

Feb. 2, 1960

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2,923,808

METHODS OF AND MEANS FOR MARKING METAL

Filed Aug. 21, 1956

3 Sheets-Sheet 1

FIG. 1

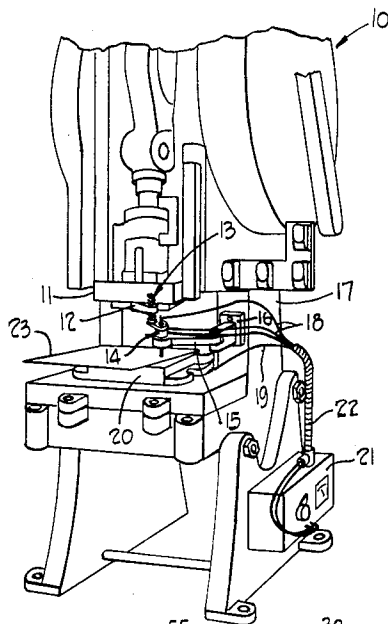


FIG. 2

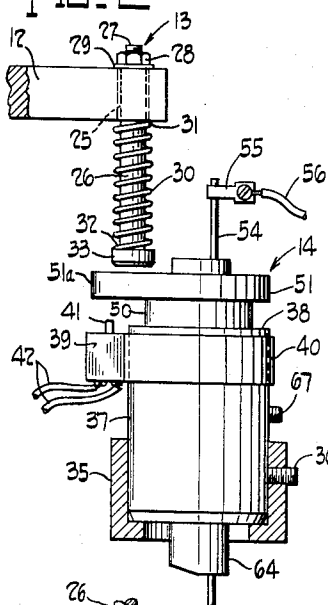
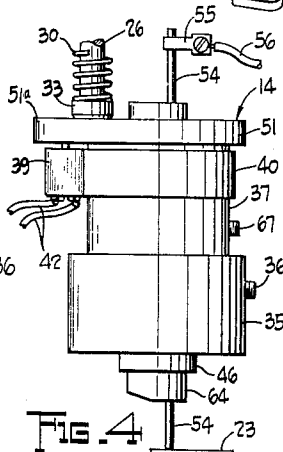


FIG. 4



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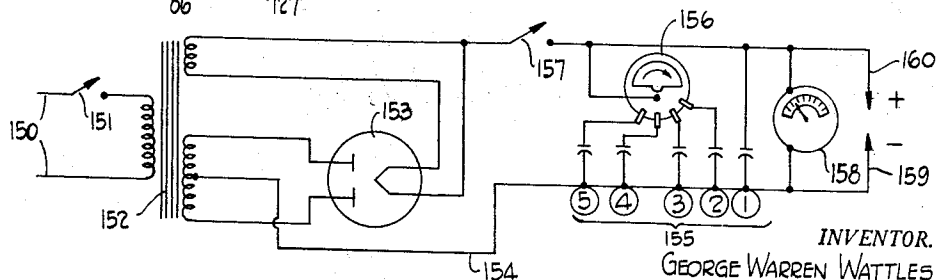
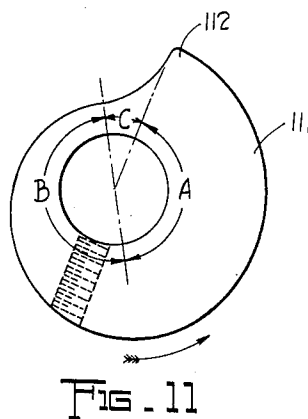
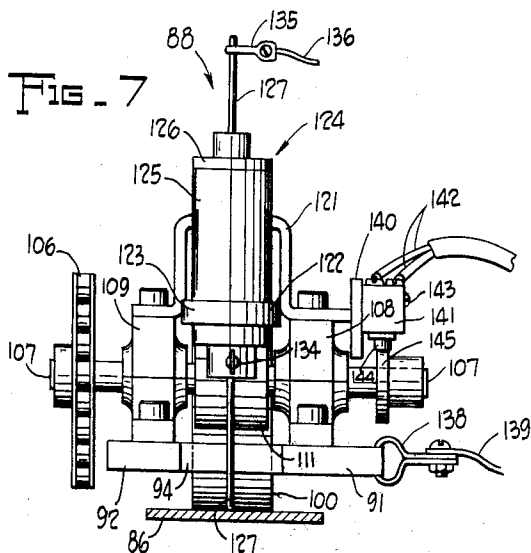
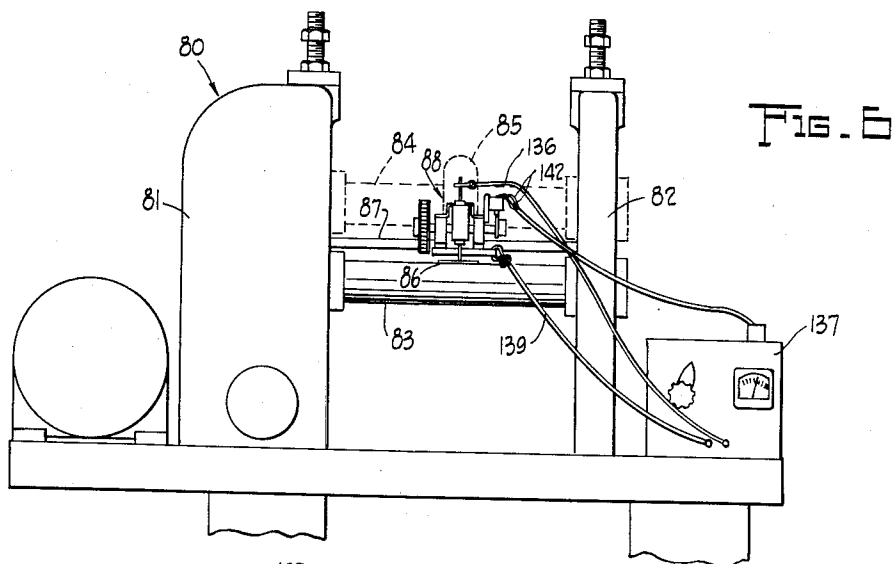


