

March 11, 1941.

R. GILLIS

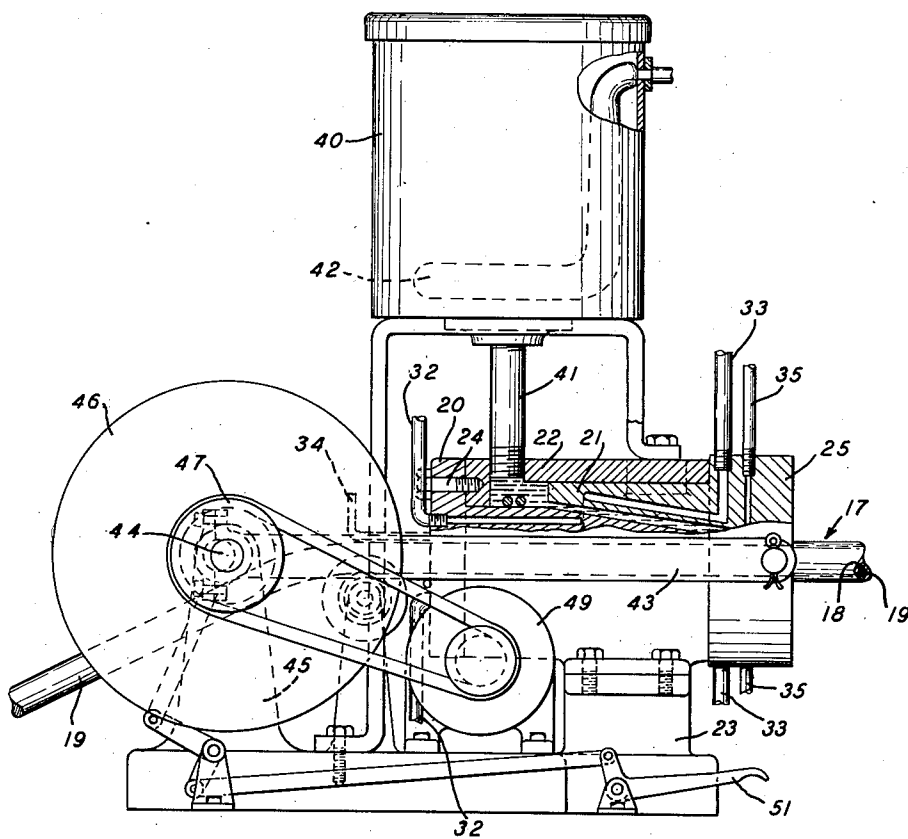
2,234,340

METHOD OF AND APPARATUS FOR FORMING METAL

Filed Dec. 7, 1939

2 Sheets-Sheet 1

FIG. 1



INVENTOR

R. GILLIS

BY

ER Nowlan

ATTORNEY

March 11, 1941.

