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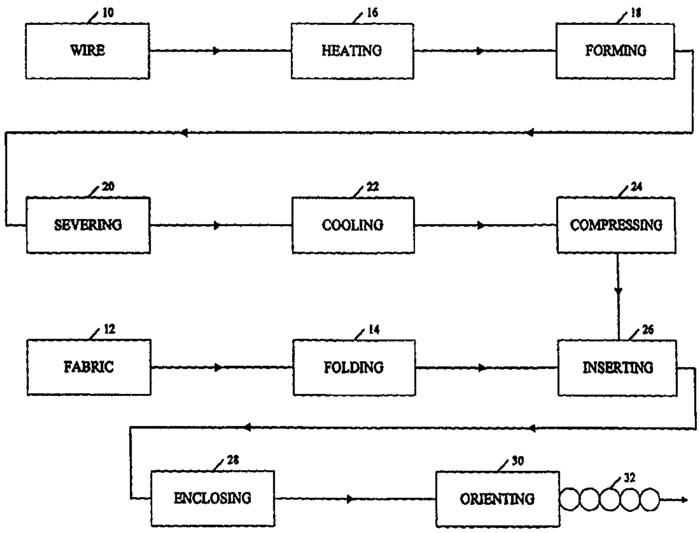

(57) Abstract

A method and apparatus for forming a length of connected, pocketed coil springs to be used in mattresses and the like where wire (10) from a supply source is heated (16) to between 450 and 500 degrees Fahrenheit by an induction heater before the wire is coiled. Thereafter, the wire is hot coiled (18), severed (20) and cooled (22) below a temperature where a permanent set might occur fromfurther processing of the spring. Thereafter, the spring is compressed (24) in preparation for its insertion (26) into a space provided by stretchable fabric from a supply reel. The fabric (12) is folded (14) on itself to provide the space. The temperature of the spring must also be sufficiently low to contact the fabric without causing burns or other damage. After insertion of a compressed spring into the space, the fabric is ultrasonically welded (28) to create individual but connected pockets for each spring. Thereafter, the springs are oriented (30) to allow each spring to expand thereby creating the length of connected, pocketed coil springs.

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METHOD AND APPARATUS FOR MANUFACTURING COIL SPRINGS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method and apparatus for manufacturing a strip or length of connected, pocketed coil springs and, more particularly, to a method and apparatus for manufacturing connected, pocketed coil springs which provide for fast, effective, efficient, and inexpensive product.

2. Description of the Related Art

Methods and apparatus for making a strip of connected individually pocketed coil springs for mattresses and cushions have been known for many years. See for example, a 1901 U.S. Patent, No. 685,160 to Marshall. A description of a modern apparatus and method is found in a 1984 U.S. Patent, No. 4,439,977 to Walter Strumpf. That patent in turn references two earlier U.S. patents from 1929 and 1931. Other U.S. patents have been issued describing various aspects of apparatus or methods for making connected, pocketed coil springs. For example, see U.S. Patents, No. 4,234,983; No. 4,565,046; No. 4,566,926; No. 4,578,834; and No. 4,854,023, all to Strumpf; No. 5,186,435 to Smith; No. 5,444,905 to St. Clair; No. 5,471,725 to Thrasher; and No. 5,509,887 to Smith. The disclosures of all of the above-mentioned patents are herein incorporated by reference.

Briefly, the method and apparatus for making a strip of pocketed coil springs include machinery that coils wire supplied from a large spool, the coil spring is compressed into a space created by folded fabric and the combination is then enclosed using ultrasonic welding. Thereafter, the attitude of the compressed spring is altered and it is expanded within the fabric pocket whereby a line of joined or connected, individually encased, coil springs is created. Multiple strips may then be bonded together by adhesives to form, for example, the central portion of a mattress where upon the strips are encased with upholstery.

