

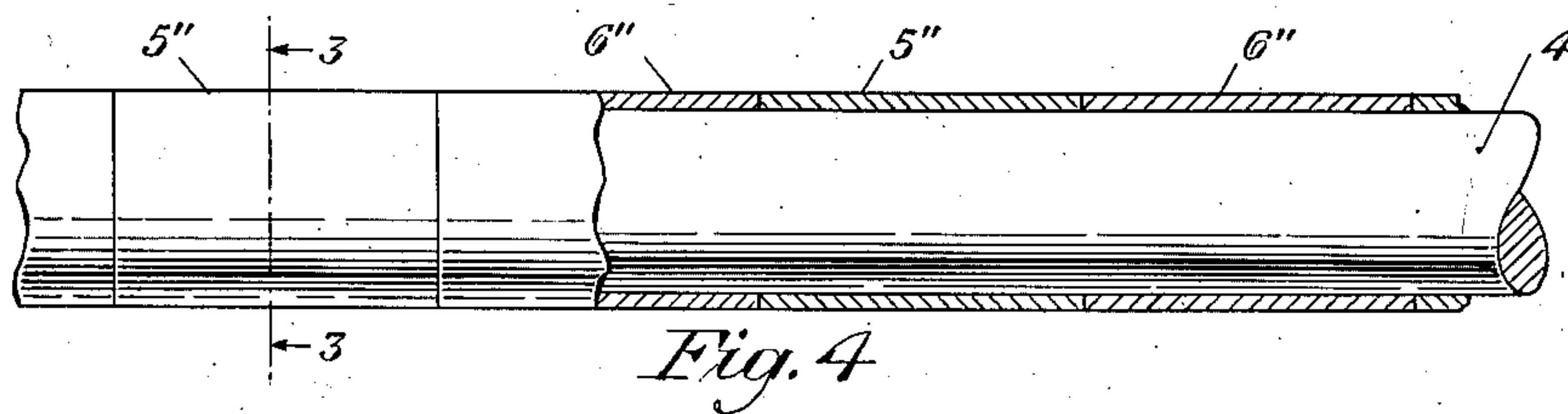
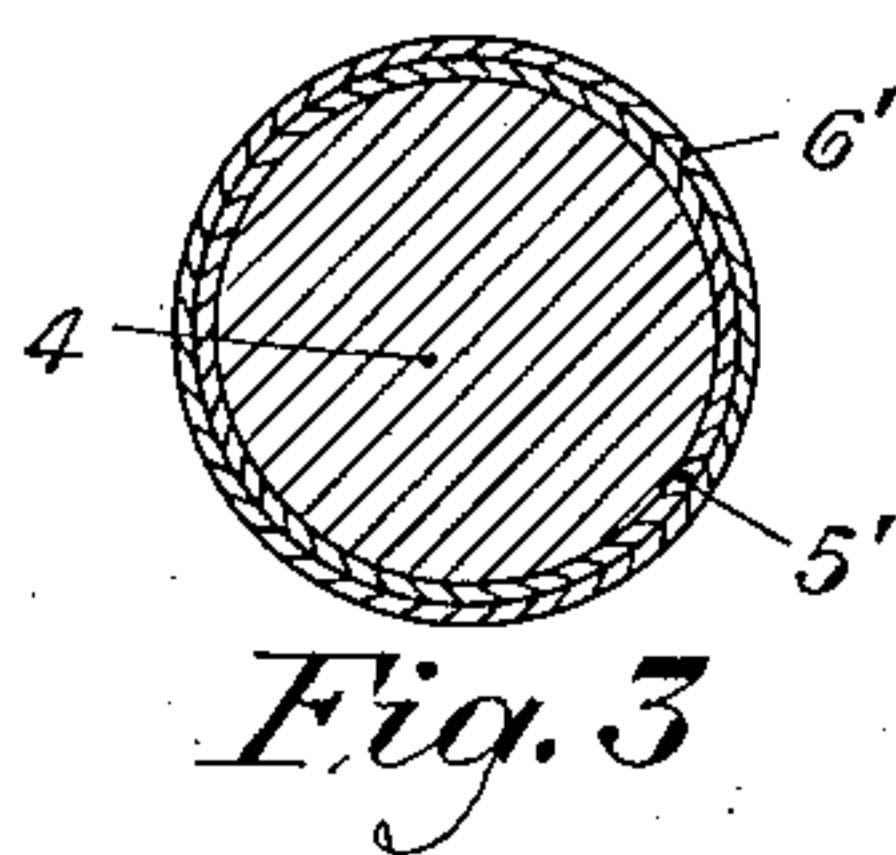