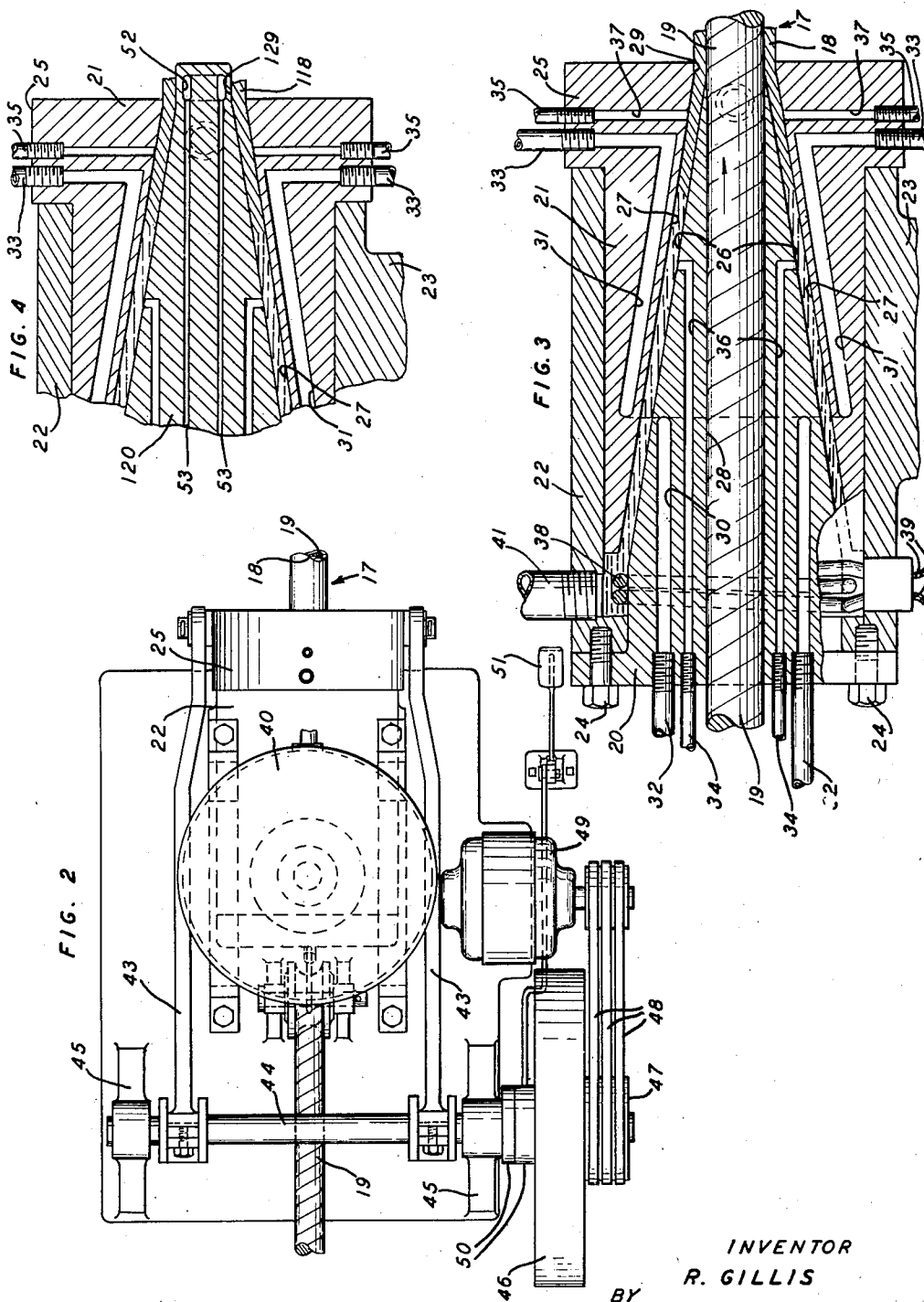
R. GILLIS

2,234,340

METHOD OF AND APPARATUS FOR FORMING METAL

Filed Dec. 7, 1939

2 Sheets-Sheet 2



INVENTOR
R. GILLIS
BY
E. R. Howlan
ATTORNEY

UNITED STATES PATENT OFFICE

2,234,340

METHOD OF AND APPARATUS FOR FORMING METAL

Randall Gillis, Westfield, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application December 7, 1939, Serial No. 308,031

14 Claims. (Cl. 29—33)

This invention relates to a method of and apparatus for forming metal, and more particularly to a method of and apparatus for forming metal into a seamless tube or into a seamless tubular sheath about an elongated core by simultaneously casting and forging the metal.

Many varieties of electrical conductor cables used in the communications arts and in arts having to do with power distribution have cores including conductor strands and electrically insulating sheaths, which cores are enveloped in seamless, snugly fitting sheaths of metal, ordinarily lead or lead alloy. In most instances these sheaths are formed in situ on the core by extruding the metal to form them through a suitable die while the core is being advanced through the die also. Concentricity of the sheath on the core, i. e. uniformity of thickness of the sheath circumferentially about the core, and uniformity of thickness of the sheath along the core are sometimes difficult to maintain in the extrusion process of forming the sheath, since variations in the fluidity of the material being extruded, as it passes through the die, on opposite sides of the core, may cause the sheath to become thicker on one side than on the other.

