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METHOD OF AND APPARATUS FOR PUNCHING AND CRIMPING OR CORRUGATING SHEET METAL

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4 Sheets—Sheet 2

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METHOD OF AND APPARATUS FOR PUNCHING AND CRIMPING OR CORRUGATING SHEET METAL

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11 Claims. (Cl. 29—3)

This invention relates to a method of and apparatus for punching and crimping or corrugating sheet lead in the manufacture of grids or plates for secondary or storage batteries.

The primary object of the present invention is to provide a method of and apparatus for punching and corrugating or crimping sheet lead for mass production of positive and negative plates or grids of the Plante, semi-Plante and Paure types.

A further and particular object of the invention is the provision of apparatus that will produce punched and corrugated or crimped lead in such a manner that unevenness and distortion is avoided inasmuch as the punched-out holes will be clean cut without undesirable burrs at their edges and distortion between them, whilst the corrugation or crimping operation which is limited to certain areas of the material will not cause the other portions to be distorted or uneven.

Further, as described in greater detail hereafter.

Figure 1 is a plan view of the sheet of material being cut and punched with a set of punches provided.

Figure 2 is a side elevation of the punch and crimping press, and shows a portion of the punch and crimping material that has been completed throughout.

Figure 3 is a side elevation of a punching and crimping press.

Figure 4 is an end elevation looking towards the right of Figure 3.

Figure 5 is a side elevation of a part of the press on an enlarged scale.

Figure 6 is an end elevation of Figure 5 looking towards the right of that figure.

Figure 7 is a plan view of Figure 5 with the punch-carrying block cut away to show part of the lower die.

Figure 8 is a plan view of a part of a feed table, and

Figure 9 is a reverse plan view of a part shown in Figure 6.

In carrying out the invention a press frame a (Figures 3 and 4) is provided in which is mounted for vertical reciprocation a block b carrying a number of rows of vertical punches and a crimping or corrugating element which will be described in greater detail hereafter. The press frame a is mounted and secured to the top of a supporting frame c (Figures 2 and 3) which also supports a die support or table d in which is mounted a die e (Figure 7) having a number of rows of perforations complementary to the rows of punches aforementioned. Further, there is provided for vertical reciprocation in a slot f in the die e a crimping or corrugating element g (Figure 7) complementary to a crimping or corrugating element h (Figure 5) carried by the block b on which the punches are mounted.

The die support or table d carries on one side thereof bearings in which are mounted rotation one above the other a pair of horizontal rolls i, i (Figure 6) for feeding the sheet lead to be punched and corrugated or crimped, one step intermediate each punching and crimping movement of the punching and crimping elements. The bite of the pair of rolls i is substantially on the same level as the upper surface of the die e and the bearing frames j, k (Figure 6) of the upper roll are provided with set screws l having lock nuts m so that by adjusting the screws accommodation for operating upon different thicknesses of lead is provided for. The bearing blocks n, o are slidably mounted for this purpose in the bearing frames j, k.

The rolls i, i are geared together by toothed wheels p and q (Figure 6) and are given a partial rotation to feed the material step by step, each movement of the sheet lead taking place between successive downward movements of the punches and the upper crimping element, and after the punches and said element have become disengaged from the material. This movement of the rolls is effected by means of bevel gearing r, s (Figures 5 and 6) of which the gear r is carried at the end of the lower roll i, while the gear s is secured to a cross shaft t (Figures 5, 6 and 7) mounted for rotation in bearings u extending out-
wardly from the side of the table e. The shaft t also has secured to it a ratchet wheel v, and rotatably mounted on it is a two-armed pawl carrying lever w (Figures 5, 6 and 7). A pawl z is pivotally mounted on one arm of the lever w and is held with its operating end in engagement with the ratchet by a spring z which is connected at one end to the lever w and at its other end to an arm (Figure 6) carried by the lower shaft x. The lever w is oscillated by a connecting rod 1 (Figures 3 and 4) operated from the main shaft of the press as hereafter more particularly described.

A similar pair of rolls 3, 3 (Figures 4 and 7) which receive the sheet lead after it has been punched and corrugated are provided, mounted in bearings on the die support on the other side of the die, these rolls serving to ensure avoidance of buckling of the lead while undergoing the punching and crimping operations. These rolls are driven step by step in synchronism with the rolls 1, i by bevel gears 4, 4, and toothed gears 5, 5 (Figure 5).

