

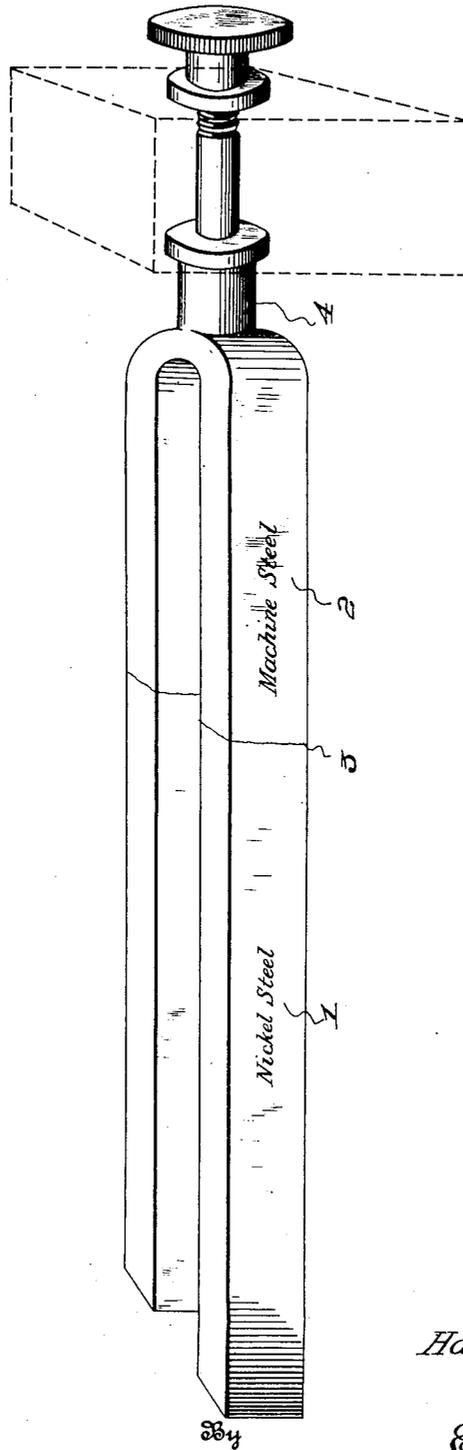
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TUNING FORK

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TUNING FORK.

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This invention pertains to the construction of tuning forks which are more especially intended to act as governors for controlling the speed of motors and synchronously operating devices or as relays for repeating electrical impulses in telegraph, telephone, radio, photo-telegraphy, where uniformity of speed is essential. An example of tuning forks of this type is found in U. S. patent to Houghtaling, No. 1,466,623 dated August 28, 1923.

Tuning forks intended for the above mentioned purposes are constructed with great precision from steels of the best quality. Nevertheless, even the best of such prior tuning forks are subject to variations in frequency, at different temperatures. These changes in frequency are caused by a change in the elasticity of the fork, and by the actual change in size due to expansion or contraction of the fork, or both.

After an extended research to develop means for overcoming this difficulty I have found that while the majority of steels, and other metals that may be used in the manufacture of forks of this kind, have a negative temperature coefficient of modulus of elasticity, certain materials may be obtained for which this coefficient is positive. A steel possessing this positive coefficient which I have used is composed of 36% nickel and having a carbon content of .18 and is commonly known as "Invar" steel but it is to be understood that my invention is not limited to the use of this material.

The low carbon steels commonly known as "machine steels" which have a carbon content between .08 and .18 have been found to have a negative temperature coefficient of modulus of elasticity. Both of the classes of steels mentioned have a positive coefficient of expansion.

I have found that by using two different steels, as for instance those mentioned, in combination, it is possible to so proportion the sections of materials in the fork as to produce a fork which does not change in frequency with changes in temperature, i. e., wherein the coefficient of expansion and elasticity of the different materials combine in such a manner that the temperature coefficient of the fork as a whole becomes zero. I have further found that by the same means, the total temperature coefficient for the fork as a whole may be made any desired value with-

in the two limits produced when the fork is made of either one of the said materials above.

The accompanying drawing illustrates in conventional form a tuning fork constructed in accordance with my invention.

I prefer to construct the outer portions 1, of the tines of nickel alloy steel and the inner portions 2 and yoke of machine steel, these parts being welded together, the line of the weld being indicated at 3. The yoke may be provided as usual with an extension or stem 4, by which it is supported upon a pillar in the synchronizing controlling apparatus, relay or other well-known apparatus in which such tuning forks are used. The proper proportions of nickel steel and machine steel will vary with the different sizes of forks employed. In forks constructed for use in controlling the speed of rotary distributors used in multiplex telegraph systems, I have constructed a fork in accordance with the invention disclosed herein in which the outer portions of the fork tines are eleven and one-tenth inches in length, made of said nickel steel, and the inner ends of the tines to the inner sides of the arch or bridge of the fork measure six and ninety-six hundredths inches, this fork having a zero temperature effect when the fork is used in the regular manner and fully equipped with sliding weights as shown in the Houghtaling Patent No. 1,466,623 previously referred to.

I have illustrated a tuning fork having two tines but it is evident that my invention is also applicable to vibratory reeds having a single tine or member and hence they are intended to be covered by my claims.

I claim:—

1. The method of constructing a tuning fork which consists in combining with a bar of steel having a negative temperature coefficient of modulus of elasticity, a bar of steel having a positive temperature coefficient of modulus of elasticity and welding the adjacent ends to form an integral bar, whereby the vibrations of the resulting integral bar are substantially unaffected by changes in atmospheric temperature.

2. A tuning fork having a vibratory member comprising a portion having a positive temperature coefficient of modulus of elasticity and another portion having a negative temperature coefficient of modulus of elasticity, the portions being welded at their adjacent ends and being so proportioned that the

vibratory member is substantially unaffected by changes in atmospheric temperature.

3. A tuning fork having a vibratory member comprising a portion of nickel alloy steel and a portion of machine steel integrally united at their adjacent ends, said portions being so proportioned that the vibration of said member is substantially unaffected by changes in atmospheric temperature.

4. The method of making a tuning fork, which consists in forming each vibratory member of a plurality of metal elements or lengths welded end to end, said members having positive and negative temperature coefficients of modulus of elasticity respectively, and each of said elements having a positive temperature coefficient of expansion, the proportionate lengths of said elements being

such that the resultant effect of said temperature coefficients upon the vibrations of said member with changes of atmospheric temperature is positive, negative or zero, as desired.

5. The method of making a tuning fork, which consists in forming each vibratory member of a plurality of steel elements welded together end to end, said elements having positive and negative temperature coefficients of modulus of elasticity respectively, and each of said elements having a positive temperature coefficient of expansion, such that the resultant effect of the temperature coefficients of expansion and elasticity upon the vibratory member is substantially zero.

In testimony whereof I affix my signature.
HAKON H. HAGLUND.