Aug. 4, 1942. K. F. RUSSELL 2,291,922

MACHINE FOR FORMING WIRE COILS

Filed Aug. 3, 1940 2 Sheets-Sheet 1

Fig. 1

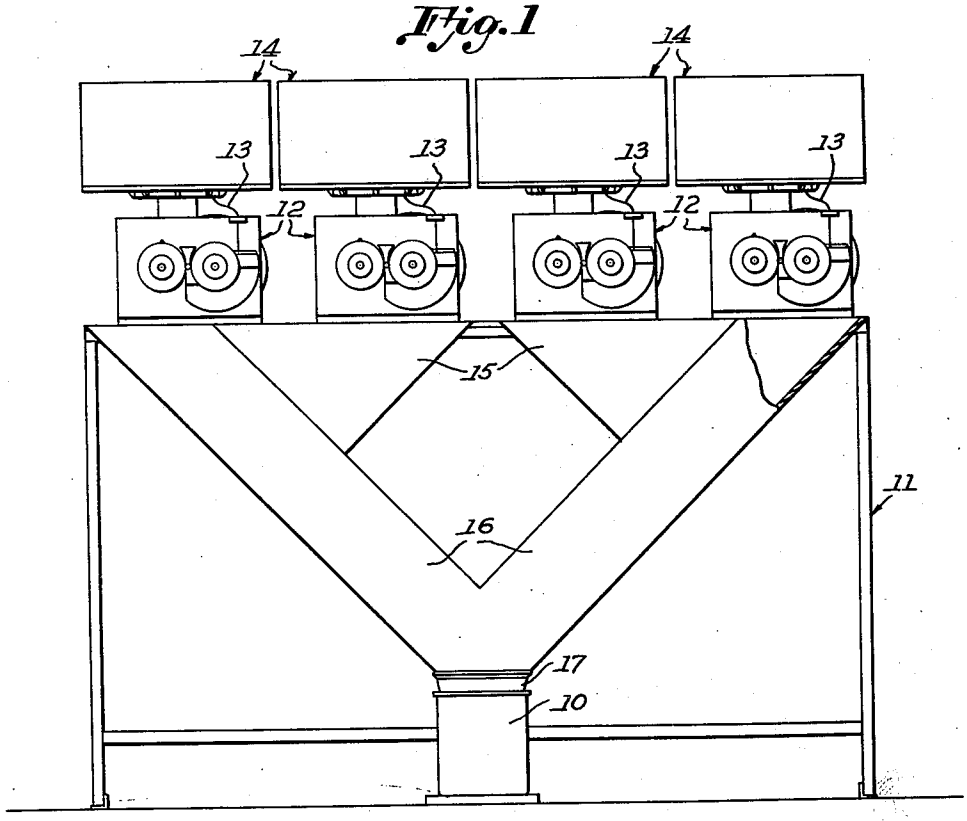


Fig. 9

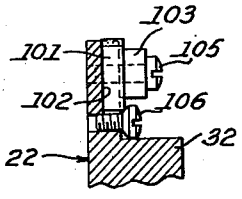
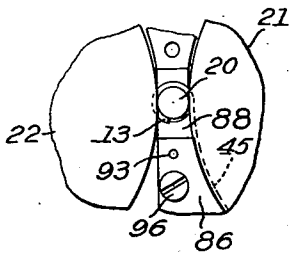


