Jan. 12, 1954 E. A. WILCKENS 2,665,473

METHOD OF HANDLING SHEETS AND FORMING DECORATED CAPS

Original Filed May 4, 1945

4 Sheets-Sheet 1

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Original Filed May 4, 1945

4 Sheets-Sheet 2

Fig. 3.

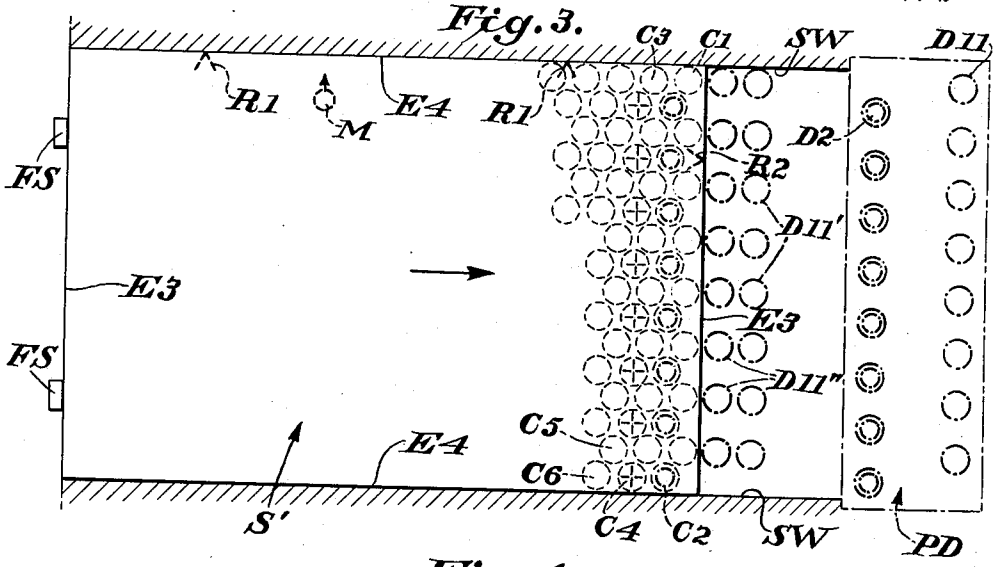
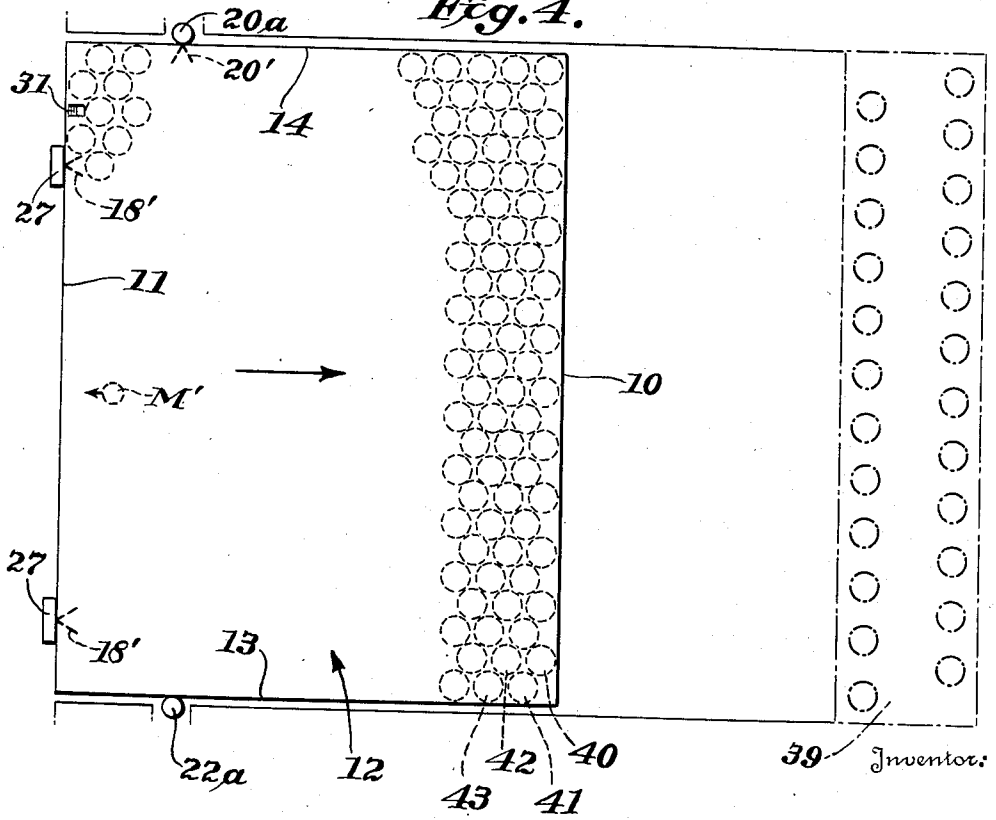


Fig. 4.



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Fig. 6.