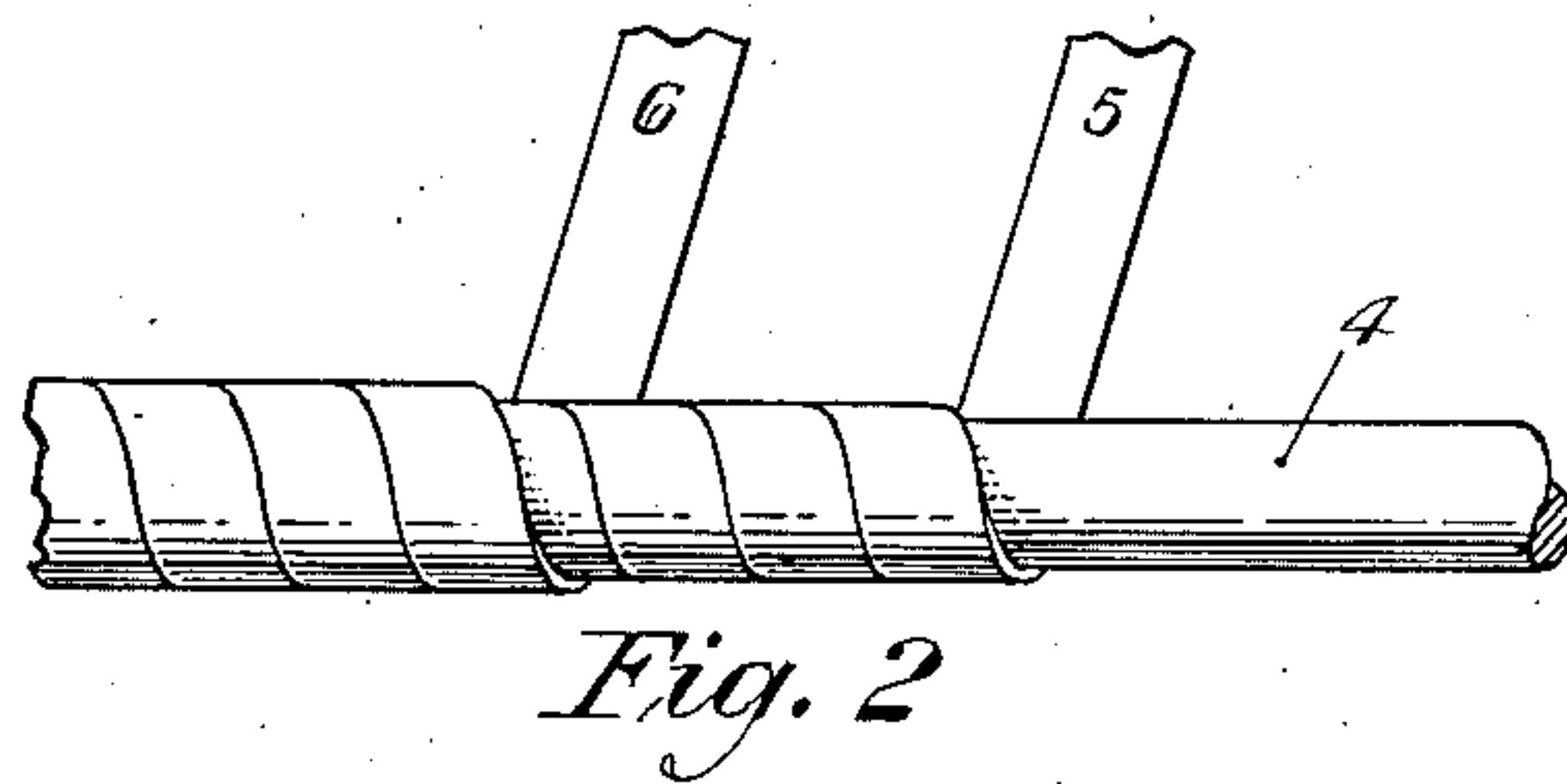
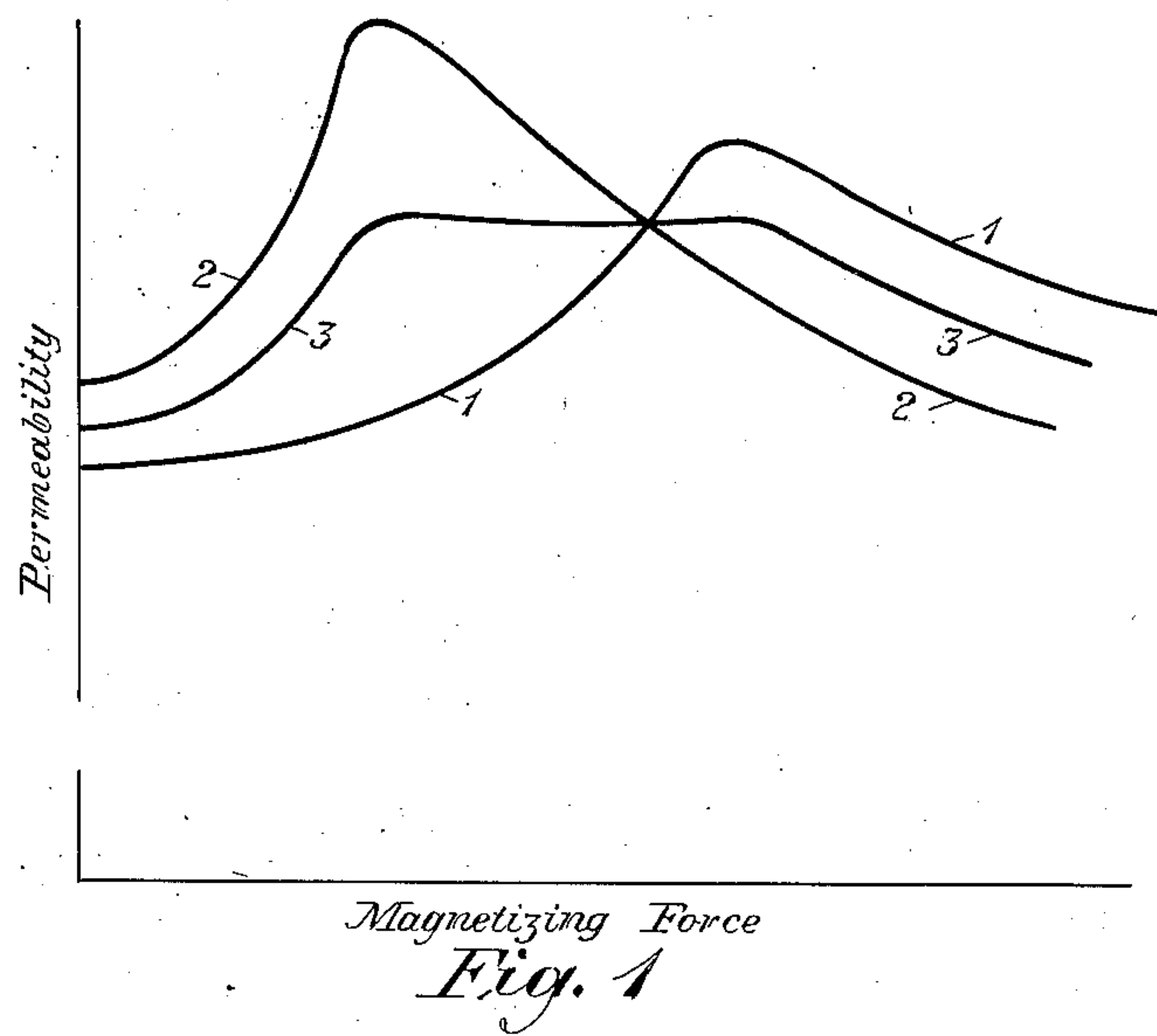
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CONTINUOUSLY LOADED CONDUCTOR

