Nov. 17, 1942. C. T. RIPLEY ET AL 2,302,057

APPARATUS FOR MAKING SPRING PACKING

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Fig. 1

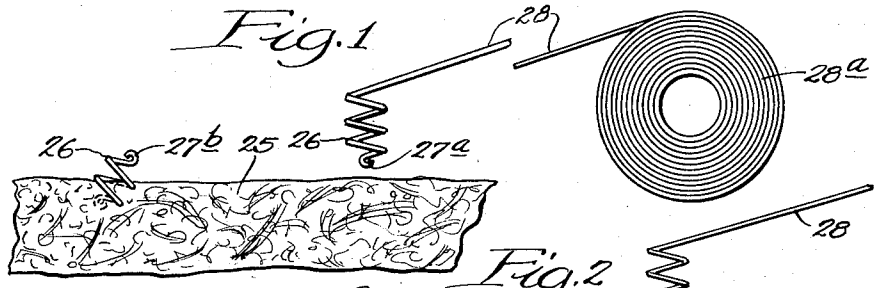


Fig. 2

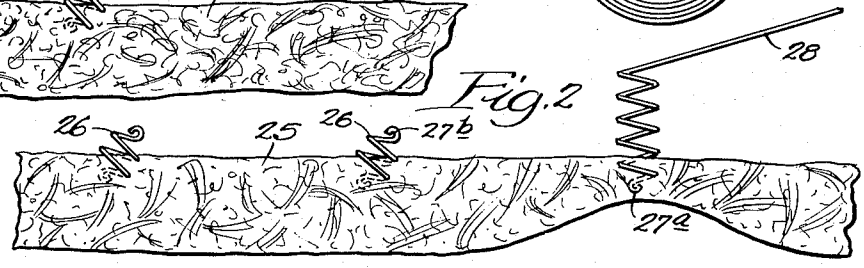


Fig. 3

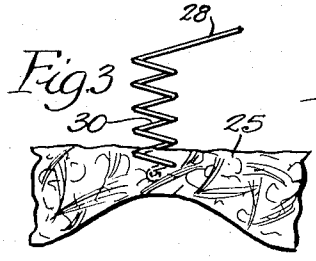


Fig. 4

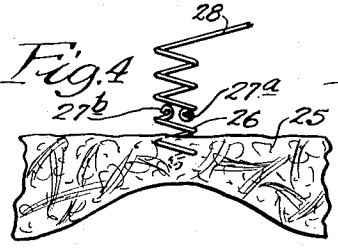


Fig. 5

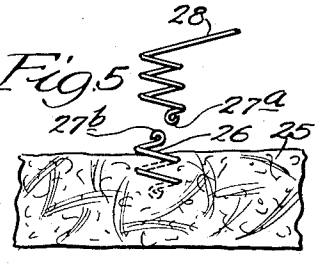
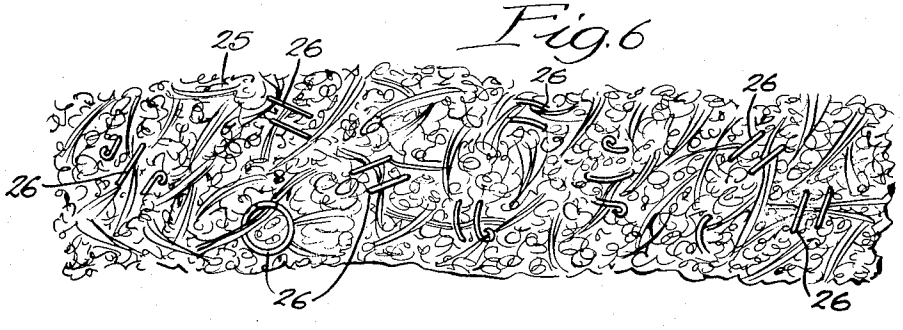


Fig. 6



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APPARATUS FOR MAKING SPRING PACKING

