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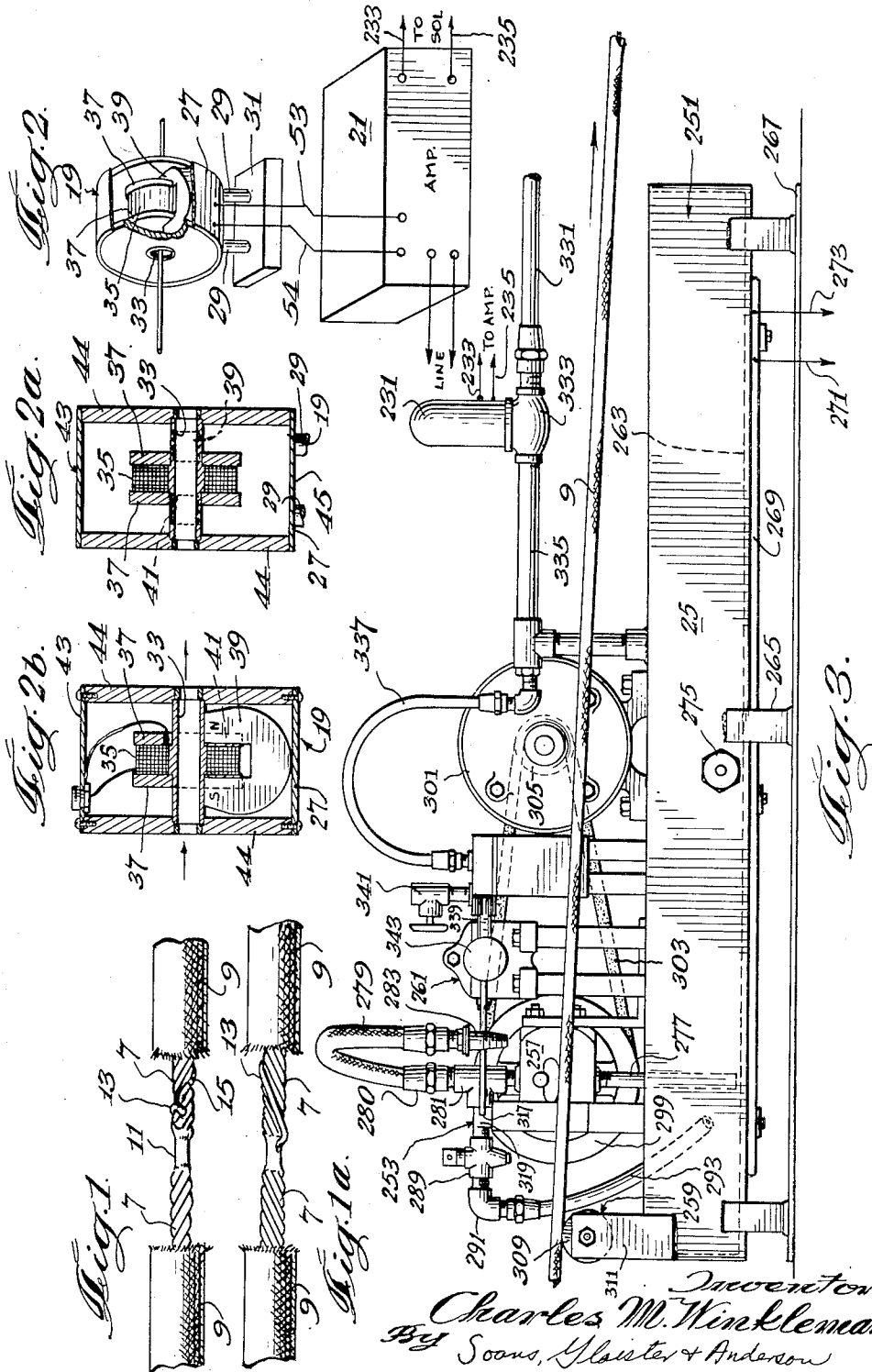
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SPLICE DETECTION PROCEDURES AND APPARATUS