FIG. 12

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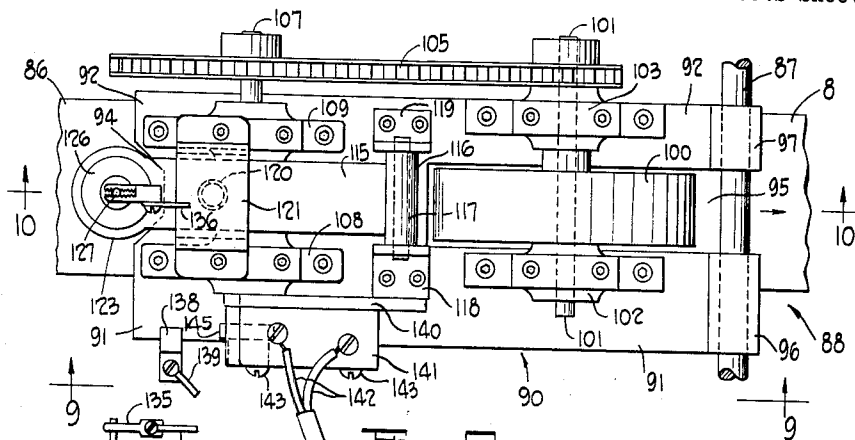


FIG. 8

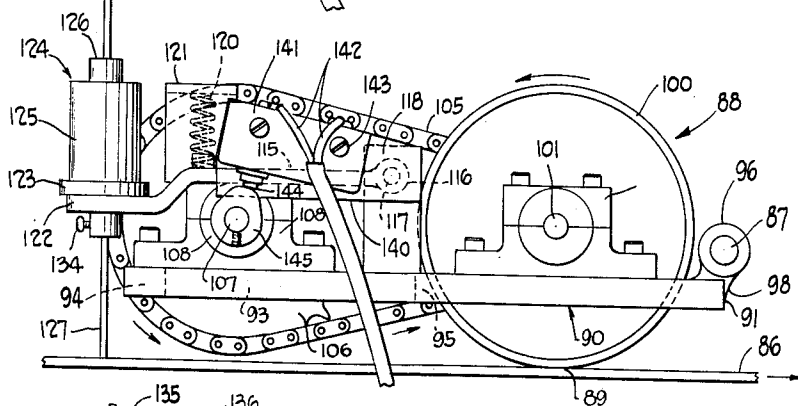


FIG. 9

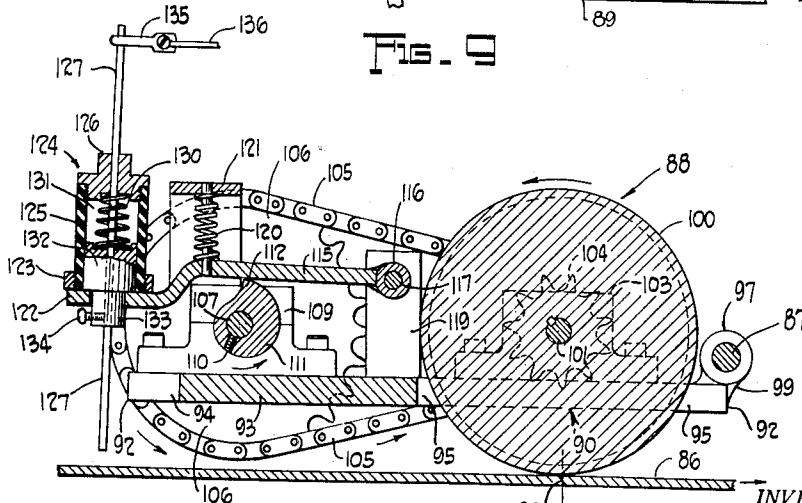


FIG. 10

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METHODS OF AND MEANS FOR MARKING METAL

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Application August 21, 1956, Serial No. 605,341

14 Claims. (Cl. 219—69)

This invention relates to methods of and means for marking metal for purposes of identification.

Although consumer goods of metal may advantageously be marked by the application of tags, labels, stencils, stamp impressions and the like, capital goods are more often marked by name plates affixed by screws, rivets or similar fastening means. For the purposes of a large installation, frequently including many of its principal components, such name plates lend themselves well enough to origin determination, but they do not, as a rule, lend themselves satisfactorily to identification of the source of the materials of construction employed in putting the installation together. For example, a processing unit in an oil refinery can be expected to show the names of the makers of such components as motors, pumps, blowers and self-contained controls, but will not usually show the origin of structural framework, piping, return bends, and many of the other metal components that make up a large part of the installation as a whole.