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Fig. 9

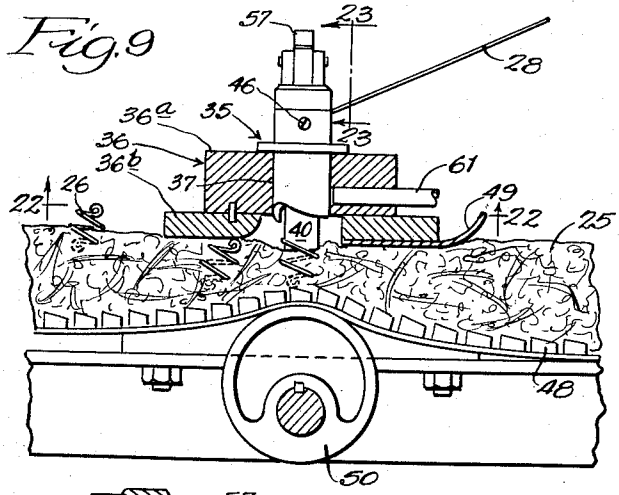


Fig. 8

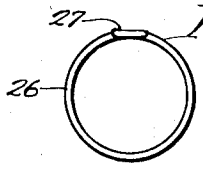


Fig. 7

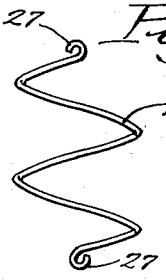


Fig. 10

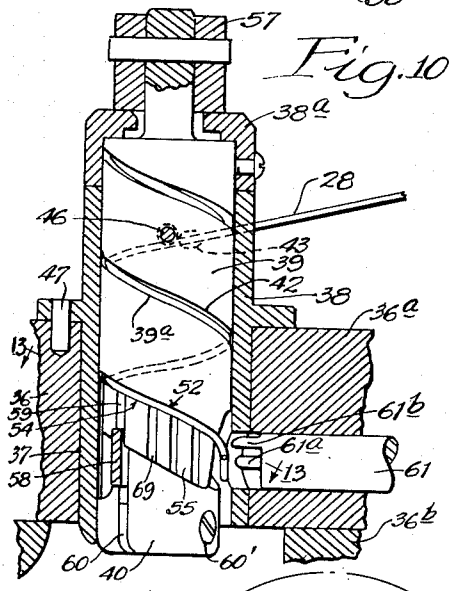


Fig. 11

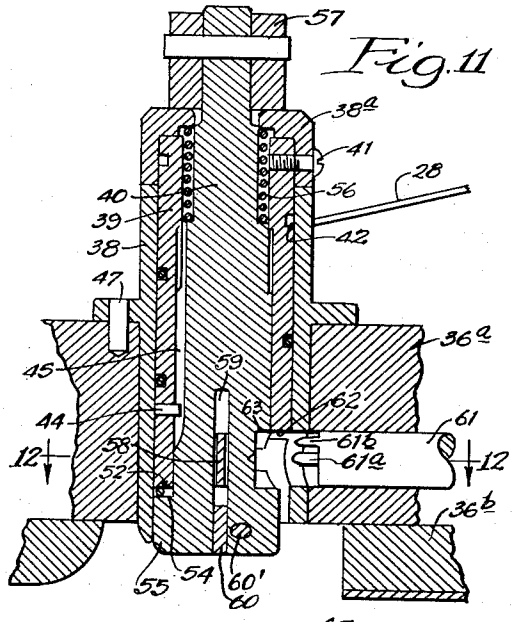


Fig. 12

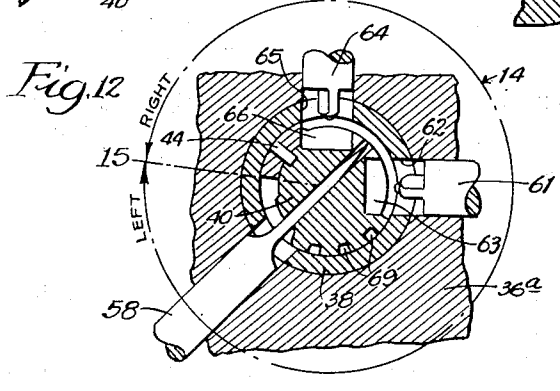
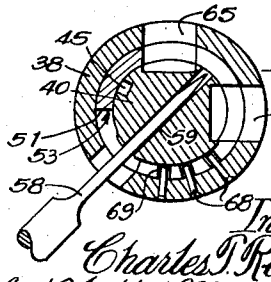


Fig. 13



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APPARATUS FOR MAKING SPRING PACKING