Filed June 27, 1951

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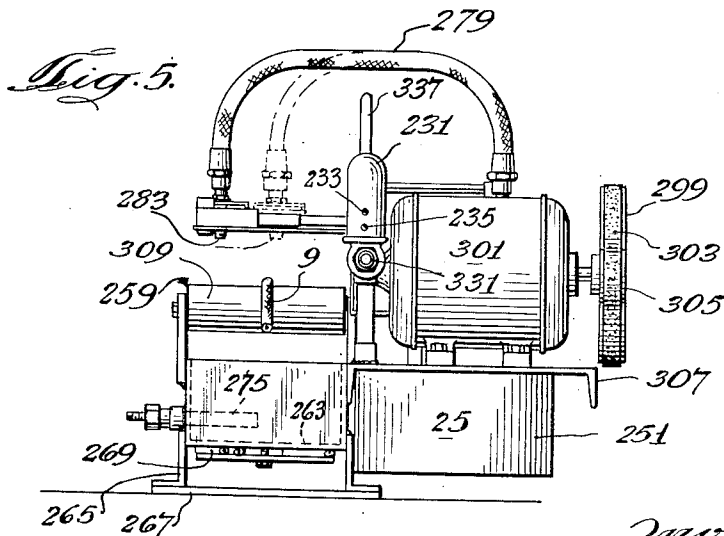
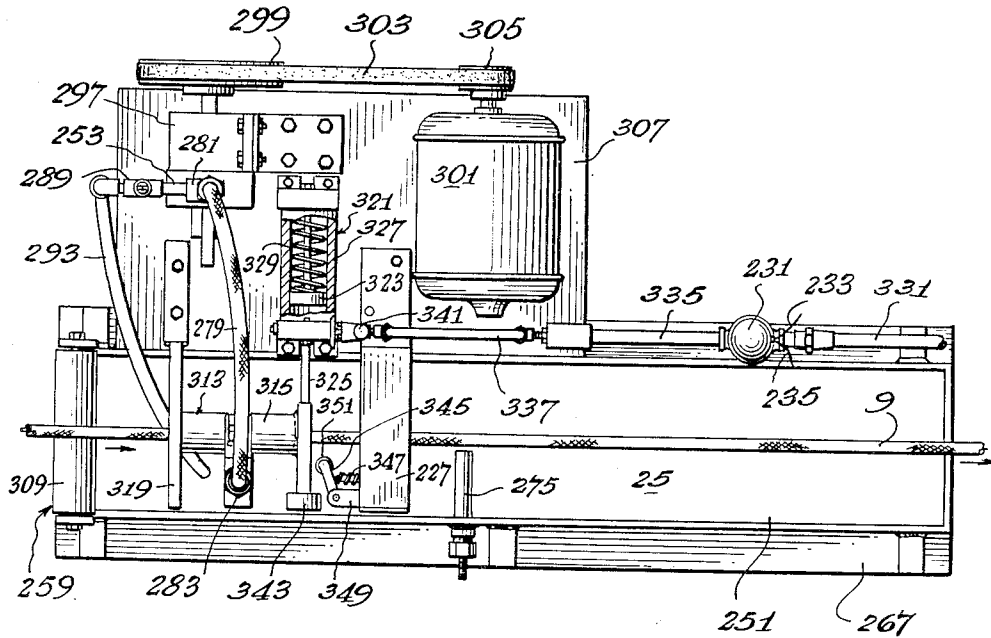
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Fig. 4.



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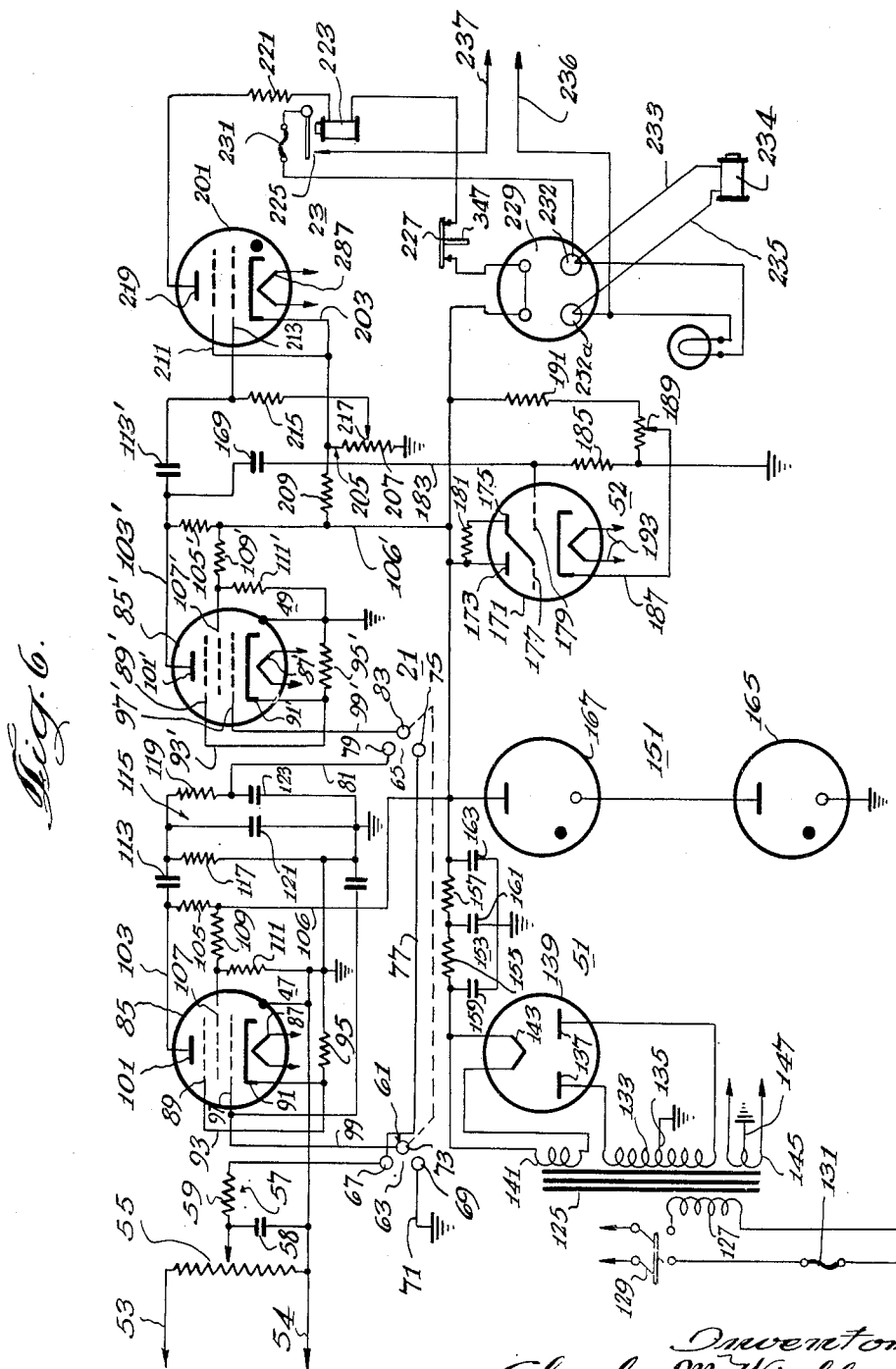
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SPLICE DETECTION PROCEDURES AND APPARATUS

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SPLICE DETECTION PROCEDURES AND APPARATUS

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Application June 27, 1951, Serial No. 233,915

8 Claims. (Cl. 324—34)

The present invention relates, in general, to apparatus and procedures for detecting splices in rope, cord and wire and particularly in the conductor portion of jacketed or covered wire, and for actuating other means, as for example mechanism for applying a suitable marking to the rope, cord or wire covering in the region of each such splice. While not limited to this use, the invention has particular application to the detection and marking of splices in stranded wire which is being jacketed by the use of vulcanization or other continuous wire insulating equipment.