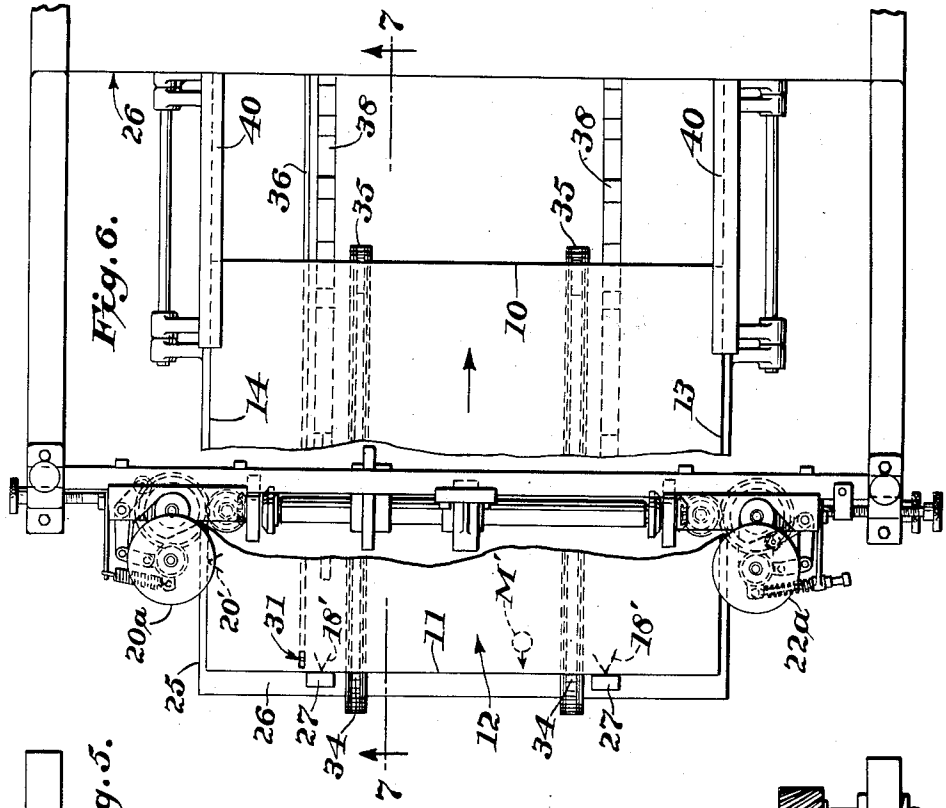
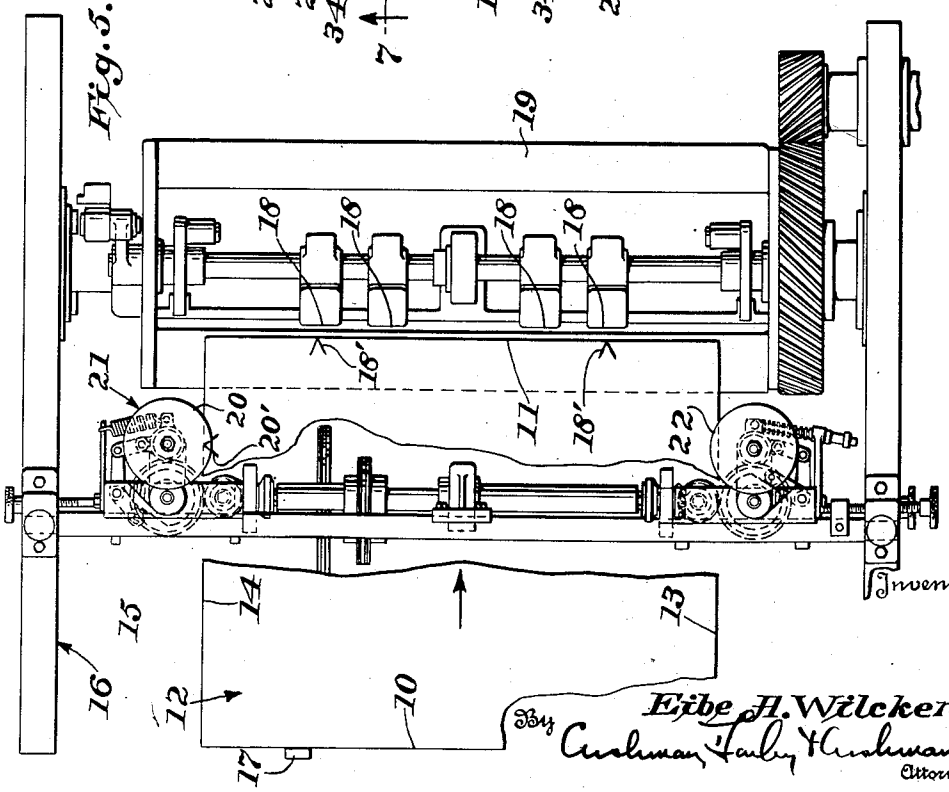


Fig. 5.



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Fig. 9.