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Fig. 14

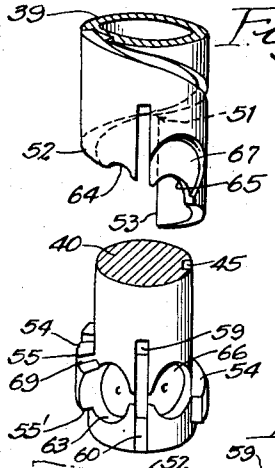


Fig. 15

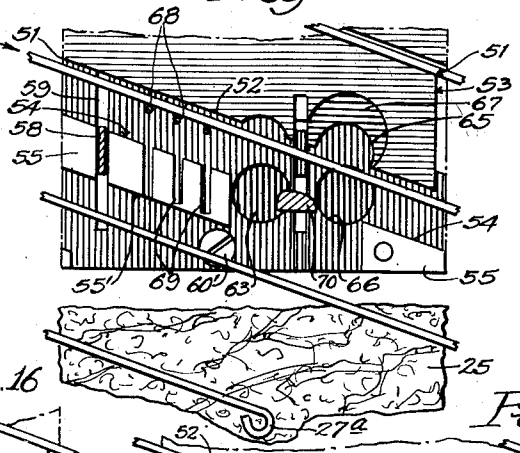


Fig. 16

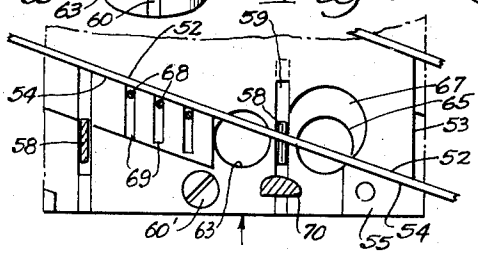


Fig. 17

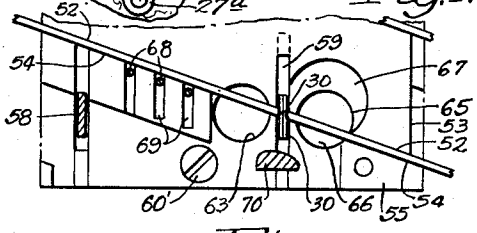


Fig. 18

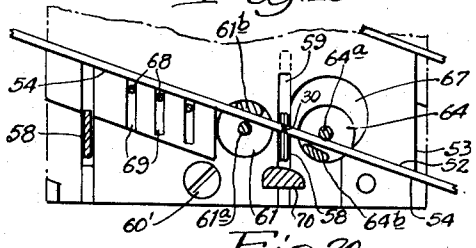


Fig. 19

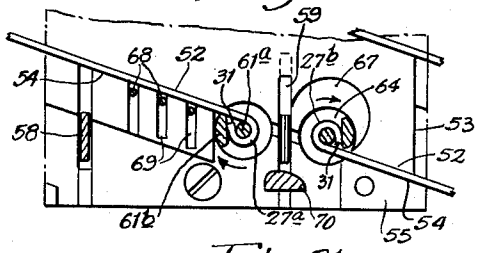


Fig. 20

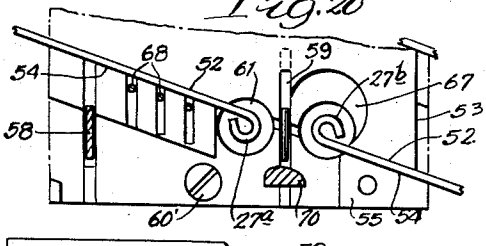


Fig. 21

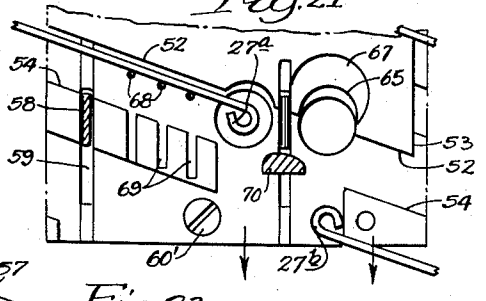


Fig. 22

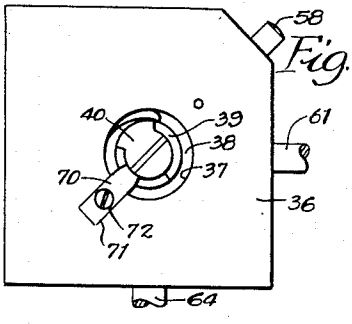
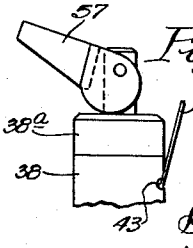


Fig. 23



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Patented Nov. 17, 1942

2,302,057

UNITED STATES PATENT OFFICE

2,302,057

APPARATUS FOR MAKING SPRING PACKING

Charles T. Ripley and Walter M. Gibbs, Chicago, Ill., assignors to Spring Packing Corporation, Chicago, Ill., a corporation of Illinois

Application March 8, 1941, Serial No. 382,374

10 Claims. (Cl. 140—71)

Our invention relates to the manufacture of spring-filled packing—a stranded capillary material such as waste with a multiplicity of springs embedded therein. This spring-filled packing is used especially for packing the journal boxes of railway rolling stock. The compression springs which are embedded within the waste perform the two-fold function of better keeping the waste pressed against the journal surfaces and holding the waste rather open so that it does not lose too much of its capillarity by becoming packed in hard lumps.

Our present invention is concerned with an improved apparatus for making the spring-filled packing and the springs therefor, and an improved die for forming the springs. The springs are preferably formed more or less simultaneously with the operation of embedding them in the waste.

Method phases of the present invention are the subject-matter of our co-pending application, Serial No. 401,748, filed July 10, 1941, on method of making spring packing.

Our improved spring-filled packing and our improved spring used therein, which are disclosed in this application, are disclosed and claimed in our copending application Serial No. 382,375, filed March 8, 1941, on "Spring-filled packing."

Among the objects of our invention are: A better control of the anchorage of the springs in the waste whereby they will be anchored effectively to the waste to keep them well distributed throughout the waste, but yet permit a ready release of the anchorage in separating the smaller body of the spring-filled waste from a larger body; an improved technique for the manufacture of the springs with terminal eyes in such a manner as to facilitate embedding the springs in the waste as an incident to or continuation of the manufacture of the springs, and which will yet provide ample working space where the terminal eyes are formed for the tools or other instrumentalities employed in forming the eyes; and an improvement in the cutting a terminal portion of a wire helix to sever a helical spring therefrom and while holding the cut-apart bodies of the wire helix in situ, turning back their severed ends.

Another object of the present invention is an improved die well adapted for carrying out the method, which is relatively simple, adaptable for multiple operation, not likely to jamb in operation, and in which the working parts, such as the cutting knife and the eye turning elements, are so arranged that they may readily be removed for replacement, sharpening, or repair and in which such elements radiate out from the die in such a manner as to leave ample room for driving engagement.

The foregoing, together with further objects, features and advantages of our invention, are set forth in the following description of, and the accompanying drawings illustrating, a specific embodiment thereof. In the drawings:

Figs. 1 to 5, inclusive, are vertical views showing successive steps in the manufacture of our spring waste;

Fig. 6 is a view of a mass of the finished product;

Fig. 7 is a side elevation of a completed spring;

Fig. 8 is a plan view of a completed spring;

Fig. 9 is a somewhat diagrammatical vertical longitudinal section through a horizontal layer or web of waste and a support for the waste and, partially in elevation, a die which may be used for effecting our method (the die being shown in the position of discharge of a completed spring);

Fig. 10 is a vertical cross-section of the jacket of the die with its sleeve and core in elevation, the section being on the same plane as that of Fig. 1 (the core being in its upward or clamping position in Figs. 10 to 13);

Fig. 11 is a section similar to Fig. 10 and on the same plane, but showing the die jacket, sleeve and core all in section;

Fig. 12 is a plan section taken on the line 12—12 of Fig. 11 through the die;

Fig. 13 is a section similar to Fig. 12, but taken on the oblique line 13—13 of Fig. 10 and omitting the frame and eye turning rods;

Fig. 14 is an axially exploded perspective view of the lower portions of the die core and die sleeve as viewed in the direction of the arrow 14 of Fig. 12;

Figs. 15 to 21, inclusive, are development views looking inwardly from the circumference of the wire helix within the helical die passage, the lateral margins of these developments starting and ending on the radius 15 of Fig. 12;

Fig. 22 is a bottom view of the die and its frame; and

Fig. 23 is a side elevation of the upper end of the die as viewed from the line 23—23 of Fig. 9, showing a lifting cam for the die core.