Where failure of a metal component leads to failure of an installation, it sometimes becomes important to fix the responsibility, which, as a rule, can be done easily only as to components that are marked by name plates. Where, for example, widespread property damage or personal injury is done in an explosion that can be traced to the failure of tubing, it is frequently difficult and sometimes impossible to determine the manufacturer. This is particularly true if the tubing is of a nature such that it does not lend itself to permanent marking on mounting flanges. Thus, because of an inability to mark his product satisfactorily, a reputable manufacturer of tubing may find himself falsely accused of responsibility for an industrial disaster of substantial proportions.

While tubing is mentioned by way of illustration, the same problem obtains elsewhere in the metal fabrication field; for example, where sheet metal parts for use in large assemblies are being stamped, punched or drilled by means of presses. Unlike the manufacturer of consumer goods, the manufacturer of such products is seldom in a position to mark his product to the best advantage. Even if applied, tags, labels, stencils and light stamp impressions afford only a highly temporary means of identification. As a result, in this field as in other fields the introduction of means of identification that are capable of persisting notwithstanding extended periods of use or abuse, as, for example, under conditions productive of corrosion and other forms of surface impairment, is a widely recognized desideratum.

The present invention has for one of its objects to provide methods and means for permanently marking metal goods while they are still in the fabrication stage, this in a manner such that the mark will not be obliterated in a few months as a result of exposure to the elements, corrosion, surface damage, or the repeated application of coating compositions. Another object of the invention is to provide for the incorporation in fabricating machinery such as tube-forming machines, punch presses and the like of novel means for marking the metal which is

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being handled, the marking being accomplished in a manner such that the mark lends itself to identification of the source of the product many months and even many years after its manufacture.

To that end, the invention contemplates depositing on or infusing into a metal product, in the course of its manufacture, one or more materials of different physical or chemical characteristics; for example, an alloy containing one or more uncommon metals or a group of common metals that are present in the alloy in unusual proportions. This deposition is accomplished by electrical means, preferably by imposing on an expendable stylus of known metallurgical composition an electrical charge of a nature such as to induce metal deposition as between the stylus and the material of which the fabricated product is being made. Where there is metal infusion of this sort, it becomes a simple matter, even after the lapse of years, to polish the surface where the mark is thought to exist, etch it and examine it microscopically and otherwise for the purpose of determining the presence or absence of any metal components so infused into it.

Other objects, advantages and features of the invention will be apparent from the description which follows and from the accompanying drawings, in which:

Figure 1 is a perspective of a punch press incorporating a metal-marking device of a type within the purview of the invention.

Figure 2 is an elevation showing the marking device of Figure 1 on a larger scale.

Figure 3 is a central vertical section with parts in elevation through the marking device of Figure 2.

Figures 4 and 5 are views similar to those of Figures 2 and 3, respectively, showing the marking device with certain of its parts in retracted position.

Figure 6 is an end elevation of a tube-forming machine showing a second metal-marking device of a type within the purview of the invention.

Figure 7 is an enlargement of the central portion of Figure 6 showing the same marking device without the associated elements of the tube-forming machine.

Figure 8 is a plan of the same marking device on a slightly larger scale.

Figure 9 is a side elevation of the same marking device, seen as if from line 9—9 of Figure 8, with the stylus carrier in its lowermost position.

Figure 10 is a vertical section on line 10—10 of Figure 8 but with the stylus carrier in an elevated position.

Figure 11 is an enlarged view of the primary cam, the same being shown in side elevation.

Figure 12 is a schematic representation of an electrical circuit that may be used with the marking devices of Figures 1 to 5 and 6 to 11.

Figure 13 is a section with parts in elevation through a hand-held marking device that may be used in the practice of the invention.

Figures 1 to 5 illustrate the invention as incorporated in a punch press 10 of the kind used in punching holes in sheet metal stock. Rigidly mounted on upper platen 11 or on some one of the other vertically moveable elements of the punch press is an arm 12 which carries a striker assembly 13 that is adapted to cooperate with an underlying stylus carrier 14. The latter is carried by a pivotally mounted arm 15 that is susceptible of arcuate movement about a pivot pin in a bracket 16 mounted on the frame 17 of the punch press. If it is desired to mark the sheet metal stock that is being subjected to the punching operation, pivotally mounted arm 15 is swung into apposition to rigidly mounted arm 12 with striker assembly 13 overlying stylus carrier 14 in the manner indicated in detail in Figure 2.

With stylus carrier 14 in this position, wires 18 ex-

tend rearwardly substantially as shown from the stylus carrier to the frame of the machine. Another wire 19 is affixed to lower platen 20; it also extends rearwardly to the machine frame. All of these wires enter a control box 21 on frame 17, first passing downwardly through a flexible cable 22. For the present, it is sufficient to notice that control box 21 is wired in the manner indicated in the circuit diagram of Figure 12.

The sheet of metal that is to be marked, designated 23, appears in Figure 1 between stylus carrier 14 and lower platen 20.

