Oct. 24, 1967 H. BURR 3,348,369

STRANDING APPARATUS

Filed April 26, 1965

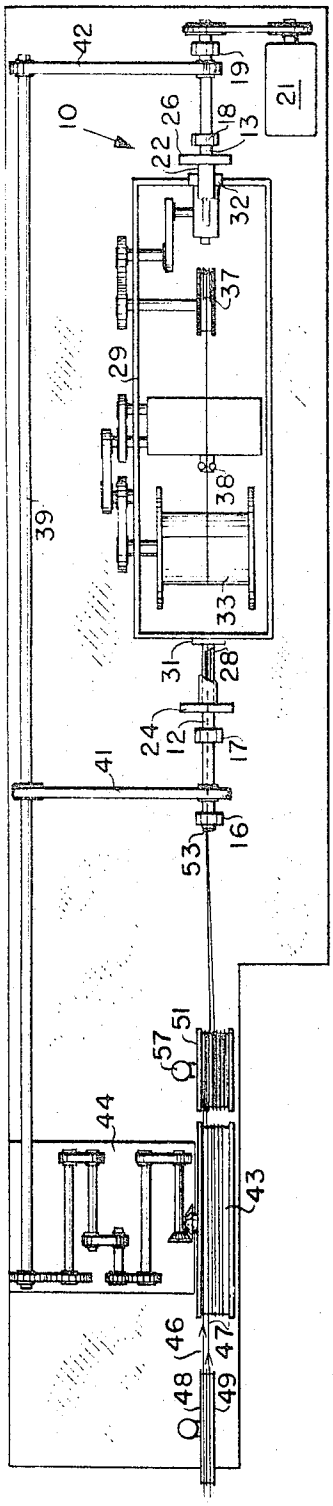


Fig. 2

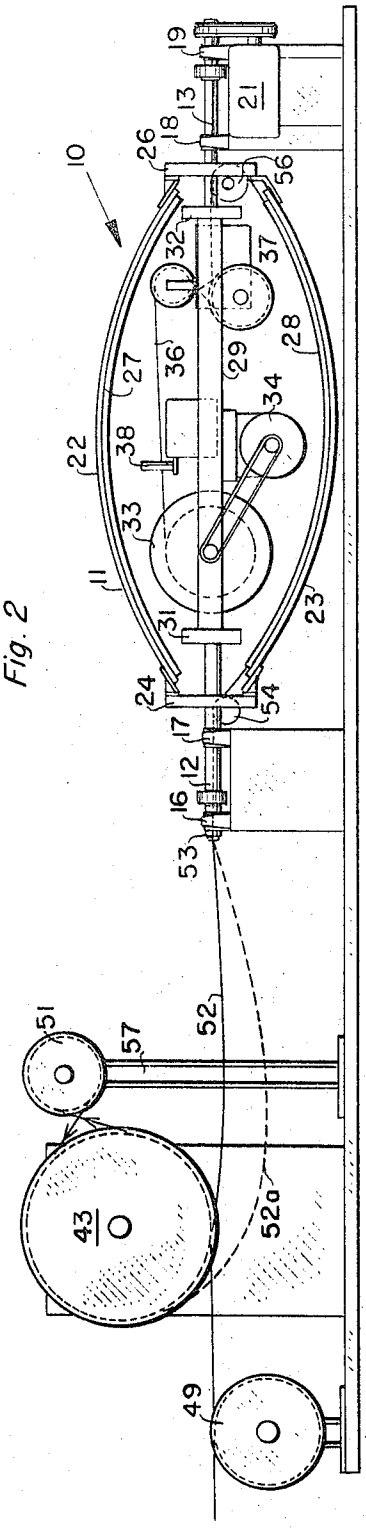


Fig. 1

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# STRANDING APPARATUS

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## ABSTRACT OF THE DISCLOSURE

A stranding means is equipped with a feed capstan and a take-up capstan and the feed capstan is operated at a speed greater than the take-up capstan.