There have been ongoing efforts over the years to enhance the methods and apparatus for making pocketed coil springs, as exemplified by the above-mentioned patents. These efforts strive to improve the product, to gain efficiencies, to reduce costs, and to increase reliability or various combinations of these objectives. One area of attention is the wire used for the coil springs.

Manipulating wire, as may be expected, induces stress, particularly when the wire is first formed to the desired diameter and again when the wire is formed into coils. Typically, small diameter wire is formed from larger diameter wire by forcing the wire, while heated, through progressively smaller dies. A coil typically is formed by forcing "cold" wire against a die that bends the wire in a desired fashion. If desired, stress relief of the finished coil could be accomplished by batch heating the formed springs in an oven, or connecting each spring to an electrical source and passing a current through the wire. Neither of these processes are particularly effective or efficient. Batch heating results in springs with inconsistent characteristics in that those in one part of an oven may be heated differently from those in another part of the oven. With electric current heating, consistent and proper heating depends upon an operator's ability to consistently connect each spring in exactly the same way. In addition, use of electric current sometimes creates an undesirable electric arc which may mechanically degrade a spring.

It is apparent that a better product will result if an effective means for heat treating the spring wire can be found, mindful of the constraints of the manufacturing process and costs.

SUMMARY OF THE INVENTION

The present invention provides for a substantial improvement on the previous methods and apparatus for producing a strip of connected, pocketed coil springs. What is first described here is a method for making a length of connected, pocketed coil springs comprising the steps of providing a wire adapted to be formed into a plurality of coil spring, providing material for forming a plurality of spaces, each space to receive a coil spring, heating the wire to a temperature for relieving stress in the wire, forming the wire into a coil spring while the wire is at an elevated temperature, cooling the resulting coil wire spring to a temperature where intended deformation of the spring will be below the elastic limit of the wire, compressing the coil spring, manipulating the material to form the spaces, inserting the compressed coil springs into the spaces, and enclosing the material around each of the spaces to form a plurality of connected, spring filled pockets.

An apparatus for forming a length of pocketed coil springs is also disclosed, the apparatus comprising in combination a wire supply apparatus for providing a wire to be coiled, a heating apparatus operatively connected to the wire supply apparatus for induction heating the wire as it passes from the supply apparatus to a coil forming apparatus, a coil forming apparatus operatively connected to the heating apparatus for bending the wire while the wire is at an elevated temperature, a severing apparatus operatively connected to the coil forming apparatus for separating coil wire springs from the wire supply apparatus, a cooling apparatus operatively connected to the coil forming apparatus for reducing the temperature of the coil wire springs, a material supply apparatus operatively connected to the coil forming apparatus for providing a length of material, a pocketing apparatus operatively connected to the material supply apparatus for receiving the length of material from the material supply apparatus and for receiving the coil wire springs from the cooling apparatus wherein each of the springs is inserted into a corresponding space formed by the length of material, an enclosing apparatus operatively connected to the pocketing apparatus for defining the spaces in the length of material thereby completing a connected length of pockets, and control means operatively connected to the cooling apparatus and to the heating apparatus for controlling the forming of the pocketed coil springs.

An object of the present invention is to provide a method and apparatus which allow for stress relief of the metal wire that forms the coil springs of a length of connected, pocketed springs. Another aspect of the present invention is to provide a method and apparatus for making a strip of connected, pocketed coil springs that integrates heating of the wire from which coil springs are formed so as to relieve stress in the wire. A further aim of the present invention is to provide a method and apparatus for manufacturing a strip of connected, pocketed coil springs which are efficient thereby achieving a cost savings. Yet another advantage of the present invention is to provide a method and apparatus for cooling formed coil springs prior to their insertion in spaces formed in a length of material.

A more complete understanding of the present invention and other objects, aspects, aims and advantages thereof will be gained from a consideration of the following description of the preferred embodiment when read in conjunction with the accompanying drawings provided herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow diagram illustrating a method for making a strip of connected, pocketed coil springs.

