Nov. 6, 1945. C. A. HALLSTROM ET AL 2,388,537

METHOD OF MAKING SPRINGS

Filed March 20, 1942

FIG. 1.

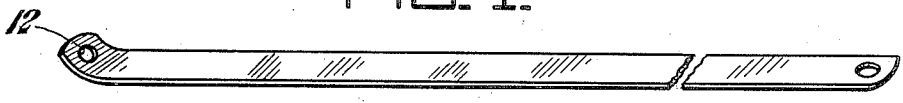


FIG. 2.

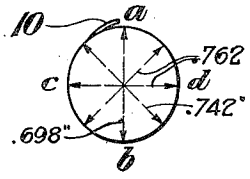


FIG. 3.

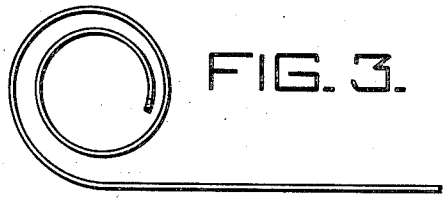


FIG. 4.

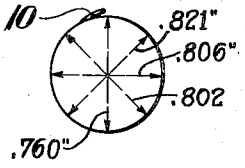


FIG. 5.

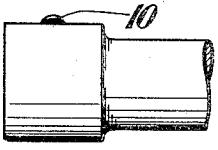


FIG. 6.

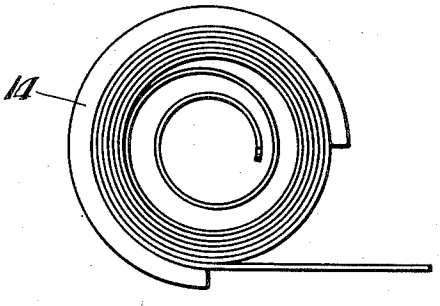
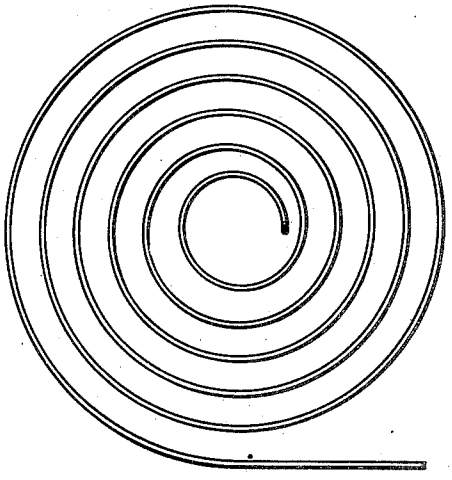


FIG. 7.



Inventors:
CHARLES A. HALLSTROM
and RAYMOND E. TIBBETTS,
by: John E. Jackson
their Attorney.

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METHOD OF MAKING SPRINGS

Charles A. Hallstrom and Raymond E. Tibbetts, Worcester, Mass., assignors to The American Steel and Wire Company of New Jersey, a corporation of New Jersey

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3 Claims. (Cl. 29—173)

The present invention relates to an improved method of making volute springs from flat, ribbon-like steel strip, and is characterized by annealing one end of a steel spring blank so as to remove the temper therefrom, and subsequently cold forming the annealed end to conform to a curvature of predetermined radius and thereafter coiling the strip about an arbor corresponding to such radius so as to form a spring in which the innermost convolutions are devoid of dead or inactive coils.

Heretofore volute springs made by prior methods have usually had their innermost ends heated to a red heat and then coiled. This has resulted in the production of springs less effective than the springs which result from the practice of the present method, since in the conventional prior practice one or more turns at the inner end of the spring are dead or inactive. The primary object of the present invention is to overcome this inherent disadvantage in prior methods.

The above and related features of the invention will be fully apparent from a consideration of the following detailed description, the accompanying drawing and the appended claims.

In the drawing:

Figure 1 is a perspective view of a length of ribbon-like spring steel strip after the same has been subjected to certain preliminary steps which characterize the present invention;

Figure 2 is a view of an arbor such as used in coiling springs according to the herein claimed method;

Figure 3 is a view of the inner portion of a partially formed spring wound on the forming arbor shown in Figure 2;

Figure 4 is a view of another forming arbor used in practicing the method;

Figure 5 is a side elevation of the type of arbor shown in Figures 2 and 4;

Figure 6 is a view of a completed spring made in accordance with the present invention and equipped with the usual retainer ring employed to hold the spring in collapsed condition; and

Figure 7 is a view of the same spring shown in Figure 6 but with the retainer ring removed.

The primary purpose of the present invention is to provide an orderly method or improved procedure which will make available a volute spring having the greatest possible recoil and to increase the distance between the convolutions thereof. The invention will be described by way of example setting forth the exact steps followed in producing a spring such as shown in Figures 6 and 7. The spring which is illustrated in the expanded condition of Figure 7 is at least three and three-sixteenths inches in outside diameter and each and every coil is characterized by an inherent ability to expand. To make such a spring we provide a forty-two inch length spring steel of ribbon-like form, the gauge of which may be, for example 21 gauge, and the width of which is three-fourths of an inch. The strip is of conventional spring steel analysis.

Both ends of the ribbon-like strip will be perforated, one perforation serving to anchor the stock to the arbor, hereinafter referred to during the formation of the spring, and also to make attachment to the device to which the spring is to be associated, the perforation at the other end being similarly uilized for attachment in assembling the spring. The end of the strip which is to ultimately form the inner convolution of the spring is heat treated in a gas annealing furnace so as to remove the temper therefrom. This conditions the steel of the spring stock so that the hardness of the first inch ranges from approximately 20 to 26 on the Rockwell C scale. The next two inches will range in hardness from 26 to 36 Rockwell C scale of the same scale. The next three inches will range in hardness from 26 to 48 Rockwell C scale. Beyond that the spring stock will all be of a hardness above 50 in the Rockwell C scale.

