

May 3, 1966

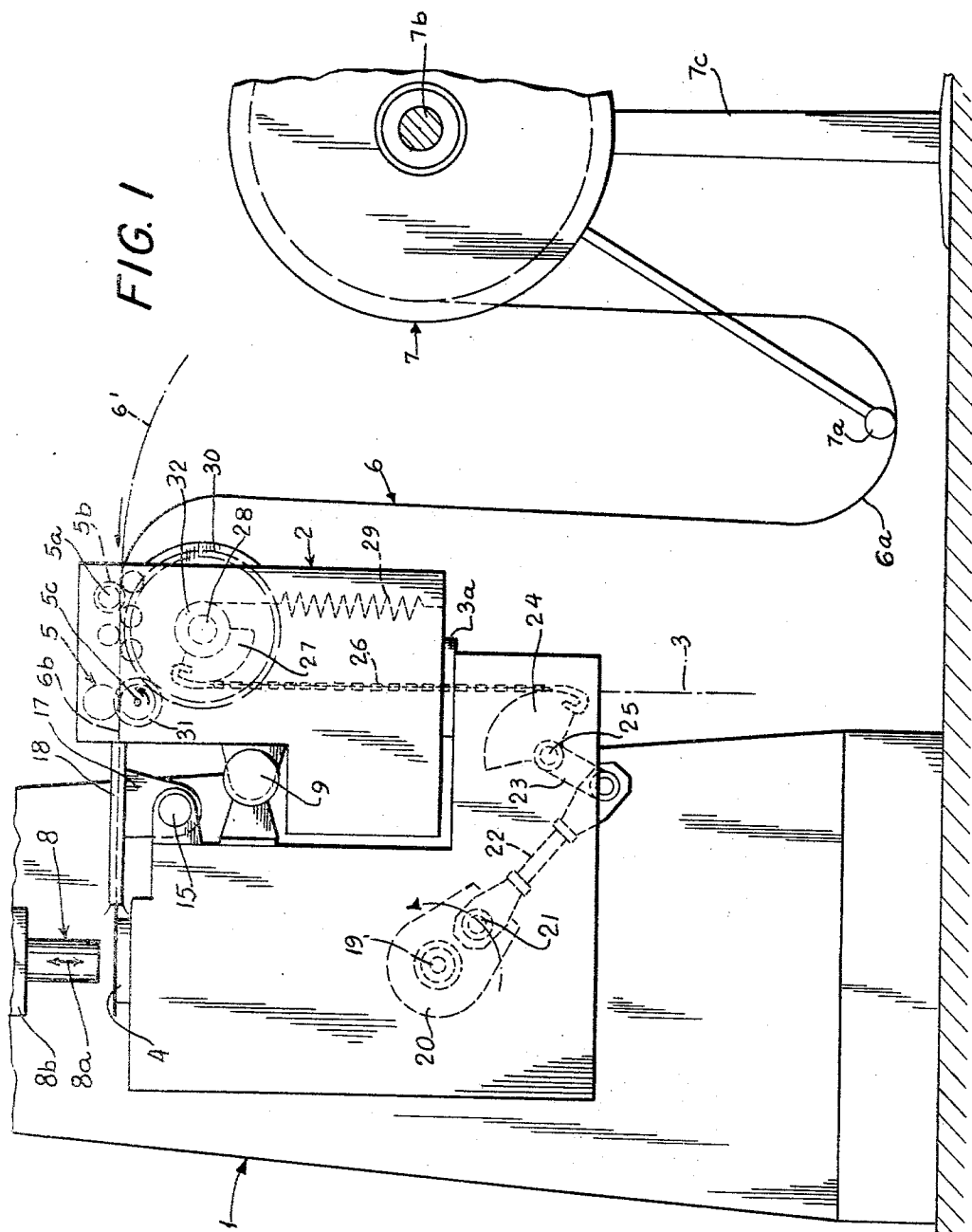
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METHOD AND APPARATUS FOR PUNCHING FLEXIBLE STRIP STOCK