The bearings of the upper roll are also provided with adjusting screws and lock nuts similar to those of the bearings i of the other pair of rolls. A table 6 is provided for supporting the length of sheet lead on its way to the feed rolls i, i. The table 6 is secured to one end of the die support and has its upper surface on a level with the upper surface of the die support and the die e. The table 6 is provided with upstanding side flanges 7, 7 for guiding the material in a straight line through the machine. A similar table 8 provided with side flanges 9 is provided secured to the other end of the die support for receiving the finished material on its way from the rolls 3, 3.

Describing now the die, punches and crimping or corrugating elements in detail, the block b carries four rows of punches 10, 11, 12 and 13 (Figures 5 and 7). Each of the punches in the rows of punches 10 and 11 is rectangular in cross section (Figure 7) whilst each punch of the rows 12 and 13 are circular in cross section. The block b also carries at each end a rectangular punch 14, 14 (Figures 5 and 7) for trimming the side edges of the material and crimping or corrugating element consisting of a bar 15 extending longitudinally of the block b which is provided with transverse corrugations on its under surface.

The die e is provided with four rows of apertures 16, 17, 18 and 19 and slots 20 and 21 complementary respectively to the punches 10, 11, 12, 13, 14, 14 and is also provided with a reciprocating crimping or corrugating bar 22 which is provided with transverse corrugations complementary to those of the bar 15. The bar 22 reciprocates in the slot f in the die e and lies below the upper crimping bar 15. The bar 22 is reciprocated in the slot so as to co-operate with the upper crimping bar 15 to crimp the material by means of a pair of two-armed levers 23, only one bar of which is shown (Figure 5), pivoted at 24 to the die support, the inner end of each lever carrying an abutment in the form of an adjustable screw 25 which bears on the under surface of the bar 15 and provided with a lock nut whereby the screw is held in adjusted position. The outer end of each lever 23 has pivoted to its one end a link 28, the other end of which is pivoted to an extension 27 of the block b. As will be understood downward movement of the block b carrying the punches and upper crimping bar 22 will, through the medium of the extensions 27, links 26 and pivoted levers 23, cause upward movement of the crimping bar 22. The latter is caused to follow the downward movement of the inner ends of the pivoted levers by means of springs 30, only one of which is shown (Figure 5).

There is also associated with the block b carrying the punches and the upper crimping element a pressure and stripping element, which is in the form of a block 29 (Figure 5) which is perforated and slotted for sliding movement on the punches and upper crimping element and carried by screws 35 which slide fittingly in holes 31 in the block b, the heads of the screws cooperating with recesses in the block 29 to limit downward movement of the pressure and stripping element. The pressure and stripping element is normally urged downwardly relatively to the punch carrying block by means of springs 32, 32 which surround the screws. The pressure block serves to hold the material firmly on the upper surface of the die and prevents it being drawn upwardly during upward movement of the punches and the upper crimping element, and also to hold the material firmly down on the die during downward movement of the punches and 100 upper crimping element.

Referring now to the operation of the apparatus, the main shaft 34 of the press has mounted on it an eccentric 35 (Figures 3 and 4) the eccentric rod of which has universal connection with a 105 slide block 36 to which is fixed the punch carrying block b. The connecting rod 1 is operated by a crank 37 which is also mounted on the shaft 34. Referring now to Figures 8 and 9, there is shown means whereby various widths of strip material 110 can be accurately fed through the feed rolls to the punches. This means comprises a pair of pivoted arms 38, 38. Each arm is pivotally mounted at 40 on a projection on one of the flanges 7 at the side of the table 6 and is provided 115 with a slot 41. A cross bar 42 extends between the pivoted arm and is provided at either end with an apertured lug which lies on the upper surface of one of the pivoted arms, and bolts are threaded through the slot 41 and apertures in the lugs, said 120 bolts having wing nuts so that the cross bar can be laterally adjusted and secured in various positions on the pivoted arms.

The cross bar has a depending flange 43 which has threaded through it a pair of bolts 44, onto 125 which is threaded a plate 45. The plate is normally pressed away from the flange 43 up against the nuts of the bolts by means of a curved spring 45a.

As will be understood when a strip of narrower 130 width than the distance between the flanges is to be crimped and punched, for example, the strip 148 (Figure 8), the cross bar 42 is adjusted so that the plate 45 resiliently presses on one edge of the strip and holds the other edge of the strip 135 against the flange 7. The bars 38 and cross bar 42 are held in position by a bolt 46 which extends through apertures in the arms 38 and in lugs extending outwardly from the side of the other flange 7.