Figure 2 is a diagrammatic view of an apparatus for manufacturing a strip of connected, pocketed coil springs.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

While the present invention is open to various modifications and alternative constructions, the preferred embodiments as shown in the drawings will be described herein in detail. It is to be understood, however, that there is no intention to limit the invention to the particular forms disclosed. On the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the invention as expressed in the appended claims.

The present invention relates to a method and an apparatus for making a line of connected, individually pocketed coil springs typically used in mattresses. The structure is commonly known as the Marshall construction. In this construction, each spring is encased within its own fabric container or pocket. Pockets are generally formed between two plies of a strip of fabric, formed by one piece of fabric being folded upon itself and then fastened together longitudinally and transversely after compressed coil springs are inserted in the spaces between the plies.

Referring now to Figure 1, there is shown a flow diagram illustrating the method of manufacturing a strip of connected, pocketed coil springs. Generally, the process begins with the provision of a spool of wire (10) and a spool of fabric material (12). The spool of material provides a fabric strip to a folding station (14) where the fabric is folded over on itself to form spaces for receiving compressed coil springs.

The wire from the spool is heated (16) with the intention of relieving stress induced during the wire making process. The wire is then pushed against a tool (18) while at an elevated temperature which causes the wire to bend into a coiled shape. Because of the heating, the resulting wire is more ductile and there is a reduction in the coil forming stress. After forming, the wire is severed (20) freeing the coil spring from the wire strand emanating from the spool. The spring is then cooled (22) in a rotating carousel before the compressing step (24) which compresses the spring to a height of about 0.5 inches. It is to understood that other mechanisms may also be used to cool the springs besides a rotating carousel. For example, a conveyor may be used. After compression, the wire spring is inserted (26) into a space provided in the folded fabric. Thereafter, the combined spring and fabric are passed to an enclosing station (28) where the fabric is formed into pockets by selectively attaching the two plies of the fabric using ultrasonic welding. The attachments occur both between each spring and along the longitudinal ends where the fabric strip folds come together or overlap. This forms an enclosure around each spring. The final step is orienting or turning (30) the spring in the pocket thereby allowing the spring to fully expand so as to create (32) the final length of connected, pocketed coil springs.

Referring now to Figure 2, there is shown in more detail the inventive method and inventive apparatus for making a length of connected, pocketed coil springs. The method and the apparatus will be recognized as both simple and cost effective. The manufacturing process is also efficient and reliable, and results in a superior product. The wire used for the springs is upholstery spring wire, SAE1065-SAE1075, and is one of three diameters: 0.071 inches, 0.083 inches or 0.094 inches. Tensile strength of the wire is approximately ASTM 230,000 to 305,000 p.s.i. It is, of course, understood that the tensile strength is a function of wire size and material. The wire is usually provided in feed rolls or supply reels (50) where the wire is wound around a tubular steel carrier in lengths of about 79,000 feet or 1800 pounds. The wire is pulled off the carrier by a set of powered rollers (51) operating at a speed to move the wire at approximately 320 feet per minute. Suitable wire may be purchased from Insteel Wire Products of Andrews, South Carolina.

The wire then passes through a magnetic induction heating apparatus or station (52). The heating apparatus is a 25KW induction device which may be purchased from Inductoheat of Romeo, Michigan. The heating apparatus is formed in an insulative box, measuring about 43 inches long, 6 inches high and 6 inches wide. The heating apparatus will increase the temperature of the wire to between 450°F and 500°F in approximate 0.63 seconds. The purpose of the heating apparatus is to heat-treat or stress-relieve the wire of those stresses induced during the wire manufacturing process and to provide a ductile material for coil forming, thereby reducing forming stresses. The heating process, like the entire process, is conducted in a stop/go or on/off manner. The heater is activated only when the wire is moving. When there is a pause in the movement of the wire the heating apparatus is turned off. This insures consistent heating of each wire segment. The wire is heated in lengths of about 41 inches, and each spring is about 9 inches in length.