Fig. 8



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Fig. 2

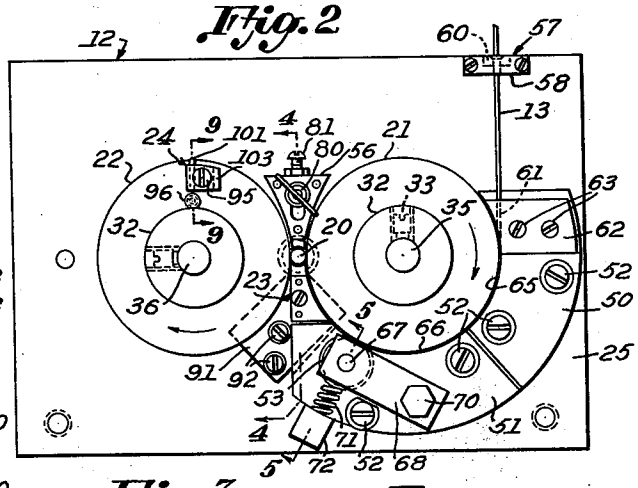


Fig. 4

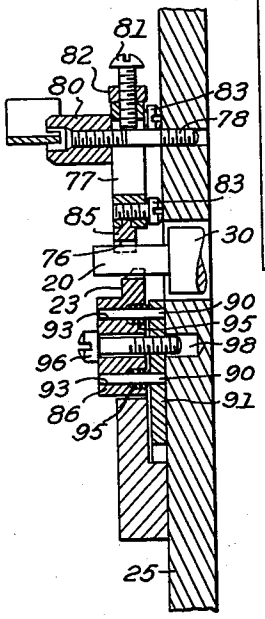


Fig. 3

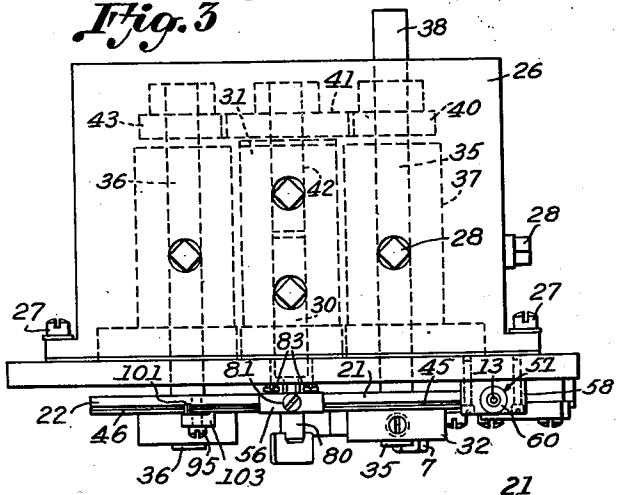


Fig. 6

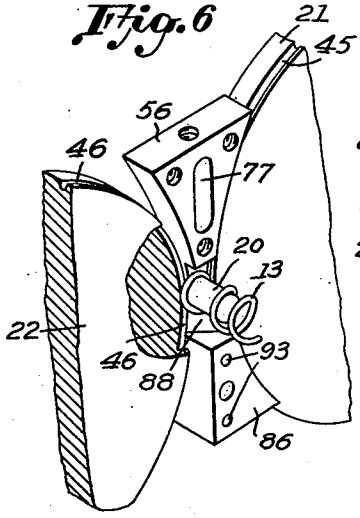


Fig. 7

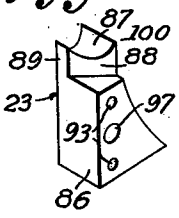
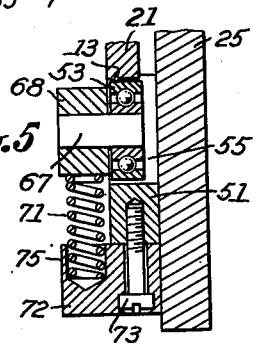


Fig. 5



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2,291,922

MACHINE FOR FORMING WIRE COILS

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Application August 3, 1940, Serial No. 350,462

7 Claims. (Cl. 153—65)

My invention relates to wire-working machinery, and is directed specifically to apparatus for forming helical coils of wire.

While the invention is widely applicable in the art, it has been initially embodied in apparatus for carrying out the method of producing filter bodies set forth in my copending application Serial No. 349,090, entitled Filter medium and method of production. Such a filter body is produced by forming wire into small helical coils and dropping the coils into a container to cause the coils to interlock and intermesh into a cohesive resilient mass. To keep the cost of such filter bodies within reasonable bounds, it is necessary to manufacture the small coils at an exceedingly high rate. I elect to confine my disclosure to this embodiment of my invention in the knowledge that those skilled in the art will find sufficient guidance therein for applying the combination wherever it may be of service.

The general object of my invention is to provide apparatus for producing helical coils of wire of predetermined lengths at high operating speed.