Referring now to the arrangement of the rows of punches, the first row, that is the row 10 that is nearest to the feeding rolls, is adapted to produce in co-operation with the row of holes 16 a series of rectangular holes 46 (Figure 1) uniformly spaced apart with the space between adjacent holes greater than the length of each hole. The next row if punches 11 is similar to the first row but these are arranged to produce, in co-operation with the row of holes 17, a series of rectangular 150
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holes 47 in the material each of which is between two adjacent holes of the first series of rectangular holes 46. The third row of punches 12 is adapted to produce, in co-operation with the row of apertures 18, a row of circular holes 48 between successive rows of complete rectangular holes with adjacent circular holes, spaced apart a greater distance than their diameter. The fourth series of punches are adapted to produce, in co-operation with the row of apertures 19, a series of circular holes 49 each of which is between two adjacent holes of the row of circular holes 48. Finally the crimping elements corrugate or crimp the material between each row of rectangular holes, as shown at 50. The material is fed step by step by the feeding rolls and as will be understood all the punches and the crimping elements operate on the material simultaneously between each feeding movement of the material so that when the latter passes out through the receiving rolls on to the receiving table the finished material is punched and crimped or corrugated as shown (Figure 2).

It is to be noted that the crimping or corrugating of each parallel strip is the last operation of the series, on the material, and this is important as it avoids the buckling of the connecting straps or lugs 51. It is also to be noted that the integral straps or lugs 51 are not corrugated thus permitting the strip material to be readily folded about the lugs into the form of a grid.

It will be seen that whilst the rows of punches and crimping elements act simultaneously on the material, each completely punched and crimped portion of the material is produced in stages by consecutive operations of the rows of punches and crimping elements on the material.

It is to be understood that the invention is not restricted to the punching of holes of the shape described and shown; for example, the circular holes may be of diamond shape instead of circular.

1. Claim:

A method of punching and corrugating or crimping sheet lead in the manufacture of grids for accumulator plates or storage batteries comprising first punching a plurality of rows of holes in the lead sheet, and then corrugating or crimping the material between the rows of holes, the crimping stopping short of the material between adjacent holes.

2. A method of punching and corrugating or crimping sheet lead in the manufacture of grids for accumulator plates or storage batteries in order to produce a series of corrugated or crimped strips connected on either side to the next strip by integral straps or lugs, which includes the act of first punching successive rows of holes to provide the connecting straps or lugs and then transversely crimping the material between the said rows, the crimping stopping short of the material between adjacent holes.

3. A method of punching and corrugating or crimping sheet lead as claimed in claim 2, which includes the punching of a row of holes in the material which forms each strip prior to the crimping or corrugating of the strip.

4. A method of punching and corrugating sheet material as claimed in claim 2, which includes punching of each row of holes by two operations, the first operation being simultaneously punching a series of holes uniformly spaced apart a distance greater than the length of each hole, and the second operation being simultaneously punching a series of holes, each of which is between two adjacent holes produced by the first operation.

5. Apparatus comprising moving means carrying a plurality of rows of punches and a crimping element, a fixed die element having a plurality of rows of holes complementary to said rows of punches and a crimping element which co-operates with said first-mentioned crimping element to crimp the material between the rows of holes produced by said punches.

6. Apparatus as claimed in claim 5, wherein is provided at each side of the rows of punches a punch which also co-operates with the fixed die so as to cut away successive portions of a marginal side edge or both side edges of the sheet material.

7. Apparatus as claimed in claim 5, wherein means is provided for feeding the material step by step to the punching and crimping means.

8. Apparatus as claimed in claim 5, wherein means is provided for feeding the material step by step to the punching and crimping means, said means comprising two pairs of feed rollers which are rotated to feed the material one step between each two operations of the punches and crimping elements on the material.

9. Apparatus as claimed in claim 5, wherein are feed means comprising two pairs of feed rollers which are rotated to feed the material one step between each two operations of the punches and crimping elements on the material and a supporting table is provided over which the material is drawn on its way to the feeding rollers, said table having side flanges for engaging the side edges of the sheet material, so that it is guided on its way to the feed rollers and punching and crimping means.

10. Apparatus as claimed in claim 5, wherein is provided on said table adjustable means whereby means is provided for feeding the material step by step to the punching and crimping means and wherein said table has adjustable means that guide different widths of material by their side edges, different widths of material can be guided by their side edge on their way to the feeding rollers.

11. Apparatus as claimed in claim 5, wherein is a supporting table over which material is movable, said table having side flanges to engage the side edges of the sheet material to guide the same and a spring pressed element to engage one edge of the material and mounted for adjustment between the side flanges of the table.

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