In the manufacture of most jacketed wire, the conductor portion of the wire is unwound from a supply spool and passed through an extrusion head mechanism, which is operable to apply a rubber compound or other insulating jacket to the conductor as it passes there-through. The jacket, if of rubber compound, is then vulcanized, or if of other material, it is otherwise treated. The entire process may be carried on as a continuous operation by the use of a continuous vulcanization machine or like equipment, or it may be carried on as a batch operation. After vulcanization or other treatment, the wire is wound upon spools and stored or shipped.

From the viewpoint of maximum operating efficiency and highest quality product, jacketed insulated wire is preferably manufactured by the use of continuous wire making equipment, such as a continuous vulcanization machine. In the operation of this type equipment the conductor is supplied to the extrusion head as a continuous length. This requires the joining or splicing together of lengths of conductor at regular intervals during the operation of the machine. Usually the end of the conductor on a supply spool is spliced to the beginning of another conductor on a replacement spool, so that when the supply spool is spent the replacement spool is available immediately to supply wire to the jacketing apparatus. However, if the spliced conductor is to pass through the extrusion head without interruption of the jacketing operation, it is necessary that the spliced wire shall have approximately the same cross sectional dimensions as the conductor and as a result, once the splice is jacketed and leaves the extrusion head, it is virtually impossible to visually or manually detect the splice. At the same time, in order to comply with insurance underwriters standards and electrical codes, all splices must be removed from jacketed wire or clearly marked, so that they can be removed when the wire is used.

To comply with these requirements, various ways of marking or otherwise indicating wire joints and splices, especially in wire made on continuous wire making equipment, have been proposed and used. These methods, in general, are unsatisfactory. In some the marking is unreliable or not clearly detectable when the wire is completed. Other procedures require that the wire insulating apparatus be shut down for varying periods. This causes uneconomical operation and frequently results in the scrapping of substantial lengths of the wire adjacent each splice.

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The principal object of the invention, therefore, is to provide an improved procedure and apparatus for detecting and marking splices, and especially splices in the conductor portion of jacketed wire made by the use of stranded conductors or continuous wire insulating apparatus, such as a continuous vulcanization machine. This and other objects of the invention are accomplished, as will appear more clearly hereinafter, by a procedure which involves, in the case of jacketed wire, the attaching of a body of magnetic material to the conductor adjacent the splice prior to the jacket-applying operation, the accomplishing of automatic detection of the attached material at any desired subsequent point in the wire making operation and the applying of a visual indicator to the surface of the covered wire over the joint.

Illustrative apparatus in accordance with the invention is shown in the accompanying drawings, in which:

Figure 1 is an elevational view showing a spliced section of jacketed wire, a portion of the covering being stripped back to show the details of the splice and one method of attaching a short strand of magnetic wire to the conductor adjacent the splice;

Figure 1a is a view similar to Figure 1 showing a short strand of magnetic material which has been attached to the conductor adjacent the splice by a second method;

Figure 2 is a perspective view illustrating a detection unit suitable for use in the practice of the invention;

Figure 2a is a cross sectional view, in side elevation, of the detector portion of the detection unit;

Figure 2b is a plan view, in cross-section of the detector;

Figure 3 illustrates, in side elevation, a portion of a wire marking apparatus embodying various of the features of the present invention;

Figure 4 is a plan view of the apparatus shown in Figure 3;

Figure 5 is an end elevational view taken from the left hand side of the apparatus shown in Figure 3, the apparatus being shown in the wire marking position by dotted lines;

Figure 6 is a schematic diagram of a control circuit adapted to actuate the marking apparatus shown in Figs. 3, 4 and 5 in response to the passage of a spliced joint through the detector mechanism.

As previously pointed out, the apparatus shown in the drawings is particularly adapted to detect and mark splices in a conductor portion, shown at 7 in Figure 1, of a jacketed wire, such as illustrated at 9 in the drawings, which splices are otherwise invisible and manually undetectable. In the practice of the invention, the magnetic properties of the wire conductor are increased in the vicinity of the spliced joint, as for example by attaching a short length of a strand of soft iron wire, which may have a diameter as small as 3–5 mils, to the conductor adjacent the splice. Conveniently, the strand of iron may be wrapped around the conductor when the splice is made. A combination of this type is shown in Figure 1 in which view the stranded conductor portions are united by a welded or silver soldered splice 11, and a short length 13 of soft iron wire is attached to one of the conductors adjacent the splice.

As an alternative, the wire 13 may be attached to the conductor 7 during welding or soldering of the joint 11, one end of the wire 13 being integrally connected to the joint and the remaining portion of the wire being layed along the length of or twisted between the strands of the conductor 7. This manner of attachment of the wire is shown in Fig. 1a, and procedures and apparatus for so attaching the wire are described in my copending application S. N. 233,916 which was filed on June 27, 1951, and which has been assigned to the assignee of this invention.

