COMBINATION SHEET FORMING APPARATUS AND SLITTER

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This invention relates to an apparatus which combines slitting operations with sheet forming. In particular, the invention is concerned with sheet forming means which handle strips of metal sheet and which form such strips by bending and folding of the strips to produce shapes of a wide variety of cross sections.

A variety of sheet forming constructions have been available, and these constructions are capable of forming lengths of metal strip into various shapes. For example, machines are available which include forming means whereby the sheet will be bent at one or more places to form crests which are used as molding for table tops. Such crests are formed into 8 configurations and many other relatively complicated cross sections.

In the operation of conventional units, it is the usual practice to provide forming rolls which engage the sheet and progressively bend the sheet until the desired configuration is achieved. The forming rolls usually comprise upper and lower sets of rolls with the initial rolls instigating bending in a particular manner and some of the subsequent rolls completing a particular bend while additional rolls may be utilized for instigating additional bends where a plurality of such operations are to be accomplished.

It is necessary in order to provide uniform production to shear or slit metal sheets introduced into the forming machines to exact widths. This presents problems, however, since an inventory of desired widths must be provided in order to allow for the production of various formed shapes. If a particular operation requires the production of a variety of different shapes, then an inventory of a corresponding number of sheets of different widths must be provided in order to be available as needed by the forming machines, which are commonly used for producing the sheets will usually be mass production systems, and if errors are made in determining proper widths, then a complete stock of sheets of all widths could be wasted.

When consideration is given in mind, it is desirable to provide a system for slitting sheets in conjunction with the operation of the forming machine. Thus, a slitter provided in line with a forming machine can be set to produce in a continuous manner sheets of a desired width which the sheets can then be continuously fed into the forming machine. Where problems arise due to improper calculations, then adjustments can be made whereby only a few of the sheets need be wasted.

The system combining a slitting and forming operation has the additional advantage of eliminating the need for maintaining a large variety of different sizes in an inventory. Thus, a slitter can be set for a desired width irrespective of the amount of material which is to be cut off and, when a change in design is desired, the slitter operation can be changed in a suitable manner.

The problem with the system which combines a slitter and forming rolls to locate the slitter whereby the material feed from the slitter can be directly picked up by the forming rolls without any intermediate handling. The positioning of the operations in closely spaced-apart relationship also permits the continuous formation of relatively short lengths of sheet into the desired shape.

Specific problems have arisen when attempts have been made to locate a slitter and forming rolls in close proximity. Such problems are due primarily to the relationship of the speed of the sheet in the slitter and the forming rolls. Forming rolls usually are driven by a single drive motor and the angular velocities of the respective rolls are preferably the same. This is desired by the art since forming machines are preferably adapted for changing the forming rolls to provide a variety of configurations, and uniform drive systems avoid additional labor and maintenance expense.

Even though the angular velocities of the forming rolls are the same, the peripheral velocities of the rolls usually change as the successive rolls perform different operations. It is, therefore, virtually impossible to provide a drive arrangement which will provide for a suitable relationship between the speed of the sheet in the slitter rolls and the speed of the sheet in the forming rolls. In this connection, it will be appreciated that if the slitter rolls are running slowly relative to the speed of the forming rolls, then pulling and tearing of the sheet, resulting in improper edges and possible misalignment, will result. On the other hand, if the slitter rolls are running at a higher speed, then buckling of the sheet will occur, and this is often intolerable particularly where long lengths are to be formed.

It is a general object of this invention to provide an improved combination wherein slitter rolls can be efficiently and economically associated with sheet forming rolls.

It is a more specific object of this invention to provide an apparatus which combines slitter rolls with forming rolls and which permits completely efficient operation of both slitting and forming functions through a wide range of relative speeds of the slitting and forming rolls.

The above and other objects of this invention will appear hereinafter and for purposes of illustration, but not of limitation, specific embodiments of this invention are shown in the accompanying drawings in which:

FIGURE 1 is a plan view of a combination slitter and forming apparatus;

FIGURE 2 is an enlarged top view of the slitter section of the construction;

FIGURE 3 is a side elevational view of the slitter section; and,

FIGURE 4 is a vertical cross-sectional view of the slitter section taken through the axes of the slitter rolls.

The apparatus of this invention is directed to the combination which includes forming rolls which are aligned for successive engagement with a sheet passing through the apparatus. Drive means are provided for the forming rolls whereby a sheet passing into the apparatus is adapted to be engaged by the forming rolls with the forming rolls serving to move the sheet through the apparatus while at the same time forming the sheet into a desired configuration.

The apparatus also includes a slitter which is mounted directly adjacent the entry end of the forming rolls. The slitter includes slitter rolls which define cutting edges, and guide means are provided in association with the slitter whereby a strip of a desired width can be formed by the slitter and then directed to the forming rolls.