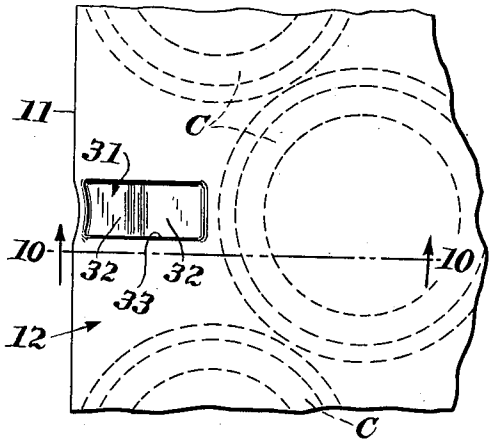


Fig. 11.

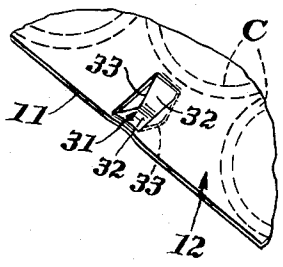


Fig. 10.

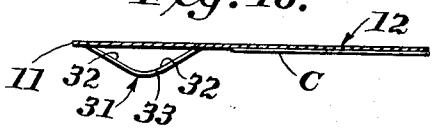
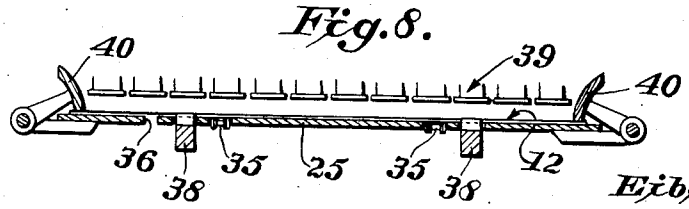


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD OF HANDLING SHEETS AND FORMING DECORATED CAPS

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Original application May 4, 1945, Serial No. 591,975, now Patent No. 2,514,819, dated July 11, 1950. Divided and this application May 15, 1950, Serial No. 162,085

4 Claims. (Cl. 29—148.2)

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The present invention relates to apparatus and methods for handling sheets and, more particularly, for handling sheets during the performance of registered operations thereon. The application is a division of my application for Apparatus for Handling Sheets, Serial No. 591,975, filed May 4, 1945, Patent No. 2,514,819, issued July 11 1950.

Bottle caps of the crown type ordinarily have a beverage identifying design or label lithographed thereon. Such caps are produced by lithographing a metal sheet with several hundred of the cap designs arranged in rows and then passing the sheet through a cap forming press which punches out the designs and forms them into skirted caps. Naturally, it is necessary that the designs be centered upon the caps and this requires registration on the cap forming press identical with that which was had on the lithographing press.

Under prior practice, registration of the lithographed designs with the dies of the cap forming press depended primarily upon having each sheet an exact rectangle of true dimensions. In order to meet these requirements, it was necessary to trim all four edges of the sheet, which resulted in a waste of metal. Furthermore, if the trimming to square the sheet failed in any respect, at least a number of the caps would be imperfect.

A further difficulty arose from the fact that after a sheet was initially registered in the cap forming press, it could shift its position while it was advanced beneath the dies.

An object of the present invention is to provide a system for handling sheets during operations performed by two apparatus and whereby the sheets will be held to the same registration on both apparatus.

Another object of the invention is to provide a system for so handling sheets which are not true rectangles, not straight-edged, and not of exact dimension in one direction, that such sheets will be properly registered during two operations thereon.

It is well-known that roll shears, i. e., shears which trim the edges of a moving strip, are highly accurate in forming properly spaced parallel side edges on a strip of metal. By prior cap forming processes the two parallel edges formed on a sheet by such shears were later trimmed off during an operation intended to make the sheet an exact rectangle. As a result of this practice, the two parallel edges provided by the roll shears, and also a strip of metal extending entirely around the sheet, were wasted. Furthermore, the square-trimming performed after roll shearing necessitated a separate operation upon the sheet.

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Another object of the present invention is to provide a system whereby use is made of the two parallel edges formed by the usual roll shear and the spacing of these edges is relied upon during handling of the sheet.

A further object of the invention is to provide a system of handling a sheet during the formation of articles therefrom and whereby a minimum area of material will be wasted.

Another object of the invention is to provide sheets with guide means which will hold them against shifting during performance of an operation on the sheet.

A further object of the invention is to increase the rate of production of cap forming presses.

The invention is described herein as applied to the formation of bottle caps from metal sheets. However, it will be perceived from the following description that the invention is applicable to the production of numerous types of articles from sheets of various materials, and particularly when it is necessary to register or align the sheet with one or more means to perform an operation thereon.

Other objects and advantages of the invention will be apparent from the following specification and accompanying drawings, wherein:

Figure 1 is a view diagrammatically illustrating the principal stages followed in the prior system of handling metal sheets during the production of bottle caps.

Figure 2 is a view diagrammatically illustrating the principal stages followed in the system of the present invention for handling metal sheets during the manufacture of articles therefrom.

Figure 3 diagrammatically shows the relation of a prior lithographed sheet of cap blanks to the cap punching dies.