In the manufacture of jacketed wire by any process

which involves drawing the wire conductor through an extrusion head or equivalent apparatus, it is generally quite important that the cross sectional dimension of the splice shall not exceed materially the cross sectional dimension of the conductor which is being spliced. The procedure and apparatus of the present invention is particularly adapted to meeting this requirement. Due to the very great sensitivity and reliability of the detection means only a very small amount of magnetic material is required in the region of the splice. This means that a short length of a small diameter wire of increased magnetic properties can be wrapped around the conductor, twisted between the conductor strands, or substituted for a section of a strand which may be cut from the conductor adjacent the joint with the result that the section of the conductor including the iron strand has substantially the same cross-sectional dimensions as the conductor and may pass through the extrusion head without difficulty thereby assuring trouble free and continuous operation of the wire making apparatus. The construction shown in Figure 1 is of the type where the wire 13 is substituted for a strand cut from the conductor 7, the ends of the jacket of the wire 9 being cut-away and the wire 13 of increased magnetic properties being included in the right hand conductor 7, as shown at 15.

In accordance with the invention, the jacketed wire 9, having sections of increased magnetic properties adjacent each splice 11 in the conductor portion thereof, is conducted through a detection unit 19. The detection unit 19 produces an electrical signal when the section of the wire having increased magnetic properties passes there-through and this signal is conducted to an amplifier 21. The amplifier 21, in turn, operates a solenoid actuating circuit 23 which controls the operation of a wire marking mechanism 25, the wire marking mechanism applying an indicator to the surface of the wire 9 over the splice 11 so that the splice may be visually detected and cut out or flagged as desired. Thus, the apparatus receives jacketed wire having concealed splices and marks these splices with visual indications so that they may be quickly and easily located. As a result, wire manufacturers may operate wire insulating equipment on a substantially continuous basis thereby effecting substantial economies while at the same time providing better quality wire.

Desirably, the detection unit 19 is of such design that movement of the body of material of increased magnetic properties attached to the wire conductor in the region of each of the splices 11, causes an electrical signal to be produced, which signal, as above pointed out, is conducted to the amplifier 21. This signal may be effected by establishing a magnetic field which extends generally longitudinally of the wire 9 and by placing a coil about the wire 9 and in the magnetic field, the coil being generally perpendicular both to the magnetic field and to the wire 9. Passage of the wire section 13 of increased magnetic properties through the field causes the magnetic lines of force to fluctuate thereby inducing a current in the coil and providing a signal which may be amplified.

In the illustrated construction, the signal is produced by a detection unit 19, one such unit being shown particularly in Figs. 2, 2a, and 2b. As shown, the detection unit 19 includes a detector 27 which is carried by suitable mounting members, such as those designated by numeral 29 in the drawings. The mounting members may be attached to a base 31 and the base, as well as the mounting members 31, are made of non-magnetic material such as brass or wood.

The detector 27 is unusually compact and comprises a guide tube 33 which is also preferably made of brass for receiving the jacketed wire 9. The tube 33 is of relatively small diameter so that the inner turns of the coil 35 can be placed in close proximity to the moving wire 9, and particularly to the wire strands 13 of increased magnetic properties. The tube is also of relatively short length in order that any whipping of the wire 9 in its passage

through the detector 27 will not cause improper operation.

A coil or winding 35 is disposed about the tube 33, this coil desirably comprising about 25,000 turns of Number 36 wire, which construction has been found highly satisfactory for providing a signal of sufficient strength for amplification. The coil 35 is provided with suitable leads which connect to the amplifier 21.

The coil 35 is held in a central position on the guide tube 33 by means of a pair of spaced disks 37 which are made of a non-magnetic material and which are secured to the tube 33. The disks 37 also serve to support and align certain magnetizing means as will appear more clearly hereinafter.

The detector 27 further includes magnetic field producing means adapted to establish magnetic lines of force which extend generally perpendicular to the coil 35 and longitudinally of the coil axis. In the illustrated construction, the field producing means comprises a single horse-shoe shaped permanent magnet 39 having high field strength, but it will be understood that additional magnets may be employed, as desired, to produce the desired sensitivity and that other types of magnets may be used. This magnet 39 is positioned so that it extends radially outwardly from the tube 33 and with its poles in abutting relation to the tube 33 so as to thereby establish a strong magnetic field in the region of passage of the wire 9, the poles being spaced longitudinally of the tube 27. In order to locate the poles of the magnet 39 closely adjacent the coil, and assure high sensitivity, the disks 37 are each formed to provide a radially extending slot 41 which receives a leg of the horse-shoe magnet 39. The slots 41 are proportioned to frictionally engage the magnet and thereby support the magnet in proper position.

In order to provide a detector 27 of pleasing appearance and to protect the magnet 39 and coil 35 from possible damage, the magnet and coil are enclosed in a housing 43 which comprises a pair of circular end members 44 which are positioned at opposite ends of the tube 33 and which are provided with suitable holes for receiving the tube, and a cylindrical shell 45 which is attached to the end members 44. The elements of the housing 43 are also preferably made of brass or other non-magnetic material.

The detector 27 is located ahead of the point where the wire 13 of increased magnetic properties is added to the conductor 7, with reference to the wire making operation. In this connection, it will be noted that the splice 11 may be located at any time by the detector 27 and, consequently, the splice 11 may be discovered at the most desirable time in the wire making operation or after a period of storage.

It should be further noted that the detector 27 is adapted to detect splices in multi-conductor cords or cable for marking. This is quite important for the reason that the splices in each conductor of a multi-conductor cable are located at different points along the length of the cable.

Since relatively small signal voltages are generally involved, the amplifier 21 should be a sensitive type. An example of a two stage, resistance coupled, amplifier unit is illustrated at 47 and 49 in Figure 6 and may be used with good results. The amplifier further includes a power supply 51 and an indicator circuit 52 which is operable to provide visual indication of the signal received from the detector 19.