It is another object of my invention to provide a simple, sturdy and reliable wire-forming and wire-cutting device adapted to operate continuously over substantial production periods with minimum attention.

Other objects and advantages of my invention will be apparent from my detailed description below, taken with the accompanying drawings.

In the drawings, which are to be considered as illustrative only:

Fig. 1 is a front elevation partly broken away of a filter-fabricating apparatus incorporating a battery of my devices for forming wire coils;

Fig. 2 is a front elevation of one of the coil forming units;

Fig. 3 is a plan view of the unit;

Fig. 4 is a vertical section on an enlarged scale, taken as indicated by the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary section on an enlarged scale, taken as indicated by the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary perspective view of selected elements that cooperate in the coil-forming unit;

Fig. 7 is a perspective view of the deflecting member shown in Fig. 6;

Fig. 8 is a fragment of Fig. 2 on an enlarged scale; and

Fig. 9 is a fragmentary section taken as indicated by the line 9—9 of Fig. 2.

The function of the apparatus shown in Fig. 1 is to deposit in a short time an exceedingly large number of small wire coils in the filtering compartment of a cylindrical air cleaner 10, the air cleaner being of the type commonly employed to separate foreign matter from air drawn into internal combustion engines. The apparatus includes a frame generally designated 11 on which is mounted a battery of four coil-forming units 12, to each of which is fed a strand of wire 13 by a wire-dispensing unit 14. While any suitable wire-feeding arrangement may be employed, I prefer to use the type of wire-dispensing units that is indicated in Fig. 1 and that is set forth with particularity in my copending application Serial No. 350,461, entitled Dispensing device for coiled wire.

Two hoppers 15 disposed to receive wire coils, dropped from the four coil-forming units 12, feed into two chutes 16 that converge at a spout 17 above the air cleaner 10. In a typical installation, each of the units 12 produces approximately fifteen hundred of the small wire coils per minute so that approximately six thousand coils per minute drop through the spout 17 into the air cleaner 10. In practice constant speed motors are employed and the rate of production is so constant that a time switch is employed in the motor circuit for energizing the four units 12, the time switch being set to operate the units through predetermined intervals of time to produce predetermined quantities of wire coils as required by the particular air cleaners in process.

The principal parts of the wire-working device shown in detail in Figs. 2–8 include a mandrel 20 which may be either stationary or rotary, means for forming wire into coils on the mandrel comprising two guide wheels 21 and 22 and associated elements, a deflecting means generally designated 23, and finally a wire-cutting means generally designated 24.

The various working parts of the mechanism may be mounted on a base plate 25 to the rear of which an oil case 26 is attached by suitable screws 27. The oil case has various lubrication openings that are normally closed by suitable plugs 28. The mandrel 20 is unitary with and extends axially forward from a floating shaft 30 (Figs. 3 and 4) that is journaled in suitable bearings (not shown) in a cylindrical bearing housing 31 inside the oil case 26. In this particular embodiment of my invention the shaft 30 has no operative connections whatsoever.

As shown in Figs. 2 and 3 the two guide wheels 21 and 22 have hub portions 32 through which set-screws 33 extend to secure the guide wheels

on the ends of respective shafts 35 and 36. The shaft 35 which is the operating shaft for the mechanism is journaled in suitable bearings in a cylindrical bearing housing 37 and has an end portion 38 protruding from the rear of the oil case 26 for driving connection with a suitable motor not shown in the drawings. A pinion 40 keyed on the operating shaft 35 in the oil case 26 meshes with a second pinion 41 on an intermediate shaft 42 that is carried by suitable bearings in the previously mentioned bearing housing 31. The intermediate shaft 42 is disposed coaxial with the floating shaft 30 merely for the sake of compactness in the mechanism, there being no mechanical connection between the two. The second pinion 41 meshes with a third pinion 43 that is keyed on the previously mentioned shaft 36, the three pinions cooperating to drive the two guide wheels 21 and 22 clockwise as indicated by arrows in Fig. 2.