Filed July 7, 1964

4 Sheets-Sheet 1



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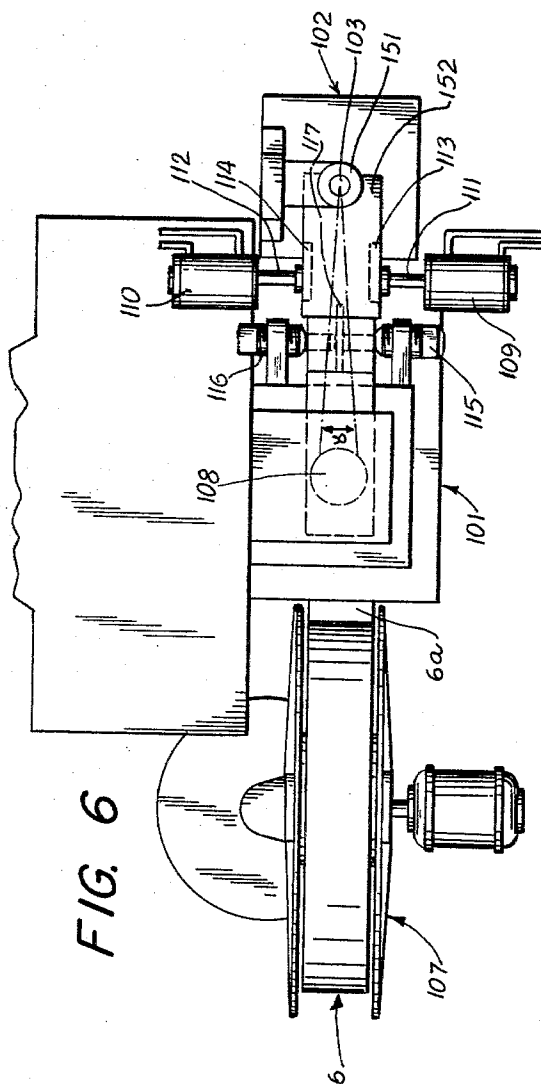
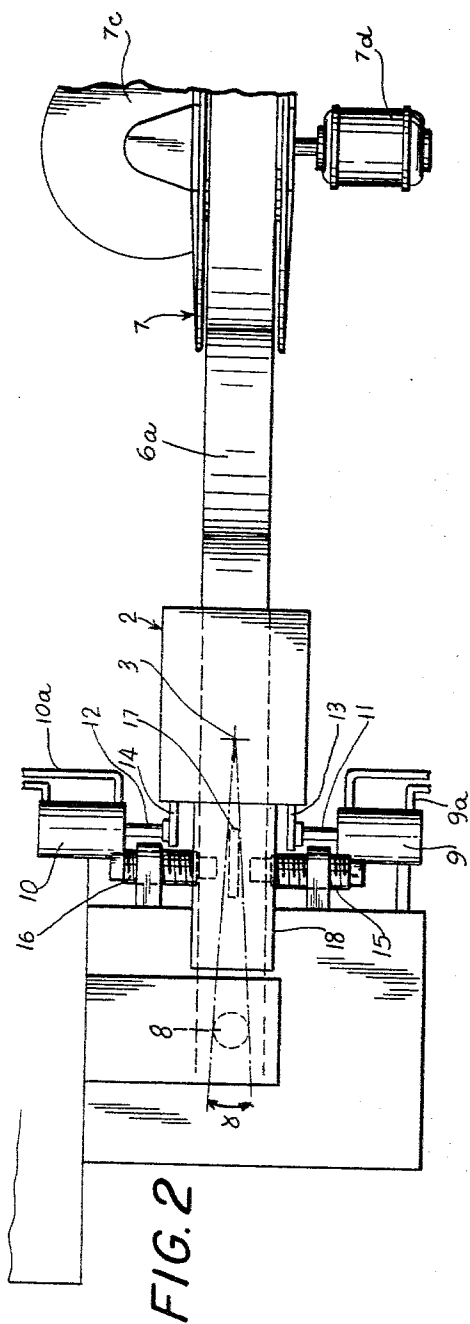
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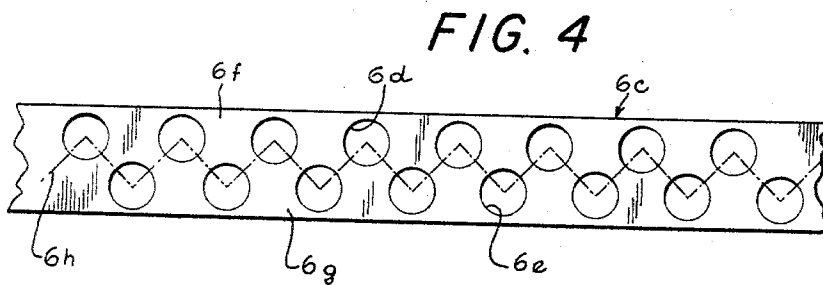
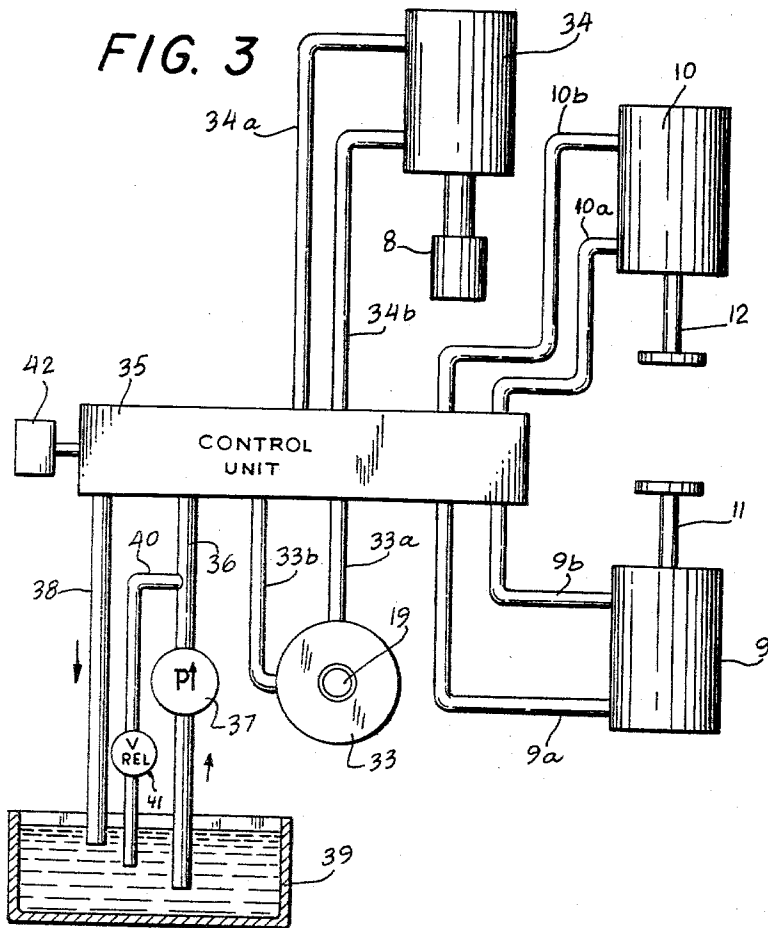
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METHOD AND APPARATUS FOR PUNCHING FLEXIBLE STRIP STOCK

