June 4, 1929.

G. W. ELMEN

1,715,543

MAGNETIC CORE

Filed June 20, 1928

FIG. 1

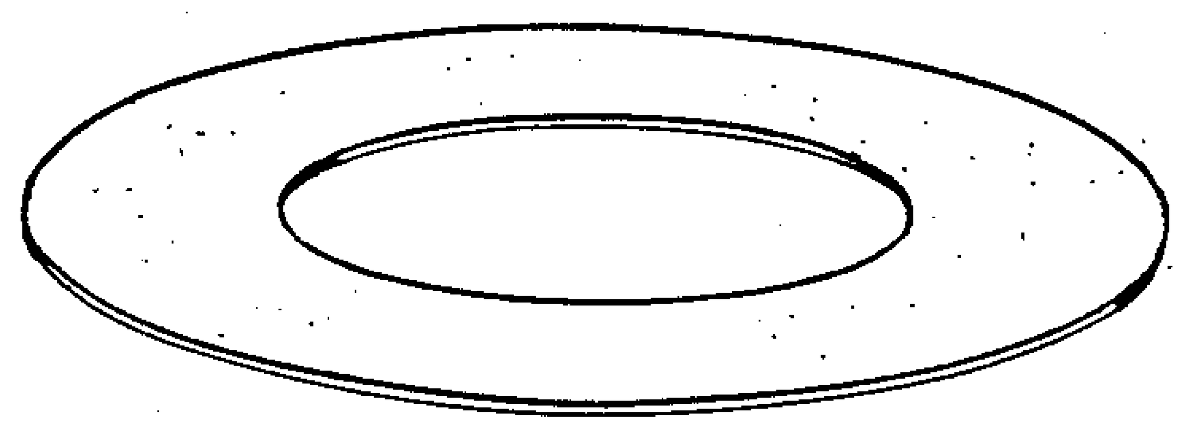
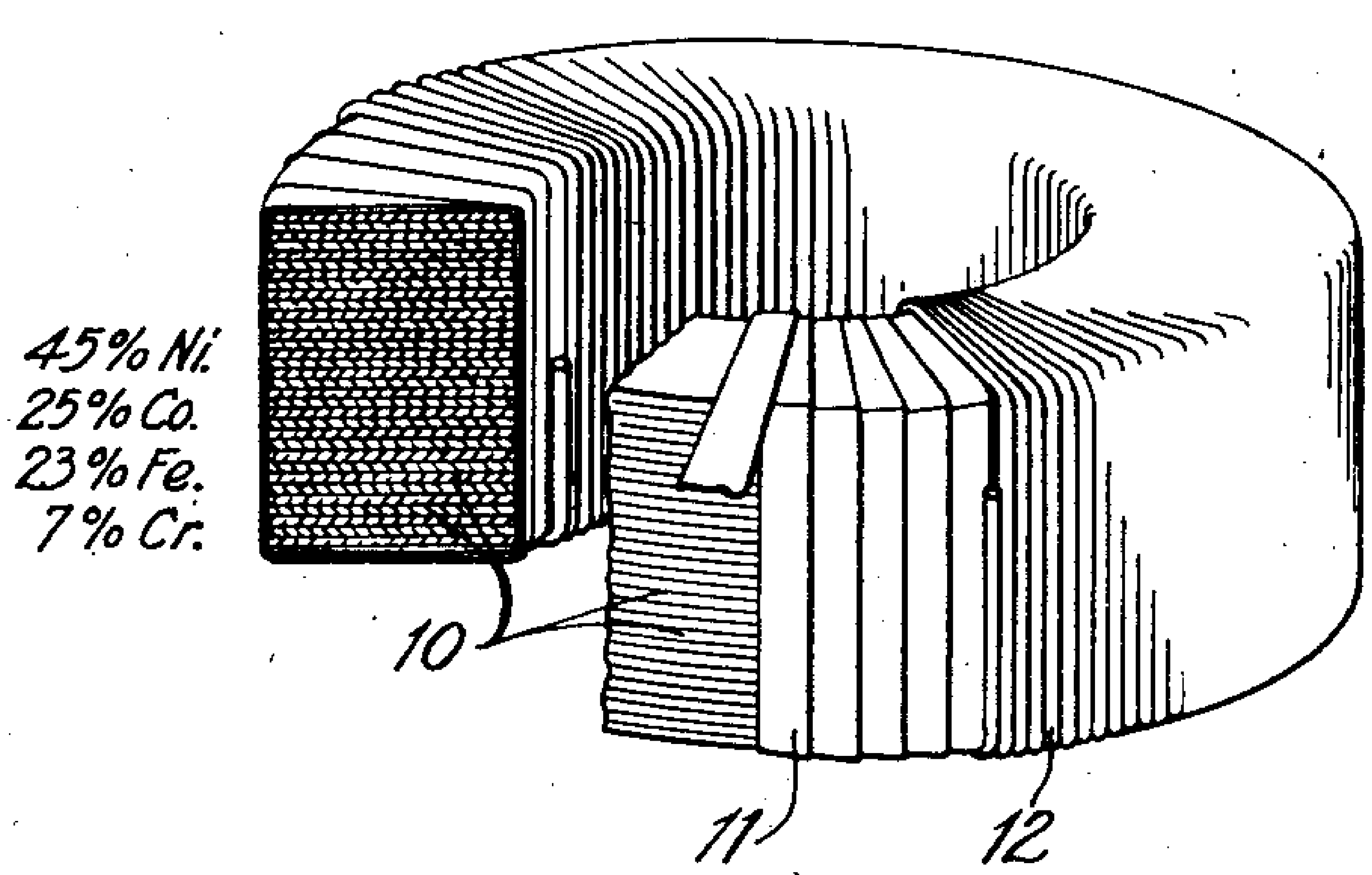


