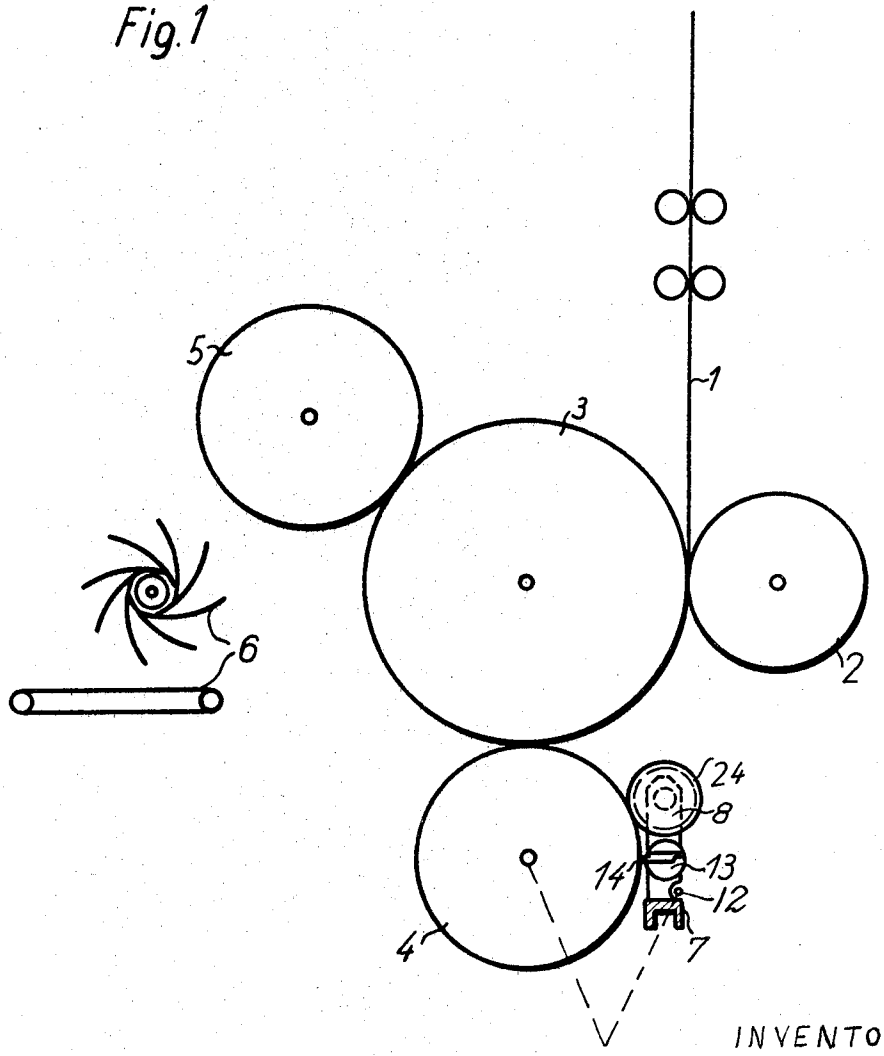
May 21, 1968 P. HEIMLICHER ET AL 3,383,852

STAPLE FORMING METHOD AND DEVICE

Filed Oct. 30, 1964 3 Sheets-Sheet 1

Fig. 1



INVENTORS
PAUL HEIMLICHER
EDUARD VON HEIN
By Wenderoth, Lind & Ponack
Attorneys

May 21, 1968 P. HEIMLICHER ET AL 3,383,852

STAPLE FORMING METHOD AND DEVICE

Filed Oct. 30, 1964 3 Sheets-Sheet 2

Fig. 2

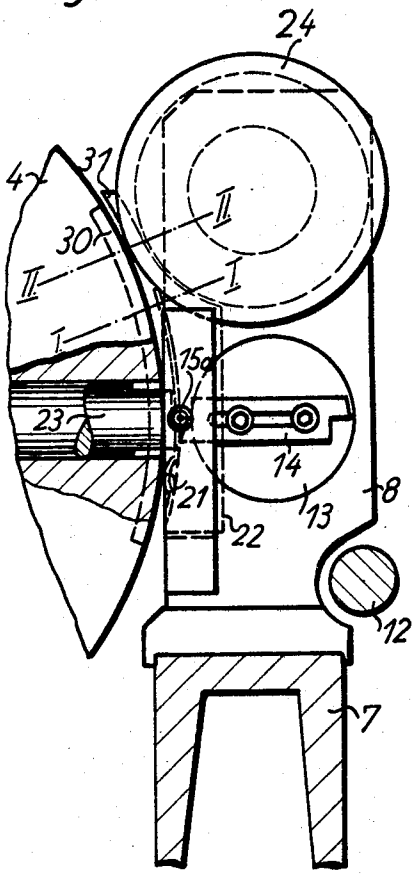


Fig. 4

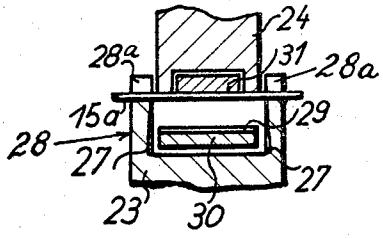
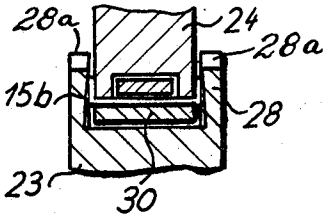