The guide wheel 21 has a peripheral groove 45 for guiding the strand of wire 13 and the second guide wheel 22 has a similar groove 46. Preferably both of the grooves 45 and 46 are in a common plane and it is contemplated that each groove will be but slightly greater in depth than one-half the diameter of the wire 13 so that whenever the wire seats in one of the grooves, it protrudes appreciably from the groove.

The means cooperative with the two guide wheels 21 and 22 to direct the wire 13 to and around the mandrel 20 includes in the preferred form of my invention a pair of arcuate guide blocks 50 and 51 mounted on the base plate 25 by suitable screws 52, a pressure roller 53 in a well 55 formed in the guide block 51 (Fig. 5), and a block 56 above the mandrel.

The wire 13 initially passes through an eye 57 which may comprise a small block 58 on the base plate 25 in which is mounted a suitable hardened bushing 60. From the eye 57 the wire passes into a channel 61 in the guide block 50 that is substantially tangential to the peripheral groove 45 of the guide wheel 21. In the particular construction shown, the channel 61 is formed by a small groove on the inner face of a small plate 62 that is removably mounted on the block 50 by suitable screws 63.

The two arcuate blocks 50 and 51 have arcuate faces 65 and 66 respectively that conform to the periphery of the guide wheel 21 to confine the wire 13 to the groove 45 in the periphery of the guide wheel.

The function of the pressure roller 53 is to exert sufficient pressure on the wire 13 in the peripheral groove 45 to cause the guide wheel 21 to engage the wire effectively and thereby to pull the wire from the dispensing unit 14. As best shown in Fig. 5, the pressure roller 53 may be mounted on a spindle 67 extending inward from an arm 68 that is pivotally mounted on the guide block 51 by a suitable cap screw 70 (Fig. 2). To continuously urge the arm 68 towards the guide roller 21, a suitable helical spring 71 may be confined between the arm and a block 72. The block 72, which is secured to the guide block 51 by a screw 73, has a recess 75 to seat the end of the spring 71.

The wire 13, by virtue of the arrangement described above, is caused to follow the traveling groove 45 to the mandrel 20, and after making contact with the mandrel is threaded into the space between the upper block 56 and the mandrel. The block 56 has a lower face 76 curved to conform with the curvature of the mandrel and therefore forces the wire 13 to follow the periphery of the mandrel and to enter the peripheral groove 46 of the second guide wheel 22. Preferably the upper block 56 is adjustable and is removable as well to facilitate initial threading of the wire 13 across the mandrel.

In my preferred construction, as best shown in Fig. 4, the upper block 56 has a vertical slot 77 by means of which it may be mounted on a stud 78 on the base plate 25 and releasably secured by a thumb-nut 80 threaded onto the stud. For vertical adjustment a set-screw 81, carrying a locking nut 82, is mounted in the block 56 to extend longitudinally into the vertical slot 77, and to provide for adjusting the spacing of the block 56 from the base plate 25 three small screws 83 may be threaded into the rear face of the block, the three screws being in effect adjustable rearward projections. Since the lower curved face 76 of the block 56 is subject to intensive wearing action by continuous friction with the traveling wire, the lower end of the block may advantageously be provided with a replaceable hardened shoe 85.

By the time the wire 13 reaches the second guide wheel 22, it is set to the curvature of the mandrel surface and tends thereafter to wrap around the mandrel as indicated in Fig. 8. At this point the wire meets the previously mentioned deflecting means 23 and is additionally set to a pitch that causes the wire to travel outward on the mandrel in the form of a helix. Preferably the deflecting means 23 is adjustable with respect to the pitch at which it sets the coils of wire on the mandrel.