Figs. 7, 8 and 10 to 21 are on a larger scale than the other figures.

Our new spring-filled waste is illustrated in Fig. 6. It is a mass of waste 25—inexpensive cotton waste will suffice—with a multiplicity of springs 26, detailed in Figs. 7 and 8, embedded

therein. The waste does not have its yarns in any particular pattern or interrelationship.

The springs, as shown in Figs. 7 and 8, are helical springs which may be about an inch and a half in diameter and two convolutions long. They are made from spring brass wire to give a maximum resiliency with a minimum danger of corrosion.

The ends of the springs are formed into outwardly turned eyes **27**, which, as shown in Fig. 8, lie in the cylindrical surface within which the helical body of the spring may be considered as lying. This is as distinguished from the eyes lying in planes at normals to the axis of the helix. The eyes are not entirely closed but leave openings large enough to pass strands or yarns of the waste. This enables the eyes to anchor themselves to strands of the waste and better prevent dislocation of the spring relative to the immediate mass of yarn in which it is embedded.

The ends of the wire of the springs are turned in against the adjoining helical body to protect a workman's fingers against any danger of being cut thereby, since his fingers can touch only rounded surfaces. For the same reason, there is not even danger of the surface of the journal being scratched by sharp-cornered ends of the spring wire. The rounded surfaces afforded by the eyes facilitate the threading of the springs into the waste. But, as previously mentioned, because the eyes are not entirely closed, they have a hooking action upon a very few—and only a very few—strands of waste, which largely precludes any unscrewing of the springs from the mass of waste. Although the barbs at the ends of the wire resulting from cutting the wire are shielded by the eying from interfering with the threading of the wires into the waste, the barbed ends are presented to some of the strands of waste once the insertion is completed, and that tends to provide an anchoring of the springs within the waste quite in addition to the hooking action.

In the ultimate product of Fig. 6, the springs are not arranged in any pattern or predetermined position, but are variously disposed; they "run every which way." The resilience of the springs being much greater axially than diametrically, when the waste is packed into a journal box, for example, the miscellaneous disposition of the springs insures that a sizable body of waste will, because of the springs, exert a resilient pressure in all directions including, most importantly of all, pressure toward the journal.

Our new method of manufacturing spring-filled waste is illustrated generally in Figs. 1 to 6. These operations are carried out in successive cycles, each cycle comprising forming another two convolutions of helix from the supply wire, severing a two-convolution helix, forming terminal eyes, and screwing a completed severed helix spring into the layer of waste.

For the beginning of such a cycle we start, as shown in Fig. 1, with a previously formed two-convolution helix of wire with a terminal eye **27*a*** formed at the lower end thereof. The helix is disposed with its axis vertical and with the lower eye spaced above the top of a layer of the waste **25** by a distance about equal to a convolution of the helix.

The first step in the method cycle is to add two more convolutions to the helix of Fig. 1 by moving the wire longitudinally along its own axis, taking the wire from the reach of wire leading from the supply **28*a***. This shifting of the wire along its own axis, while retaining a fixed path for the helix, results in the previously formed portion of the helix shown in Fig. 1 being screwed downwardly along the helical path, with the eye **27*a*** leading, so that about the lowermost convolution is threaded into the layer of waste as at the right in Fig. 2. At this time the lower side of the layer of waste is elevated in the region beneath the infed helix so that the thickness of the layer is at least locally reduced by about one-half. (Preferably the normal thickness of the layer of waste is a little more than the length of the spring.) The helix now has four convolutions, the lower of which is threaded into the compressed layer of waste.

The second step, as shown in Fig. 3, is to cut the wire at **30**, severing the lower double convolution. (It is never necessary, in our process, to cut the wire between the helix and the supply reach.) The cutting leaves slight barbs at the severed ends of the wire.

The third step, as shown in Fig. 4, is to form eyes **27*a*** and **27*b*** in the severed ends of the wire. The new eye **27*a*** becomes the lower eye of a future convolution helix, like the initial two-convolution helix of Fig. 1, while the eye **27*b*** becomes the upper terminal eye of the severed new two-convolution helix. As to each eye, the eye is formed by turning the severed end of the wire in a plane tangential to the helix at that point, with the turning being axially away from the body of the helix, the terminal of which the eye defines. During the eye-forming operation of Fig. 4, the terminal reaches of wire are clamped at a spaced distance back from the cut, so that the body of the severed helix remains fixed during the eye formation. As a result, the completed eyes are spaced apart by a distance resulting from the length of wire incorporated in the eyes.

It will thus be seen that the complete formation of the completed spring of Fig. 4 from the supply wire has not been accomplished during this cycle. Instead it was formed largely during the previous cycle. That is, the two helical convolutions of the completed spring and its lower terminal eye **27*a***, as shown in Fig. 1, were formed during the preceding cycle; only the spring-forming steps of severing the wire and forming the upper terminal eye **27*b*** were performed in the current cycle.