FIG. 2



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UNITED STATES PATENT OFFICE.

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MAGNETIC CORE.

Application filed June 20, 1928. Serial No. 287,017.

The present invention relates to improvements in inductance coils, particularly loading coils and systems employing such coils.

This application is a continuation with respect to certain divisible subject matter of application Serial No. 119,622, filed June 30, 1926.

It has been found that the transmission of telegraph impulses over long coil loaded composited lines materially impairs the transmission of telephone currents simultaneously traversing the lines. The effect manifests itself by an irregular distortion of the speech sounds which interferes with the intelligibility of the telephone conversation, at the same time materially reducing the average volume of the received speech. During the operation of the telegraph circuits there is manifest in the telephone receiver a rapid undulation or fluttering of the tone. This effect, known as "Morse flutter", has been found to be caused by the variation of the effective resistance and effective inductance, and varying hysteresis if the loading coil core material.

It is a general object of this invention to improve electrical transmission over coil loaded signaling lines, especially such lines as are composited for telegraph and telephone transmission or other lines upon which currents of different frequencies representing different messages are impressed simultaneously.

Another object of the invention is to cause the effective resistance and the inductance of inductance coils to remain constant.

A feature of the invention is an inductance coil of highly constant inductance having substantially no hysteresis loss and very low eddy current loss.

A further feature of the invention is an inductance coil in which the magnetic circuit has high permeability, high constancy of permeability and high resistivity.

In accordance with the present invention loading coils are constructed with cores of magnetic material having such a high degree of constancy of permeability, such small hysteresis loss, and such satisfactory values of permeability and resistivity that a great reduction of "Morse flutter" can be produced without introducing any compensating disadvantages.

In a preferred embodiment, the above mentioned objects of this invention are attained by employing loading coils having cores of alloys of iron, nickel, and cobalt, which, when properly heat treated, have low eddy current losses and are substantially devoid of hysteresis losses at flux densities ordinarily employed in loading coils, and also are possessed of the desired high and constant permeability and high resistivity.

Magnetic alloys containing nickel between 8% and 80%, cobalt between 5% and 80%, and iron between 10% and 45% of the iron-nickel-cobalt content, with or without the addition of fourth elements to increase their resistivity or for other purposes, such as molybdenum, chromium, tungsten, vanadium, tantalum, zirconium, copper, silicon, aluminum and manganese fulfill these requirements. Of these fourth elements molybdenum and chromium appear to be preferable.

One embodiment of the present invention will now be described in connection with the accompanying drawing, in which:

Fig. 1 is a perspective view of a section or ring of a loading coil core constructed of material in accordance with the present invention; and

Fig. 2 depicts partly in cross-section a plurality of sections or rings assembled to form a complete loading coil core.

In carrying out one method of practicing the present invention a magnetic composition containing approximately 45% nickel, 25% cobalt, 23% iron and 7% molybdenum (or chromium) is given the shape as shown in Fig. 1 by rolling the composition into laminations and stamping out rings 0.003″ thick and having 3-1/2″ and 3″ outside and inside diameters, respectively. The rings are then given a heat treatment consisting in heating them at about 1100° C. for about one hour and cooling to room temperature at an average rate of about 50° C. per minute; they are then insulated with insulating varnish, assembled into cores, served with tape 11 and wound with the windings to be connected to the signaling circuit when in service.