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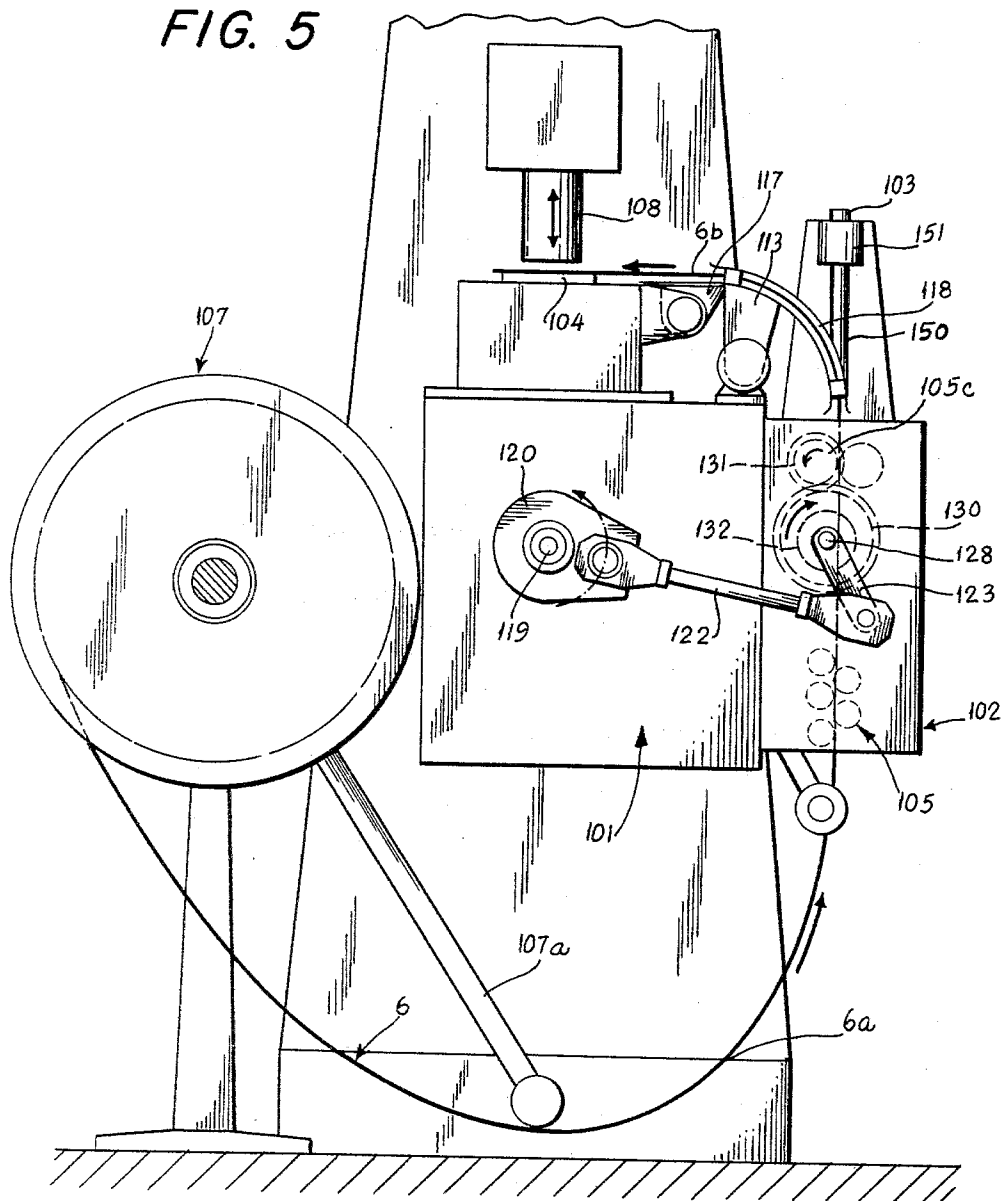
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METHOD AND APPARATUS FOR PUNCHING FLEXIBLE STRIP STOCK