The fourth step in the cycle, as shown in Fig. 5, comprises a release of the completed spring from its positional relationship to the newly formed two-convolution helix of wire and the lowering of the bottom of the layer of waste, so that the waste will expand to its normal thickness. As it does so, the spring is pulled down into the layer of waste to a greater extent than it was initially threaded, with the result that a substantial portion of the spring is submerged in the layer of waste. This pulling in of the spring results from the lower end of the spring becoming anchored in the waste while it is compressed and before it is re-expanded. This anchorage results in part from the lower convolution having been threaded into the waste, in part from a strand or two of the waste working into the eye through the slight unclosed gap thereof and anchoring themselves in the eye, and in part by the barb at the end of the severed end of the eye catching in some of the waste.

The fifth step in the cycle, which may largely overlap the fourth step, is a horizontal shifting of the layer of waste corresponding to the interval at which springs are to be embedded in the

layer of waste. The completion of this fifth step is shown in Fig. 1.

This cycle may be simultaneously carried out in multiple at intervals transverse to the direction of shift of the layer of waste (that is, at intervals in a front-to-back line in Fig. 1), so that during each cycle a plurality of springs are completed and screwed into a layer of waste at intervals transversely thereof. Thus, with the completion of a plurality of cycles embedding springs at intervals longitudinally of the layer of waste, a large area of waste with springs embedded at longitudinal and transverse intervals is produced. This spring-embedded layer is then twisted and folded and matted together in such a manner as to form the spring-filled waste mass of Fig. 6, wherein the springs are rather uniformly distributed through the mass but not in any particular order or pattern.

Particular attention is called to the placement of the terminal eyes in reference to the helical bodies of the springs. If the planes of the eyes were more or less at normals to the axes of the helical spring bodies, the instrumentalities employed in turning the severed ends of the wire into the eyes would be confined to rather close quarters between convolutions. But by forming the eyes so that the plane of each eye is substantially a tangent to the imaginary cylindrical surface in which the helix of the body of the spring is inscribed, the axis of the eye becomes more or less a radius from the axis of the helical body of the spring. This gives us almost unlimited room radially outwardly from the axis of the helix, and along the axis of the eye, for the instrumentalities employed in turning the wire into the eye. The space between convolutions and the substantial gap left between the completed eyes also afford reasonable working space arcuately about the axes of the eyes for the instrumentalities which form them.

Any usual economical means for severing the wire will leave barbs at the severed ends. We so form the terminals of the springs that these barbs cannot have any objectionable results such as injuring the fingers of the workman or impeding the threading of the springs into the waste. But, on the other hand, we do retain the barbed ends of the wire and turn them to good use where they can be of service; namely, in engaging and sticking to strands of the waste, the better to anchor the springs in the waste without danger of dislodgment.

Our new method of manufacturing the spring-filled waste is illustrated with more refinements in detail in connection with Figs. 9 to 23, which also illustrate a die which we have invented as peculiarly well adapted for carrying out our method.

The die **35** comprises a frame **36** (including a bottom plate **36***a* and a block **36***b*), a vertical bore **37** through the frame, a jacket **38** set into the bore, a sleeve **39** (Fig. 10) fitted into the bore of the jacket, and a core **40** slidably mounted within the bore of the sleeve (Fig. 11).

The jacket **38** is made in two pieces, a main body, the lower half of which is set into the bore of the frame, and an upper portion constituting a cap **38***a*, which is inwardly flanged to overlie the top of the sleeve **39** and which is fixed to the sleeve by a cap screw **41**. The die provides a helical guideway **42** into which and through which the wire **28** is fed longitudinally of itself to form the wire into the helix. The guideway **42** is formed in part by a helical groove or channel cut into the cylindrical periphery of the sleeve **39** and completed by the bore of the jacket **38**. A feed hole **43** for the incoming wire **28** is disposed tangentially through the wall of the jacket **38** at the back thereof, as shown in Figs. 10 and 23. A key pin **44** fixed in the wall of the sleeve and extending inwardly from its bore engages a longitudinal groove **45** in the side of the core **40**, as shown in Fig. 11, to spline the core to the sleeve so that the core may shift axially within the sleeve but not turn relative to it. The main body of the sleeve **39** is fixed to the jacket **38** by a set screw **46** (Fig. 9). The jacket in turn is made non-rotatable in its seat in the bore of the frame by a pin **47** (Fig. 10). Thus, once assembled, the frame **36**, the jacket **38**, the sleeve **39** and the core **40** are all fixed relative to each other except that the core may shift longitudinally within the sleeve.

As shown in Fig. 9, the layer of waste **25** is supported upon a longitudinally flexible horizontal floor or belt **48**, which in turn is supported for horizontal progressive movement leftward. The die **35** is positioned immediately over the waste-supporting floor **48** at such height that the bottom of the die comes about only level of the top of the layer of waste. Because of the stringy nature of the waste, a guide shoe **49** with upturned ends will prevent the waste catching on the die.

For elevating the bottom of the waste to compress the thickness of the waste beneath the inthreading spring at the appropriate time in the cycle, an eccentric wheel **50** may be rotated to raise the floor **48** immediately beneath the die.

Before describing the operation in greater detail, we shall first describe the remaining structure of the die.