One object of the present invention is to provide a simple and reliable method of forming a seamless sheath about an elongated core in a manner to assure uniformity of thickness of the sheath, both circumferentially and longitudinally of the core.

Another object of the invention is to provide simple rugged and reliable apparatus for forming about an elongated core a seamless sheath which shall be of uniform thickness throughout.

One embodiment of the invention may be in a method of forming a sheath on a core comprising steps of casting the sheath about the core with an excessive diameter and of reducing the diameter, the process of casting merging inseparably into the process of reducing the diameter.

Another embodiment of the invention may be in an apparatus for forming a sheath on an elongated advancing core passing therethrough comprising a tapering mold to receive molten sheathing material and having one wall thereof movable with respect to the other to simultaneously mold and forge the sheath material about a core.

Other objects and features of the invention will appear from the following detailed description of an apparatus constructed in accordance with the invention for carrying on the method of the invention, taken in connection with the

accompanying drawings in which the same reference numerals are applied to identical parts in the several figures and in which

Fig. 1 is a view in side elevation and partly in vertical central section of an apparatus constructed in accordance with the invention;

Fig. 2 is a plan view thereof;

Fig. 3 is an enlarged view in vertical central section of the combined casting mold and forging members; and

Fig. 4 is a view, similar to Fig. 3, of a modified form.

As herein disclosed, the primary essentials of the invention are best shown in Fig. 3, the associated parts and devices shown in Figs. 1 and 2 being ancillary. There is stationary convex casting and forging member 20 of a generally conical form, about which is positioned a complementary concave, conically hollow, coaxially positioned, reciprocable casting and forging member 21. The latter has a cylindrical outer surface to fit slidably into a cylinder or sleeve 22 supported and mounted on a base or pedestal 23. The stationary member 20 is rigidly mounted in the left end of the cylinder 22, as by screws 24, while the member 21 extends out beyond the right end of the cylinder and is there provided with an enlarged circumferential shoulder 25. As here shown the conical outer surface 26 of the fixed member 20 and the conical inner surface 27 of the reciprocable member 21 have the same apical angle, so that these surfaces are always parallel to each other. While this is the preferred construction, there may also be instances in which the apical angles of the two cones are made to differ more or less, so that the space defined between the two surfaces is not then of equal width in all parts, as is the case in the drawings.

The member 20 is formed with an axial bore 28, and the member 21 may be formed with an axial bore 29. The bore 28 is dimensioned to receive and pass a cylindrical, elongated core 19 which is to be provided with a seamless continuous sheath 18, e. g. of lead or lead alloy. The bore 29 has a diameter to match the predetermined outer dimensions of the sheath. In most instances the length of the bore 29 will be vanishingly small.

The member 20 is further formed within its mass with a coaxial chamber 30, and the member 21 is provided with a similar chamber 31. These chambers may each be cylindrical as at 30 or conical as at 31, as may be dictated by the mass of the members in which they are. A suitable temperature regulating fluid, water, oil,

steam, air, or the like is circulated through these chambers by means of pipes 32 and 33 communicating therewith from sources not shown. Lubricating oil or other fluid may be fed to the surface 26 through pipes 34 and passages 36 and to the surface 27 through pipes 35 and passages 37.

An electrical heating element 38 may be located, if desired, around the left end of the member 20 in the annular chamber at the left of the left end of the member 21. This heating element may be fed with electric current through leads 39 from any suitable source not shown.

A melting tank or supply tank 40 is supported above the sleeve 22 in any suitable fashion and has a delivery pipe 41 opening from its bottom into the annular chamber at the left of the member 21. There may be an electrical heating device 42 in the tank 40 to melt or to keep molten its contents, fed from any suitable source of electric current not shown.

Generally parallel links 43 are pivotably secured to opposite sides of the shoulder 25 at one end, at the other end, are journaled on cams or eccentrics on a transverse shaft 44 journaled in pillars 45. The shaft also has a fly-wheel 46 and a driving pulley 47. The pulley 47 is driven by belts 48 from a motor 49. A clutch device 50 of any suitable construction and actuable by a treadle 51 serves to couple the fly-wheel 46 and pulley 47 to the shaft 44 at will.