My invention relates to stranding apparatus and particularly to such apparatus comprising novel strand advancing means.

In the cabling art it has long been known to twist a plurality of strands together by means of a flyer that supports a loop of the stranded material and rotates it around a take-up reel. The lay of the strand twist depends upon the number of rotations made by the flyer per unit advance of the stranded material onto the take-up reel, and, when it is important to have a uniform length of lay, the take-up reel is fed by a capstan of some type that meters the stranded material onto the reel at a preselected constant speed. The flyer usually takes the form of an arch or bow and the metering capstan has the effect of dragging the stranded material around this bow. This dragging effect stretches the conductors and increases their electrical resistance.

My apparatus has special advantage for the manufacture of telephone cable pairs where the telephone wires are insulated with paper applied in a tubular spiral. In this case the stranding operation is continuous with the operation of applying the paper insulation and has particular economic advantage in that it eliminates the customary intermediate steps of reeling and unreeling, I have discovered that it is an advantage in this process of insulating telephone wires to apply the paper while the wires are under slight tension. When this tension is relaxed it has the effect of bunching up the paper somewhat and relieving the strain that the paper may undergo due to twisting. But this is only true if the relaxation of tension takes place before the strand has been twisted.

I have discovered that I can overcome the tendency to elongate the conductors and also relieve the strain in the wires prior to twisting by interposing a smooth surfaced capstan immediately upstream of the rotating elements of my strander, wrapping the insulated wires around the capstan and turning it at a speed that exceeds the speed of the metering capstan that pays the twisted wires onto the take-up reel.

My stranding apparatus thus comprises a cradle, storage means supported by the cradle, and metering means also supported by the cradle that meters twisted strand onto the storage means at a pre-selected rate of advance. The twisted strand comprises a plurality of individual wires such as insulated conductors. My apparatus also comprises a flyer rotating around the cradle and supporting the strand, the strand being twisted by the rotation of the flyer. Preferably the strand receives a double twist, being twisted upstream and again downstream of the flyer. My apparatus also comprises a smooth-surfaced capstan



upstream of the flyer having a surface speed greater than the rate of advance of the strand, the wires being wrapped around the capstan and advanced thereby but slipping on the capstan so as not to advance with it at speeds substantially exceeding the rate of advance imparted by the aforesaid metering means. Preferably the wires pay from the capstan so as to form a slack catenary loop under the capstan between the capstan and the flyer. The angle of wrap of the wires decreases with increasing slackening of the catenary; the wires slip on the capstan when the catenary becomes sufficiently slack, and advance with the capstan when the catenary has reduced slackness. By this means the catenary is automatically maintained slack paying into the flyer. Preferably my capstan will have a surface speed from 1% to 6% in excess of the speed of advance of the strand of the metering means and the angle of wrap of the wires will be between 1000° and 1500° to provide the correct slippage.

A more thorough understanding of my invention may be gained from the appended drawing.

In the drawing:

FIGURE 1 is a side elevation of an apparatus of my invention.

FIGURE 2 is a plan view of the apparatus of FIGURE 1. My stranding apparatus comprises a strander, indicated generally by the numeral **10** of conventional construction wherein a flyer **11** comprising a hollow shaft **12** upstream and a hollow shaft **13** downstream rotates in journals **16, 17, 18, 19**, driven by a motor **21**. The flyer **11** also comprises bows **22, 23** fastened to end plates **24, 26** that are rigidly fixed to the respective shafts **12, 13**. To the inside of the bow **22** there is affixed a guide tube **27** and to inside of the bow **23** there is affixed a second guide tube **28**.