It ought to be noted that other heating processes have been tried for the Marshall construction but without success. These have been found to be expensive, slow and inconsistent. For example, in batch furnace heating, some springs will be exposed to different temperatures than other springs. In another process, called electrical resistance heating, electrodes are clamped to a fully formed spring and heat is generated by passing an electric current through the spring. The quality of this technique is dependent upon consistent mechanical contact between the clamping electrodes and the spring, a difficult feat to accomplish in a high speed production process. Frequently, this method also produces hot spots, burrs and the like.

Batch furnace heating require large pieces of equipment, is expensive and requires additional handling. The creation of burrs by electrical resistance heating is especially detrimental when fabric pocketing follows in the manufacturing process.

After the wire is heated it moves to a forming apparatus or station (54) where the wire is formed into a coiled shape while at an elevated temperature. This is done by forcing or pushing the wire against a tool. The tool is hardened steel and is shaped to bend the wire pushed against it in a continuous and predetermined manner. The result is a coil of about 2 5/8 inches in diameter. After the coil spring is formed, the wire is severed by a moveable cutting blade which shears the wire as it is forced against a stationary blade. It is to be noted that heating the wire before it is coiled allows for the "hot" forming of each spring. It is believed that heating the wire before the coil forming step relieves stresses induced during the wire making operation when the wire is reduced in diameter; and the heating step will allow the coil forming step to be accomplished with less induced stress because the wire is being "worked" at an elevated temperature when it is in a more ductile state.

After heating, forming and severing, the spring is moved to a cooling apparatus or station (58) where each coil spring is positioned on a circular cooling carousel (59) which is mounted to rotate in a timed, indexed fashion. The carousel has a number of slots or openings, such as opening (61), for receiving springs.

Each spring rests on the carousel as the carousel is rotated for a predetermined time. The amount of time each spring spends on the carousel is a function of the required temperature drop. The carousel is designed to support each spring for the predetermined time. The design of the carousel is a function of the manufacturing rate, the number of slots to be used and the position of the carousel slots when the springs are received and expelled by the carousel. During the time that the spring is being carried by the carousel, or for a portion of that time, the spring may be subjected to cooling air from a blower (57). The power of the blower, whether the air should be refrigerated, the amount of air being moved, the temperature of the air and other such factors are a function of the predetermined cooled temperature to be reached, the velocity of the carousel, the starting temperature of the spring, the size of the opening or slot in the carousel and the diameter of the carousel, for example. Other factors may also be relevant. For the materials mentioned above, the desired "cooled" temperature is approximately 150°F. Thereafter, the cooled spring is moved to a compressing apparatus or station (60) where an air operated piston descends and compresses each coil spring to about a half inch in preparation for its insertion into a pocket.

The cooled spring temperature, approximately 150°F, is a function of the metal used and should be below that temperature where a permanent deformation set will occur when the spring is compressed. Thereafter, the compressed spring is inserted into a fabric pocket; hence, the temperature must also be sufficiently low so as to not burn the fabric.

In addition to the wire supply apparatus, there is a fabric material supply apparatus or station (62). A large spool of fabric material provides a length of fabric which is stretchable in a direction parallel to the direction of movement of the fabric. The fabric then proceeds to a folding apparatus or station (64) where the fabric is guided automatically to fold over onto itself to create a space which will later be occupied by the compressed springs. A pair of rollers (65) provide the drive for pulling the fabric from the supply station.

The fabric then moves to a pocketing or inserting apparatus or station (66) where it intersects the movement of the now cooled and compressed coil springs. There, a cover plate keeps the springs compressed while a pushing mechanism slides each compressed spring into a space formed by the folded fabric. Next, the fabric containing the compressed springs moves to an enclosing apparatus or station (68). There, an ultrasonic welding mechanism descends and completes the construction of an enclosed pocket by selectively connecting together the fabric of the two folded parts, both in a direction parallel to the line of travel of the fabric, and also in a line perpendicular to the direction of movement of the fabric. This separates one spring from its neighbor in line. Another set of drive rollers (69) pulls the fabric containing the springs from the enclosing station.