Referring now to Figures 2 and 3, it will be noted from Figure 2 that arm 12 is provided with a hole 25 loosely accommodating a rod 26 forming part of striker assembly 13. At its upper end 27, which projects above arm 12, rod 26 is reduced in diameter and threaded to enable it to receive an adjusting nut 28 that seats on a washer 29. Below arm 12, rod 26 is encompassed by a coil spring 30, of which upper end 31 bears against arm 12 and lower end 32 seats on an integrally formed striking head 33. Rod 26 is moveable upward in opposition to spring 30 but is biased by the spring toward a position in which only its threaded upper end 27 extends above the level of arm 12. Thus striking head 33 is enabled to make yielding contact with the stylus carrier.

Stylus carrier 14 consists, among other things, of a metal receptacle 35, formed as shown in Figures 2 and 3, to which the pivoted arm 15 shown in Figure 1 may be attached in any convenient way. Although susceptible of arcuate movement on arm 15 in the manner already described, receptacle 35 is not free to move up or down. For present purposes, it may be considered as stationary. Held rigidly in place in receptacle 35 by a set screw 36 is a non-conductive liner 37 the lower end of which conforms to the shape of the lower end of receptacle 35. For reasons which will appear, liner 37 is provided at its upper end with a flat end face 38. On the exterior surface of liner 37 a normally-closed microswitch 39 is mounted, as by a metal strap 40, in such manner that switch-actuating pin 41 can extend above end face 38 for a short distance. Leading from microswitch 39 are wires 42, these being two of the wires collectively designated 18 in Figure 1.

Bearing in the manner shown in Figure 3 against an interiorly directed end flange on liner 37 is a stout coil spring 45 the upper end of which is in engagement with a slidable nonconducting adapter 46. At its upper end, the latter is characterized by an axially extending portion 47 formed after the fashion of a collar. It is internally threaded for engagement with an externally threaded portion 48 that depends as shown from a metal sleeve 49. Being threaded into adapter 46, sleeve 49 likewise is slidable within liner 37. Normally, adapter 46 and sleeve 49 are in the elevated position shown in Figure 3, being urged into that position by spring 45.

The upper end 50 of sleeve 49 is internally threaded to accommodate a correspondingly threaded portion of an overlying cap-like member 51, preferably formed of metal. As indicated in Figures 2 and 3, cap-like member 51 has a lateral extension 51a which constitutes a striker plate. Loosely disposed in an opening in the central portion of cap-like member 51 is a plug 52 of non-conductive material that is provided with an off-center hole 53 adapted to receive stylus 54, which may be of metal, carbon or some other conductive material. Attached by a metal clamp 55 to the upper end of stylus 54 is a wire 56 which leads to control box 21, this being another of the wires collectively designated 18 in Figure 1. Wire 56 imposes a positive electrical potential on stylus 54; wire 19 (Figure 1), a negative electrical potential on lower platen 20 and metal sheet 23.

Stylus 54 extends downwardly to and through a non-conductive plunger 60 having an external diameter slightly smaller than the internal diameter of sleeve 49. A coil spring 61 intervenes between a spring seat 62 on

the upper end of plunger 60 and a like seat on the lower end of plug 52. The normal effect of spring 61 is to bias plunger 60, and therefore the parts associated with it, into a depressed position within stylus carrier 14. Plunger 60 has a downwardly-facing transverse shoulder 63 (Figure 5) that is adapted to seat against an interiorly extending flange on the depending portion 48 at the lower end of sleeve 49. Below shoulder 63 is a cylindrical portion 64 of reduced diameter that is formed as an integral part of plunger 60. In the embodiment of the invention shown in the drawings, the lower end of cylindrical portion 64 projects downwardly out of a central opening in the bottom of receptacle 35; see Figures 2 and 3.

A set screw 65 provided with a pin at its end projects inwardly through depending portion 48 of sleeve 49 into a vertically extending guide slot 66 in the cylindrical portion 64 forming part of plunger 60. Set screw 65 keeps plunger 60 from turning in sleeve 49 but permits it to slide in a direction paralleling the longitudinal axis of stylus 54; see Figures 3 and 5. Sleeve 49 is itself kept from turning in liner 37 by means of a similar set screw 67 the inner end of which projects into a similar slot 68 in the surface of sleeve 49. Set screw 67 also operates as a stop to prevent spring 45 from pushing adapter 46 and sleeve 49 upwardly to an undesired extent.

An off-center hole 70 that is in alignment with the off-center hole 53 in plug 52 accommodates stylus 54. It is of a size to permit free sliding movement of the stylus in plunger 60 and cylindrical portion 64. However, for the purposes of the invention, it is desirable that one or the other, preferably cylindrical portion 64, be provided with a one-way clutch that permits such movement to take place in one direction but prevents it from taking place in the opposite direction. Well known in other arts, one-way clutches of this sort may take any one of a variety of forms.

In the embodiment of the invention shown in the drawings, the clutch is characterized by transverse bore 71 of a size sufficient to accommodate a detent 72 that is pivoted as at 73 within cylindrical portion 64. Biasing the detent into engagement with stylus 54 is a pin 74 that is backed by a plunger 75 and a coil spring 76. These elements are accommodated within a suitably formed intercepting bore in cylindrical portion 64. A threaded plug 77 at the lower end of the plunger serves as means for closing the end of the bore, retaining spring 76 in operative position, and adjusting the tension on the spring.