A cradle **29** is mounted on the shafts **12, 13** by means of bearings **31, 32** so that the cradle **29** can hold substantially level due to a low center of gravity, while the flyer **11** rotates around it. Within the cradle **29** there is mounted a take-up reel **33** driven by a motor **34** also mounted on the cradle **29** and electrically supplied by means of slip rings, not shown. The take-up reel **33** is driven at a relatively high speed through a slip clutch in a known manner so that it applies a selected tension to strand **36** being paid onto it, but the speed of the strand **36** which is maintained constant, is determined by a metering capstan **37** also mounted on the cradle **29**. Traverse guide rolls **38** guide the strand evenly onto the reel **33**. Although I have shown a reel take-up for my strander, it will be understood that other take-up means such as a take-up into a drum package similar to that shown in my Patent 3,079,747 can also be used. A line shaft **39** is driven by means of chains and sprocket assemblies **41, 42** from the shafts **12, 13**, and this in turn drives a capstan **43** through a gear-train **44** at a circumferential speed betwen 1% and 6% greater than the circumferential speed of the capstan **37**. The capstan **43** receives two insulated strands **46, 47** from guide sheaves **48, 49**. The capstan **43** has a ground and polished cast iron surface of cylindrical shape and there are 8 coaxially mounted sheaves **51** guiding the conductors **46, 47** onto the surface of the capstan **43**. As the two parallel conductors **46, 47**, each of which is insulated with a spiral tube of paper, leave the sheaves **48, 49** they pass around the bottom of the capstan **43** for about 120° and up onto the furthest left of the two sheaves, as seen facing down-

stream in FIGURE 2. The parallel conductors then pass to the top of this capstan **43** take a turn of about 300° around it and pass to the next two of the sheaves **51** from which they pass twice again to the upper portion of the capstan **43** in each case taking another turn of about 300°, and then the two conductors pass to the last two sheaves from which they pass around the top of the capstan a final time and leave the bottom of the capstan in a catenary **52** leading into a forming die **53** of the strander **10** where the strands are twisted together to form the twisted pair strand **36**. In their last turn around the capstan **43** the conductors **46, 47** have an angle of contact with the capstan of about 180° if the catenary **52** takes the form of the solid line in FIGURE 1. Since, however, the surface of the capstan **43** is turning faster than the conductors are entering the forming die **53** slack is generated in the catenary **52** which drops to the dashed line **52***a*. In this position the angle of contact of the last turn of the conductors around the capstan has been reduced to about 90° and the conductors slip on the capstan until the catenary is raised again by the action of the metering capstan **37** drawing the conductors into the strander. The capstan **43** is thus seen to be self-adjusting and to keep a slack feed into the strander at all times without special attention by an operator. The twisted strands pass over a sheave **54** and into the tube **28** which they leave to pass over another sheave **56**. The sheaves **54, 56** are rotating with the flyer **11** and as the strand **36** passes from the rotating sheave **56** to the stationary capstan **37** it receives a second twist having the same direction as the twist imparted in the die **53**.

The insulated conductors paying onto the sheaves **48, 49** are under tension, being pulled by the capstan **43**. But, since the capstan **43** turns faster than the strand is being taken up, the strand is slack as it enters the strander. This relaxation of tension reduces the length of the conductors relative to the surrounding insulation and permits the insulation to bunch up slightly. However, the strand cannot become too slack or the catenary **52** would drag on the ground. This is prevented by the slippage of the conductors on the surface of the capstan **43** when the catenary **52** becomes slack. I have found that the angle of contact of the conductors with the surface of the capstan **43** should be about 1080° and in no case less than 1000° nor more than 1500° to achieve the proper amount of slippage. This angle can be reduced, by moving the rolls **51** mounted on a stand **57** more distant from the capstan **43**, and increased by having the stand **57** closer to the capstan. It can be increased, of course, by taking another turn of the conductors **46, 47** around the capstan, and for this purpose, additional sheaves **51** can be added to the stand **57**. Change gears of known type are provided in the gear train **44** to change the speed of the capstan **43** within the stated limits compared to the speed of the metering capstan **37**.