In the construction suggested by the drawings, the deflecting means 23 is in the form of a metal block 86 having a curved surface 87 at its upper end to fit close to the periphery of the mandrel 20 and having immediately below the curved surface an inclined deflecting face 88 disposed to lie in the path of the wire as the wire issues from the groove 46 of the second guide wheel 22. Since the deflecting face 88 is subject to unrelenting friction, it is advisable in practice to form the face on a hardened element 89 that is replaceably mounted on the block 86. As shown in Fig. 4, the block 86 is slidingly mounted on a pair of dowel pins 90 extending forward from a thin plate 91 that is attached to the face plate 25 by suitable screws 92 (Fig. 2). The two bores 93 in the block 86 that receives the dowel pins 90 are counterbored to seat concealed helical springs 95 that continuously press the block 86 away from the underlying plate 91, and this action of the two springs is opposed by a screw 96 that extends through an oversized bore 97 in the block 86. The screw 96 is threaded into the underlying plate 91 and the base plate 25 has a suitable recess 98 to permit a liberal range of longitudinal movement of the screw. When the screw 96 is threaded into the underlying plate 91 to a substantial extent, only a relatively small portion of the deflecting face 88 near the outer edge 100 of the plate is in the path of the wire 13 and the wire is consequently set to a relatively low pitch. If the screw 96 is loosened, however, to permit the concealed springs 95 to shift the block 86 outward, a correspondingly greater extent of the deflecting face 88 will lie across the path of the wire and the wire will be set to a correspondingly greater pitch.

The friction of the wire against the mandrel 20 in the vicinities of the guide wheel 21, the upper block 56, and the guide wheel 22, causes

the mandrel to rotate, but even if the mandrel were held fixed against rotation, the wire would issue continuously from the end of the mandrel to form coils of any desired length. In the apparatus under consideration relatively short coiled lengths are desired, and a feature of my invention is the conception of arranging the cutting means 24 on one of the guide wheels 21 or 22 to sever the coiled wire before it leaves the mandrel 20.

The relation between the circumference of the guide wheel and the number of cutting means mounted thereon will be readily understood. In the present arrangement the cutting means 24 is mounted on the second guide wheel 22 and only one cutting element is mounted on the guide wheel, since the circumference of the guide wheel designedly approximates the length of wire desired in each of the short coils produced by the apparatus. As best shown in Figs. 2 and 9, the cutting means 24 may include a blade member 101 of exceedingly hard material mounted in a radial slot 102 in the guide wheel 22. The blade member intersects the peripheral groove 46 and may protrude radially from the guide wheel to a slight extent if necessary to compensate for clearance between the guide wheel and the mandrel 20. The radial slot 102 opens onto the front face of the guide wheel 22 and the blade member 101 is appreciably wider than the slot so that the blade member lies partially outside the slot for engagement by a small clamp block 103. For clamping action the block 103 is releasably secured to the guide wheel by a suitable screw 105. To permit radial adjustment of the blade member 101, a tapered screw 106 may be mounted in the guide wheel 22 to serve as an adjustable wedge effective against the inner end of the blade member.

The operation of the mechanism may be readily understood from the foregoing description. Once the wire 13 is threaded onto the mandrel 20 from the peripheral groove 45 of the guide wheel 21 to the peripheral groove 46 of the guide wheel 22, operation may be continuous at high speed as long as the wire is continuously fed to the mechanism. With each revolution of the guide wheel 22 the blade member 101 moves into an effective position opposite the mandrel 20 to sever the wire, the movement of the blade being synchronized with the travel of the wire, and the advancing end of the severed wire immediately encounters the deflection face 88 to start a new coil. Each coil displaces the preceding coil on the mandrel 20 and the completed coils drop successively from the mandrel into a hopper 15 therebelow.

Various changes and substitutions suggested by the foregoing description may be made in various practices of my invention; I reserve the right to all such variations that properly come within the scope of my appended claims.

I claim as my invention:

1. In a machine for forming wire into helical coils, the combination of: a cylindrical mandrel; a first guide wheel adjacent the mandrel providing a first guide groove to force the wire against the mandrel at a first point; a second guide wheel adjacent the mandrel providing a second guide groove to force the wire against the mandrel at a second point thereby to cause the wire to coil around the mandrel, said two guide grooves defining a given peripheral direction around the mandrel and holding a portion of the traveling wire in said peripheral direction; and deflecting means adjacent the mandrel in the path of the wire as the wire leaves said second groove, said deflecting means being adapted to force the wire away from said peripheral direction thereby to bend the wire continuously to a pitch on the mandrel.