The loaded fabric moves next to an orienting or turning apparatus or station (70) where the pocketed springs, which will have partially expanded, are rotated by approximately 90° and allowed to expand fully to about 6 3/4 inches. The rotation and full expansion are accomplished by a series of rotating paddles which beat the pockets as the strip is pulled along by a chain drive (71). The final result is a completed length of connected, pocketed coil springs having the usual configuration of a connected row of fabric cylinders.

Controlling the process and the manufacturing apparatus is a control apparatus (74) which functions to signal the appropriate stations when each is to perform an operation on the wire or on the fabric. In this fashion, the invention described above allows for a production rate of approximately 72 coil springs per minute. The control apparatus also provides for the stop/go, on/off or indexed movement of the entire process.

The inventive method and apparatus provides for a number of advantages. First, stress imparted to a wire during the wire forming stage is reduced and the stress induced during coil forming is minimized. Second, minimizing such stress greatly improves the performance characteristics of the springs. Unwanted and undesirable deformation of the wire is dramatically reduced, and durability of the springs is enhanced.

Third, when the undesirable deformation of a spring is reduced or eliminated, less wire is required to produce a durable coil spring. There is a cost saving of material in the approximate range of 10-25%. The stress-relieving process may also enable the use of lower tensile strength wires, another cost savings.

Finally, the present invention provides for a heat treating operation which conforms to an in-line manufacturing operation. The heating is rapid, non-contacting, and independent of the condition of the wire. The result is consistent springs from one to the next. Furthermore, no delay is introduced into the existing manufacturing operation.

The present specification describes in detail two embodiments of the invention. Other modifications and variations will, under the Doctrine of Equivalents, come within the scope of the following claims. For example, changes in various stations or apparatus are considered equivalents. Changes of temperatures because of wire material changes are also considered equivalents. Obviously, new technology or other variations will also be equivalent, as there is no intention to limit in any way the application of the Doctrine of Equivalents.

CLAIMS

1. A method for making a length of connected pocketed coil springs comprising the steps of:

providing a wire adapted to be formed into a plurality of coil springs, said wire having an elastic limit;

providing material for forming a plurality of spaces, each space to receive a coil spring;

heating said wire to a temperature for relieving stress in said wire;

forming said wire into a coil shape while said wire is at an elevated temperature;

cooling the resulting coil wire spring to a temperature where intended deformation of said spring will be below the elastic limit of the wire;

compressing said coil spring;

manipulating said material to form said spaces for said coil springs;

inserting a compressed coil spring into each of said spaces; and

enclosing said material around each of said spaces to form a plurality of connected, spring filled pockets.

2. A method as claim in 1 wherein:

said heating step includes increasing the temperature of said wire to a range, approximately 450°F-500°F.

3. A method as claimed in 1 including the step of:

providing a tool for causing said wire to bend.

4. A method as claimed in 2 wherein:

said wire providing step includes providing wire from among wire diameter sizes of 0.071, 0.083 and 0.094 inches.

5. A method as claimed in 2 wherein:

said cooling step includes cooling said wire after forming to approximately 150°F.

6. A method as claimed in 4 including the step of:

producing connected pocketed springs at a rate of approximately 72 per minute.

7. A method as claimed in 6 wherein:

providing said wire at a flow rate of approximately 320 feet per minute.

8. A method as claimed in 1 including:

severing said wire after said coil spring forming step;

compressing said wire after said coil spring forming step; and

orienting said springs after said enclosing step.