Although I have described my invention as applied to a horizontal double-twisted strander it will be understood that the strander **10** might have the reel **33** mounted lengthwise in the cradle **29** and thus impart only a single twist without departing from my invention and the strander might be mounted vertically instead of horizontally, also within the scope of my invention.

In the practical use of my invention the insulated conductors **46, 47** are threaded around the capstain **43** and the sheaves **51**. It will be noted that I have mounted the capstan and sheaves on cantilevered shafts to facilitate the stringing operation. When it is preferred, cords or lead wires may be substituted for the conductors **46, 47** during the preliminary stringing.

The conductors are strung through the forming die **53**, over the sheave **54**, through the tube **28** using a snake or stiff wire of known type, over the sheave **56**, around the capstan **37**, through the traverse guide rolls **38** and onto the take-up reel **33**. When the motor **21** is then started the strand entering the tube **28** is found to be free from harmful tension and is automatically fed to the strander at the proper speed due to slippage on the capstan **43** without further attention from an operator.

The apparatus hereinabove described is understood to be exemplary rather than definitive. Other embodiments and modifications coming within the full scope of my invention are defined in the following claims.

I claim:

**1.** Stranding apparatus comprising:
- (A) a cradle,
- (B) strorage means supported by said cradle,
- (C) metering means supported by said cradle, metering twisted strand comprising a plurality of individual wires into said storage means at a preselected rate of advance,
- (D) a flyer rotating around said cradle and supporting said strand,
- (E) said strand being twisted by the rotation of said flyer,
- (F) a smooth-surfaced capstan upstream of said flyer,
  - (a) said wires being wrapped around said capstan and advanced thereby,
  - (b) said wires being slippable on said captan so as not to advance therewith at speeds substantially exceeding said rate of advance, and
- (G) means driving said capstan at a surface speed greater than the speed of said metering means.

**2.** The apparatus of claim **1** wherein said capstan surface speed is 1–6% greater than said rate of advance.

**3.** The apparatus of claim **1** wherein said surface is polished and the angle of wrap of each of said wires around said capstan is between 1000° and 1500°.

**4.** Stranding apparatus comprising:
- (A) a cradle,
- (B) storage means supported by said cradle,
- (C) metering means supported by said cradle, metering twisted strand comprising a plurality of individual wires into said storage means at a preselected rate of advance,
- (D) a flyer rotating around said cradle and supporting said strand,
- (E) said strand being twisted upstream and again downstream of said flyer by the rotation thereof,
- (F) a smooth-surfaced capstan upstream of said flyer,
  - (a) said wires being wrapped around said capstan and advanced thereby,
  - (b) said wires being slippable on said capstan so as not to advance therewith at speeds substantially exceeding said rate of advance, and
- (G) means driving said capstan at a surface speed greater than the speed of said metering means.

**5.** The apparatus of claim **4** wherein said capstan surface speed is 1–6% greater than said rate of advance.

**6.** The apparatus of claim **4** wherein said surface is polished and the angle of wrap of each of said wires around said capstan is between 1000° and 1500°.

**7.** Stranding apparatus comprising:
- (A) a cradle,
- (B) storage means supported by said cradle,
- (C) metering means supported by said cradle, metering twisted strand comprising a plurality of individual wires, into said storage means at a preselected rate of advance,
- (D) a flyer rotating around said cradle and supporting said strand,
- (E) said strand being twisted by the rotation of said flyer,
- (F) a smooth-surfaced capstan upstream of said flyer,
  - (a) said wires being wrapped around said capstan and advanced thereby,
  - (b) said wires paying from said capstan so as to form a slack catenary loop under said capstan between said capstan and said flyer,
  - (c) the angle of wrap of said wires around said

capstan decreasing with increasing slackening of said catenary,

(d) said wires slipping on said capstan upon said catenary becoming sufficiently slack and advancing with said capstan upon said catenary having reduced slackness, whereby said catenary is automatically maintained slack paying onto said flyer, and

(G) means driving said capstan at a surface speed greater than the speed of said metering means.

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