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CONTINUOUSLY LOADED CONDUCTOR

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8 Claims. (Cl. 178—45)

My invention relates to continuously loaded conductors and more particularly to a method of making such a conductor stable, so that the variation of its inductance with the strength of currents sent over it is minimized.

A continuously loaded conductor is one in which the distributed inductance is increased by surrounding the conductor with magnetic material, as in the form of a wrapping of tape or in the form of a solid sheath continuously deposited by electrolytic means. Continuously loaded conductors are useful for various situations in telephone practice, particularly in connection with submarine cables.

One difficulty encountered in the use of some continuously loaded conductors is that the inductance varies too much with the strength of currents sent over the wire. This is particularly true as regards relatively large direct currents used for operating, testing and signaling purposes.

An object of my invention is to reduce this variability of the inductance. The method of attaining this object may be understood by the following disclosure of examples of practice of the invention, having reference to the accompanying drawing.

Figure 1 is a curve diagram to which reference will be made in discussing the principles involved in the invention; Fig. 2 is a diagrammatic elevation of a conductor of my invention in process of manufacture; Fig. 3 is a diagrammatic cross-section of a modified form of a conductor of my invention, and Fig. 4 is a diagrammatic, longitudinal section of yet another modification.

On Fig. 1, curves 1 and 2 represent the variation of the permeability of two different types of magnetic material with the strength of the magnetizing force in the materials. Since, as is well known, the inductance of a continuously loaded conductor is directly proportional to the permeability of the magnetic material, the inductance of a conductor loaded with either of these materials would vary in proportion to the permeability variations shown. This amount of variability might make either of these two materials undesirable as a loading material to be applied continuously on the conductor. By combining both materials on the same conductor, however, it is possible to reduce the range of the permeability variation to that represented by curve 3. Curve 3 has been drawn for an equal mixture of the materials whose permeability variations are shown by curves 1 and 2, but in the case of particular materials, some other propor-

tion of mixing might be more desirable. More than two materials could be combined on the same conductor to reduce the variability of the inductance still further. It is rather common for a given simple material to yield a peaked characteristic curve like 1 or 2 in Fig. 1. Curve 3 of that figure averages the corresponding ordinates of 1 and 2. Hence a desired curve like 3 with a flat top over a certain range can generally be secured by choice of two suitable materials having curves with peaks at the respective ends of that range.

The two or more types of magnetic material to be placed on the conductor may be combined in several ways: They may be placed in successive layers on the conductor or they may be applied in sequence along successive short lengths of the conductor. In the latter case, it is important that the interval over which each type of material is applied shall be short enough to avoid selective transmission effects resulting from reflection of electric waves at the junctions of the different types of loading.

The desired differences in the permeability characteristics of the various materials to be combined can be produced by variations in composition, in heat treatment or in mechanical working. With magnetic materials comprising nickel-iron alloys this can be accomplished readily, because the magnetic properties of these alloys are particularly sensitive to such differences in treatment.

In Fig. 2, a simple conductor 4 is covered with a shell formed by wrapping the tape 5 closely around it in a helical course. Then another tape 6 is wrapped outside 5 in the same way. The material of tape 5 corresponds to curve 1 or 2 of Fig. 1 and the material of the other tape 6 corresponds to the other curve 2 or 1 of Fig. 1.

In Fig. 3, one material 5 is electro-plated over the core 4 and the other material 6 is electro-plated over that.

In Fig. 4, the two materials are plated in longitudinal alternation, that is, a certain length is plated with material 5', then a length with 6', then 5', and so on in alternation.

What I claim is:

1. A continuously loaded electric conductor in which the loading material comprises two or more different materials, said materials being applied in periodic sequence to successive lengths of the conductor.

2. A continuously loaded electric conductor in which the loading material comprises two or more different materials, said materials being

5 applied in successive layers upon the conductor, each layer being in the form of a closely-wound helical tape, and each material having a peaked curve of permeability plotted against magnetizing force, these curves being such that the curve of their average ordinates is flat topped.

10 3. A continuously loaded electric conductor having a magnetic sheath comprising two or more different materials, the magnetic characteristics and proportion of combination of said materials being such that at a certain magnetizing force the permeability of one material is relatively higher than that of another while at another magnetizing force the permeability of said other material is relatively higher than that of said first material.

20 4. A conductor consisting of a core of conductive material surrounded by two materials, each material having a peaked curve of permeability plotted against magnetizing force, these curves being such that the curve of their average ordinates is flat topped.

25 5. A conductor consisting of a core of conductive material surrounded by two materials having approximately the same average permeability over a range of magnetizing forces, but one material having a permeability considerably higher than that of the other at one force value and

the other material having a permeability considerably higher than that of the first material at another force value.

5 6. A continuously loaded electric conductor in which the loading material comprises two or more different materials, said materials being applied along the length of the conductor to successive portions thereof each in alternation with the other or others.

10 7. The method of establishing uniform permeability in a loaded electric conductor which consists in establishing decreasing permeability with increasing magnetizing force in a part of the loading, and establishing increasing permeability with increasing magnetizing force in another part of the loading whereby the resultant permeability is substantially uniform.

20 8. A conductor consisting of a core of conductive material, an electroplated sheath surrounding it and having a certain permeability-magnetizing force characteristic, and another electroplated sheath surrounding the first mentioned sheath and having a different permeability-magnetizing force characteristic, the resultant combination of the two characteristics giving a uniform permeability with magnetizing force.

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