9. An apparatus for forming a length of pocketed coil springs comprising in combination:

a wire supply apparatus for providing a wire to be coiled;

a heating apparatus operatively connected to said wire supply apparatus for induction heating said wire as it passes from said supply apparatus to a coil forming apparatus;

a coil forming apparatus operatively connected to said heating apparatus for bending said wire while said wire is at an elevated temperature;

a severing apparatus operatively connected to said coil forming apparatus for separating coil wire springs from said wire supply apparatus;

a cooling apparatus operatively connected to said coil forming apparatus for reducing the temperature of said coil wire springs;

a material supply apparatus operatively connected to said coil forming apparatus for providing a length of material;

a pocketing apparatus operatively connected to said material supply apparatus for receiving said length of material from said material supply apparatus and for receiving said coil wire springs from said cooling apparatus wherein each of said springs is inserted into a corresponding space formed by said length of material;

an enclosing apparatus operatively connected to said pocketing apparatus for defining the spaces in said length of material thereby completing a connected length of pockets; and

control means operatively connected to said cooling apparatus, and to said heating apparatus for controlling the forming of said pocketed coil springs.

10. An apparatus as claimed in 9 including:

a compressing apparatus operatively connected to said cooling apparatus for receiving said coil springs from said cooling apparatus and for compressing said springs before said springs are inserted into said spaces formed in said material;

a folding apparatus operatively connected to said material supply apparatus for receiving material from said material supply apparatus and for forming said spaces to receive said coil springs; and

an orienting apparatus operatively connected to said enclosing apparatus for rotating said springs in the spaces formed by said material.

11. An apparatus as claimed in 10 wherein:

said heating apparatus increases the temperature of said wire to a range, approximately 450°F to 500°F.

12. An apparatus as claimed in 11 wherein:

said cooling apparatus reduces the temperature of said elevated temperature springs to approximately 150°F.

13. An apparatus as claimed in 12 wherein:

said control means provides for production of approximately 72 connected, pocketed springs per minute.

14. An apparatus as claimed in 13 wherein:

said wire supply apparatus supplies wire at approximately 320 feet per minute.

15. An apparatus as claimed in claim 9 wherein:

said cooling apparatus is a rotatable carousel which receives springs from said coil forming apparatus.

16. An apparatus as claimed in claim 9 wherein:

said cooling apparatus causes said coil wire springs to reach a temperature where intended deformation of said spring will be below the elastic limit of said wire.

17. An apparatus as claimed in claim 10 wherein:

said cooling apparatus causes said coil wire springs to reach a temperature where the compression of said springs will be a deformation below the elastic limit of said wire.

18. An apparatus as claimed in claim 15 wherein:

said cooling apparatus causes said coil wire springs to reach a temperature where intended deformation of said spring will be below the elastic limit of said wire.