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4 Sheets-Sheet 4

FIG. 5



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1

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**METHOD AND APPARATUS FOR PUNCHING
FLEXIBLE STRIP STOCK****Hubert Müller, Karlsruhe-Durlach, Germany, assignor to
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J 24,128

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The present invention relates to a method and apparatus for punching or stamping strips or bands consisting of fibrous, metallic or plastic material. More particularly, the invention relates to an improved method and apparatus for punching holes in a staggered pattern known as zig-zag punching.

All such conventional zig-zag punching apparatus of which I am aware at this time operate on the principle that the punch moves laterally with reference to the strip stock or that the die and the strip move laterally with reference to the punch. A serious drawback of such apparatus is that they must be provided with complicated rocking means for the die or for the punch and, in the event that the punch moves laterally with reference to the strip stock, the apparatus must be provided with two or more sets of material handling devices which serve to transfer stamped-out pieces of strip stock to a further processing station. Also, the mass of parts which are used to rock the punch or the die is comparatively large so that the apparatus cannot be operated at high speed and its energy requirements are comparatively high.

Accordingly, it is an important object of the present invention to provide a novel method of stamping a zig-zag pattern in a continuous strip of metallic or nonmetallic stock in such a way that the punch need not perform any other but reciprocatory movements in a direction toward and way from the die or vice versa, that the mass of parts which must be moved in order to produce a zig-zag pattern is reduced to a minimum with attendant reduction in energy requirements of the apparatus, and that the die or the punch may remain stationary at all times.

Another object of the invention is to provide a method of the just outlined characteristics according to which stampings in a staggered or zig-zag pattern may be obtained from metallic, fibrous or other strip stock at a rate and with an accuracy insuring economical mass production of such stampings in a simple and compact apparatus.

A further object of the invention is to provide a stamping or punching apparatus (hereinafter called punching machine) which may be utilized for practicing the above outlined method and which may be rapidly converted to obtain different patterns in strips or bands of different thickness and/or width.

An additional object of the invention is to provide a punching machine of the just outlined characteristics wherein the weight of parts which must be shifted or rocked back and forth in order to form a staggered pattern is minimal, and wherein such parts may but need not include the mechanism which feeds the strip to the punching station.

A concomitant object of the invention is to provide an improved mechanism for shifting or rocking the strip with reference to the punch and die in a punching machine of the above outlined characteristics.

Still another object of the invention is to provide a punching machine for zig-zag punching of flexible strip stock which is constructed and assembled in such a way that it suffices to shift a small portion of the strip so that the source of strip stock need not share the movements which are necessary to form in the strip a staggered pattern.

2

A further object of the invention is to provide a novel attachment which may be used in a punching machine of the above outlined characteristics and which enables the machine to shift a comparatively short length of strip stock at rapidly following intervals to insure high output in stampings or rapid transformation of a strip into a perforated product.