The helical groove or channel **39***a* in the periphery of the sleeve, which helps define the helical guideway **42**, extends as such downwardly only to the point **51**, as shown in Figs. 14 and 15 and located in Fig. 13. Below the point **51** only the top wall of the channel survives, that being the lower edge **52** of the sleeve. The lower edge **52** of the sleeve, which edge is one convolution long, begins and ends at a vertical edge **53** which lies in a plane radial to the axis of the die and which is one convolution high. Thus, the edge **53** represents the vertical offset between the ends of the helical convolution to which the lower edge **52** of the sleeve conforms.

Near its lower end the core **40** is radially enlarged to the bore of the jacket to underhang the lower edge of the sleeve **39**, whereby to present an upwardly facing clamping shoulder **54** helically parallel with and complementing the lower edge **52** of the sleeve, as will be seen from Figs. 10, 14 and 15. This enlargement **55** is in the nature of a rib, having a bottom edge **55'** helically parallel with the edge or shoulder **54**, whereby the radius of the periphery of the core therebeneath is reduced, as it is just above the shoulder **54**, to clear a path for the downward continuation of the helix. This avoids an obstruction to downward feeding of the completed springs and their terminal eyes. A spring **56** normally pushes the die core from the clamping position of Figs. 10 and 11 to the rather widely open unclamped position indicated in Fig. 15. In that position the clamping edge **52** of the sleeve and the clamping shoulder **54** of the die, although still helically parallel, are separated far enough to permit the passage, along a continuation of the helix, of the terminal eyes of the springs. From this nor-

mally open position the die core may be raised to clamping position with the wire between the sleeve edge 52 and the clamping shoulder. A cam lever 57 pivoted to the upwardly protruding stem of the core and working against the jacket cap 38a may be employed to multiply the clamping force. (See Fig. 23.)

A chisel-edged cutter 58, shown in Figs. 12 and 13, is reciprocally journaled in the frame and diametrically penetrates the sleeve and core to bring its cutting edge normally a little inwardly of the wire at an elevation which is about at the mid point of the lower edge 52 of the sleeve. The core-penetrating end of the cutter is of flattened rectangular section and is reciprocable in a narrow vertical slot 59 milled diametrically into the end of the core and closed by a plug 60. (The plug may be removably retained by a set screw 60', as shown in Figs. 10 and 16.) This keeps the cutter from turning.

A turner 61 for forming the lower eye of the anterior spring is rotatably and reciprocably journaled in the frame, as shown in Figs. 10, 11 and 12 and indicated in Fig. 18. The turner 61 is in the form of a round shaft having at its inner end a central mandrel pin 61a preferably of hard piano wire and a turning wing 61b radially spaced from the mandrel pin a distance sufficient to accommodate the diameter of the wire. To permit the turner 61 to be shifted axially inwardly far enough to receive the wire between the mandrel pin and wing, the jacket and sleeve are radially traversed by cross bores 62 aligned with the cross bore in the frame which journals the turner shaft 61, and the periphery of the core is correspondingly radially countersunk at 63.

A similar turner 64 with a mandrel pin 64a and a turning wing 64b, as shown in Fig. 12 and indicated in Fig. 18, is journaled in the frame in angularly spaced relation to the turner 61 and works through a cross bore 65 in the sleeve and the jacket and into a countersink 66. The turner 64 is for forming the upper eye of the posterior spring. The turners 61 and 64 are positioned to operate equidistant on the anterior and posterior sides of the cutter 58. It so happens that in the die illustrated the axes of the turners 61 and 64 are at right angles to each other and in the same, or substantially in the same, horizontal plane, which means that the axis of the cutter 58 bisects the angle of the turners.

Adjoining its lower edge 52 at the region of the turner 64, the periphery of the sleeve is provided with a shallow crescent-shaped depression 67, as shown in Fig. 14 and indicated in Figs. 15 and 19, partially embracing the semicircle of the sleeve cross bore 65. The purpose of the depression 67 is to clear the end of the wire projecting beyond the cross bore 65 during the turning operation.

As shown in Figs. 14 and 15, the upwardly facing clamping shoulder of the core is interrupted a very short distance by one end of the cutter slot 59 and also throughout a considerable distance on either side of the other end of the cutter slot 59 and beneath the working position of the turners 61 and 64. This is partly to provide clearance for the downward axial shifting of the completed spring, including especially its upper terminal eye, and also in part because it would be impossible to obtain any clamping action at the region of the eye.

As is seen by a comparison of Figs. 15 and 20, the wire is clamped between the bottom edge 52 of the sleeve and the clamping shoulder 54 of the core along the reaches of wire both posteriorly and anteriorly adjoining the respective eyes as they are formed. On the other hand, when the core is moved down to its unclamped position the shoulder 54 is too far below the lower edge 52 of the sleeve to constitute a guide for the wire as it is progressed along its own axis, along that part of the way for the wire which is bounded by the lower edge 52 of the sleeve. To extend the lower limits of the guideway closer to the region of the turner 61, we provide a plurality of spaced guide pins 68 which, as shown in Fig. 13, are driven radially through the wall of the jacket 38 and protrude inwardly a short distance from its bore. As shown in Fig. 15, these guide pins 68 are disposed at a distance below the lower edge 52 of the sleeve to form a passage between the guide pins 68 and the edge 52 of about the same height as the height of the guide channel 39a. Thus, the pins 68 co-operate with the lower edge 52 of the sleeve in defining an extended guideway which accommodates the wire but confines it to its helical path almost up to the position of the turner 61. The radial enlargement 55 of the core, which gives body to the clamping shoulder 54, is vertically slotted at 69 to accommodate the pins 68 when the core is pulled up to clamping position, as shown in Fig. 16.