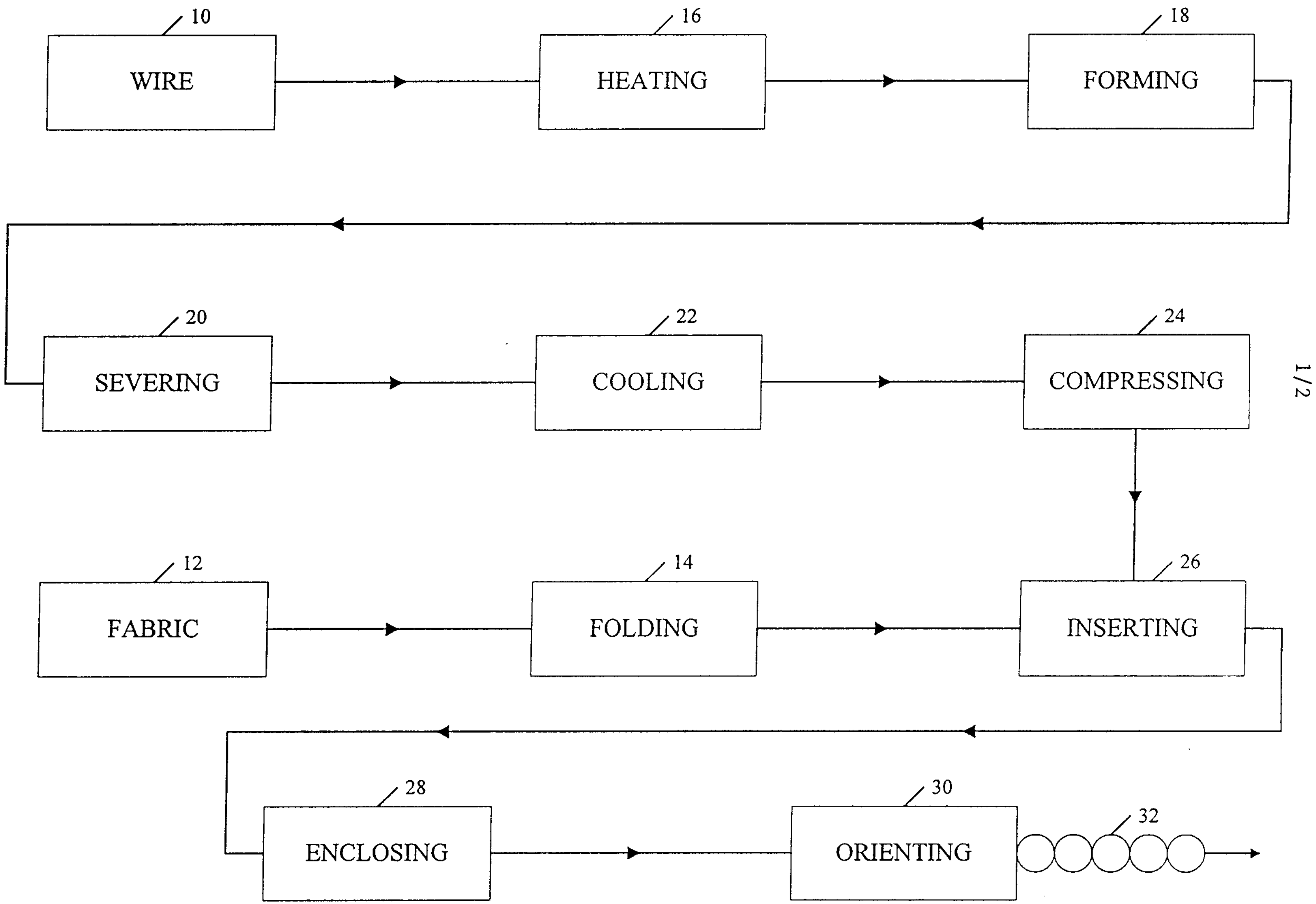
19. An apparatus as claimed in claim 17 wherein:

said heating apparatus increases the temperature of said wire to a range, approximately 450°F to 500°F.

20. An apparatus as claimed in claim 19 wherein:

said cooling apparatus is a rotatable carousel which receives springs from said coil forming apparatus.