With the above objects in view, one feature of the present invention resides in the provision of a method of punching or stamping a strip of fibrous, metallic or other stock in a preferably horizontal punching plane located between the die member and the punch member of a punching machine. The method comprises the steps of intermittently moving one of the members toward and away from the other member whereby the punch member performs a punching operation on the stock which is located in the punching plane while the one member moves toward the other member, feeding consecutive portions of the strip through the punching plane between intermittent movements of the one member toward the other member (i.e., while the punch member is spaced from the die member), and rocking such consecutive portions of the strip back and forth in the punching plane and between intermittent movements of the one member toward the other member whereby the two members automatically form in the strip a zig-zag pattern of holes, cutouts or depressions.

The strip preferably consists of flexible stock and is of constant width. As a rule, the distance between the axis of the punch member and the fixed axis about which the strip is rocked back and forth will exceed between four and ten times the width of the strip.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved punching machine itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic fragmentary side elevational view of a punching machine which embodies one form of the present invention;

FIG. 2 is a diagrammatic top plan view of the structure shown in FIG. 1;

FIG. 3 is a diagram showing the control unit of the punching machine;

FIG. 4 illustrates a portion of a strip which has been treated in the machine of FIGS. 1 and 2;

FIG. 5 is a diagrammatic fragmentary side elevational view of a modified punching machine; and

FIG. 6 is a diagrammatic top plan view of the structure shown in FIG. 5.

Referring to FIGS. 1 and 2, there is shown a punching or stamping machine which embodies one form of the present invention. This machine comprises a frame 1 supporting a strip feeding and straightening attachment 2 which is rockable in a bearing 3a so as to swivel about a vertical axis 3. The axis 3 preferably passes through the center of gravity of the attachment 2, and the latter is provided with a set of cooperating advancing rolls 5 which serve to feed a strip 6 of paper, plastic, metal or the like into the stamping or punching plane above a fixed die 4. The strip 6 is being paid out from a source here shown as a reel 7 in such a way that it forms a hanging loop 6a, and the withdrawal of convoluted stock from the reel 7 takes place intermittently at regular intervals in synchronism with the operation of a punch 8 which is mounted to reciprocate vertically (see the double-headed arrow 8a) and is supported by a punch holder 8b carried by the frame 1. The length of the loop 6a is sufficient to allow

3

for unimpeded rocking of the attachment 2 about the vertical axis 3 without any twisting of that portion 6b of the strip 6 which is guided between the advancing rolls 5 in a direction toward the die 4. In other words, twisting of the strip 6 will take place only in that portion thereof which forms the loop 6a. As shown, the roll 5a is provided with flanges 5b to prevent lateral displacements of the strip portion 6b with reference to the attachment 2 and to thereby insure that the strip portion 6b shares all rocking or swiveling movements of the attachment. The material which is removed or bent from the strip portion 6b is detached from the punch 8 by conventional stripping means not forming part of the present invention and not shown in the drawings. The punch 8 merely reciprocates in a vertical direction (arrow 8a) but need not move laterally as in many types of conventional punching machines which are used for so-called zig-zag punching or stamping of bands, sheets, strips and similar stock.

The angle alpha through which the attachment 2 is rocked about the vertical axis 3 is selected in such a way that its magnitude bears a certain relationship to the width of the strip 6 and to the diameter of the punch 8. Also, the distance between the axis of the punch 8 and the axis 3 is preferably correlated to the width of the strip 6; in the present instance, the distance between the axis 3 and the axis of the punch 8 is about four and one-half times the width of the strip. In general, the ratio of the width of the strip 6 to the distance between the axis 3 and the axis of the punch 8 will be in the range of between 1:4 and 1:10. In the illustrated embodiment, the angle alpha is about 7 degrees.

The attachment 2 is rocked by double-acting hydraulic or pneumatic cylinders 9, 10 whose piston rods 11, 12 may abut against projections or lugs 13, 14 provided on the attachment. The extent of such rocking movement may be regulated by adjustable stops 15, 16 which are mounted on the frame 1 and cooperate with a follower in the form of a tongue 17 provided on the attachment 2. The stops 15, 16 resemble threaded screws or spindles which are adjustable axially to determine the exact magnitude of the angle alpha. The attachment 2 is provided with a guide in the form of a spout 18 which defines a channel to direct the strip portion 6b through the gap between the die 4 and punch 8. The guide 18 may be mounted on the frame 1 if the width of its channel is sufficient to allow for angular movement of the strip portion 6b in its own plane. In other words, the strip portion 6b should be free to rock back and forth about the axis 3 together with the attachment 2 in such a way that it remains in a plane which is the so-called punching or stamping plane and which may but need not be perpendicular to the axis 3.

