

STRIP FORMING METHOD AND APPARATUS

This invention relates to a method of and apparatus for the production of articles in continuous succession by forming from strip material and parting-off the formed articles from the strip.

In some conventional arrangements for forming articles such as generally channel shaped ducting, studding and the like, a special parting-off head is required to support the particular profile of the formed article to enable parting-off to be carried out without deformation or collapse of the article. When a different size or shape of product is required, the head has to be modified or interchanged with another to accommodate the new product, giving rise to a very significant "stand-still" time for the machine, possibly of several hours, while the conversion takes place. Similar problems arise when changing the forming tools, such as rolls, particularly when the channel-shaped profile to be formed has its free edges turned inwardly parallel to its base, requiring additional tools to produce the necessary forming.

An object of the invention is to provide a method of producing articles, such as generally channel-shaped ducting, studding and the like, which enables parting-off of the differently shaped and/or sized articles to be performed without substantial modification to the parting-off head, as well as apparatus for carrying out the method and in which the forming tools may be readily modified for changing the shape and/or size of the product.

According to the invention, a method of producing articles in continuous succession by forming from strip material comprises partially dividing the

strip, prior to completion of the forming, to leave adjacent strip portions joined by a connecting portion, such that parting-off a pair of successive formed articles may be carried out by severing the portion.

Severing of the connecting portion may be readily performed using a simple flat die to support the wall portion containing the portion, avoiding the use of a complex cutting head dedicated to the particular article being produced.

Preferably, the connecting portion is formed with the strip stationary and, conveniently, prior to commencement of the forming operation.

In a particularly convenient form of the method, the partial division of the strip is effected on a stationary part of the strip during the performance of the forming operation on another moving part of the strip.

From a further aspect of the invention, apparatus for carrying out the method comprises forming means for forming the strip to the desired profile, means for partially dividing the strip prior to completion of forming, to leave adjacent strip portions joined by a connecting portion, and means for parting-off a pair of successive formed articles by severing the connecting portion.

Preferably, parting-off is effected on the moving strip by means of a co-acting cutter and die, the cutter and die conveniently being accelerated to the speed of the moving strip prior to parting-off.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic representation of one form of apparatus for carrying out the method of the invention;

Figure 2 is an enlarged diagrammatic view of part of the apparatus of Figure 1;

Figure 3 is an enlarged view, similar to Figure 2, of another part of the apparatus of Figure 1;

Figure 4 illustrates alternative results of one operational step in the method;

Figure 5 is an enlarged diagrammatic perspective view of part of the apparatus of Figure 1 seen from the opposite side to that shown in Figure 1, and

Figure 6 is a further enlarged view of part of the apparatus of Figure 5 seen from the same side as Figure 5.

In the apparatus illustrated in Figure 1, coated steel strip 1 is supplied from a drum 2 which is driven in rotation by a suitable conventional drive means 3, such as an electric motor, in order to unwind the strip in use. The strip is first fed through a succession of operational stations A, B, C, at which various operations are performed on the strip, as will be described hereafter. Feeding of the strip through the stations A, B, C is effected by a pair of feed rollers 2A driven intermittently under computer

control to bring successive locations on the strip beneath the stations A, B, C at which operations are performed while the strip is stationary. Alternative locations for the rollers 2A are shown in broken lines respectively at either end of the stations A, B, C, the chosen location depending upon whether the strip is to be pushed or pulled through the stations.

The strip is then fed through a series of forming rolls, indicated collectively by the reference 4, which act upon the strip in conventional manner to form it into a desired profile, such as a part-rectangular channel, of which the free longitudinal edges may be inwardly or outwardly turned.

In practice, each roll has an upper roll 4A and a lower roll 4B, the rolls being arranged in pairs transversely of the longitudinal direction of the strip, as illustrated in Figure 2. Each roll 4A, 4B is carried on a bed 5 mounted on a main frame 6 for adjustment in opposed directions transversely of the frame. Adjustment may be effected by any suitable means such as screw devices or fluid-actuated cylinders (not shown). The rolls 4A, 4B forming the sides of the channel relative to the base are all mounted on the respective beds 50 for simultaneous adjustment as a group at either side of the strip, although they may be sub-divided, if required, depending upon the particular form of the article to be produced. Some of the rolls, indicated at 5 in Figure 1 and each having a pair of rolls 5A, 5B, provide additional forming to turn inwardly the free edges of the channel. In this embodiment of the invention, these rolls are arranged for independent movement relative to the remaining rolls.