In operation, material for the cable sheath, e. g. lead or a suitable lead alloy, may be melted in the tank 40 or brought molten to the tank and stored therein. A core 19 to be sheathed enters through the bores 28 and 29 from any suitable supply not shown. The sheath and core 19 emerging from the bore 29 are drawn to the right by any suitable means not shown. The molten sheath material flows down through the pipe 41 into the annular chamber around the left end of the member 20 and thence into the conically tapering, parallel walled space between the members 20 and 21. The heat exchange between the hot material entering from the pipe 41 and the heater 38 on the one hand and the fluid circulated through the chambers 30 and 31 on the other hand is so controlled and adjusted that the material passing along from left to right between the surfaces 26 and 27 changes progressively from fluid to plastic to easily malleable to solid and emerges from the bore 29 as a solid seamless sheath 18 on the core 19, fitting the latter snugly and of positively controlled, unvarying thickness both circumferentially and longitudinally.

During this procedure, the treadle 51 has been actuated to couple the fly-wheel and drive to the shaft 44 which then, through its cams and the links 43, drives the member 21 in rapid, brief reciprocation inside of the sleeve 22 with respect to the member 20. The result is that the distance between the mold faces 26 and 27 which form and shape the sheath is pulsatingly varied. The movable face or wall 27 of the mold moves in a direction having components both perpendicular and parallel to the opposite fixed face or wall 26. Thus the material, solidifying slowly as it passes between these faces is subjected to a continuous pulsating forging effect. It is both cast and forged; and the one merges into the other in such wise that there is no point of division between the casting and the forging.

The sheath is fully formed in all its dimen-

sions as it leaves the members 20 and 21 and is simultaneously applied to the core. Hence the thickness of the sheath at every point is already determined when the sheath meets the core, determined by the members 20 and 21, and cannot vary either circumferentially or longitudinally. The sheath is positively controlled to be concentric with the core and uniform along it.

Since the core plays no part in forming the sheath, the apparatus may be modified, as shown in Fig. 4, for the manufacture of seamless tubing of unlimited length, which will not only have no longitudinal seam but will also be free from circumferential joints, seams or welds of any kind.

The apparatus disclosed in Fig. 4 is identically like that already described in all respects, except that the stationary mold member 120 has no axial bore, since no core such as 19 is now under consideration. The conical body of the member 120 terminates in a short cylindrical nose or mandrel 129 to aid the pipe 118 being drawn from between the members 120 and 21 from collapsing under the tensile stress of being pulled away. To assist further in fully hardening the pipe, this nose or mandrel 129 may be provided with an individual cooling water chamber 52 and supply pipes 53 whereby to thoroughly chill the formed pipe.

In the embodiments herein disclosed, the convex mold member 20 or 120 is shown as fixed, while the concave mold member 21 is shown as reciprocable. The modifications required to reverse these relations are believed to be too obvious to require description or illustration. Also, while the invention is particularly described as applied to the case of sheathing a cable core with lead or lead alloy, it may also be used for other materials, for example for artificial plastics which are capable of being melted, cast and forged in the same way. In general, the embodiments of the invention herein disclosed are illustrative and may be modified and varied in many ways without departing from the spirit and scope of the invention as set forth in and limited only by the appended claims.

What is claimed is:

1. The method of forming material which comprises the steps of advancing molten material in a continuous elongated body, cooling the advancing body to convert the material thereof progressively from fluid to plastic to solid, and simultaneously forging that part of the progressively cooled material in which the change from fluid to plastic to solid is proceeding.

2. The method of forming material which comprises the steps of advancing molten material in a continuous elongated body, cooling the advancing body to convert the material thereof progressively from fluid to plastic to solid, and simultaneously subjecting the progressively cooled material to pulsating pressure to forge that part of the same in which the change from fluid to plastic to solid is proceeding.

