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BIMETALLIC SPRING

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Fig. 1.

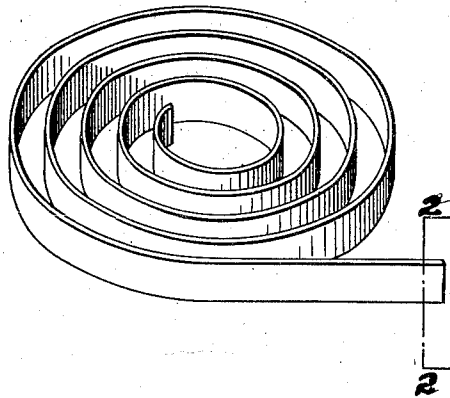
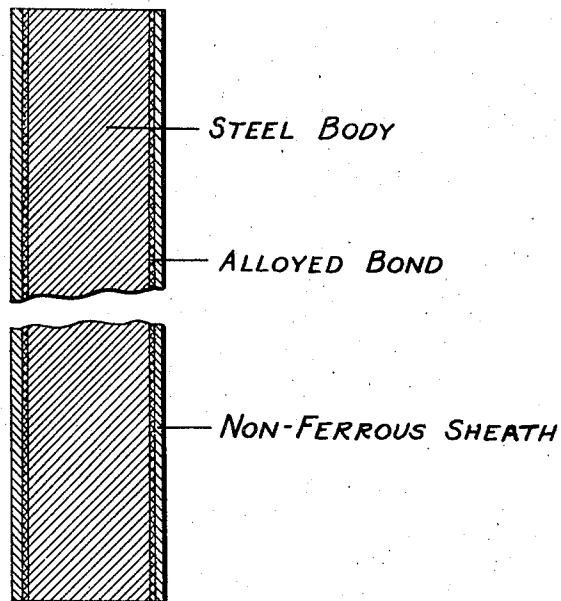


Fig. 2.



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UNITED STATES PATENT OFFICE

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BIMETALLIC SPRING

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5 Claims. (Cl. 267--1)

This invention consists in a new and improved bimetallic spring. An important field of use of the invention is in coiled torsion springs of flat cross-section, such as clock springs or watch springs and for purposes of illustration the invention is herein described as embodied in a spring of that type.

In a broad aspect my invention consists in a spring comprising a hardened and spring-tempered steel body with a non-ferrous sheath of greater heat conductivity than the steel body and united thereto by a bond of the steel and non-ferrous metal interalloyed or mechanically intermingled in an intermediate zone. I have discovered that springs and particularly torsion springs thus characterized possess many striking advantages with respect to durability in service, appearance, convenience and economy of manufacture and reduction of internal coil friction in winding or unwinding.

Copper clad bars and wire have been known heretofore and in these products the copper is integrally united to the steel, the copper actually entering the body of the steel and forming a zone of alloy therewith. In the rolling operation this bond remains intact and the copper coating or sheath is reduced in thickness in approximately the same proportion as the steel body of the core. The copper sheath thus formed is integrally or metallurgically united to the steel body and in this respect is to be distinguished from plated structures wherein a non-ferrous coating is electrolytically applied to the surface of the steel core. There are serious limitations to plated constructions which render them unsuitable for springs. For example, electro-deposits cannot be applied to a ferrous base before hardening and tempering, since in the heat of the hardening operation electro-plated surfaces are seriously impaired. Accordingly, electro-deposition can be applied only after hardening and is of no effect, of course, in reducing the hardening strains in the product. Further, electro-deposition does not make springs entirely rustproof because corrosion and electrolytic action is set up between the electro-deposited film and the steel body of the spring. An electro-plated surface moreover is not in all cases permanently bonded to the steel core but is likely to peel off, particularly when the spring as a whole is being flexed repeatedly.

An important advantage instant to the use of any copper clad spring is that, since the general conductivity of copper is considerably greater than steel, the bimetallic spring may be hardened and tempered with greater efficiency than a corresponding spring of solid steel. This will be apparent when it is considered that in a copper sheathed spring, steel is replaced by copper in those parts of the structure where hardness

and temper are not required, that is to say, in the surface portion of the spring whereas, the inner steel core of the spring is formed entirely of steel, capable of being hardened and tempered. Thus, the finished spring is entirely relieved of residual strain in its surface portion. Since these portions comprise copper they are substantially unaffected by the hardening and tempering operation and no initial strain is developed in them. The spring, therefore, tends to maintain its desired shape without warping or twisting and the soft outside layer of copper acts as a cushion making the spring more durable and better adapted to stand repeated flexings in use without breakage.

Bimetallic springs of my invention present the further advantage of an attractive surface finish and thus eliminate the necessity of a polishing operation of more than slight extent, because the surface of the copper sheath has a cold-rolled surface finish which is essentially smooth and which requires no more than a buffing or brightening operation in order to be brought to an attractive degree of lustre.

These and other features of my invention will be best understood and appreciated from the following description of a preferred embodiment thereof, selected for purposes of illustration and shown in the accompanying drawing, in which,—

Fig. 1 is a view in perspective of a portion of a clock spring; and

Fig. 2 is a sectional view on a greatly enlarged scale on the line 2—2 of Fig. 1.

In the construction of a clock spring of the type illustrated I employ copper clad steel ribbon rolled to an overall thickness of .0090 inch. One satisfactory steel for this purpose contains 1.10 per cent carbon, although spring steel of any commercial composition may be employed and the optimum chemical and physical composition of the spring material may be selected without consideration of its surface or rolling finish. As suggested in Fig. 2, the core or inner body of the steel is elongated and substantially rectangular in cross-section. Its thickness may be about .005 inch. The copper sheath comprising the opposite surfaces of the spring is approximately .0004 inch in thickness and the alloyed bond which is partly steel and partly copper comprises approximately .0001 inch in thickness.