Figure 3 shows one possible arrangement for this, wherein the rolls 5A, 5B are mounted on beds 70 distinct from the beds 50 of Figure 2 and movable transversely of the frame 6 by, for example, hydraulic cylinders 8, which may be remotely controlled, so that the rolls 5A, 5B may be brought into or out of action separately from the remaining rolls, depending upon whether the product to be formed has in turned edges or not. These possibilities for adjustment of the rolls provide an extremely adaptable arrangement, which may be rapidly modified to produce products, within limits, of different shapes and/or dimensions, without the necessity for removing existing rolls and replacing them with different ones. This can reduce the down time of the apparatus very significantly as compared with some conventional apparatus.

The formed strip leaving the forming rolls requires parting-off into desired lengths and this is effected at a parting-off station by a die 9 cooperating with a cutting device 10. It is advantageous, for continuity of production, to perform the cutting operation on the moving strip, for which purpose it is necessary prior to each cutting operation to accelerate the die 9 to match the speed of travel of the strip. In order to achieve this, the die is coupled to a drive device, illustrated as a screw 11 driven, for example, by an electrical stepper motor 12 which, under automatic computer control, accelerates the die to the required speed and returns it to its starting position after the parting-off operation. The parted off product sections are fed onto a run-out table 13 which can include means 14 for moving the products off the table surface to one side or the other, at will.

It is an important feature of the invention that the strip is partially severed prior to completion of forming by the rollers 4, 5 and preferably

prior to the commencement of such forming, so as to leave successive strip portions 5, each of the required length, connected together by only a small connecting portion or lug, or possibly a plurality thereof. The partial severing of the strip, which takes place at station C, can be effected in a plurality of ways, of which three alternatives are illustrated in Figures 4A to 4C. Each manner of partial severing leaves in the strip one or more gaps 14 and one or more connecting lugs 15 between the successive strip portions 1A, 1B. The preferred manner of severing the strip is that shown in Figure 4A and will be used to illustrate the performance of the method using the apparatus of the invention in the following description.

The forming method of the invention is carried out, using the apparatus described, in the following manner. Strip 1 unwound from the reel 2 is allowed to form a loop L1 prior to being fed through the stations A, B and C. This allows for the intermittent feeding of the strip passing through these stations, by the feed rollers 2A, the strip being stopped momentarily, as governed by suitable automatic computer controlled timing means applied to the roller drive, to enable the necessary functions to be completed at stations A, B and C. Tools arranged at stations A and B can, for example, perforate the strip where required, and a partial severing operation is performed at station C leaving successive lengths of strip 1A, 1B spaced by the gaps 14 and connected only by the remaining lug 15. Following these steps, the strip is once again set in motion and forms a second loop L2 prior to entering the rolls 4 so that the strip passing through the rolls can remain in a continuously moving state, even when the strip is stopped at stations A, B and C. As can be seen more clearly from Figure 5, the flat strip 1 is progressively formed by the rolls 4 and 5 to produce a succession of

channel-shaped articles each, in the particular form illustrated, having inwardly turned longitudinal upper edges.