Figure 4 diagrammatically shows the relation of a lithographed sheet to the cap dies by the procedure of the present invention.

Figure 5 is a plan view of the feed table of a lithograph press, the view illustrating the lowermost or impression cylinder and the sheet gripping device associated with that cylinder, the upper cylinders being omitted.

Figure 6 is a plan view of the feed table of a cap forming press constructed in accordance with the present invention, the dies being omitted.

Figure 7 is a vertical section view of the cap forming press of Figure 6, the section being taken on the line 7—7 of Figure 6. Figure 7 is on a smaller scale than Figure 6.

Figure 8 is a transverse sectional view on the line 8—8 of Figure 7.

Figure 9 is a fragmentary plan view showing a portion of a sheet provided with the guiding element of the present invention.

Figure 10 is a sectional view on line 10—10 of Figure 9, and

Figure 11 is a fragmentary perspective view of a sheet provided with a guiding element of the present invention.

Referring to Figure 1, this figure diagrammatically illustrates the principal stages of the procedure heretofore used in forming the metal sheets, lithographing them and forming bottle caps therefrom. In stage A of Figure 1, the reference character S*t* designates a strip of metal which is moving to the right from a large roll, not shown. In some instances, this strip may have already received a background color or finish. The strip S*t* includes sides edges E' which are te original edges of the strip and are uneven. By the operation of stage A, the strip was trimmed by roll shears, not shown, to provide the parallel and properly spaced edges E''.

In stage B of Figure 1, flying shears, not shown, cut the strip S*t* cross-wise at longitudinally spaced points to form sheets S including the long edges E2 formed by the fly shears. Because of the inaccuracies arising in the cutting of a rapidly moving strip by fly shears, the edges E2 were not always parallel, properly spaced, or at right angles to the parallel edges E''. For that reason, the four-side square trimming indicated in stage C was performed to remove the material shown outside of the solid lines in stage C. This was intended to make the sheet a rectangle and provide it with short edges E3 and long edges E4. About $\frac{3}{16}$'' of material had to be removed from each edge of a sheet S of the dimensions shown in stage B, resulting in a total loss and waste of about eighteen square inches of material, or over three per cent of the total sheet S of stage B. In addition, it wasted the perfectly parallel side edges E'' provided by the roll shears in stage A. The "squared" sheet is designated S' in stage C.

Stage D of Figure 1 indicates how the rectangular sheet S' was registered in a lithograph press by the prior practice. As is diagrammatically indicated in stage D, the sheet S' was initially placed upon and moved across the feed table of the press in the direction of the central arrow by conveyor chains, not shown. Its trailing edge E^4 was then engaged by spring-loaded pushing elements P acting on the trailing edge at the points indicated by the arrows. However, immediately after the pushers P engaged the sheet, side gauging elements RG and SG moved in toward its side edges E^3. Gauge RG assumed a rigid position, but the gauge SG was spring-loaded when adjacent the sheet and urged the sheet against RG while the sheet was moved to the right in stage D by the pushers P and toward the gripper stops GS carried on the impression roll of the press. The purpose of this combined action by the pushers P and spring-loaded side gauge SG was to place the leading edge E^4 firmly against all of the gripper stops GS and also properly positioned the sheet axially of the press roll, viz., against rigid side gauge RG. The grippers associated with the gripper stops GS then closed to grip the sheet and pull it through the press rolls to be lithographed on its top face. The side gauges RG and SG moved out of contact with the sheets immediately after the sheet was gripped.

It will be observed that by the above action, the leading edge of the sheet, i. e., one of the long edges E^4 formed during the square-trimming of stage C was registered at the two points R^1 designated by V-marks. The other point of registration, i. e., by the rigid side gauge RG, is indicated by the V-mark R^2 on one short edge E^3. After the grippers engaged the sheet and it was also engaged by the impression roll and blanket roll of the press, it could not shift. Therefore, the rows of cap designs placed on the sheet S' by the lithograph press were in registration with the points R^1 and R^2.

After the sheet was lithographed, it was moved from the lithograph press through a long drying or baking oven including a conveyor on which the sheets stood on one long edge E^4 and were kept separated from each other. The sheets moved with the conveyor in the drying oven for a period of about ten minutes and were then individually removed by an attendant who stacked the sheets face upward. The attendant took each sheet from the drying oven in such a manner that they were all oriented in the same manner on the stack. Each sheet would have a mark such as M lithographed thereon (but at a point clear of the cap designs) to indicate which edges of the sheet were registered at the points R^1 and R^2. If the design to be applied required an additional lithographing step the mark M indicated the direction in which the sheets should be moved during that operation.

When all lithographing and drying or baking was completed, the sheets were then stacked with their lithographed faces downward and the stack of sheets was moved to a cap forming press.

Stage E of Figure 1 illustrates the prior handling of a sheet S' in the cap forming press, and in which press it was moved in the direction of the central arrow, i. e., to the right in Figure 1. It will be noted that one of its shorter edges E^3 thereby became the leading edge of the sheet.