The amplifier 21 is connected to the detection unit 19 through suitable lead-in conductors 53 and 54, the lead-in conductors connecting to a potentiometer 55 which can be used to adjust the signal voltage impressed on the amplifier units. The potentiometer 55 is connected to an input circuit 57 which is adapted to conduct the signal from the detector 19 either to the first amplification stage 47 or to the second amplification stage 49 depending upon the position of a control switch 61.

During commercial operations, there may, and often

are, various relatively high frequency voltages present. For this reason, the input circuit 57 includes an L-type filter including a resistance 59, which is connected to the potentiometer 55 and to the gang-switch 61, and a condenser 58 which is connected between the potentiometer and resistance 59, and to the conductor 54, conductor 54 being grounded. The gang-switch 61 includes two single-pole-double-throw switches 63 and 65. One post 67 of switch 63 is connected to the resistance 59, the other post 69 of this switch being connected to ground as shown at 71. The pole 73 of the switch 63 is connected to the first amplification stage 47. The other switch unit 65 associated with the gang-switch 61 includes a post 75 which is connected to post 67 of switch 63 through conductor 77 and to the resistance 59 of the filter. The other post 79 is connected to the output of the first amplification stage 47 through conductor 81. The pole 83 of this switch 65 is connected to the second stage 49 of amplification. Thus, a signal received from the detector 19 may be conducted to either of the amplification stages, 47 or 49, by switching the gang-switch 61.

The first and second amplification stages, 47 and 49, as previously indicated, may be connected in series and are generally similar. Accordingly, the corresponding elements of these stages, 47 and 49, are similarly numbered, with the numerals identifying the elements of the second stage being differentiated by the symbol prime. The first amplification stage 47, in the illustrated embodiment, comprises a pentode type tube 85, having a heater 87. The suppressor grid 89 and cathode 91 of the tube 85 are joined together by conductor 93, and the cathode is connected to ground through a cathode bias resistor 95.

The grid 97 is connected to the pole 73 of switch 63 associated with gang-switch 61 through conductor 99 and the plate 101 is connected to the power supply 51 through a conductor 103, a plate load resistance 105, and conductor 106. The screen grid 107 of the tube 85 is also connected to the power supply 51 through a voltage divider network so as to apply a lower voltage to the screen grid 107. The voltage divider network comprises a pair of resistances 109 and 111 connected in series, the screen grid 107 being connected between these two resistances. Resistance 109 is connected to the power supply and resistance 111 is connected to ground.

The signal from the first amplification stage 47 is conducted to the second stage 49 through a coupling condenser 113. More particularly, the signal from the first amplification stage 47 is conducted to the post 79 of switch 65 associated with the gang-switch 61 through a "pi" type filter 115, a grid leak resistance 117 being in parallel with the filter 115. The filter circuit is adapted to filter off the high frequency energy, hereinbefore referred to, and comprises resistance 119 which is connected between two condensers 121 and 123. These condensers are also connected to ground.

The second stage 49 of amplification is directly coupled to the solenoid actuating circuit 23 through coupling condenser 113'.

The power supply 51 is of a conventional construction adapted to provide full wave rectification and includes a power transformer 125 having a primary winding 127 connected to a source of supply (not shown) through a double-pole-single-throw on-off switch 129 and a safety fuse 131. The power transformer 125 includes a secondary coil 133 having a grounded center tap 135, the coil 133 being connected to the plates 137 of a dual-diode rectifier tube 139. The transformer 125 further includes another coil 141 which is connected to the cathode 143 of the diode 139. Finally, the power transformer 125 comprises a heater coil 145 having a grounded center tap 147, this coil being connected to the heaters 87 and 87' of the pentodes 85 and 85'.

The cathode 143 of the diode 139 is connected to a voltage regulator arrangement 151 through a conven-

tional filter circuit 153 comprising resistances 155 and 157 which are connected in series, and condensers 159, 161 and 163 which are in parallel to ground. The voltage regulator unit 151 comprises a pair of voltage regulator tubes 165 and 167 which are connected in series between ground and the output of the filter circuit 153, thereby providing a constant voltage to the amplifier 121.

The indicator circuit 52, which provides visual indication of a signal from the detector 19, is also connected to the output of the second amplification stage 49 through a coupling condenser 169. The indicator circuit 52 is well known and includes the conventional type indicator or electron ray tube 171 which has two plates 173, 175 and two grids 177, 179. Plate 173 is connected directly to the power supply 51, the other plate 175 being connected to the power supply 51 through a high resistance 181 and to grid 177. The other grid 179 is connected to the coupling condenser 169, which is connected to the output of the second amplification stage 49, through conductor 183 and to ground through resistance 185. The cathode 187 of the indicator tube 171 is connected to the power supply 51 through a potentiometer 189 and resistance 191. The potentiometer 189 is connected to ground, and provides a sensitivity adjustment for the indicator tube 171.

By viewing the indicator tube 171, it is possible to ascertain exactly the time at which the wire splices 11 located in the wire 9, pass through detection unit 19 and to thereby check the overall operation of the apparatus. The indicator tube 171 may also be used to adjust the signal voltage for optimum operating conditions. The indicator tube 171 also includes a heater 193 which is connected to the power transformer 125.

The solenoid actuating circuit 23, in the illustrated arrangement, coacts with the marking mechanism 25 to cause this mechanism to place a visual indication on the wire 9 in response to a signal received from the detection unit 19. However, the circuit 23 may be connected to other circuits for controlling other mechanism. For example, the circuit 23 may be adapted to interrupt the operation of a portion of the wire making machinery so as to permit the cutting out of the section of wire including the splice 11 or to effect automatic removal of the splice.