The formed articles leaving the rolls 4 and 5 approach a cutting station to be separated by the cutter 10 cooperating with the die 9. Again, in order to achieve continuity of operation, it is desirable to perform the cutting operation with the strip in continuous motion and, for this purpose, the die 9 is accelerated by the stepper motor 12 and screw drive 11 to the speed of the travelling strip, prior to separating successive articles by severing the connecting lug 15 between them while the articles continue in motion. Initiation of movement of the die 9 is effected in response to sensing the presence of the gap 14 between successive articles by means of sensors 20, preferably of an optical or infra-red type, signals from which are fed to the controlling computer which then initiates acceleration of the die and cutter assembly by way of the screw 11 and motor 12. By careful timing of commencement of acceleration of the die and cutter assembly, these latter can be brought into very close proximity with the lug to be severed. As can be seen more clearly in Figure 6, the thickness of the cutting blade is substantially the same as the width of the slot 14, so that the blade is effectively guided during its movement through the slot. The lower edge 21 of the blade forms the cutting edge and this is bounded by a pair of ears 22 which are spaced by substantially the width of the lug 15 so that the lug is embraced by the ears during the initial part of the descent of the blade for accurate location of the blade relative to the lug. Moreover, the die 9 has a degree of free movement in the direction of strip movement. The die is provided with a slot 23, which again is of substantially the same width as the blade thickness, and this enables a final location of the blade relative to the die and lug to be effected as the

ears 22 enter the slot 23, causing a small longitudinal adjustment of the die to take place, if necessary, prior to the final downward movement of the blade 10 to effect parting-off of the articles. The articles to be severed are supported adjacent the lug by a plain flat surface 23A of the die 9 surrounding the slot 23, obviating the need for complex support apparatus. The timing of the cut in relation to the various other movements and adjustments is effected by the controlling computer.

A severed article is illustrated at P (Figures 1 and 5) and this falls onto a run-off table 13 from which it may be removed by an ejector mechanism in the form of one or more projections 24 extending radially from a body 14 carried by a drive shaft 25 rotatable in one direction or the other, again under the control of the computer, to eject an article laterally of the table to one side or the other thereof. The direction of rotation of the shaft may be computer controlled to enable one or more articles to be ejected at one side of the table, followed by ejection of one or more articles at the opposite side of the table.

It will be seen that, with the arrangement described, parting-off of a variety of sizes and shapes of article can be effected by a single blade and die assembly, without modification of the latter, thereby avoiding the significant down times experienced in conventional forming apparatus having die heads designed to sever through the entire product. It will be understood that the invention is not limited by the size and shape of product, large variations in which may be accommodated.



CLAIMS

1. A method of producing articles in continuous succession by forming from strip material comprising partially dividing the strip, prior to completion of the forming, to leave adjacent strip portions joined by a connecting portion, such that parting-off a pair of successive formed articles may be carried out by severing the portion.
2. A method according to Claim 1, wherein the connecting portion is formed with the strip stationary.
3. A method according to Claim 1 or Claim 2, wherein the connecting portion is formed prior to commencement of the forming operation.
4. A method according to any one of Claims 1 to 3, wherein the partial division of the strip is effected on a stationary part of the strip during the performance of the forming operation on another moving part of the strip.
5. A method according to any one of the preceding claims, wherein severing of the connecting portion is effected on the moving strip.
6. A method according to Claim 5, wherein a cutting device is accelerated to match the speed of the strip prior to severing of the connecting portion by the device.



7. A method according to any one of the preceding claims, wherein the partial severing of the strip is effected so as to leave a single small connecting portion disposed generally centrally of the strip.

8. Apparatus for carrying out the method of any one of Claims 1 to 7, comprising forming means for forming the strip to a desired profile, means for partially dividing the strip, prior to completion of forming, to leave adjacent strip portions joined by a connecting portion, and means for parting off a pair of successive formed articles by severing the connecting portion.

9. Apparatus according to Claim 8, wherein drive means are provided for advancing the strip intermittently between severing operations by a distance equal to the length of a severed article.

10. Apparatus according to Claim 9, wherein the drive means is a pair of opposed rollers.

11. Apparatus according to any one of Claims 8 to 10, wherein a co-acting cutter and die is provided and operable to effect parting-off of the formed articles.

12. Apparatus according to any one of Claims 8 to 11, wherein means are provided and operable to accelerate the dividing means to the speed of the moving strip prior to parting-off of the moving articles.

13. Apparatus according to any one of Claims 8 to 12, wherein the forming means are rolls, and means are provided for adjusting some of



the rolls relative to others in order to modify the format of the formed article without substantial dismantling of the rolls.

14. Apparatus according to Claim 13, wherein the roll-adjusting means are fluid-operated.

15. Apparatus according to Claim 14, wherein the roll-adjusting means are remotely operable.