In the cap forming press operation, the stack of lithographed sheets had the top sheet removed therefrom and positioned in the lower portion of an upwardly inclined feed table such as generally indicated in Figure 6, and with the lithographed side of the sheet S' turned down. As a result, one of the shorter edges E^3, comprising the trailing edge, rested against fixed stops designed FS in stage E. Although stage E illustrates in dotted lines the registry points R^1 and R^2 established on the sheet in the lithographing press, it will be clear from the following that these points had no significance whatever during registration in the punch press and that the sheet could be swung laterally 180° from the position illustrated.

The cap forming press feed table included two upstanding side walls designated SW which were spaced apart by a distance corresponding to the dimension which sheet S' was supposed to have between edges E^4, plus clearance. The walls SW terminated immediately beyond the lines of punch dies indicated by the dot-dash lines PD in stage E of Figure 1. As a result of the above structure, when a sheet S' was placed on the cap forming press feed table, its long edges E^4 contacted with the side walls SW and its trailing short edge E^3 contacted with the fixed stops FS. A conveyor chain then moved the sheet upwardly, or to the

right in stage E, until its lower edge was engaged by feed dogs which moved it step by step beneath the punch dies at PD. The registration was by the side walls SW and the feed dogs. Obviously, if the trimming of stage C which established the spacing between edges E^4 was inaccurate, a sheet S' could be so narrow that it would move laterally. The registration of the cap forming dies with the cap designs would thereby be inaccurate. Alternatively, if the sheet was slightly oversized, it would buckle or even become jammed between the side walls SW. A still further difficulty could arise if the side edges E^4 were not parallel, and particularly if the trailing portion of the sheet was thereby of less dimension between these side edges than was the case with the leading portion. In such a case, if the leading portion fitted exactly between the side walls SW so that the designs on that portion of the sheet were properly registered with the cap forming dies, nevertheless, after the leading portion moved past the upper ends of the walls SW, the trailing portion could shift so that poor registration occurred.

Summarizing the above-stated disadvantages of the prior system illustrated in Figure 1, it will be observed that by that system, registration in the cap forming press of stage E primarily relied upon having the sheets of exact dimensions and true rectangularity. This was a different type of registration from that used during the lithographing (stage D) wherein registration actually was solely dependent on having only two edges substantially at a right angle to each other, with no reliance upon the exact dimensions of those edges or the other edges. Also, in order to obtain proper registration during the cap forming operation, it was necessary that the trimming be accurate as to dimension and that all edges be square, which wasted metal and required the special operation of stage C. Finally, it was possible for the sheet to shift during the cap forming operation.

Still another disadvantage of the prior system is evident from Figure 3. Figure 3 is primarily an enlargement of stage E of Figure 1 but, in addition, shows the layout of the cap designs applied to the sheet S' during stage D of Figure 1 and also the layout arrangement of the cap forming dies PD. Because these designs are on the lower face, they are shown in dotted lines.

Referring to Figure 3, it will be observed that sheet S' has applied thereto a row C^1 of cap designs immediately adjacent the leading narrow edge E^3. The next row C^2 has its designs staggered with respect to those of row C^1 and the designs of the two rows are also "nested," in that opposed portions of the cap design perimeters are extremely close to each other. For example, on a sheet of caps used on the usual soft-drink or beer bottle, which caps have their tops of a diameter of 26 millimeters, or approximately one inch, the design, on the sheet S' (including the portion to be formed into a skirt) was one-and-a-half inches in diameter. However, adjacent designs were only about one-half a millimeter apart. The designs in row C^1 were positioned equally as close to the edge E^3 of the sheet and the design in row C^1 adjacent edge E^4 was less than .1'' from that edge. A third row C^3 had its designs directly behind those of row C^1 and nested with respect to those of row C^2. A fourth row C^4 had its designs in alignment with those of row C^2. Rows C^5 and C^6, with designs respectively behind those of rows C^1 and C^2, are also illustrated.

Obviously, the rows of designs were too close together to enable closely adjacent rows to be stamped on the same stroke of the punches. For example, punch and die elements could not be positioned as closely together as the designs. This is clear from the right-hand portion of Figure 3, wherein row D^{11} of the punches PD is shown spaced from row D^2 a distance corresponding to the spacing between rows C^1 and C^6 of the designs on sheet S'. However, both rows of punches reciprocated together on any stroke of the press.

The sheet S' was moved up the feed table by a conveyor chain until its trailing edge was engaged by a feed dog mechanism which so positioned the sheet that the design row C^2 was beneath the row D^2 of cap forming punches. The punches were then reciprocated so that punch row D^2 stamped caps from design row C^2. This action is indicated by the dot-and-dash line circles within the designs of row C^2. Simultaneously, the punches of row D^{11} descended in the paths indicated by the dot-and-dash circles $D^{11'}$. Then the sheet advanced to bring design row C^4 beneath punch row D^2. The designs of this row, containing cross-marks in the drawing, were then punched out, while the row D^{11} of punches descended in the paths indicated by the dot-and-dash circles $D^{11''}$. It will be observed from the circles $D^{11''}$ that on this stroke the punches D^{11} descended extremely close to the leading edge E^3 of sheet S'. Obviously, if the length of sheet S' between its edges E^3 was very slightly oversize, the punches D^{11} would cut a sliver from the leading edge E^3. Such a sliver would remain in the die and cause the next cap formed by the die to be ruined. Furthermore, it meant that all of the designs on the sheet would be slightly out of registration.