The solenoid actuating circuit 23, in the illustrated construction, comprises a thyatron type tube 201 which is triggered by a signal from the second amplification stage 49 of the amplifier 21. The thyatron tube 201 includes a cathode 203 connected to a voltage divider 205 comprising a potentiometer 207 and a resistance 209 connected in series. Resistance 209 is connected to the power supply 51 and the potentiometer 207 is connected to ground, the cathode 203 being connected between the resistance 209 and potentiometer 207. The cathode 203 is also connected to the suppressor grid 211 of the thyatron tube.

The control grid 213 of the thyatron tube 201 is connected to the output of the amplifier 21 and to ground through grid resistance 215 and the sliding tap 217 on the potentiometer 207. Through adjustment of the potentiometer 207 the sensitivity of the solenoid actuating circuit 23 may be controlled so as to prevent firing of the tube when incidental or spurious signals are generated in the detector 19 and not filtered out by the amplifier 21. The thyatron tube 201 also has a heater 287 which is energized by the heater coil 145 of the power transformer 125.

The plate 219 of the thyatron tube 201 is connected to a current limiting resistor 221 which is adapted to restrict the plate current of the tube to the limits of the circuit elements. The resistance is in series with a solenoid 223 having contacts 225 which are closed by operation of the thyatron tube 201 and, when closed, cause the marking mechanism 25 to operate. The solenoid 223 connects to a reset switch 227 and to the power supply 51 through a plug 229.

The reset switch 227 is mechanically operated by the marking mechanism 25 and is operable to open the plate circuit of the thyatron tube 201 so as to restore the solenoid actuating circuit 23 to a condition to receive another signal from the amplifier 21 and to de-energize the solenoid 223. The solenoid contacts 225, which close when the thyatron tube 201 is triggered by a signal from the amplifier 21, are in series with a safety fuse 231, and a prong 232 of plug 229. The prong 232 is connected to another prong 232a of the plug 229 through conductor 233, a valve actuating solenoid 234 associated with the wire marking mechanism 23 and conductor 235. The prong 232a and contacts 225 are connected to a source of electrical energy (not shown) through leads 236 and 237, respectively.

In operation, a signal from the amplifier 21 causes the thyatron tube 201 to fire and contacts 225 to close. This causes valve actuating solenoid 234 associated with the wire marking mechanism 25 to be energized and the wire to be marked, as will appear more clearly herein-after.

The wire marking mechanism 25 is operable to apply an indication or mark to the wire closely adjacent the splice 11 in response to the operation of the detection means 19. The mechanism 25, in the illustrated construction, is operable to apply melted wax, which may be colored, at a proper time, to a moving wire which may be coming from a continuous vulcanization mechanism or otherwise. The wax solidifies on the wire adjacent the splice 11 which is then easily locatable when desired. As shown in Figs. 3, 4 and 5, the marking mechanism 25 basically comprises a reservoir 251 for containing liquid wax or other marking liquid, and conduit means 253 which communicates with the reservoir 251 and through which the marking liquid is preferably continuously circulated. The marking mechanism 25 further includes means, such as a pump 257, for continuously circulating the liquid from the reservoir 251 through the conduit means 253, and guide means 259 for directing the wire 9 over the surfaces of the liquid in the reservoir 25. In addition, the marking mechanism 25 includes oscillating means 261 which are provided for alternately causing the conduit means 253 to discharge liquid onto the moving wire 9 at selected times.

The reservoir 251, in the illustrated construction, comprises a generally rectangularly shaped pan which is supported upon legs 265 mounted on a bed plate 267 or the like and which is open at its top. When wax is employed for marking the wire 9, the pan is heated to keep the wax fluid, and accordingly, a strip heater or resistance unit 269 is in heat conductive relation with the bottom of the pan 263 and is connected to a source of power (not shown) through conductors 271 and 273. In order that the wax be kept in a melted condition without affecting its physical characteristics, a thermostwitch 275 is provided for controlling the resistance unit 269, the connections between the thermostwitch 275 and resistance unit 269 not being shown but they may be interconnected in well known ways. The thermostwitch 275 is mounted on the side of the pan and extends therein (Fig. 4).

The pan 263, in the illustrated construction, extends a substantial distance along the direction of travel of the wire 9 so as to facilitate the recovery of any surplus wax carried by the wire. If found necessary, splash guards and wiping means for removing excess wax from the wire may also be used.

The conduit means 253 associated with the circulating pump 257 includes an inlet tube 277 which connects the pump with the reservoir 251 and a flexible discharge section 279 which is connected to the circulating pump 257 through a coupling 280 and a T fitting 281. The discharge section 279 terminates in a nozzle 283 through which the marking fluid is applied to the wire 9.

In the illustrated construction, provision is made for continuous flow of wax within the conduit system. This

is done by connecting the T fitting 281 as part of a bypass conduit including a valve 289, an elbow 291 and a hose section 293 which discharges into the reservoir 251 adjacent the pump inlet 277. Through control of the valve 289, the amount of liquid wax discharged from the nozzle 283 may be controlled. It has been found advisable to use this method of control when using wax as the marking fluid for the reason that if the flow is interrupted or intermittent in nature, wax tends to congeal or freeze making the operation difficult and unsatisfactory. It is important that the hose 293 discharge at the inlet end of the tube 277 so that the wax is continuously agitated. This assures trouble-free feeding of the wax to the conduit means 253 and highly satisfactory operation.

The circulating pump 257 may comprise a gear pump 297 of conventional construction and, as before indicated, it is connected intermediate the inlet pipe 277 of the conduit means 253 and T fitting 281. The pump includes a drive pulley 299 which is connected to an electric motor 301 by a belt 303 and a motor pulley 305. The motor and pump 297 are mounted on a frame 307 made from suitable plate, angle and channel sections. The pump is operable to continuously circulate fluid through the conduit means 253.

