, of two smooth faced rollers between which the wire passes, means for driving the proximate portions of the peripheries of the rollers, one in the direction of the movement of the wire, and the other in the opposite direction, and a die against which the wire from the rollers is forced, arranged to support the coil against that roller traveling in such opposite direction the axis of the coil being formed by the die being situated on that side of a plane extending through the axes of the two rollers opposite the side on which the forcing means is arranged.

13. The combination with means for forcing a wire to be coiled in the direction of its length, of a coiling die against which the wire is forced, a carrier for the coiling die having a transversely extending opening, a frame, a bolt passing loosely through the opening into the frame, and two screws on the carrier on opposite sides of the opening engaging the frame to hold the carrier in an adjusted position, and a screw interposed between the frame and the carrier for adjusting the latter longitudinally.

14. In a wire coiling machine, the combination with a forcing means, of two smooth-faced rollers having their axes lying in a common plane, a die having a curved groove receiving the wire from the rollers and arranged on one side of the common plane, and a coil abutment arranged substantially at the common plane of the axes of the two rollers to provide with the die and the two rollers a coil forming chamber.

15. In a wire coiling machine, the combination with a wire forcing means, of two smooth-faced rollers having their axes lying in a common plane, guiding means for guiding the wire from the forcing means having a portion provided with a groove through which the wire travels, said groove opening toward the adjacent periphery of one of the rollers so that such roller tends to hold a wire in said groove, and a coiling die situated on the side of said common plane opposite the forcing means at such a point that the wire is coiled about an axis situated on that side of the common plane opposite the side on which the forcing means is situated.

16. In a wire coiling machine, the combination with a forcing means, of two smooth-faced rollers having their axes in a common

plane, a coiling die having a curved surface and situated on that side of the common plane opposite the side on which the forcing means is situated, the center of the die curve also being situated on the side of the plane opposite the side on which the forcing means is situated, so that a coil may be formed having a diameter greater than the diameter between the nearest portions of the two rollers.

17. In a wire coiling machine, the combination with a forcing means, of two smooth-faced rollers having their axes in a common plane, a coiling die having a curved surface and situated on that side of the common plane opposite the side on which the forcing means is situated, the center of the die curve also being situated on the side of the plane opposite the side on which the forcing means is situated, so that a coil may be formed having a diameter greater than the diameter between the nearest portions of the two rollers, and an abutment for cooperation with that portion of the coil substantially opposite that portion engaged by the die, said abutment beng arranged between the two rollers and spaced from one of said rollers so that the wire may pass between the abutment and such roller to engage the die.

18. In a wire coiling machine, the combination with a forcing means, of two smooth-faced rollers having their axes in a common plane, a coiling die having a curved surface and situated on that side of the common plane opposite the side on which the forcing means is situated, the center of the die curve also being situated on the side of the plane opposite the side on which the forcing means is situated, so that a coil may be formed having a diameter greater than the diameter between the nearest portions of the two rollers, and guiding means between the forcing means and the rollers, said guiding means having a portion projecting between the rollers and terminating adjacent the common plane to provide an abutment for the coil being formed, said portion having guide grooves for the wire opening toward one of the rollers so that said roller may cooperate with the walls of the groove to guide the wire to the die.

19. The method of coiling wire which comprises forcing the wire over a surface concave transversely of the wire and convex in the direction of the movement of the wire, while holding the portion engaging the surface against sidewise movement, and subjecting the coil to a gradually decreasing axial retarding movement in its convolutions adjacent the portion being coiled by said concave surface.

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