The specific improvement of the instant invention relates to the provision of clutch means which are associated with a drive shaft for the slitter rolls. The clutch means are interposed between the shaft and the means designed to rotate the shaft whereby the shaft will be capable to drive the sheet through the slitting rolls as long as the sheet is not pulled at a faster rate by the forming rolls. The slitter rolls are deliberately set for rotation at a speed less than the known speed of movement of the sheet in the forming rolls whereby the forming rolls will take over driving of the sheet when the sheet enters the forming rolls. At this point, the clutch comes into play
so that the slitter rolls in effect become idlers as long as the sheet is pulled through the slitter by the forming rolls.

FIGURE 1 illustrates a forming apparatus 10 which includes a series of rolls 12 through 28. It will be noted that each of these rolls is of the slitting configuration, and a cooperating set of rolls is located below the upper series of rolls illustrated. In accordance with conventional practice, the cooperating rolls serve to form a sheet which is inserted at the right-hand side of the construction. The respective rolls perform successive bending operations whereby a cramped configuration can be achieved.

The slitting station of the apparatus is generally designated by the numeral 32. This station includes a bed 34 upon which the sheet is formed is placed. A guide bar 36 is attached to the bed by means of the fastener 38. It will be noted that the bed defines a slot 40 whereby the position of the bar 36 can be adjusted.

A housing 42 is provided at the station 32 and slitting rolls 44 and 46 are supported in this housing. The support for the rolls is provided by means of respective shafts 48 and 50. A gear 52 is tied to the shaft 48 and the gear 52 is provided for rotating the rolls. When the sheet is being moved, the sheet is pulled through the slitting rolls.

The gear 52 meshes with gear 54 which is tied to the shaft 50. A drive gear 56 is fitted around the shaft 50 and a clutch 58 provides the connection between this drive gear and the shaft 50. In a structure built in accordance with the concepts of this invention, a driven pinion roller clutch, produced by The Torrington Company, was employed for accomplishing the drive connection. It will be appreciated, however, that various conventional clutch means could be utilized to achieve the results of this invention.

In the preferred form of this invention, the bed 34 is located at a level above the line between the forming rolls. This arrangement permits location of the slitter closely adjacent the leading forming rolls whereby even short lengths of sheet can be passed between the slitting rolls and then engaged by the forming rolls without any intermediate handling. As shown in FIGURE 3, a pair of deflectors 66 and 68 are employed for achieving proper movement of the sections of sheet after the slitting operation. The deflector 68 engages the section 70 of the sheet which is to be formed and directs the sheet downwardly to a point between upper forming roll 12 and its corresponding lower forming roll 12'. The deflector 66 engages the seconded section of sheet 72 whereby this section of sheet will be directed upwardly out of an interfering position with respect to the machine operation.

The instant invention contemplates the provision of a single drive means for both the slitter and forming roll operation. The motor (not shown) preferably imparts driving action to one of the gears 74 which are associated with the respective forming rolls. Interconnecting idler gears such as shown at 76 enables a single drive gear to impart the rotary movement to each of the forming rolls employed.

Gears 78 and 80 are connected to the gear 74 associated with the forming roll 12. The gear 80 is in driving engagement with drive gear 56 and, therefore, the main drive of the system is capable of imparting rotary action to the slitter rolls.

In the operation of the construction, the sheet 82 is placed on the table 34 and an operator or some automatic means is employed to move the sheet between the slitter rolls. Due to the driving action of the main drive gears, the sheet will be drawn through the slitter rolls whereby the sections 70 and 72 will be continuously formed. It will be appreciated that the desired width of the sheet is determined by the spacing between the slitter rolls and the guide bar 36.

By selection of appropriate gear ratios, the speed of rotation which is imparted to the slitter rolls is less than the speed of rotation of the lead forming rolls. When the section 70 is directed between the forming rolls 12 and 12', the forming rolls will begin to draw the sheet through the apparatus at a rate faster than the sheet is drawn through the slitter rolls.

The clutch 58 is provided so that the main drive gear for the system will cause the gear 56 to drive the shaft 50. However, the clutch operates to relieve such driving action by the gear 56 whenever the slitter roll 46 begins to rotate the shaft 50 faster than the speed of rotation of the gear 56.

It will be appreciated that this arrangement completely eliminates problems which arise due to different rotary speeds in combination slitting and forming operations. In accordance with this invention, a single drive speed is dependent upon the speed imparted to the sheet during forming. Accordingly, the forming rolls can be changed to accommodate the formation of different shapes without effecting the slitting operation. The only consideration necessary is that the slitter rolls operate at a lower speed than the speed of the sheet in the forming section. With such an arrangement, the forming rolls will always cause the slitter rolls to overrun the drive mechanism thereafter. There is never any problem in a system of this nature with regard to buckling of the sheet or with regard to tearing or other damage to the sheet due to improper relationships between the relative speeds of the slitting and forming units.

The arrangement described provides definite economies from the standpoint of initial cost and operating efficiency. The unit includes only a single main drive and various combinations of forming rolls can be located on the respective drive shafts without necessitating any large scale adjustments in the gear ratios. The fact that the peripheral speeds of individual forming rolls may be different is not a critical factor from the standpoint of slitter operation since the slitter can operate at any speed in excess of the speed imparted by the drive means.