The wire guide means 259 associated with the marking mechanism is adapted to direct the wire which is to be marked longitudinally across the reservoir 251 in a region below the outlet nozzle 283 of the conduit means 253. The guide means 259 includes a sheave 309 which is rotatably mounted on plates 311 secured at one end of the pan 263.

The oscillating means 261 which in the illustrated construction, alternately directs the outlet nozzle 283 of the conduit means 253 over the wire and away from the wire to mark and prevent marking, respectively, of the wire 9 comprises a carriage 313 which carries the nozzle 283 of the conduit means 253. The carriage 313, as shown in the drawings includes a horizontally extending plate 315 which slides transversely of the wire 9 in a groove 317 formed in a supporting arm 319. This supporting arm is mounted on the frame 307. The nozzle 283 is connected to the plate 315. The plate 315 is welded or otherwise fixedly connected to actuating means 321 which is adapted to move the carriage 313 transversely of the direction of movement of the wire 9, so as to carry the nozzle 283 over and away from the wire 9.

The actuating means 321 for moving the plate 315 (and the nozzle 283) transversely of the wire 9 comprises a fluid actuated piston 323 which is connected to the nozzle support plate 315 by a rod 325. The piston is supported in a cylinder 327 and is normally disposed in its outwardmost position by means of a spring 329 which extends between the base of the cylinder 327 and the piston 323 (Fig. 4).

The piston 323 is arranged to be actuated by a source of fluid pressure (not shown) which is connected to the cylinder 327 through conduit 331, the solenoid actuated valve 333, conduits 335, 337 and 339. The valve 333 is controlled by solenoid 231 which is actuated by the amplifier 21 and actuating circuit 23 when a signal is received from the detector 19.

There will be a time lag between the time at which the splice 11 is detected by the detector 19 and the time at which the splice 11 passes below the nozzle 283 of the conduit means 253. Accordingly, in order that the marking can be adjusted to substantially coincide with the splice it will be found advantageous to provide means for accomplishing a determinable time lag between detection of the splice 11 and the time at which movement of the nozzle 283 begins. As an example of how this can be accomplished, a bleeder valve 341 is connected to the conduit 337 so that a certain amount of fluid, which is pressurized air in the illustrated apparatus, may be bled off thereby slowing the operation of the cylinder

piston 323 and movement of the nozzle 283 over the wire. Adjustment of this valve may be made so that the nozzle will arrive over the wire coincident with the passage of a splice 11 therebelow.

The provision of the bleeder valve 341 is an important feature of the invention as it makes the apparatus adaptable for widely varying wire speeds while, at the same time, assuring marking of the wire 9 at the splice 11. In this connection, wire is manufactured at substantially different rates depending upon the type of wire being produced and proper adjustment of the bleeder valve 341 assures proper marking of the wire by the apparatus. It will be apparent that a dial (not shown) may be provided in association with the valve 341 and calibrated for various wire speeds to thereby facilitate adjustment of the valve 341 when the wire speed is varied.

It is, of course, necessary to shut off the valve 333 so that the carriage may be returned to its normal standby position by the spring 329 in the cylinder 327. This is accomplished by opening the reset switch 227 in the plate circuit of the thyatron tube 201 thereby cutting off this tube 201 and closing valve 333. The reset switch 227 is opened by means of a cam 343 carried by the carriage 313. The cam 343 engages a spring pressed arm 345 and forces the arm away from the cam causing a connected shaft 347 to open the contacts of the switch 227. The arm 345 is pivotally mounted on a support member 349 secured to the switch 227 and carries a cam engaging roller 351 to facilitate actuation of the arm by the cam 343. The cam 343 and switch 227 are preferably so positioned relative to each other that the switch 227 is opened at the time the nozzle 283 is over the wire 9.

In operation, when a splice 11, which is manually and visually undetectable, passes through the detection means 19, the iron wire 13 or other body of magnetic material adjacent the splice causes a signal voltage to be generated, which signal is amplified in the amplifier 21. The amplified signal triggers the thyatron tube 201 in the solenoid actuating circuit 23 and closes the solenoid 231 thereby opening valve 333 and applying fluid pressure to the wire marking device 25. As a result, the piston 323 is actuated causing the nozzle 283 on the conduit means 253 to be moved over the wire, thereby causing a quantity of the wax which is continuously discharged from the nozzle 283 to be applied to the jacketed wire in the region of the splice. When the nozzle 283 is over the wire 9, the reset switch 227 associated with the solenoid actuating circuit 23 is opened thereby deenergizing solenoid 231 and cutting off the fluid pressure. The spring 329 in the cylinder 327 restores the piston 323 and carriage 313 to standby position.

The above described apparatus is completely automatic in operation and makes possible the quick and accurate marking of concealed splices in the conductors of jacketed wire. The apparatus thus permits substantially continuous operation of all types of wire insulating machines. Moreover, the invention results not only in more efficient wire production but in the production of wire of better quality than has been possible by the prior practices. The apparatus is simple in construction and trouble free in operation.

Various of the features of the invention believed to be new are set forth in the following claims.

I claim:

1. A method for locating concealed splices in jacketed wire which comprises the steps of adding a strand of wire having increased magnetic properties in the region of a splice in a wire conductor thereby increasing the magnetic properties of a portion of the wire conductor which is to be jacketed in the region of a splice in said conductor, establishing a magnetic field, positioning a coil adjacent said magnetic field, moving the wire resulting from the jacketing of said conductor through said magnetic-field and said coil thereby producing an electrical

signal in said coil, and actuating mechanism in response to the signal produced at the region of said splice to make said splice easily locatable.