Under these conditions, stylus 54 can move downward but not upward within the cylindrical portion 64 that depends from plunger 60. In other words, plunger 60 and cylindrical portion 64 can move upward but not downward on stylus 54. Therefore, when a suitable force is exerted against the lower end of stylus 54, as by contact with metal sheet 23, stylus 54 and plunger 60 will move upward as a unit within limits that depend on the location of set screw 65 and/or the tension on spring 61. In general, however, the limit of upward movement of plunger 60, cylindrical portion 64 and stylus 54 is determined by set screw 65 and slot 66. The limit of downward movement of plunger 60 and cylindrical portion 64 is determined by the location of shoulder 63, which is engaged by the interiorly directed flange at the bottom of sleeve 49.

Normally, assuming the parts to be in the position shown in Figures 2 and 3, downward movement of arm 12 and striker assembly 13 brings head 33 on rod 36 into engagement with striker plate 51a on cap-like member 51 of stylus carrier 14. Continued downward movement of arm 12 and striker assembly 13 forces striker plate 51a downward. After striker plate 51a has moved downward for a short distance, it engages pin 41 on microswitch 39, thus causing the contact points in the microswitch to separate and the circuit to open. Continued downward

movement of striker assembly 13 and striker plate 51a brings the parts into the position illustrated in Figures 4 and 5, in which cap-like member 51 seats on flat end face 38 on the upper end of liner 37, thereby effectively limiting the downward movement of cap-like member 51, sleeve 49 and adapter 46, all of which come to rest in substantially the position shown in Figure 5.

As already indicated, plunger 60 and stylus 54 tend to move downward as a unit in response to the downward force exerted by spring 61 against spring seat 62 on plunger 60. This is in consequence of the action of detent 72 on stylus 54. Thus as cap-like member 51, sleeve 49 and adapter 46 move downward, the effect is to impose downward movement on spring 61, plunger 60 and stylus 54. As the latter nears metal sheet 23, provided that the electrical system is in full operation, a spark is struck between the end of stylus 54 and metal sheet 23.

The precise point at which sparking occurs depends on the electrical characteristics obtained under the prevailing conditions, on the composition and condition of stylus 54, on the composition and condition of metal sheet 23, and on the length of the spark gap. If, as assumed, the charge on stylus 54 is positive, there is a deposition in metal sheet 23 of some of the material of which stylus 54 is formed, regardless of whether stylus 54 be of carbon, metal or some other suitable conducting material. The material so transferred from stylus 54 to metal sheet 23 infuses into and under some circumstances probably alloys with the material of metal sheet 23, thereby producing a permanent mark in the metal sheet.

This mark, even when coated over by a heavy layer of rust, can be detected by removing the rust by abrasion or by the action of a suitable chemical, polishing the exposed surface of metal sheet 23, and examining it under a microscope. Other methods of determining the nature of the infusion are also available. If, therefore, a distinctive metal is employed in stylus 54, such as an alloy of unusual composition, the elements entering into the alloy can be detected in the mark in metal sheet 23. Thus it becomes possible, for the purpose of identifying the marker of the product, to fix the source of the metal that was used in making it.

Depending on the characteristics of the electrical system and the frequency of use, stylus 54 will of course tend to burn away, thus producing with time a condition in which stylus 54 will neither make contact with metal sheet 23 nor approach it closely enough to permit a spark to jump between them. In such circumstances, it is a simple matter to urge stylus 54 into a new position within plunger 60, as by holding stationary the projecting lower end of cylindrical portion 64 and tapping lightly on the upper end of stylus 54. The same result can be accomplished by holding stylus 54 stationary and pushing upward on the projecting lower end of cylindrical portion 64. If the electrical system is not disconnected in the meanwhile, insulating gloves or tools designed to insulate against electrical shock should be used for the purpose. In either case, the net effect is to move stylus 54 downward within plunger 60, or, viewed from another standpoint, to move plunger 60 upward on stylus 54, thus restoring a condition in which the spark jumps from stylus 54 to metal sheet 23.

Figures 6 to 11 illustrate the invention as incorporated in a tube-forming machine 80. Such machine includes two spaced roll stands 81 and 82. At the rear end of the machine, seen as in Figure 6, is a lower roll 83 that is unopposed by an overlying upper roll. To the rear thereof are other rolls arranged in pairs. The upper roll 84 of the first succeeding pair appears in phantom in Figure 6, wherein it is designated 84. Attached to it is a tube-forming element 85 of conventional shape. The strip from which the tube is formed appears just above lower roll 83, being designated 86.

Somewhat above the level of the top of lower roll 83 is a rigidly mounted rod 87 which extends between the

two roll stands. Rod 87 is used for supporting a marking device 88 which extends rearwardly from rod 87 toward the trailing end of strip 86. This relationship is shown in Figure 8, in which the marking device appears to the left of supporting rod 87. As will appear from what is brought out below, there is contact between strip 86 and marking device 88 in the zone indicated by the dotted line at 89 in Figure 9. Thus marking device 88 is supported both by strip 86 and by rod 87.