As shown in Fig. 22, a lug 70 is set into a slot 71 in the bottom surface of the frame plate 37b and removably held by a screw 72. The lug 70 projects radially into the bore 37 of the frame and extends to clearance distance from the core 40 at a radial position a little below the cutting end of the knife 58. The protruding inner end of the lug 70, which was somewhat rounded at its top surface, thus extends across but below the helical path of the wire.

Having previously described the spring-filled waste of Fig. 6 and the springs employed therein of Figs. 7 and 8 and also having previously described, in connection with Figs. 1 to 6, our method of making the springs and inserting them in the waste, and having now completed a description of the structure of the die we have devised as a preferred apparatus for carrying out that method—we shall now describe the operation of the die by reference particularly to Figs. 9 to 21.

In identifying the sequence of operation of the cycle, as shown in Figs. 15 to 21 with that shown in Figs. 1 to 5, it should be borne in mind: First, in Figs. 1 to 5, the springs are shown in elevation with their terminal eyes at the far (back) side and therefore the reaches of wire immediately adjoining the eyes seem to be inclined toward the lower left; on the other hand, the developments of Figs. 15 to 21 are outside views looking radially inwardly, and in them the reaches of wire adjoining the terminal eyes appear as inclined to the lower right. Second, the position of Fig. 21 is to be identified with the position of Fig. 5; and the position of Fig. 15 is to be identified with the position of Fig. 2. The two sequences of view do not start on quite the same phase of the cycle.

Accordingly, the more clearly to correlate the sequences of Figs. 15 to 21 to that of Figs. 1 to 5, we shall start with Fig. 21, which illustrates the position of the wire within the die at the stage of Fig. 5, the upper end of the just-completed spring being shown as starting to pull away from the die by the expansion of the layer of waste to its normal thickness.

The newly completed spring having been re-

leased by the die, and being pulled down by the expansion of the layer of waste 25, when the eccentric wheel 50 is rotated to its lower position, the newly formed spring is entirely withdrawn from the die by the shifting to the left of the layer of waste, as indicated in Fig. 9. This leaves a two-convolution helix of wire in the die, the upper end extending tangentially to the supply roll and the lower end terminating in the eye 27 as shown in Fig. 21.

Additional wire 28 is fed tangentially into the die through the port 43 (Fig. 23) to shift the wire along its own axis within the die to form two more convolutions, making a total of four convolutions, as indicated in Fig. 15. The feeding of the wire through the helical guideway 42 conforms and sets it to the characteristic helix of the spring. During this infeeding of wire for two more convolutions, the two convolutions previously formed are fed helically downwardly through the die without much guiding save a little lateral guiding between the core and jacket. It is not necessary to guide the two previously formed convolutions in close confinement, because they have already been formed into a set helix.

The initial downward helical movement of the terminal eye 27*a* from the position of Fig. 21 to the position of Fig. 15 is guided, however, in part by the pin 68 and by the terminal riding over the top surface of the lug 70, which guiding aids help the enlarged terminal of the wire in passing out from the die along the proper path without danger of its getting caught somewhere in the die or combing out through a wrong opening.

Next, as shown in Fig. 16, the core 40 is moved upwardly within the sleeve 38 and against the pressure of the spring 56, which may conveniently be effected with the aid of the cam lever 57 shown in Fig. 23. This clamps the wire between the core shoulder 54 and the bottom edge 52 of the sleeve 39, on both sides of the knife 58.

Next, as shown in Fig. 17, the wire is severed at 30 by longitudinal movement of the knife 58 in the normal position of Fig. 12. The cutting edge of the knife may be progressed to the bore of the jacket 38 so that it later serves as an anvil. But preferably the knife edge is stopped a trifle short of the bore, so that the knife does not completely sever the wire. The completion of the severing is then accomplished by the subsequent turning of the wire ends into terminal eyes, and thereby a small barb 31 (Fig. 19), as previously mentioned, is formed at each severed end of the wire. But even with a complete severance of the wire by the knife 58; something of a barb 31 is formed.

Next, as shown in Fig. 18, the turner 61 is slid radially inwardly from its normal position of Fig. 12 until its central pin 61*a* and its wing 61*b* lie below and above, respectively, either side of the wire a short distance in from its severed end.

Then, as indicated in Fig. 19, the turner 61, while held in its inward position, is rotated clockwise (Fig. 19) through about three-fourths of a revolution. By this rotation the wing 61*b* wraps the end of the wire around the central mandrel pin 61*a* to form a lower terminal eye 27*a* for the unsevered two-convolution helix of wire in the die. The turner 61 is so conformed, and placed at such a distance back from the severed end of the wire, that when the wire is wrapped about the mandrel pin the end of the wire does not entirely close the eye but leaves a slight gap.

Next, as shown in Fig. 20, the turner 61 is withdrawn outwardly to its normal position of Fig. 12.

The turner 64 is similarly shifted to an inner position, turned through about three-fourths of a revolution to form the other eye 27*b*, and then withdrawn. Either of the two eyes may be formed by its turner before the other is formed, but for convenience and speed we prefer that the operations of forming the two eyes be carried on simultaneously, and it is so illustrated in Figs. 18, 19 and 20. It will be noted that while both turners rotate clockwise in Fig. 19, the eye 27*a* is formed by turning the end of the wire downwardly while the other eye 27*b* is formed by turning the end of the eye upwardly.