When the strip portion 6b is being advanced by one or more intermittently rotating rollers 5 and when this strip portion rocks about the axis 3, the punch 8 is spaced from the die 4. The punch thereupon descends to remove or to bend some material from one marginal portion of the strip 6, whereupon the strip is rocked and fed again to move another zone of its material (adjacent to the other marginal portion) into requisite position for punching. This is called zig-zag punching or stamping. The control unit for regulating the operation of the cylinders 9, 10 in such a way that one of the cylinders moves the follower 17 in abutment with one of the stops 15, 16 and the other cylinder moves the follower 17 in abutment with the other stop is shown in FIG. 3. The cylinders 9, 10 are preferably of the hydraulic type, but it is equally possible to provide purely mechanical or electrical rocking means for the attachment 2. For example, the attachment may be rocked by a system of cams or by a set of cranks, as long as its movements are properly synchronized with reciprocatory movements of the punch 8 and with the operation of the drive which feeds the strip 6 during intervals when the punch 8 is moved away from the die 4.

In certain instances, the strip may be directed by hand

4

in a manner as illustrated in FIG. 1. The phantom line identified by the numeral 6' indicates a strip which is being controlled by hand whereby the operator allows the strip 6' to follow movements of the attachment about the vertical axis 3. The reel 7 cooperates with the deflecting arm 7a which forms the loop 6a. The core of this reel is mounted on a horizontal shaft 7b which is carried by a pedestal 7c. If desired, the core may be rotated by a motor 7d whenever the drive for the rollers 5 becomes active to feed the strip 6 by a step in a direction toward the punching station.

The drive for rotating one or more advancing rollers 5 is shown in FIG. 1. This drive includes a drive shaft 19 for disk 20 which carries an eccentric pin 21 secured to one end of a connecting rod 22. The other end of this rod 22 is articulately secured to an arm 23 on a segment 24 which is rockable about a horizontal pivot 25. The segment 24 is connected with the lower end of a motion transmitting chain 26 the upper end of which is secured to a second segment 27 rockable about a horizontal pivot 28 mounted in the attachment 2. The segment 27 is biased by a spring 29 which is mounted in the attachment and serves to rock the segment 27 in a clockwise direction so as to advance the strip portion 6b toward the punching station. The straight portion of the chain 26 is always located in the axis 3. The segment 27 is coupled to a gear 30 which meshes with a pinion 31 on the shaft of the advancing roll 5c. The connection between the gear 30 and segment 27 includes a one-way or freewheeling clutch 32 of any known design which enables the segment 27 to rotate with respect to the gear 30 when the segment 24 is caused to rotate in a clockwise direction. Thus, the chain 26 merely serves to tension (expand) the spring 29 after the spring has caused the gear 30 to rotate in a clockwise direction and to thereby rotate the roll 5c in a counterclockwise direction. The shaft 19 is driven intermittently by a hydraulic motor 33 shown in FIG. 3, and the punch 8 is reciprocated by a double-acting cylinder 34 which is mounted in the holder 8b. FIG. 3 illustrates a control unit 35 which serves to synchronize the operation of the cylinder 34 with the operation of the cylinders 9, 10 and motor 33. Thus, the control unit 35 will admit compressed fluid to the lower end of the cylinder 34 at the time the motor 33 receives fluid to rotate the shaft 19 and to tension the spring 29. This means that the punch 8 moves away from the die 4 and the spring 29 is free to turn the roll 5c so as to advance the strip portion 6b by a step toward the punching station. Once the punch 8 has moved away from the die 4, the control unit 35 admits fluid to the cylinders 9, 10 in a sense to rock the attachment 2 and to place the follower 17 in abutment with the stop 15. The punch 8 then descends and removes or bends some material from the strip 6 in a zone adjacent to one marginal portion of the strip. The operation is then repeated in the same way excepting that the control unit 34 alternatively admits pressure fluid to different ends of the cylinders 9, 10 so that the attachment 2 rocks back and forth and its follower 17 alternatively abuts against the stops 15, 16. Of course, when the cylinder 9 receives pressure fluid through the conduit 9a for the purpose of moving the follower 17 in abutment with the stop 16, the cylinder 10 receives pressure fluid through the conduit 10a to retract the piston rod 12 and to allow the follower 17 to move in a direction toward the stop 16.

The control unit 35 is connected with a supply conduit 36 containing a pump 37, and with a return conduit 38 leading to an oil tank 39. The supply conduit 35 is connected with a bypass conduit 40 containing a pressure relief valve 41. The means for operating the control unit 35 comprises a motor 42 which causes this unit to selectively connect or disconnect the conduits 9a, 9b, 10a, 10b, 33a, 33b and 34a, 34b from the supply conduit 36 or return conduit 38 so that the cylinders 9, 10, 34 and the motor 33 will be operated in the above described sequence.