Among other things, marking device 88 includes an M-shaped metal frame 90 which consists in the main of two side members 91 and 92 (Figure 8). These side members are bridged as indicated at 93 in Figure 10, thus leaving a short slot 94 at the trailing end of the marking device and a considerably longer slot 95 at the forward end of the marking device. Ears 96 and 97 (Figure 8) are welded to side members 91 and 92, respectively, the welds appearing at 98 and 99 in Figures 9 and 10. By means of ears 96 and 97, frame 90 can be made to pivot in an arc about the longitudinal axis of rod 87, thus permitting upward displacement of the trailing end of the marking device when needed to accommodate joints or other thick portions of strip 86.

A metal traction wheel 100 is rigidly mounted on a rotatable horizontal shaft 101 that extends between two like bearings 102 and 103 that are mounted on side members 91 and 92, respectively (Figure 8). On one end of shaft 101 is mounted a small sprocket 104, shown in dotted lines in Figure 10, by which the motion imparted to traction wheel 100 by strip 86 is communicated to a chain 105 that extends rearwardly of the marking device to a large sprocket 106. Sprocket 106 is rigidly mounted in alignment with sprocket 104 on a rotatable shaft 107 which extends horizontally between two other bearings 108 and 109 that are themselves mounted on side members 91 and 92, respectively. Thus sprocket 106 and shaft 107 are driven by chain 105 from traction wheel 100.

As indicated in Figure 10, a set screw 110 serves to affix a primary cam 111 to shaft 107 in approximately the central vertical plane of the marking device. As is apparent from Figures 10 and 11, cam 111 has a fairly well defined lobe 112 on the portion of the cam opposite set screw 110. From Figure 11, it can be seen that cam 111 has a dwell phase, indicated at A, of approximately 150°. This is followed by an approach phase B that covers an arc of approximately 180°. Following approach phase B is lift phase C measuring approximately 30°. Because of the relatively short lift phase, the camming action exerted by lobe 112 is not gradual but drastic.

Directly over cam 110 is a movable tongue 115 provided at its forward end with a cylindrical bushing 116 by which the tongue is mounted for arcuate movement about a stationary shaft 117. The latter extends horizontally between two like brackets 118 and 119, best seen in Figure 8, that are mounted on side members 91 and 92, respectively, near the forward end of bridge portion 93. Exerting a downwardly directed force on tongue 115 is a coil spring 120 that is mounted as shown in Figure 10 in inverted U-shaped spring retainer 121. The lower portions of spring retainer 121 are mounted on bearings 108 and 109 for shaft 107.

As indicated in Figures 9 and 10, tongue 115 is provided at its trailing end with an offset portion 122. Rigidly affixed to it, as by brazing, is an internally threaded collar 123 which receives the lower end of a stylus carrier 124 consisting, among other things, of a shell 125 of non-conductive material that is externally threaded at its lower end and internally threaded at its upper end: see Figure 10. Screwed into the threaded upper end of shell 125 is a cap-like member 126, preferably of metal, in which is a central opening of a diameter sufficient to accommodate the stylus 127.

Below cap-like member 126, a coil spring 130 extends axially of the chamber 131 in shell 125. The upper end

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of spring 130 seats against cap-like member 126; the lower end, against a plunger 132 of non-conducting material. Plunger 132 has a depending cylindrical portion 133 that is formed integrally with it. Stylus 127 passes through a hole extending centrally through plunger 132 and cylindrical portion 133. It is held in position therein by means of an adjusting screw 134. Plunger 132, which serves as a chuck, is slidably positioned within shell 125. It is biased toward a position at the bottom of the shell by the downward force imposed on it by spring 130.

At the upper end of stylus 127 is a clamp 135 for attaching a wire 136 that runs to a control box 137 (Figure 6). Such wire imposes a positive electrical potential on stylus 127. A negative electrical potential is imposed on frame 90 by means of a clamp 138 and wire 139 which likewise extends to control box 137. Clamp 138 and wire 139 are omitted for purposes of clarity from Figures 9 and 10. Thus the desired spark discharge may occur under suitable circumstances between the lower end of stylus 127 and strip 86. The latter acquires the negative potential of frame 90 through the intervention of wheel 100.

To bring about the desired spark discharge, stylus 27 is caused to approach strip 86 in gradual fashion, this by the operation of that portion of cam 111 that has been designated as approach phase B in the foregoing description of cam 111 as illustrated in Figure 11. While tongue 115 is in contact with this portion of the cam, the tongue is progressively depressed by spring 120 and the action of gravity into the horizontal position illustrated in Figure 9. After the cam has completed approach phase B, by which time a spark will have jumped from stylus 127 to strip 86, it is desirable that a drastic lifting action be exerted on stylus 127.

This action is needed to minimize any tendency that might otherwise be present in the device to weld stylus 127 to strip 86. It is for this purpose that cam 111 is provided with the lift phase C (Figure 11). It will be obvious from a consideration of Figures 10 and 11 that rotation of the cam in the direction indicated by the arrow in Figure 11 results in rapid lifting of tongue 115 and therefore of stylus carrier 124 and stylus 127 to a position well removed from strip 86.