2. In a machine for forming wire into helical coils, the combination of: a cylindrical mandrel; a first guide wheel adjacent the mandrel providing a first guide groove to force the wire against the mandrel at a first point; a second guide wheel adjacent the mandrel providing a second guide groove to force the wire against the mandrel at a second point diametrically opposite from said first point, said two grooves being in a common plane perpendicular to the axis of the mandrel to hold the portion of the traveling wire between said two points in said plane; and deflecting means adjacent the mandrel and intersecting said plane in the path of the wire as the wire leaves said second groove, said deflecting means being adapted to force the wire out of the plane thereby to bend the wire continuously to a pitch on the mandrel.

3. In a machine for forming wire into helical coils, the combination of: a cylindrical mandrel; a first guide wheel adjacent the mandrel providing a first guide groove to force the wire against the mandrel at a first point; a second guide wheel adjacent the mandrel providing a second guide groove to force the wire against the mandrel at a second point thereby to cause the wire to coil around the mandrel, said two guide grooves defining a given peripheral direction around the mandrel and holding the intervening portion of the traveling wire in said peripheral direction; guide means adjacent said mandrel between said guide wheels providing a fixed guide surface concentric to said mandrel to cooperate with the mandrel to confine the traveling wire between said guide wheels; deflecting means adjacent the mandrel in the path of the wire as the wire leaves said second guide groove, said deflecting means being adapted to force the wire away from said peripheral direction thereby to bend the wire to a pitch on the mandrel; and means movable periodically against the mandrel to sever the wire.

4. In a machine for forming wire into helical coils, the combination of: a mandrel; means including a wheel adjacent the mandrel to hold the traveling wire against the mandrel and to cause the wire to coil about the mandrel, said wheel having a peripheral groove engaging the traveling wire at one point and confining the traveling wire at said point against movement longitudinally of the mandrel; and a cutting blade mounted on said wheel across said groove to cooperate with said mandrel to cut the wire periodically.

5. In a machine for forming wire into helical coils, the combination of: a cylindrical mandrel; a first guide wheel adjacent the mandrel providing a first guide groove to force the wire against the mandrel at a first point; a second guide wheel adjacent the mandrel providing a second guide groove to force the wire against the mandrel at a second point diametrically opposite from said first point, said two grooves being in a common plane perpendicular to the axis of the mandrel to hold the portion of the traveling wire between said two points in said plane; deflecting means adjacent the mandrel and intersecting said plane in the path of the wire as the wire leaves said second groove, said deflecting means

being adapted to force the wire out of the plane thereby to bend the wire continuously to a pitch on the mandrel; and a cutting blade mounted on said second wheel in a position intersecting said second groove to cooperate with said mandrel to cut the wire periodically.

6. In a machine for formnig wire into helical coils, the combination of: a cylindrical mandrel; a first guide wheel adjacent the mandrel having a peripheral groove to conduct the wire to the mandrel, said groove being of less depth than the diameter of the wire; a pressure wheel acting against the periphery of said guide wheel to force the wire into said peripheral groove for frictional engagement of the wire; a second guide wheel adjacent the mandrel having a second peripheral groove cooperating with the mandrel to hold the portion of the wire between the two guide wheels in a given peripheral direction around the mandrel; guide means providing a fixed guide surface concentric to said mandrel between said two wheels to confine the wire between the wheels; a deflecting means adjacent the mandrel in the path of the wire as the wire leaves said second groove, said deflecting means being adapted to bend the wire out of said given peripheral direction thereby to give pitch to turns of wire on the mandrel; and a blade on said second wheel intersecting said second groove to cooperate with the mandrel to cut the wire periodically.

7. In a machine for forming wire into helical coils, the combination of: a mandrel having a continuous cylindrical surface; means including a wheel adjacent the mandrel to hold the traveling wire against said continuous cylindrical surface of the mandrel and to cause the wire to travel about the mandrel, said wheel having a peripheral groove engaging the traveling wire at one point and cooperating with said continuous cylindrical surface to confine the traveling wire at said point against movement longitudinally of the mandrel; and a cutting blade mounted on said wheel across said groove to cooperate with said mandrel at said point by pressing the wire against said continuous cylindrical surface to cut the wire periodically.

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