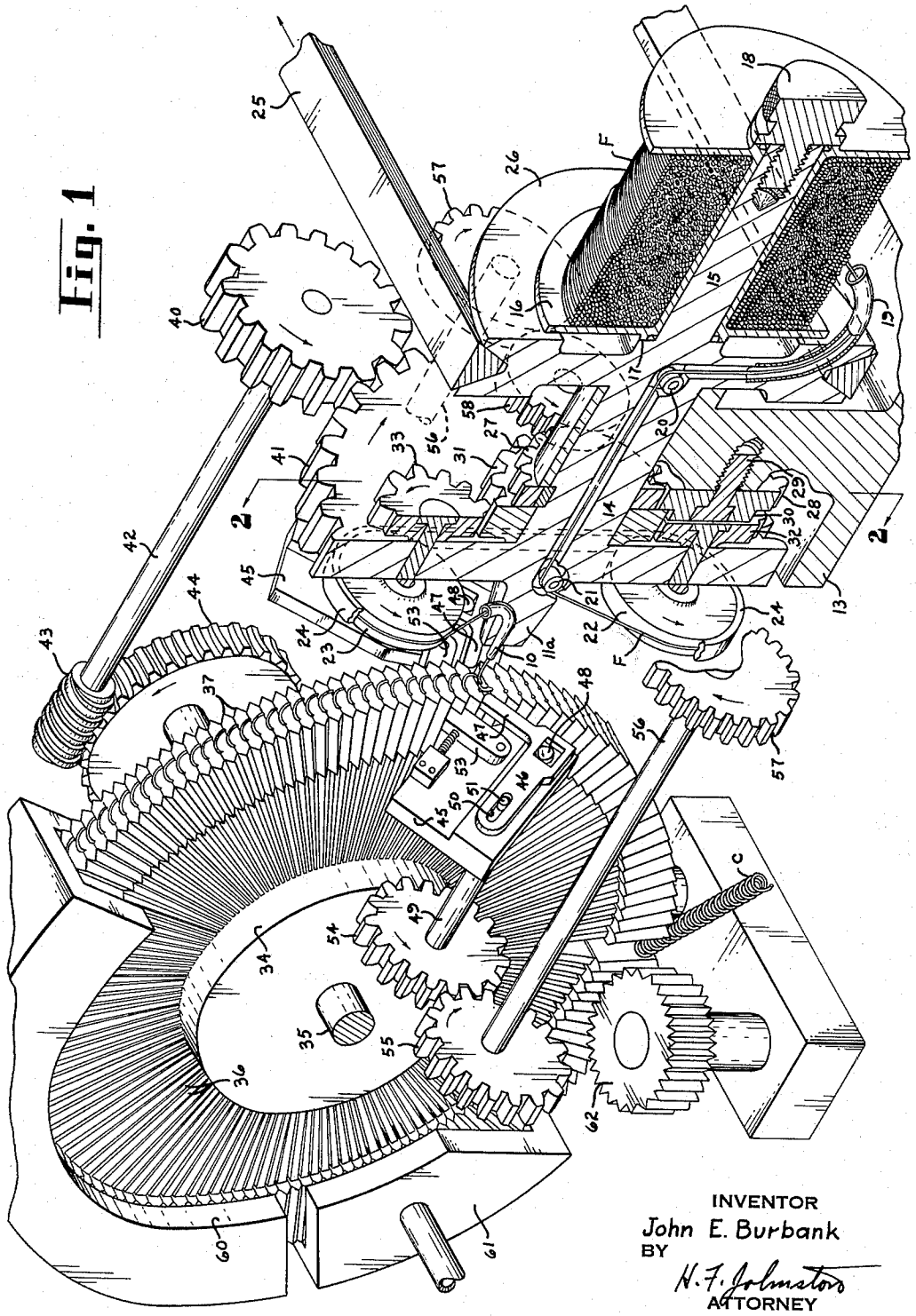
Feb. 2, 1965 J. E. BURBANK 3,168,606

COIL FORMING METHOD AND APPARATUS

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Fig. 1



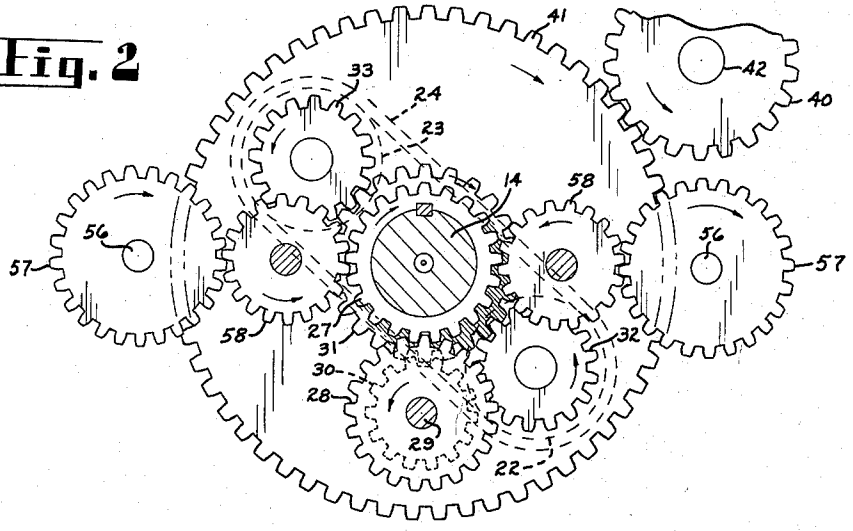
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COIL FORMING METHOD AND APPARATUS

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Fig. 2



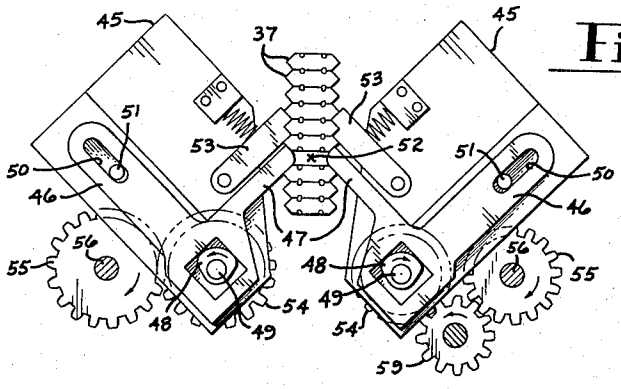


Fig. 3

Fig. 4

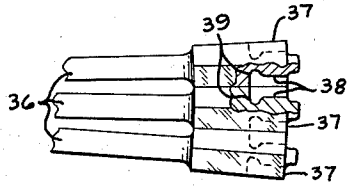


Fig. 5

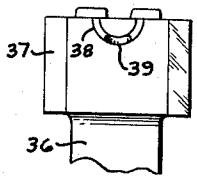
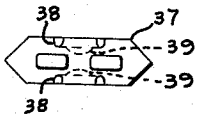


Fig. 7



Fig. 6



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COIL FORMING METHOD AND APPARATUS

John E. Burbank, Stamford, Conn., assignor to Scovill Manufacturing Company, Waterbury, Conn., a corporation of Connecticut

Filed Dec. 26, 1961, Ser. No. 161,960
3 Claims. (Cl. 264—281)

My invention is an improved method and apparatus for forming coils, especially from a filament or wire of thermoplastic material. It is primarily intended for, but not necessarily limited to, the manufacture of plastic filament coils for zipper fasteners.

One of the objects of the invention is to avoid the difficulties in prior methods of making such coils resulting from winding around a needle or mandrel under tension. In such prior methods, any slight difference in diameter or quality of material makes a conspicuous difference in the coil. On the other hand, in my improved method and apparatus, the amount of filament for each convolution is accurately measured out.

Another object of the invention is to form each convolution of the coil independently of a mandrel, catch it in the act of being formed and hold it until set by the action of heat.

Another object of the invention is to provide an improved method and apparatus which feeds the filament from a source of supply which bodily rotates around an axis and pushes it through a guide which also rotates about such axis, whereby the filament freely assumes the shape of a helix without the use of a needle or mandrel.

The invention also provides means for catching each such convolution as it is discharged from the guide, by means of a multi-finger conveyor. In such conveyor, the size, shape and spacing of the coils are determined by precisely sized metal parts. This arrangement has the further advantage that any desired shape may be formed on portions of the coils to provide for secure interlocking engagement of one zipper coil with another.

Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawing, I have shown for purpose of illustration, one embodiment which my invention may assume in practice. In the drawings:

FIG. 1 is a schematic view in perspective with parts broken away to facilitate the showing of the improved method and apparatus;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 showing mainly the gear system rotated about 45° in a counterclockwise direction from FIG. 1;

FIG. 3 is a face view of the mechanism for opening and closing the die pieces;

FIG. 4 is a partially sectionalized side view of the die pieces on an enlarged scale;

FIG. 5 is a face view of one of the die pieces;

FIG. 6 is an end view of the same; and,

FIG. 7 is a side view of a finished coil such as provided by my machine.

Considering first that portion of the machine which feeds the plastic filament, herein indicated by the letter F, through the end of a discharge guide or nozzle **10**, a frame **11** is mounted on a centrally located shaft or axle **14** to rotate bodily in a bearing **12** on a suitable stand or table **13**,

Extending from the right-hand side of the frame **11** as viewed in FIG. 1, is a shaft **15** on which is mounted a filament supply spool **16**. This spool, with its supply of filament F, in general rotates bodily with the frame **11**, and in addition, it may rotate relative to the frame under the control of friction against the surface **17** which

may be adjusted by a thumb screw **18**. The filament F is led from the spool **16** through a tube **19** fixed in a suitable manner to the rotating frame, directed over guide pulleys **20** and **21** and thence, around feed pulleys **22** and **23**. A belt **24** fits tightly over the feed pulleys **22** and **23** and insures that the filament will be held sufficiently to prevent any slippage on the feed pulleys.

The discharge guide or nozzle **10** is fixed in an extension **11***a* of the frame, and its entrance end is arranged to be tangent to the feed pulley **23** and out of the path of the belt **24**. The discharge end of the nozzle **10** is preferably eccentric to the axis of rotation on the frame **11** an amount equal to the radius of the coil to be formed. Thus, for each revolution of the frame **11**, there will be positively fed an amount of filament equal to that required for one coil convolution and the filament will emerge in such fashion that it will naturally tend to assume the desired helical shape and size.

The above-described mechanism is operated from a suitable motor by a drive belt **25** engaged over the pulley **26** attached to or forming a part of the frame **11**. The feed pulleys **22** and **23** are driven by planetary gearing at a relatively slow speed from the differential action of the following described gearing. A gear **27** fixed to the axle **14** meshes with gear **28** mounted on a stub shaft **29** attached to the base or stand **13**. A stepped-down portion **30** of the gear **28** meshes with the wider gear **31** which is mounted to turn on the axle **14**, and this latter gear meshes with the gears **32** and **33** which are keyed to the shafts of the feed pulleys **22** and **23**, respectively. The gears **32** and **33**, as well as the feed pulleys, of course, travel with the frame **11** in a planetary path around the central axis of the frame.

Now coming to that portion of the machine which catches the coil convolutions and holds and shapes them, a wheel **34** keyed to the shaft **35**, carries a large number of spokes or fingers **36**. These spokes are somewhat flexible to permit the die pieces **37**, carried one on the free end of each spoke, to be separated to the extent necessary to receive successively the coil convolutions at one point and to eject them in the form of a coil C at another point approximately eight-tenths of a revolution away from the point where the coil enters. The result is actually a multiplex molding device, or in another sense, a conveyor.

Adjacent faces of any two die pieces may be said to constitute a complete die having complementary recesses **38** of the desired size and shape to form the coil. Preferably, these recesses are enlarged as indicated at **39** at their inner end so as to form enlarged heads H on the coils so they may interlock more securely with a complementary coil in a zipper fastener.

The wheel **34** may be driven at the desired relatively slow speed by a gear **40** meshing with the larger gear **41** which is either keyed to or forms a part of the frame **11**. A shaft **42**, a suitable worm **43** and a worm gear **44** connect the gear **40** with the wheel **34**. It will be observed that the feed pulleys **22** and **23**, as well as their driving gears **32** and **33**, may be conveniently mounted on the same large gear **41**.