It will be noted from Figures 7, 8 and 9 that a mounting plate 140 is affixed to bearing 118. The function of mounting plate 140 is to provide means for holding the microswitch 141 in position. From microswitch 141 wires 142 lead to control box 137. Screws 143 hold microswitch 141 in place on mounting plate 140 (Figure 9). A pin 144 for actuating microswitch 141 projects from its under face, as shown in Figures 7 and 9. A secondary cam 145 mounted at the extreme outer end of shaft 107 operates on pin 144 to actuate and de-actuate microswitch 141.

Microswitch 141, which is of the normally closed type, is actuated by cam 145 to open the circuit in much the same manner as that in which microswitch 39 is actuated to open the circuit in the embodiment of the invention described in Figures 1 to 5. Opening of the circuit in this manner does not greatly affect the characteristics of the current that is supplied to stylus 54 (Figures 1 to 5) or to stylus 127 (Figures 6 to 11). The reason for including the microswitch is mainly to protect certain portions of the control box circuit, as will appear from what is said immediately below regarding Figure 12. This circuit, the elements of which are contained in the control box, is the same in each of the two embodiments of the invention.

Referring to Figure 12, the main leads are designated 150. In one of them is a line switch 151 by which the current supplied to the control box may be interrupted. A transformer 152 is employed to step up the voltage from the usual value of 120 volts to its ultimate value of approximately 500 volts. Coupled to the transformer in

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the manner illustrated is a rectifying tube 153 of the type known to the electrical trade under the number 5U4G. Electric energy at a potential of 500 volts is fed by line 154 from transformer 152 to a series of five capacitors, collectively designated 155, coupled as shown to a four-position switch 156 of the shorting type. The microswitch 39 or 141, as the case may be, is connected to the circuit where indicated by the switch symbol 157. A volt meter 158 is connected across lines 159 and 160, which are connected to the marking device in the manner already explained.

Encircled letters 1 to 5 represent taps connected to the various capacitors. Preferably the capacitors at taps 1 and 2 are of the 80 microfarad type; the capacitors at taps 3 to 5, of the 40 microfarad type. By cutting out taps 2 to 5, a current having an amperage of 200 milliamperes is obtained. With switch 156 in suitable position, taps 2, 3, 4 and 5 will give amperages of 400, 500, 600 and 700 milliamperes, respectively. Thus the electrical characteristics of the current transmitted to the stylus may be varied over a wide range. It is because of the fact that current of these characteristics may do damage to rectifying tube 153 if it feeds back through the circuit that the microswitch indicated at 157 in Figure 12 is incorporated in the circuit.

A further form which the invention may take is illustrated in Figure 13, which shows a hand-held marking device. In this case the device comprises a stylus carrier 165 incorporating a metal barrel 166 at one end of which is a cap 167 of non-conductive material. Extending through a threaded opening in the center of cap 167 is an adjusting screw 168 that operates on a coil spring 169. The latter seats on an enlarged metal head 170 to which is connected a wire 171 for transmitting capacitor discharge current to stylus 172. Stylus 172, which is mounted in head 170, extends longitudinally through barrel 166, passing through a half-washer 173 of non-conductive material that is held in place by a screw 174. At the lower end of barrel 166 it passes through a non-conductive spacer 175.

As illustrated in Figure 13, stylus 172 is in actual contact with a sheet of metal 176 to which is attached, as by clamp 177, a wire 178 for placing a negative electrical potential on the sheet. If, as contemplated, a positive electrical potential is placed on stylus 172, as by wire 171, the sparking action already described in connection with the two previously described embodiments of the invention will tend to take place as stylus 172 is brought manually into juxtaposition to the sheet. Once the spark has jumped between them, the stylus carrier 165 may be retracted without making actual contact with sheet 176 although such contact is usually desirable and is not ordinarily to be avoided. When the spark strikes between the two, a portion of the material of stylus 172 is infused into sheet 176; this action is aided by actual contact.

The electrical circuit is similar to that shown in Figure 12 except that there is no microswitch in the system. Wires 179 and 180 are respectively connected to stationary and movable contacts 181 and 182, which replace the microswitches of Figures 1 to 5 and 6 to 11. Normally, contacts 181 and 182 are in engagement with each other, the former being rigidly affixed to the half-washer 173 and the latter being movable away from it by manual movement of an L-shaped actuating member 183 provided with an opening 184 accommodating stylus 172. A spring 185 in a spring housing 186 operates to keep the contacts in engagement with each other until such time as the projecting outer end of actuating member 183 is pressed inwardly to open the circuit at this point. This is done just before stylus 172 is brought into apposition to sheet 176.

Although three different ways of carrying out the invention have been disclosed above, it is susceptible of other embodiments. It may, if desired, be incorporated in a cold rolling mill, in a slitting machine, in a trimming

machine, in a straightening machine or in any similar machine by which work is being performed on metal under circumstances in which it is feasible to subject the metal to the action of a stylus connected to a source of electrical current as above described. The metal may be stationary at the time of marking, as in the punch press of Figures 1 to 5, or it may be in motion, as in the tube-forming machine of Figures 6 to 11. Preferably, the step of marking the metal is of course performed automatically, being coordinated with the movement of a suitable part of the machine, but even on moving metal it may be performed manually at intervals determined by a timing device or other suitable apparatus.