3. In an apparatus for forming material, means to confine and form advancing molten material into a continuous elongated body, means to cool the advancing body to convert the material thereof progressively from fluid to plastic to solid, and means to simultaneously forge that part of the progressively cooled material in which the change from fluid to plastic to solid is proceeding.

4. In an apparatus for forming material, means to confine and form advancing molten material

into a continuous elongated body, means to cool the advancing body to convert the material thereof progressively from fluid to plastic to solid, and means to simultaneously subject the progressively cooled material to pulsating pressure to forge that part of the same in which the change from fluid to plastic to solid is proceeding.

5. In an apparatus for forming material, a mold having side walls and an open end, means to supply molten material to be formed to the mold to pass therethrough and out through the open end, and means to pulsingly vary the distance between two side walls of the mold to forge material passing therebetween.

6. In an apparatus for forming material, a mold having side walls and an open end, means to supply molten material to be formed to the mold to pass therethrough and out through the open end, means to control the temperature of the side walls to progressively cool material passing through the mold from fluid to plastic to solid, and means to pulsingly vary the distance between two side walls of the mold to forge material passing therebetween while the change from fluid to plastic to solid is proceeding.

7. In an apparatus for forming material, a mold for continuous casting of molten material comprising a fixed wall on one side of the mold cavity, and a movable wall on the other side of the mold cavity, in combination with means to reciprocate the movable wall toward and from the fixed wall to forge material passing between the walls while the material is cooling.

8. In an apparatus for forming material, a mold for continuous casting of molten material comprising a fixed wall on one side of the mold cavity, and a movable wall on the other side of the mold cavity, in combination with means to reciprocate the movable wall in a direction having components both perpendicular and parallel to the fixed wall to forge material passing between the walls while the material is cooling.

9. In an apparatus for forming material, a member having a convex mold cavity surface thereon, and a member having a completely concave mold cavity surface thereon, in combination with means to pulsingly vary the distance between the two surfaces to force material in the mold space between the two surfaces while the material is cooling from fluid to plastic to solid.

10. In an apparatus for forming material, a member having a convex mold cavity surface thereon, and a member having a complementary concave mold cavity surface thereon, in combination with means to reciprocate one of the members to pulsingly vary the distance between the two surfaces to force material in the mold

space between the two surfaces while the material is cooling from fluid to plastic to solid.

11. In an apparatus for forming material, a guide member, a first mold member fixedly mounted thereon, a second mold member reciprocable in the guide member toward and from the first member, a convex mold surface upon one of the mold members and a concave mold surface upon the other mold member defining a mold cavity therebetween, and means to reciprocate the second mold member to pulsingly vary the distance between the two mold surfaces.

12. In an apparatus to form material into a hollow elongated body, a convex tapered member, a complementary concave tapered member coaxial thereto and cooperating therewith to define a conical annular mold cavity therebetween, means to supply molten material to the large end of the mold cavity, and means to reciprocate one of the members with respect to the other to pulsingly vary the distance therebetween to force material in the cavity while the material is cooling from fluid to plastic to solid.

13. In an apparatus for sheathing an elongated core, a first mold member having a bore therein to receive and pass an advancing core, a second mold member to coat therewith and having an aperture to receive and pass the core and a sheath thereon, two mold surfaces one on each member defining an annular mold cavity therebetween and coaxial with the core, means to supply molten sheath material to the cavity, and means to reciprocate one of the mold members with respect to the other mold member to force the material in the cavity into a sheath about the core while the material passing through the mold changes from fluid to plastic to solid.

14. In an apparatus for sheathing an elongated core, a first mold member having a bore therein to receive and pass an advancing core, a second mold member to coat therewith and having an aperture to receive and pass the core and a sheath thereon, two mold surfaces one on each member defining an annular mold cavity therebetween and coaxial with the core, means to supply molten sheath material to the cavity, means to control the temperatures of the two mold members to cause sheath material passing through the mold cavity to change progressively from fluid to plastic to solid, and means to reciprocate one of the mold members with respect to the other mold member to forge the material in the cavity into a sheath about the core while the material passing through the mold changes from fluid to plastic to solid.

RANDALL GILLIS.