If the sheet was too short, the caps formed from leading row C^1 would have a portion missing from the leading sides of their skirts and all of the designs would also be out of registration.

The feed dogs then moved the sheet forward for a distance corresponding to the distance between the centers of rows C^1 and C^3 and the third stroke of the punches punched out the designs in rows C^1 and C^6. Succeeding movements of the sheet were of a distance corresponding to the space between the centers of rows C^1 and C^3 so that the third and eight, and then the fifth and tenth rows were punched. With thirty-six rows to a sheet, the thirty-sixth row had its designs in alignment with those of row D^2. On the next to the last, or nineteenth stroke, punch row D^{11} would punch the thirty-third design row while punch row D^2 came down beyond the sheet, leaving only the thirty-fifth row to be punched. For the final punch stroke, the feed dogs moved the sheet forward a distance corresponding to the distance between rows C^1 and C^3, and punch row D^{11} punched the thirty-fifth design row.

Summarizing the above, if the sheet S' was either too long or too short, difficulties resulted which were of even more practical importance than the lack of registration discussed above. Therefore, the "square-trimming" of stage C (Figure 1) which established the distance between the edges E^3 was regarded as extremely critical.

Figure 2 diagrammatically illustrates the steps followed by the procedure of the present invention. Figures 4 to 11 illustrate these steps in more detail and also illustrate the apparatus. Referring to the first step of the invention procedure, shown at the left of Figure 2 and desig-

nated stage A^1, a strip *St'* moving from a roll, not shown, of the metal, is trimmed by roll shears to parallel and accurately spaced edges **10** and **11**. The strip is then cut cross-wise by fly shears as indicated in stage B^1 to form the sheet designated by the numeral **12**. Sheet **12** includes the long edges **10** and **11** formed by the roll shear and the short edges formed by the fly shear and designated **13** and **14**, respectively. It will be observed that the edges **10** and **11** are the edges formed by the roll shear in stage A^1. In some instances, the strip *St'* may have a background color applied thereto.

The sheets **12** are stacked and then, without any further trimming or squaring such as followed at stage C in the Figure 1 prior practice, are successively delivered to the feed table **15** of a lithograph press generally indicated by the numeral 16 in Figure 5. Stage D^1 of Figure 2 also indicates this positioning of the sheet. Although stage D^1 and Figure 5 show the sheet **12** oriented to have its long edge **10** trailing, the other long edge **11** could be the trailing edge during this stage.

It will be noted that the sheet **12** illustrated as used in the present invention is larger than that used with the prior system. The reasons for this are hereinafter explained.

Referring to Figure 5 and also to stage D^1 of Figure 2, the sheet **12** is moved to the right as shown by the central arrows in both figures by dog chains, not shown, and until its trailing edge **10** is engaged by spring loaded pushers **17** diagrammatically illustrated in both figures.

While sheet **12** is being moved to the right in Figure 5 and stage D^1, a side gauging device such as the driven roller **20** included in a gauging mechanism **21** is moved toward the edge **14** of sheet **12** and then becomes rigid in the position illustrated. At the same time, a gauge such as roller **22** moves in against the opposite side edge **13** of the sheet. Roller **22** is spring-loaded and thereby urges the sheet against the now rigid roll gauge **20**.

Immediately before the gauges **20** and **22** have moved inwardly as described above, the spring-loaded pushers **17** will engage the trailing edge **10** of the sheet to move its leading edge **11** into contact with the gripper stops **18** mounted on impression roll **19** and associated with the usual sheet grippers.

The result of the above action will be that the leading edge **11** will be moved into contact with all the gripper stops and its side edge **14** will be positioned at a predetermined point axially of the press couple. In other words, the sheet will be registered at the points **18'** and **20'** indicated by the V-marks on stage D^1 of Figure 2. The side gauges **20** and **22** will move away from and out of contact with the sheet immediately after the sheet is gripped by the gripper stops **18**. These gauges can be in contact with the sheet for some distance along its edges but the final gauging takes place at the instant the grippers close. Therefore, the side gauging takes place at a very definite point on the edge of the sheet. If the sheet is out of square, it may have a slight sidewise movement as it advances and until the grippers close. The instant the grippers close, the side gauges retreat.

The side gauges described above are similar to those disclosed in the application of Eibe A. Wilckens and Ellis M. Magill for "Sheet Feeding and Gauging Mechanisms," Serial No. 471,168, filed January 2, 1943, Patent No. 2,396,481, issued March 12, 1946. However, any suitable side-gauging mechanism having the action described above may be used.