To separate the die pieces **37** on the end of the resilient fingers **36** so as to receive the filament ejected from the discharging guide or tube **10**, provision is made for a pair of separator and retaining dog units, one disposed on each side of the wheel **34** so as to act in unison upon said die pieces. Each unit consists of a support block **45** on which is mounted a cam plate **46** having a ratchet finger **47** that engages with the beveled surface of each side of the die pieces. The block **45** may be supported in a stationary position by any suitable means (not shown). The cam plate **46** is actuated by a cam **48** on the end of shaft **49**. The cam plate

has an oscillatory and slidable connection to the support block 45 through an elongated slot 50 and pin 51 projecting from said support block. Upon each rotation of the cam 48, the end of the finger 47 will move in a rotary direction (the left finger being in a counterclockwise direction—the right finger in a clockwise direction) and individually move each of the die pieces forwardly away from adjacent following die pieces and provide an opening 52 into which the filament F can be caught. As the pieces are advanced by the ratchet finger 47, a preceding piece will be caught by a spring-actuated detent dog 53 pivoted on the support block and serving to prevent retrogression of the die pieces. For operating the cam 48, the shaft 49 is driven through a pair of spur gears 54 and 55, the latter being supported on shaft 56 having at its opposite end another spur gear 57 meshing with an intermediate gear 58 driven by gear 27 previously described.

As pointed out above, the units for advancing, separating and catching the die pieces in turn on both sides of the wheel 34 are identical except for one difference. In FIG. 3, it is to be noted that for the right-hand unit, an idler gear 59 operates between the gears 54 and 55, for the purpose of imparting identical motion to the cams but in a reverse direction.

It will thus be seen that for each revolution of the frame 11, an accurately measured amount of filament will be positively pushed through the discharge guide 10, and since it emerges in a rotating or twirling fashion, it will naturally assume the shape of a helix. The wheel 34 is moved past the discharge guide 10 and the die pieces separated sucessively so that each convolution as it is formed, is pushed into or caught in an open die, whereupon such die closes to form that convolution to the desired shape. Preferably, each convolution is deformed out of a true helix so that the portion containing the heads H is more nearly perpendicular to the center line of the coil.

The wheel 34 is made large enough to carry a large number of die pieces so as to give time to set or cure the coil convolutions into the desired shape while permitting a satisfactory speed of operation. The coil is set to shape by heat while held in the dies and this may be accomplished by an electrically heated shoe 60 extending around a substantial portion of the wheel. After passing the heating shoe 60, the dies may be cooled by a suitable spray of water which may be introduced into a suitable housing 61. During this stage of the process, the dies are held tightly closed between the spring actuated detents 53 and restraining wheels 62 having toothed engagement with the side faces of the die pieces. These wheels 62 are braked with sufficient force to maintain the dies tightly closed and as soon as the die pieces pass these wheels, they will spring forward and allow the finished coil to be released so that it can be pulled away from the dies.

What I claim is:

1. A method of forming coils from a thermo-plastic filament comprising

(*a*) positively feeding from a bodily rotating source of supply and pushing through a guide rotating about the same axis as said source of supply, an amount of filament equal to one complete convolution of the coil to be formed upon each complete rotation of said guide, whereby the filament freely assumes the shape of a helix as it emerges from the guide;

(*b*) catching and holding each convolution as it emerges from the guide by a device having coil receiving recesses moving across the path of the coiling filament; and,

(*c*) subjecting a series of such convolutions to heat so as to set them in the desired shape.

2. A machine for forming plastic filament coils comprising in combination:

(*a*) a frame mounted to rotate about an axis;

(*b*) a discharge guide fixed on said frame;

(*c*) a filament supply spool carried by said rotating frame which may additionally rotate on its own axis to permit unwinding of the filament;

(*d*) means for positively feeding a length of filament from said spool and pushing it through said discharge guide for each complete rotation of said frame, which length is equal to that required in a single convolution of the coil to be formed; and,

(*e*) means providing a series of coil-holding recesses movable across the path of the coiling filament as it emerges from said discharge guide.

3. A machine for forming plastic filament coils comprising in combination:

(*a*) a frame mounted to rotate about an axis;

(*b*) a discharge guide fixed on said frame with its discharge end eccentric to said axis;

(*c*) a filament supply spool carried by said rotating frame which may additionally rotate on its own axis to permit unwinding of the filament;

(*d*) means for positively feeding a length of filament from said spool and pushing it through said discharge guide for each complete rotation of said frame, which length is equal to that required in a single convolution of the coil to be formed;

(*e*) a continuous series of coil-holding and forming dies movable across the path of the coiling filament as it emerges from said discharge guide;

(*f*) means for opening said dies in turn as they move into the path of the emerging filament in timed relation to the rotation of said frame whereby each successive die opening occurs at each complete convolution of said frame to successively receive the individual convolutinos of the coil; and,

(*g*) means for closing the dies to grip and form the filament to the desired shape while in the die.

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