The particular design of the slitter is highly important from the standpoint of improved operating characteristics. The location of the slitter immediately adjacent the forming nip of the forming section permits the forming of very short lengths. The use of the deflectors in the manner illustrated permits the accomplishment of this feature and also provides advantages since scrap sections are directed away from the working area so as not to interfere with working operations.

It is to be noted that the unit described will provide extremely efficient operation particularly where material to be formed must be reduced in width to achieve the proper configuration after forming. The unit described does not require the provision of an inventory of exact widths of material. Even scrap lengths can be inserted into the unit of this invention since the combination of the slitter will automatically cut the material to the desired width for forming. An added advantage of the machine resides in the fact that an operator can run a piece through the machine and if a proper configuration is not achieved due to improper width of the sheet, immediate adjustments can be made. There is, therefore, no danger of losing an entire lot of sheet material which may have been inaccurately cut in an independent operation.

It will be understood that various changes and modifications may be made in the construction described which provide the characteristics of this invention without departing from the spirit thereof particularly as defined in the following claims.
That which is claimed is:

1. A sheet forming apparatus wherein a plurality of forming rolls are aligned for successive engagement with a sheet passing through the apparatus, and wherein drive means are provided for said rolls whereby the rolls serve to draw the sheet through the apparatus during forming, the improvement comprising a sheet slitter located adjacent the entrance end of the apparatus, drive means for said slitter, and clutch means associated with the slitter, the slitter drive means being adapted to operate the slitter whereby a sheet inserted therein will be driven to said rolls by the slitter, the drive means for said rolls imparting a rotational speed to the rolls whereby the speed of movement imparted to the sheet by the rolls exceeds the speed imparted by the slitter, said clutch means permitting said slitter to overrun its drive means whereby the driving movement of the slitter is imparted by said sheet after said rolls are in engagement with the sheet.

2. An apparatus in accordance with claim 1 wherein said rolls comprise a series of upper rolls and a corresponding series of lower rolls with said sheet being driven between the upper and lower rolls during forming thereof.

3. An apparatus in accordance with claim 1 wherein said slitter comprises upper and lower slitting rolls defining opposed cutting edges with said sheet being fed between said slitting rolls.

4. An apparatus in accordance with claim 3 wherein said slitting rolls are mounted on upper and lower shafts disposed in parallel relationship, a first gear tied to one of said shafts with the drive means for said slitter operating to rotate said gear, and intermeshing gears on the respective shafts whereby the driven shaft imparts driving movement to the other shaft.

5. An apparatus in accordance with claim 4 wherein said clutch is associated with said first gear on said one shaft.

6. In a shape forming apparatus wherein a series of upper and lower forming rolls are aligned for successive engagement with a sheet passing between the upper and lower rolls, successive rolls being of different configurations, and wherein drive means are provided for all of the rolls, said drive means rotating said rolls at the same angular velocity with successive rolls having different peripheral velocities due to their respective configurations, said rolls serving to draw the sheet through the apparatus during forming, the improvement comprising a sheet slitter located adjacent the entrance end of the apparatus, drive means for said slitter, and clutch means associated with the slitter, the slitter drive means being adapted to operate the slitter whereby a sheet inserted therein will be driven to said rolls by the slitter, the drive means for said rolls imparting a rotational speed to the rolls whereby the speed of movement imparted to the sheet by the rolls exceeds the speed imparted by the slitter, said clutch means permitting said slitter to overrun its drive means whereby the driving movement of the slitter is imparted by said sheet after said rolls are in engagement with the sheet.

7. An apparatus in accordance with claim 6 wherein a single motor is provided for operating the drive means for said forming rolls and the drive means for said slitter.

8. An apparatus in accordance with claim 6 wherein said slitter comprises upper and lower slitting rolls defining opposed cutting edges with said sheet being fed between said slitting rolls.

9. An apparatus in accordance with claim 8 wherein a flat bed is provided adjacent the entry between said slitting rolls, a guide bar on said bed and aligned in the direction of movement of said sheet, said guide bar being spaced sidewise of said slitting rolls whereby the said sheet is adapted to be engaged with said guide bar during passage through said slitting rolls for controlling the width of the sheet to be passed between the forming rolls, and including means for adjusting the position of said guide bar.

10. An apparatus in accordance with claim 8 wherein the sheet is carried between the slitting rolls at a level above the level at which the sheet is carried between the forming rolls, and including first and second deflecting means located at the exit end of said slitting rolls, said first deflecting means directing the sheet to be formed downwardly into position adjacent the entry end of said forming rolls, and said second deflecting means directing the severed portion of the sheet upwardly away from the forming rolls.

11. An apparatus in accordance with claim 8 wherein said slitting rolls are mounted on upper and lower shafts disposed in parallel relationship, a first gear tied to one of said shafts with the drive means for said slitter operating to rotate said gear, and intermeshing gears on the respective shafts whereby the driven shaft imparts driving movement to the other shaft.

12. An apparatus in accordance with claim 11 wherein said clutch is associated with said first gear on said one shaft.

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