FIG. 4 shows a portion 6c of a strip 6 which has been

5

caused to advance past the punching station. The portion 6c is formed with circular cutouts 6d, 6e which are respectively adjacent to the marginal portions 6f, 6g so that the line 6h connecting the centers of consecutively formed cutouts 6d, 6e is a zig-zag line. Of course, the punch 8 may form cutouts of more complicated shape and the zig-zag pattern in the strip portion 6c may comprise inclined rows each of which contains three or more cutouts.

FIGS. 5 and 6 illustrate a modified punching machine with a stationary feeding attachment 102. Only the guide 118 is arranged to swivel about a fixed vertical axis 103 so that the mass of that part of the machine which causes the strip portion 6b to rock back and forth is reduced to a minimum. The attachment 102 is fixed to the frame 101, and the upper end of the loop 6a is fed from below so as to pass between the advancing rolls 105. The guide 118 defines an arcuate path which extends through an angle of about 90 degrees and discharges the strip portion 6b into a horizontal punching plane above the fixed die 104 and below the working end of the reciprocable punch 108. The intake end of this guide 118 is connected with the lower end portion of a rocking shaft 150 whose axis coincides with the axis 103 and whose upper end portion is rotatable in a fixed bearing 151 carried by the frame 101 or by the attachment 102. The means for rocking the shaft 150 comprises two cylinders 109, 110 having piston rods 111, 112 which engage projections or lugs 113, 114 provided on a plate 152 carried by the shaft 150. The attachment 102 supports two adjustable stops 115, 116 cooperating with a follower 117 on the shaft 150 or guide 118. In the embodiment of FIGS. 5 and 6, the angle alpha is about 7 degrees and the distance between the axis of the punch 108 and the fixed axis 103 again exceeds four and one-half times the width of the strip 6. The twisting of the strip takes place in the zone between the driven feed roll 105c and the intake end of the guide 118, i.e., the length of the twisted strip portion is much shorter than in the machine of FIGS. 1 and 2.

The reel 107 contains a supply of convoluted strip stock and is provided with an arm 107a which forms the loop 6a. The drive for the roll 105a is much simpler than in the machine of FIGS. 1 and 2 because the attachment 102 need not be rocked with the strip portion 6b. This drive comprises a drive shaft 119 for a disk 120 which is connected with one end of a rod 122. The other end of the rod 122 is connected with an arm 123 on the shaft 128 of a gear 130 which meshes with a pinion 131 on the shaft of the roll 105c. The connection between the shaft 128 and gear 130 comprises a free-wheeling clutch 132 which rotates the gear 130 in a clockwise direction only so that the strip 6 is fed intermittently in synchronism with the operation of cylinders 109, 110 and the cylinder (not shown) which reciprocates the punch 108.

The axis 103 may but need not coincide with the longitudinal extension of that strip portion which is adjacent to the intake end of the arcuate path defined by the guide 118. Thus, the shaft 150 may be adjacent to the path of that strip portion which moves past the roll 105c.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A method of punching a strip of fibrous, metallic or other stock in a punching plane between the die member and the punch member of a punching machine, comprising the steps of intermittently moving one of said members toward and away from the other member; feed-

6

ing consecutive portions of the strip through said punching plane between intermittent movements of said one member toward said other member; and rocking such consecutive portions of the strip laterally back and forth in said punching plane and between intermittent movements of said one member toward said other member whereby said members form a zig-zag pattern in the strip.

2. A method of punching a strip of fibrous, metallic or other stock in a punching plane between the die member and the punch member of a punching machine, comprising the steps of intermittently moving one of said members toward and away from the other member in a direction which is substantially perpendicular to said punching plane; feeding consecutive portions of the strip through said punching plane between intermittent movements of said one member toward said other member; and rocking such consecutive portions of the strip in said punching plane between intermittent movements of said one member toward said other member about an axis whose distance from the axis of said punch member exceeds between four and ten times the width of the strip whereby said members form a zig-zag pattern in the strip.

3. A method of punching a strip of flexible fibrous, metallic or other stock of constant width in a punching plane between the die member and the punch member of a punching machine, comprising the steps of intermittently moving one of said members toward and away from the other member; feeding consecutive portions of the strip through said punching plane between intermittent movements of said one member toward said other member; forming in the strip a hanging loop in a zone upstream of that portion thereof which is located in said punching plane; and rocking such consecutive portions of the strip back and forth in said punching plane between intermittent movements of said one member toward said other member so that the looped portion of the strip is twisted in response to rocking and said members form a zig-zag pattern in the strip.