In Fig. 2 is shown a plurality of laminations or rings about 0.003″ thick and 3½″ and 3″ outside and having inside diameters, respectively, made of an alloy containing 45% nickel, 25% cobalt and 23% iron and 7% chromium. 11 indicates the jute tape and 12 the winding proper. By way of example, cores of this composition when given the heat treatment mentioned had an initial permeability of about 375, a resistivity of about 80 microhms per centimeter cube and substantially no hysteresis losses. When tested for "Morse flutter" they exhibited a flutter effect of less than 1% of that of iron powder used as a core material and prepared in accordance with the technique common to the art at the present time.

It may be desirable to provide air-gaps in the magnetic rings, especially in those of the laminated type, for the purpose of increasing the magnetic stability during and after the application of disturbing magnetizing forces which may be encountered when the cores are used for loading multiplex lines (carrier frequencies) and composited lines (simultaneous telegraphy and telephony).

Although the invention as specifically illustrated herein has been described as practiced in the form of laminations, the invention is not limited to the production of cores of this type but is adapted to the production of cores of magnetic materials of many shapes or forms.

Other suitable compositions and methods of heat treatment as well as the general principles to be followed in selecting a suitable heat treatment are set forth in applicant's U. S. application Serial No. 119,622 filed June 30, 1926, British specification No. 273,638 complete accepted November 16, 1927 and U. S. application Serial No. 220,387, filed September 19, 1927.

Materials in laminated form of compositions such as herein described may be employed in the cores of toroidal or other coils with closed magnetic circuits with an effective permeability considerably greater than is commonly obtained with dust cores of iron and nickel-iron alloys and less variation of inductance and less hysteresis loss per unit of volume of the material. By using small air gaps the effective permeability may still be made to approximate that obtained with dust core practice with a still greater constancy of inductance.

The present type of iron-nickel-cobalt alloy may also be reduced to powdered form with the general advantages inherent in that type of magnetic core. Such powered compositions may be insulated and compressed into cores with suitable binders in accordance with the methods and by use of any of the insulating materials and binders described in the following U. S. Patents: 1,647,737 and 1,647,738, both granted November 1, 1927 to V. E. Legg, 1,651,957 and 1,651,958 both granted December 6, 1927 to H. H. Lowry, 1,669,642 and 1,669,644 both granted May 15, 1928 to J. W. Andrews. When heat treating the cores after they are compressed the heat treatments to be employed may be selected in accordance with the principles of application Nos. 119,622 and 220,387 filed June 30, 1926 and September 19, 1927, respectively, and British Patent No. 273,638 complete accepted November 16, 1927. Alternatively the dust may be pot annealed at a temperature between 900° C. and 1000° C. for about 1 hour, cooled to room temperature at an average rate of about 100° C. per hour, pressed into cores by using the binders and insulating materials described in the patents mentioned above, again pot annealed at a temperature between 400° C. and 600° C. for about 40 to 100 hours and cooled at an average rate of about 100° C. per hour, for the purpose of producing the magnetic properties desired.

What is claimed is:

1. A loading coil comprising a core composed at least chiefly of a magnetic composition of iron, nickel, and cobalt, the nickel being between 8% and 80%, the cobalt being between 5% and 80% and the iron between 10% and 45% of the iron-nickel-cobalt composition.

2. A loading coil in accordance with the foregoing claim in which the magnetic composition includes material amounts of material composed of the following elements taken in any number from one upward: molybdenum, chromium, tungsten, vanadium, tantalum, zirconium, copper, silicon, aluminum, and manganese, not, however, excluding others.

3. A loading coil comprising a magnetic circuit composed chiefly of a composition of nickel, cobalt, and iron in proportions of 8% to 80%, 5% to 80% and 10% to 45% heat treated to develop suitable permeability and low hysteresis loss.

4. A telephone loading coil having a magnetic core consisting in part, at least, of an alloy of nickel, cobalt, and iron in the proportions of nickel 20% to 70%, cobalt 10% to 50%, and iron 10% to 45% respectively.

5. A telephone loading coil having a magnetic core composed chiefly of magnetic material having a change in permeability of less than 1% as the flux density is changed from near zero to 200 c. g. s. units.

In witness whereof, I hereunto subscribe my name this 18th day of June, 1928.

GUSTAF W. ELMEN.