2. A method for locating concealed splices in jacketed wire which comprises the steps of increasing the magnetic properties of a portion of a wire conductor which is to be jacketed by adding a strand of soft iron wire to the conductor of said jacketed wire adjacent each splice on said conductor, establishing a magnetic field, positioning a coil about said magnetic field, moving said wire resulting from the jacketing of said conductor through said magnetic-field and said coil to produce a signal voltage in said coil, amplifying said signal voltage, and applying a visual indication to said jacketed wire in the region of said splice in timed response to said amplified signal voltage.

3. A method for marking concealed splices in jacketed wire which comprises the steps of increasing the magnetic properties of a portion of a wire conductor which is to be jacketed by adding a strand of soft iron wire to said conductor section adjacent each splice, establishing a magnetic field, positioning a coil about said magnetic field, moving the wire resulting from the jacketing of said conductor generally parallel to the lines of force of the magnetic field and through said coil to produce a signal voltage in said coil, amplifying said signal voltage, and applying a wax indicator to said wire by moving a continuously flowing stream of wax into contact with said moving wire in response to said amplified signal and in the region of said splice.

4. Apparatus for marking a moving strand of jacketed wire at preselected points comprising in combination a reservoir adapted to contain a wax liquid, a pump having an inlet and an outlet, an inlet conduit which is connected to said pump and which communicates with said reservoir, a pair of outlet conduits connected to said pump outlet, one of said outlet conduits discharging into said reservoir, the other of said outlet conduits being adapted to discharge the liquid onto the strand at preselected times, valve means in said one outlet conduit for controlling the rate of flow in said outlet conduits, means for movably supporting the discharge end of said other outlet conduit over said reservoir, guide means for directing said strand intermediate the discharge end of said other outlet conduit and the liquid in said reservoir, fluid pressure means connected to said movable supporting means for alternately moving the discharge end of said other outlet conduit over and away from the moving strand whereby the liquid is deposited on said strand at selected times, said fluid pressure means including means for controllably bleeding off fluid, whereby the rate of movement of said supporting means may be varied to accommodate the apparatus for various wire speeds.

5. Apparatus for marking a moving strand of jacketed wire at preselected points comprising in combination a reservoir adapted to contain a liquid, a pump having an inlet and an outlet, an inlet conduit which is connected to said pump and which communicates with said reservoir, a pair of outlet conduits connected to said pump outlet, one of said outlet conduits discharging into said reservoir the other of said outlet conduits being adapted to discharge the liquid onto the strand at preselected times, valve means in said one outlet conduit for controlling the rate of flow in said outlet conduits, means for movably supporting the discharge end of said other outlet conduit over said reservoir, guide means for directing said strand intermediate the discharge end of said other outlet conduit and the liquid in said reservoir, air pressure means connected to said movable supporting means for laterately moving said outlet end over and away from said strand, said air pressure means including a piston, a source of fluid pressure, means for connecting said source of pressure to said piston, and valve means communicating with said connecting means for reducing the pressure in said piston

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by bleeding fluid from said piston whereby the rate of movement of said supporting means may be varied to accommodate the apparatus for various wire speeds.

6. Apparatus for marking a moving strand of jacketed wire at preselected points comprising in combination a reservoir adapted to contain a liquid, a pump having an inlet and an outlet, an inlet conduit which is connected to said pump and which communicates with said reservoir, a pair of outlet conduits connected to said pump outlet, one of said outlet conduits discharging into said reservoir the other of said outlet conduits being adapted to discharge the liquid onto the strand at preselected times, valve means in said one outlet conduit for controlling the rate of flow in said outlet conduits, means for movably supporting the discharge end of said other outlet conduit over said reservoir, guide means for directing said strand intermediate the discharge end of said other outlet conduit and the liquid in said reservoir, air pressure means connected to said movable supporting means for alternately moving said outlet end over and away from said strand, said air pressure means including a piston, a source of fluid pressure, means for connecting said source of pressure to said piston, valve means communicating with said connecting means for reducing the pressure in said piston by bleeding fluid from said piston whereby the rate of movement of said supporting means may be varied to accommodate the apparatus for various wire speeds, and resilient means connected to said piston for restoring said piston when the fluid pressure is released.

7. Apparatus for marking a moving strand of jacketed wire at preselected points comprising in combination a detector adapted to detect a magnetized portion of said strand and produce an electric signal, an amplifier connected to said detector, a solenoid actuating circuit connected to said amplifier and controlled thereby, said circuit including a thyratron tube responsive to said signal, said thyratron tube having a plate circuit including a solenoid and a restoring switch connected in series, means for energizing said amplifier and said solenoid actuating circuit, and means for marking the moving strand including a movable marking device, a piston actuated means connected to said marking device, a source of fluid pressure for operating said piston actuated means, a conduit for connecting said source of pressure to said piston actuated means, a valve in said conduit which is con-

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trolled by said solenoid, and switch actuating means on said piston for operating said restoring switch in the plate circuit thyratron.

8. Apparatus for marking a moving strand of jacketed wire at preselected points comprising in combination a detector adapted to detect a magnetized portion of said strand and produce an electric signal, an amplifier connected to said detector, a solenoid actuating circuit connected to said amplifier and controlled thereby, said circuit including a thyratron tube responsive to said signal, said thyratron tube having a plate circuit including a solenoid and a restoring switch connected in series, means for energizing said amplifier and said solenoid actuating circuit, and means for marking the moving strand in timed response to said signal including a movable marking device, a piston actuated means connected to said marking device, a source of fluid pressure for operating said piston actuated means, a control valve for varying fluid pressure in said piston actuated means to adjust the rate of movement of said marking device and accommodate the apparatus for varying rates of wire movement, a conduit for connecting said source of pressure to said piston actuated means, a valve in said conduit which is controlled by said solenoid, and switch actuating means on said piston for operating said restoring switch in the plate circuit thyratron.

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