4. A method of punching a strip of fibrous, metallic or other stock in a punching plane between the die member and the punch member of a punching machine, comprising the steps of intermittently moving one of said members toward and away from the other member; guiding the strip in an arcuate path extending through an angle of about 90 degrees so that the leading end of the thus arched strip portion extends into said punching plane; feeding consecutive portions of the strip stepwise through said punching plane between intermittent movements of said one member toward said other member; and rocking such consecutive portions of the strip back and forth in said punching plane about an axis which is adjacent to the trailing end of the arched strip portion whereby said members form a zig-zag pattern in the strip.

5. A method as set forth in claim 4, wherein the axis about which the strip is rocked coincides with the longitudinal extension of that portion of the strip which is located immediately upstream of said arcuate path.

6. A method as set forth in claim 4, wherein the strip consists of flexible stock and, in response to rocking thereof, is flexed in a zone adjacent to the intake end of said arcuate path.

7. A machine for punching a flexible strip of fibrous, metallic or other stock, comprising a die member; a punch member; means for moving one of said members intermittently toward and away from the other member; means for feeding consecutive portions of the strip between said members during intervals between movements of said one member toward said other member; and means for rocking such consecutive portions of the strip back and forth between movements of said one member toward said other member so that said members form a zig-zag pattern in the strip.

8. A machine for punching a flexible strip of fibrous, metallic or other stock, comprising a frame; a die member and a punch member mounted in said frame; means for moving one of said members intermittently toward

7

and away from the other member; an attachment articulately mounted in said frame and comprising means for feeding consecutive portions of the strip between said members during intervals between movements of said one member toward said other member; and means for rocking said attachment with the strip about an axis which is spaced from said punch member so that such consecutive portions of the strip are rocked back and forth between movements of said one member toward said other member and said members automatically form a zig-zag pattern in the strip.

9. A machine as set forth in claim 8, wherein said punch member is arranged to reciprocate vertically toward and away from said die member and wherein the axis about which said attachment is rocked is spaced from and parallel with the axis of said punch member.

10. A machine as set forth in claim 8, wherein the means for feeding consecutive portions of the strip is arranged to feed the strip in a horizontal punching plane located between said members.

11. A machine for punching a flexible strip of fibrous, metallic or other stock, comprising a die member; a punch member; means for moving one of said members intermittently toward and away from the other member; means for feeding consecutive portions of the strip between said members during intervals between movements of said one member toward said other member; rocking means for rocking such consecutive portions of the strip back and forth between movements of said one member toward said other member so that said members form a zig-zag pattern in the strip; and stop means for limiting the movement of said rocking means between two spaced end positions.

12. A machine as set forth in claim 11, wherein said stop means comprises a pair of adjustable stops.

13. A machine for punching a flexible strip of fibrous, metallic or other stock, comprising a die member; a punch member; means for moving one of said members intermittently toward and away from the other member; a source of convoluted strip stock; means for feeding consecutive portions of the strip from said source into the space between said members during intervals between movements of said one member toward said other member; and means for rocking such consecutive portions of the strip back and forth between movements of said one member toward said other member so that said members form a zig-zag pattern in the strip.

14. A machine as set forth in claim 13, wherein said source comprises a reel and further comprising means for forming in the strip a hanging loop in a zone located ahead of said feeding means.

15. A machine for punching a flexible strip of fibrous,

8

metallic or other material, comprising a die member; a punch member; means for moving one of said members intermittently toward and away from the other member; feeding means for feeding consecutive portions of the strip between said members during intervals between movements of said one member toward said other member; guide means defining an arcuate path for a portion of the strip intermediate said feeding means and said members; and rocking means for rocking said guide means back and forth between movements of said one member toward said other member so that said members form a zig-zag pattern in the strip.

16. A machine for punching a flexible strip of fibrous, metallic or other material, comprising a die member; a punch member; means for moving one of said members intermittently toward and away from the other member; feeding means for feeding consecutive portions of the strip between said members during intervals between movements of said one member toward said other member; guide means defining an arcuate path for a portion of the strip intermediate said feeding means and said members, said arcuate path extending through an angle of about 90 degrees and said guide means having an intake end into which the strip is being fed by said feeding means; and rocking means for rocking said guide means back and forth between movements of said one member toward said other member so that said members form a zig-zag pattern in the strip, said rocking means comprising a shaft connected with the intake end of said guide means.

17. A punching machine as set forth in claim 16, wherein said punch member is arranged to reciprocate vertically toward and away from said die member and wherein the discharge end of said guide means is arranged to discharge consecutive portions of the strip into a horizontal punching plane extending between said members.

18. A punching machine as set forth in claim 17, wherein said rocking means comprises a pair of fluid-operated cylinders arranged to rock said shaft and said guide means about a vertical axis which is spaced from the axis of said punch member.

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