It will be understood that the steel and the copper are mechanically intermingled or interalloyed in the intermediate zone of their bond, the copper contents of the alloy decreasing inwardly from the sheath and the steel content of the alloy decreasing outwardly from the steel body.

Having provided an annealed blank of bimetallic ribbon stock of the character described, it may be hardened and spring tempered in accordance

with any desired commercial method. For example, the strip may be conducted through an electric furnace and then quenched and so hardened. Subsequently, it may be again electrically heated in a drawing furnace and thus drawn to the spring temper best adapting it for its intended use. After the tempering operation the strip is wound into the form desired in the finished spring. It may be advisable in some cases to subject the formed spring to further drawing operation after it has been wound.

As already intimated the greater thermal conductivity of the copper-sheathed strip very favorably affects the efficiency or susceptibility of the encased steel to the hardening and tempering changes of temperature to which it is subjected, as compared with a solid steel strip. The steel it will be understood is hardened and tempered through its copper sheath.

An advantage incident to the employment of a bimetallic strip in manufacturing springs is that the non-ferrous surface of the strip obviates the necessity for lubricating the surfaces to inhibit staining or corrosion between the stages of the processing. Heretofore, it has been customary to apply oil or grease to the surface of a steel strip at various steps of its manufacture.

The copper sheath itself has no initial strains imposed upon it in the hardening and tempering operations and also tends to relieve and absorb initial strains in the spring as a whole, confining them to the interior of the spring, that is to the steel core thereof. In other words, such strains as are incident to hardening and tempering are prevented from reaching the surface portions of the spring. The surface strains which always exist to some degree in solid steel springs are eliminated in bimetallic springs of my invention with the result that the spring of my invention may be flexed more severely and a greater number of times than a solid steel spring and since it has been freed from practically all objectionable initial strains it is effective to supply a greater amount of energy in service than a corresponding solid steel spring of the same thickness.

The bimetallic spring of my invention has the further advantage of very greatly reducing the internal friction loss of the spring coil because its non-ferrous contact surfaces have a low coefficient of friction and slip readily upon one another while the spring is unwinding and delivering its energy.

The advantages above discussed are attained in a bimetallic spring having its two side walls sheathed in copper, and as shown in Fig. 2 the upper and lower edges of the spring are not sheathed although they may be if preferred. Ordinarily, however, the ribbon stock material of the spring will be sheared from the sheathed sheet material and accordingly the material of the steel core will be exposed at the end edges of the strip.

The present invention may be embodied to advantage in springs of all sizes and shapes, although I have particularly in mind clock-type springs from 1 inch in width to the smallest watch springs and all intermediate sizes. The present loss by rusting and breakage in commercial watch and clock springs is a very serious economic waste. It will be appreciated that in a clock or watch spring of thin ribbon steel a comparatively slight amount of surface rusting

reduces the effective thickness and strength of the spring stock to a serious degree. This loss and waste may be obviated entirely, or to a large extent, in accordance with my invention herein disclosed.

I have referred herein to copper as an example of one suitable material for the sheath but other non-ferrous metals would be suitable and may be employed as desired. For example, aluminum has been found satisfactory in many cases and when used presents an attractive silver-colored finish in the spring coil. I wish, therefore, to include within the scope of my invention any non-ferrous metal capable of forming an inter-alloyed bond with a steel base adapted to be spring-tempered.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is;—

1. A spring of thin flat material comprising an inner steel body having a surface sheath of non-ferrous metal united thereto by a bonding layer of steel and said non-ferrous metal mechanically intermingled, the steel body being hardened and spring tempered with minimum residual hardening strain, and the non-ferrous sheath being of greater heat conductivity than the inner steel body and supplying a finished surface having a low coefficient of friction.

2. A coiled spring of thin flat material comprising a steel body, long and narrow in cross section and having a surface sheath of non-ferrous metal united thereto by a bonding layer of steel and said non-ferrous metal mechanically intermingled, said steel body being spring tempered and substantially free of hardening stress and said non-ferrous sheath being of greater heat conductivity than the inner steel body and providing the coil with contacting surfaces having a low coefficient of friction.

3. A helical spring of resilient metallic ribbon comprising an inner steel body having a surface sheath of copper united thereto by a bonding layer of both said metals intermingled, the steel body being hardened and spring tempered with minimum residual stress and hardening strain, and the copper sheath being of greater heat conductivity than the inner steel body and supplying a rustproof surface effective to reduce the friction of the spring in winding or unwinding.

4. A spring of thin resilient bimetallic ribbon wound in a helix and comprising an inner steel body of elongated, substantially rectangular cross section having a surface sheath of copper united to its side walls by bonding layers of copper and steel intermingled, the steel body being hardened and spring tempered within its sheath and the copper sheath being of greater heat conductivity than the inner steel body and supplying a stress free, finished surface having a low coefficient of friction and being thereby effective to reduce the friction of the spring in winding or unwinding.

5. A coiled clock spring of flat ribbon stock comprising an inner body of spring tempered steel having upon its side walls a non-ferrous sheath of greater heat conductivity than the inner steel body and united thereto by bonding layers of said steel and non-ferrous metal intermingled and thus provided with freely slipping rustproof surfaces contacting in the wound spring, the steel body being exposed only in the edges of the ribbon stock.

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