After the sheet **12** is gripped by the grippers associated with the gripper stops, it will be drawn through the press couple and lithographed on the face shown uppermost in stage D^1 and Figure 5. A register mark such as M' will be applied to the top and lithographed face of each sheet by the transfer roll to indicate which edges were registered in the lithograph press. This mark will, of course, be at a point clear of the designs and is shown greatly enlarged.

It will be observed that the register and gauging mechanisms described above in connection with Figure 5 and stage D^1 of Figure 2 are substantially identical with those used and followed in the prior system described in connection with stage D of Figure 1.

After the sheets have been lithographed, they move through a drying or baking oven while standing on one edge and in the same manner as has been described above in connection with the prior practice of Figure 1. When drying or baking has been completed, the sheets are piled in a stack, all oriented in the same direction and with their lithographed faces turned up, in accordance with the usual practice. If further lithographing is required, it is carried out as has been described in connection with Figure 5 and stage D^1 of Figure 2 and the drying and subsequent stacking repeated. After final lithographing, the sheets are stacked with the lithographed side down.

Stage E^1 of Figure 2 and also Figure 4 illustrates the manner in which the sheets are handled in the cap forming press by the apparatus of the present invention. Figures 6 to 8 illustrate the construction of the cap forming press. Referring to the views mentioned, the stack of lithographed sheets is placed on the sheet feeder, not shown, of the punch press wtih their lithographed faces down and the registered edges **11** (marked M') to the left as viewed in stage E^1 and Figures 4 and 6. The top sheet is then delivered to the inclined feed table **25** of the punch press. Because of the manner in which the stack is oriented, this will cause the registered edge **11** to be lowermost or to the left as viewed in all these figures. In other words, the new orientation of the sheet shown in stage E^1 of Figure 2 may be compared with that in stage D^1 by stating that to reach the stage E^1 position, the sheet of stage D^1 will be turned over, with its edge **11** serving as the pivot, and so that its lithographed face will be lowermost in stage E^1. This change of position is apparent from a comparison of the position of the mark M' in stage D^1 with the mark M' of stage E^1.

The lower edge **26** of the feed table **25** is provided with rigid stops **27** with which the register points **18'** will contact. In addition, feed table **25** is equipped with side gauging mechanisms including rollers **20***a* and **22***a*. The roller **20***a* is identical in action with the roller **20** of the lithograph press **16** and the roller **22***a* is identical with the roller **22** of the lithograph press. After the sheet is dropped on the inclined table **25**, its registered edge **11** will, by gravity, slide into firm contact with the rigid stops **27**. Then the roller **20***a* will move inwardly and laterally to a rigid position and roller **22***a* will move in under spring loading to contact with the opposite edge, thereby urging edge **14** of the sheet against the momentarily rigid roll **20***a*. It

will be noted that roll 20a will contact with the edge 14 at the register point 20' established in the lithograph press. Because the other registered edge 11 is registered against the stops 27, the sheet is now registered at the same points at which it was registered in the lithograph press.

A die 30 including upper and lower cooperating die elements generally illustrated in Figure 7 is mounted at the lower edge of the feed table 25. As soon as the spring-loaded side gauge 22a has urged the sheet 12 to the position illustrated in Figure 6, for example, this punch mechanism will be actuated in timed relation to the operation of the side gauges so as to provide a guiding means such as element 31 (Figures 9 to 11) in the sheet 12, preferably adjacent its registered edge 11. The guide tab or element 31 is in the form of a strap bent downwardly from the sheet and preferably of V-shaped form as viewed from one side to include legs 32 having opposite side edges 33. The side edges 33 lie in planes which are normal to a line passing through the register points 18'. In addition, the planes in which the edges 33 lie are at predetermined and fixed distances, respectively, from the registry points 20' on the edge 14.

Immediately after the punch 30 has formed the guide element 31, its punch elements move clear of the sheet. This entire punching action will occur immediately before the side gauges retract or immediately after they have retracted. In any event, a flight 34 on each of the two usual conveyor chains 35 of the cap forming press will now move into contact with the lower edge 11 of the sheet as shown in Figure 6 to move the sheet up the feed table 25. The feed table 25 is provided with a groove 36 in which the guide element 31 will move. The side walls of groove 36 are properly spaced to prevent the guide element 31 from moving or twisting laterally therein. In accordance with the usual practice, after chain 35 has moved the sheet upwardly a predetermined distance, the lower edge of the sheet will be engaged by feed dogs such as indicated at 38 and these dogs will move the sheet step by step beneath the punches 39 and over the cooperating dies in the same manner as followed in prior practice and described above in connection with Figure 3. Hold-down members 40 may move downwardly upon the side edges of the sheet as illustrated in Figures 6 and 7 and in the usual manner to prevent the sheet from buckling along a line cross-wise of the feed table as it is pushed upwardly. However, these members will not exert sufficient pressure to cause the sheet to be deviated from the straight line path imparted to it by the engagement of the side edges 33 of guide element 31 with the side walls of the groove 36. The side edges 13 and 14 need not be engaged by any guide means after guide element 31 has been formed.