Thus it is apparent that the six inch length of the spring stock which is to ultimately form the inner convolutions will range in hardness from 20 to 48 Rockwell C scale. The thus annealed end of the stock is placed in a press so as to form an arcuate bend such as shown in Figure 1 for the purpose of conforming the same to the radius of a cold forming arbor to be used in the next step of manufacturing the article. For example, the left end of the stock shown in Figure 1 is pressed to arcuate form corresponding approximately to three-eighths of an inch radius for subsequent engagement with the arbor of the configuration shown in Figure 2.

The arbor as indicated by the dimensions in Figure 2 is slightly out of round, the left half illustrated being a true semi-circle of .698 inch in diameter. The arcuate portion included between the radial lines *a*—*b* and *c*—*d* is of such radius that the diameter measured in any portion of the upper right-hand quadrant will be .762 inch. The diameter as measured in the lower right-hand quadrant will be .742 inch. The arbor is provided with a hook-like projection 10 for engagement with the perforation 12 formed at the end of the blank strip B which is

to become the inner end of the spring. The arbor is then turned one and one-half turns. This will cold form the end of the spring into the volute form shown in Figure 3. The complete convolution formed in the center measures approximately .915 inch, which is the size required to fit a .900 arbor to be used in the assembly of which the spring is to ultimately form a component part. Thereafter the spring is coiled tight on a backed off arbor of the shape and dimensions shown in Figure 4. The diameter of this arbor at its largest point, as shown in Figure 4, is .821 inch. This arbor is given a sufficient number of turns to coil up the entire strip, with the exception of about three inches at the outer end, which portion extends out on a tangent to the outermost convolution of the spring. After the spring is thus wound to the desired extent, a retainer ring 14 is slipped over it so as to facilitate assembling and handling.

If the entire forty-two inch length of the spring stock is initially coiled on an arbor, as in conventional prior practice, without performing the cold forming operation which characterizes the present invention, experience shows that it results in overstressing the tempered steel so that when the retainer is removed the outside diameter falls below three inches and the spaces between the convolutions are correspondingly closer. It has also been found that there will be two to two and one-half inches of dead or inactive inner coils at the center of the spring made by the prior methods, thus reducing the active working capacity thereof.

On the other hand, by the practice of the present invention involving cold forming a portion of the tempered steel in the spring, the stock can be wound on a larger arbor gauging .821, for example, such as shown in Figure 4. This reduces the surface stress and results in a recoil of the spring to an outside diameter of from three and three-sixteenths inches to three and five-eighths inches with increased spaces between the convolutions of the finished spring. Thus there is produced a spring such as shown in Figure 7 in which all parts of the convolutions are alive and active. Otherwise expressed, there are no dead, inactive inner convolutions such as will be present in springs made by conventional prior practice.

From the detailed sequence of steps described, it is manifest that the method involves a series of essential steps for the production of volute springs comprising providing a length of flat, spring tempered steel of ribbon-like form, perforating the ends thereof, annealing one end so as to remove or negative the effect of the spring temper of the steel, cold forming the said annealed end so as to make it conform to a predetermined radius, then engaging one perforated end with an arbor, such as shown in Figure 2, of a shape and size to correspond approximately to such radius, thereupon coiling the strip around the arbor while the strip is cold, that is, at normal room temperature, and subsequently coiling said end portion and approximately the remainder of the strip about a larger arbor, such as shown in Figure 4, so as to thus form a spring devoid of inactive coils at the center thereof.

While we have described quite precisely a preferred mode of operation with particular reference to specific dimensions corresponding to those used in an actual reduction to practice, it is to be understood that the drawing and description are to be interpreted in an illustrative rather than a limiting sense since various modifications may be resorted to by those skilled in the art without departure from the underlying features and principles of the invention.

We claim:

1. In the manfacture of springs, the method which comprises providing a piece of spring-tempered metal strip, subjecting a predetermined end-length thereof to treatment effective to gradually vary the hardness of successive portions of said end-length within predetermined limits, cold forming said end-length by coiling it upon itself about an arbor of relatively small diameter in the center of the spring, and thereafter coiling said end-length and the major portion of the remainder of said strip upon itself about an arbor of relatively larger diameter in the center of the spring, whereby there is produced a spring devoid of dead inactive coils at the center.

2. In the manufacture of springs, the method which comprises providing a piece of spring-tempered steel stock, subjecting a predetermined end-length thereof to an annealing treatment effective to gradually vary the hardness of successive portions of the stock from approximately 20 to 48 on the Rockwell "C" scale, cold forming said end-length by coiling it upon itself about an arbor of relatively small diameter in the center of the spring, and thereafter coiling said end-length and major portion of the remainder of said stock about itself on an arbor of relatively larger diameter in the center of the spring whereby there is produced a spring devoid of dead inactive coils at the center.

3. In the manufacture of springs, the method which comprises providing a piece of spring-tempered steel strip, subjecting an approximately 6-inch end-length of the strip to an annealing treatment effective to impart a hardness gradient thereto from approximately 20 to 50 on the Rockwell "C" scale, shaping the softer extremity to an arc of predetermined radius of curvature, cold forming the strip by coiling said end-length upon itself about an arbor in the center of the spring having a volute cross-sectional contour of relatively small diameter, and thereafter coiling said end-length and the greater part of the remainder of the strip upon itself about a similar arbor of relatively larger diameter in the center of the spring, whereby there is produced a spring devoid of dead inactive coils at the center.

CHARLES A. HALLSTROM.
RAYMOND E. TIBBETTS.