After the eye-forming operations are completed, as in Fig. 20, the core 40 is released to permit gravity, aided by the spring 56, to push the core downwardly to release the clamping of the wire, as shown in Fig. 21.

This completes the cycle of operation of the die.

To initiate the first cycle, as when a new supply spool 28*a* of wire is to be fed into the die, the end of the wire is inserted through the feed hole 43 (Fig. 23) and pushed axially of the wire itself through the helical guideway 42 until it hits the knife 58 (which may be temporarily pushed inwardly for the purpose of a limiting stop). Then the core may be raised to clamping position, and the turner 61 pushed in and turned to form the initial terminal eye 27*a*. Then more wire 28*a* is fed into the die to form two more convolutions and advance the cycle to the position of Fig. 15.

Our die for making the spring is a relatively simple one despite the difficulty of illustrating it. It is easily taken apart and put back together. The working parts, such as the active ends of the turners and the sharp edges of the knife, are easily accessible by withdrawing those members. And although the working ends of the turners and the knife are operating in relatively close quarters, the bodies of those members extend radially outwardly from the spring being made, to external positions where there is ample room for connecting them with manual or machine-operated instrumentalities for effecting or facilitating their operation. The die is one which is well adapted for multiple operation at high speed for quantity production. The two turners 61 and 64 may, as structural units, be identical.

While we have illustrated and described this specific embodiment of our method and apparatus for making it, we contemplate that many changes and substitutions may be made without departing from the scope and spirit of our invention. The phraseology of the claims assumes a position in which the axis of the helix is vertical, but it will be understood that the term is used only in a relative sense in defining the relationship of the parts.

We claim:

1. A die for forming from spring wire terminally eyed coiled springs for spring-filled packing, comprising a jacket member having a bore, a sleeve member fitted into the bore, a helical groove in one of the members along the bore and closed by the other member to provide a helical guideway for receiving the wire and forming it into a helix as the wire is fed longitudinally of itself through the guideway, the

lower wall of the groove being omitted along a lower reach of the guideway, a core member mounted to reciprocate axially within the sleeve member, and near its lower end carrying a radial enlargement which presents a helically conformed upwardly facing shoulder shaped to complement the upper wall of the groove along the region of said lower wall omission and to cooperate therewith to clamp the wire at spaced regions therealong, a cutter mounted to cut the wire intermediate said clamping regions whereby to sever lower convolutions of the wire as a helical spring, turners mounted to engage the severed ends of the wire on either side of the cut and between said clamping regions whereby to bend the ends of the wire into terminal eyes, and means for shifting the core downwardly whereby to release its clamping of the wire and to permit removal of the severed spring.

2. A die according to claim 1, wherein the core member is shifted downwardly far enough for the lower terminal eye of the remaining wire helix to pass between said shoulder of the core member and said complemented upper wall of the groove to permit helical progression of the remaining helix of wire.

3. A die according to claim 1, wherein the cutter extends diametrically through the sleeve and core members between convolutions of the wire and cuts the wire in a direction radially outwardly of the die.

4. A die according to claim 1, wherein the cutter extends diametrically through the sleeve and core members between convolutions of the wire and cuts the wire in a direction radially outwardly of the die and the turners, in forming the eyes, rotate about axes radially of the die.

5. A die according to claim 1, wherein the core member protrudes above the sleeve and jacket members for engagement by mechanism for vertically shifting the core member.

6. A die for forming from spring wire terminally eyed coiled springs for spring-filled packing, comprising means forming a helical guideway for receiving wire fed into the guideway longitudinally of the wire, a cutter for cutting the wire at an intermediate position along the helical guideway to sever lower convolutions of the wire as a coiled spring, means for clamping the wire in the guideway at regions arcuately spaced anteriorly and posteriorly of the point of cutting, and turners engaging the end reaches of the wire between their clamped regions and their severed ends to turn the end reaches into terminal eyes.

7. A die according to claim 6, wherein the turners are reciprocally journaled along axes radial to the helix and are shifted inwardly to overlap and engage the wire and are rotated to turn the end reaches of wire into the eye, and are shifted outwardly to clear the wire.

8. Apparatus for forming from spring wire terminally eyed coiled springs and embedding them in a layer of waste in the manufacture of spring-filled packing, the apparatus comprising a die having a helical guideway into which wire is fed and progressed longitudinally of the wire to form the wire progressively into a helix, means for supporting a layer of waste beneath the die to be penetrated helically by the helix of wire as it is helically progressed out of the die, means for clamping the wire at arcuately spaced regions along the helix of wire in the die, means for cutting the wire at a point intermediate said clamping regions to sever lower convolutions of the helix of wire as a coiled spring after its leading end has been fed into the waste, and means effective during the clamping but after the cutting for forming the end reaches of wire adjacent the cut into terminal eyes.

9. Apparatus for forming from spring wire terminally eyed coiled springs and inserting them in packing material to form spring-filled packing, comprising means for forming the wire, as progressed longitudinally of itself, into a helix, a cutter for cutting the wire at an intermediate position of the helix, said means including clamping parts for clamping the wire of the helix at regions arcuately spaced anteriorly and posteriorly of the point of severance, and rotatably mounted turners engaging the end reaches of the wire between their clamped regions and their severed ends to turn the end reaches into terminal eyes.

10. Apparatus according to claim 9, wherein the turners are reciprocably journaled along axes radial to the helix for inward shifting to positions overlapping and engaging the wire and for rotation to turn the end reaches of the wire into eyes, and for back-shifting outwardly from the helix to clear the wire.

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