The guide element 31 which is illustrated is readily formed by a die which makes two straight and parallel cuts and then presses the intermediate portion to a V-shape. It can be formed in between two cap designs of the row of designs nearest the registered edge 11 as shown in Figure 4. As shown in Figure 4, the lay-out of the cap designs on a sheet is such that the row of designs nearest an edge 11 or 10 is spaced a sufficient distance apart to provide adequate space between two adjacent designs for a tab of adequate width. Furthermore, the designs of the next row parallel to edge 11, although partially nested between those of the outer row as described in connection with Figure 3, are far enough from the edge 10 or 11 of the sheet to permit the guide element 31 to be of adequate length. The guiding element 31 included in the present invention is highly efficient because, with a minimum area, it provides optimum straight edge surfaces and sufficient depth to prevent the element 31 from rising entirely out of engagement with groove 36. In practice, a sheet approximately $25\frac{3}{16}$'' by $32\frac{1}{16}$'' requires a guide element having a width of approximately ¼'' and a length less than one inch, with its greatest depth approximately ¼''.

Placing the guiding means 31 adjacent registered edge 11 further prevents any deviation from the registration established in the lithograph press.

It will be perceived from the above that by the present invention, sheets will be registered in the cap forming press at the same points at which they were registered in the lithographing press. Therefore, it is not necessary that the sheet include perfectly straight and parallel side edges 13 and 14, or even that the two registered edges 11 and 14 be exactly at right angles to each other. Slight deviations in both these factors may be present so long as the sheet contains an area having the minimum dimensions necessary to produce the set number of caps for its size, i. e., in the present instance, an area measuring $25\frac{3}{16}$'' by $32\frac{1}{16}$''. In short, the only exact characteristics required by the present apparatus and process are that the edges 10 and 11 which are the leading and trailing edges in the cap forming press, be parallel and exactly the proper distance apart. As has been stated above, roll shearing such as performed in stage A^1 is entirely efficient to provide such characteristics. It will be noted that one aspect of the invention is the use of the roll-shear-formed edges as the leading and trailing edges in the lithographing and cap forming stages, thereby making it feasible to leave the fly-shear formed edges on the sheet to serve as side edges. As has been stated above, the use of the same registration system in both the lithographing and cap forming presses requires less perfection in these edges.

Figure 4 diagrammatically shows the lay-out of designs on the sheet 12 and the layout of the dies 39. The steps by which the sheet is moved beneath the punches and over the dies are the same as have been explained in connection with the prior practice system of Figure 3. In addition, the rows of cap designs are arranged in the same spacing as on the prior sheet S' of Figure 3, except that the rows of designs 40, 41, 42, 43, etc., extend parallel to the wide edges 10 and 11 of the sheet 12. Obviously, the invention could be used upon sheets having shorter edges 10 and 11 but, for increased production and operating efficiency, it is desirable to use as large sheets and as many dies as possible. With the present invention, use of larger sheets than have heretofore been used becomes possible, because (1) the roll-shear will uniformly produce parallel edges 10 and 11, (2) the system of registration enables such sheets to be accurately registered in both presses, and (3) the guiding element prevents the sheet from twisting or deviating from a straight path during cap punching.

Also, the fact that the procedure of the present invention enables a sheet to be moved through the cap forming press in the same manner in which it is moved through the lithograph press, i. e., with a wide edge cross-wise, makes registration more accurate. As shown in Figure 4,

the cap forming press used with the sheet 12 may have two rows of dies, with twelve dies in each row, thereby forming twenty-four caps on each stroke of the press. The cap forming presses used with the prior sheet S' included two rows of only eight dies each.

Although the invention has been described as applied to cap forming, it will be apparent that it is applicable to numerous types of apparatus wherein operations requiring registration are performed upon sheets of various materials.

It will also be noted that numerous phases of the invention are applicable in operations wherein no designs are applied to articles.

The apparatus of Figures 6 and 7 is claimed in said parent application Serial No. 591,975.

The terminology used in the specification is for the purpose of description and not of limitation, the scope of the invention being indicated in the claims.

I claim:

1. The method of forming articles from a sheet, comprising providing two parallel edges on the sheet by roll-shearing, providing two additional edges substantially normal to said parellel edges, without additional trimming of the sheet registering one of said parallel edges and a point on one of said additional edges with respect to the feed mechanism of a design producing apparatus, feeding the sheet perpendicularly to the registered edge while performing the design producing operation of said apparatus, turning the sheet over and in that position again registering the same edge and point with respect to the feed mechanism of apparatus for performing another design producing operation requiring predetermined orientation with the design produced by the first operation, feeding the sheet perpendicularly to the registered edge and performing the second operation in said required orientation.

2. A method of the character described in claim 1 wherein the last-mentioned design-producing operation is a punching operation.

3. A method of the character described in claim 1 including the step of providing a guiding element on the sheet during registration of the sheet with the last-mentioned feeding mechanism.

4. A method of the character described in claim 1 wherein said registered edge is the leading edge during the feeding movement of one of said operations and is the trailing edge during the feeding movement of the other of said operations.

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