FIG 1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WIRE
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ENCLOSING
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ORIENTING
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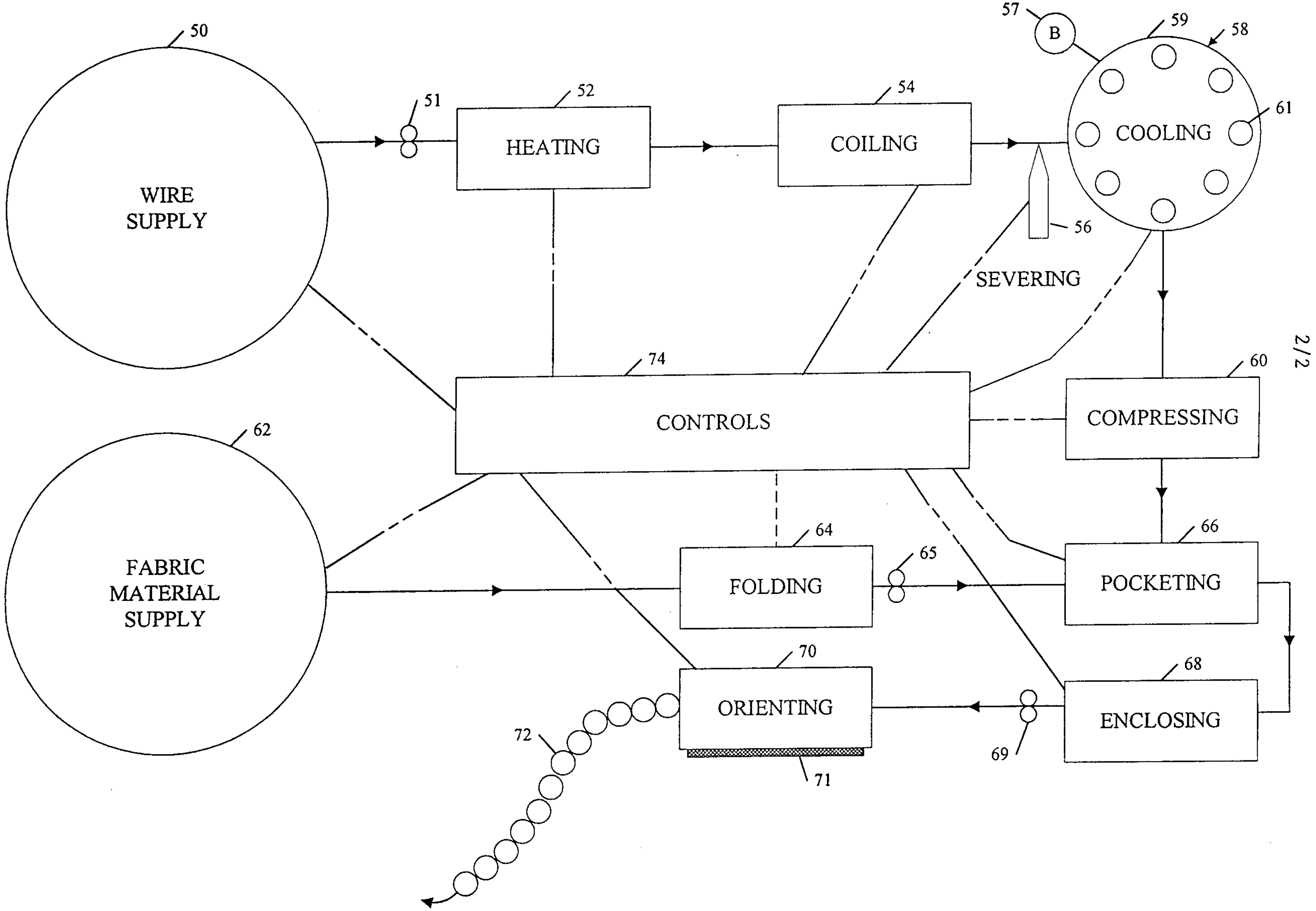
FIG 2



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/11355

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B21F 27/00; C21D 9/02; B21F 35/00
US CL : 29/896.92; 140/3CA; 148/568, 580, 598, DIG. 908
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 29/896.92; 140/3CA; 148/568, 580, 598, DIG. 908

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,439,977 A (STUMPF) 03 APRIL 1984, See entire document.	1, 3, 8, 9 and 10
Y	US 2,219,376 A (YOUNG et al.) 29 October 1940, col. 1, line 19 to col. 2, line 16; col. 4, line 26.	1, 2, 9, 10, 11, 19
Y	US 3,541,832 A (LOFTUS et al.) 24 November 1970, col 1, line 46 to col. 2, line 12.	1, 9
Y	US 5,572,853 A (ST. CLAIR et al.) 12 November 1996, col. 5, lines 5-21, col. 7, lines 15-19.	1, 2, 9, 10, 11, 15, 19, 20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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