The manner of forming, supporting and operating the stylus carrier is of course susceptible of changes. Coupled to the stylus may be a progressive feeding device of a suitable sort, thus making it unnecessary for the operator to re-adjust the stylus in the stylus carrier. The stylus itself may be of any one of a wide variety of conductive materials, some metallic and some non-metallic. Notable among the non-metallic materials is carbon. Among the metallic materials are iron, brass, copper, zinc, tin, lead, platinum, nickel and numerous others. If, as is likely to be the usual case, the stylus is made of a metallic alloy, the ingredients of the alloy may be present in conventional or non-conventional proportions.

Other changes in the apparatus and in the way of carrying out the invention will suggest themselves. Included among such changes will be changes that may be made in the electrical circuit illustrated in Figure 12, in which other values, features and components may be employed, if desired. By way of example, the circuit may be so designed that the selected amperage may be between about 50 and about 1000 milliamperes, providing thereby a broad range of low amperages; similarly, the voltage in a given case may vary from a relatively low value, such as 20 or 30 volts, to a value well in excess of 500 volts. In general, changes of a broad nature may be made in the apparatus and method of the invention so long as the net effect is the deposition or infusion of the material of an expendable stylus into the body of the sheet, strip or other material that is being marked.

It is intended that the patent shall cover, by summarization in appended claims, all features of patentable novelty residing in the invention.

What is claimed is:

1. In a machine handling moving metal strip, supporting structure; a stylus carrier supported from the supporting structure; a stylus carried by the stylus carrier; means for moving the metal strip through the machine; means imposing a negative electrical potential on the metal strip and a positive electrical potential on the stylus; and means responsive to movement of the metal strip operating to bring the stylus carrier and metal strip into periodic juxtaposition to each other with a view to causing a spark to jump from the stylus to the metal strip, said means operating repeatedly during continuing movement of metal strip in the same direction.
2. A machine as in claim 1 in which the stylus carrier is actuated by traction means driven by the moving metal strip.
3. A machine as in claim 2 incorporating rotary means operating on the stylus carrier, said rotary means being located between the traction means and the stylus carrier.
4. A machine as in claim 3 in which the rotary means operating on the stylus carrier take the form of a cam.
5. In a metal-working machine of the nature of a press, supporting structure; means on the supporting structure for locating the work; a stylus carrier supported from the supporting structure; a movable stylus mounting in the stylus carrier; a moveable stylus releasably mounted in the stylus mounting; moveable means supported from the supporting structure for urging the stylus mounting toward the work; and, for causing a spark to jump from the stylus to the work, means imposing a negative electrical po-

tential on the work and a positive electrical potential on the stylus.

6. A machine as in claim 5 in which the carrier itself is normally stationary.

7. A machine as in claim 6 in which the moveable means take the form of a striker assembly carried by one of the moveable components of the machine.

8. In a metal-working machine, supporting structure; a work support; a stylus carrier supported from the supporting structure, said stylus carrier incorporating a movable plunger provided with an opening through which the stylus can project in the general direction of the work; a stylus moveably disposed in the opening in the plunger incorporated in the stylus carrier, the plunger and stylus being coupled together in such manner that neither is free to move without the other; means for imposing a positive electrical potential on the stylus and a negative electrical potential on the work; and, coordinated with the operation of the machine as a whole, resilient means urging the stylus and the work into juxtaposition to each other to the end of striking a spark between them.

9. In a metal-working machine, supporting structure; a work support; a stylus carrier supported from the supporting structure, said stylus carrier incorporating a movable plunger provided with an opening through which the stylus can project in the general direction of the work; a stylus movably disposed in the opening in the plunger, the plunger and stylus being coupled together in such manner that one is free to move without the other; means for imposing a positive electrical potential on the stylus and a negative electrical potential on the work; and, coordinated with the operation of the machine as a whole, resilient means urging the stylus and the work into juxtaposition to each other to the end of striking a spark between them.

10. A metal-working machine as in claim 9 in which the plunger is free to move axially relative to the stylus in one direction but not in the opposite direction.

11. A metal-working machine as in claim 10 in which the plunger incorporates a clutch acting on the stylus.

12. In a metal-working machine, a work support, a stylus, a moveable plunger surrounding the stylus in such fashion that the stylus extends centrally through the plunger, a movable shell surrounding the plunger, and, for imposing movement on the stylus through the intervention of the movable elements surrounding the stylus, means releasably interconnecting the stylus and the plunger.

13. In a metal-working machine, a work support, a stylus, a moveable plunger surrounding the stylus in such fashion that the stylus extends centrally through the plunger, a movable shell surrounding the plunger, and, for imposing movement on the stylus, means releasably interconnecting the stylus and the plunger.

14. A marking device as in claim 13 in which the plunger incorporates a clutch permitting relative movement of the plunger in one direction relative to the stylus but not in the opposite direction.

References Cited in the file of this patent

UNITED STATES PATENTS

2,066,588	Taylor	Jan. 5, 1937
2,079,310	Benett	May 4, 1937
2,125,172	Kinzel	July 26, 1938
2,273,819	Cooke et al.	Feb. 24, 1942
2,337,341	Miller et al.	Dec. 21, 1943
2,490,302	Holfelder	Dec. 6, 1949
2,513,838	Beall	July 4, 1950

FOREIGN PATENTS

759,864	France	Dec. 6, 1933
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OTHER REFERENCES

The Welding Engineer, July 1947 edition, pp. 64 and 66.