Fig. 5



INVENTORS
PAUL HEIMLICHER
EDUARD VON HEIN

By Mueller and Toren,
Attorneys

May 21, 1968 P. HEIMLICHER ETAL 3,383,852

STAPLE FORMING METHOD AND DEVICE

Filed Oct. 30, 1964 3 Sheets-Sheet 3

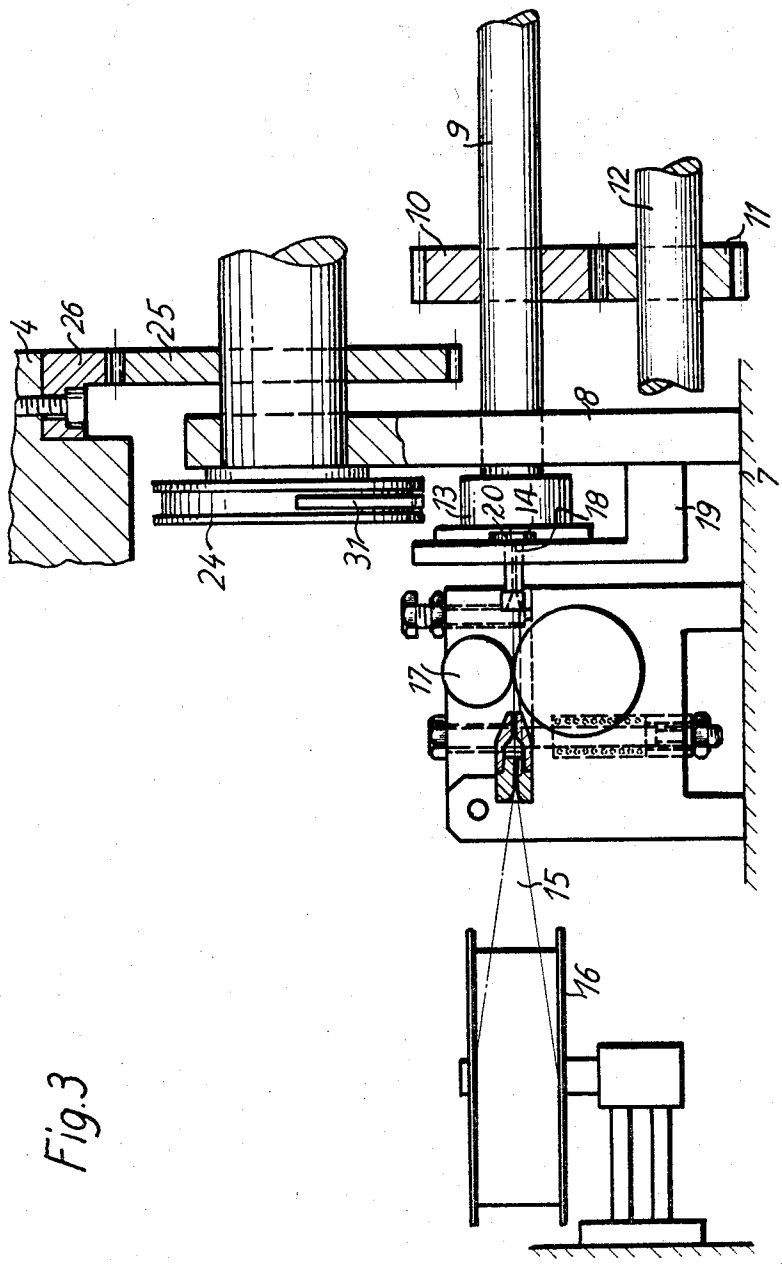


Fig.3

INVENTORS
PAUL HEIMLICHER
EDUARD VON HEIN

By Mayer and Toren
Attorneys

United States Patent Office 3,383,852 Patented May 21, 1968

3,383,852

STAPLE FORMING METHOD AND DEVICE

Paul Heimlicher, Bolligen, and Eduard von Hein, Bern, Switzerland, assignors to Maschinenfabrik Winkler, Fallert & Co., AG., Bern, Switzerland

Filed Oct. 30, 1964, Ser. No. 407,633
Claims priority, application Sweden, Nov. 8, 1963, 12,317/63
15 Claims. (Cl. 59—76)

ABSTRACT OF THE DISCLOSURE

The disclosure is directed to a wire stapling machine in which cutting of a fed staple wire is effected by a revolving knife in a manner such that the speed of cutting of the staple, which corresponds to the circumferential speed of the knife, is low compared to the circumferential speed of a stapling cylinder operable to transport the cut staple lengths to bending means and to a point of use. A further feature of the disclosure is that, during bending of the cut wire lengths into staples, the speed of the cut wire lengths, relative to bending means cooperable with the stapling cylinder, is substantially zero.

The apparatus of the invention includes a drive shaft for rotating a stapling cylinder on which is mounted a stapling piston which is reciprocable radially of the stapling cylinder and has a forked outer end projectable beyond the periphery of the stapling cylinder to pick up and transport cut staple lengths. A second shaft is driven from the stapling cylinder by gearing interconnecting it with the stapling cylinder shaft, and the gear ratio of this gearing can be selected in accordance with the desired speed of the second shaft. The second shaft supports a rotatable disk carrying at least one cutting knife cooperable with a fixed die to cut the wire into cut staple lengths. At a position spaced angularly in the direction of rotation of the stapling piston, there is a rotatable bending disk which is cooperable with the cut staple length in the fork of the stapling cylinder to bend the cut staple length into a staple, and this bending disk is rotated from the drive shaft of the stapling cylinder at a peripheral velocity substantially equal to that of the stapling cylinder so that, during bending of the cut staple length, the speed of the cut staple length relative to the bending means is substantially zero. This bending disk has a peripheral groove and a stripper is engaged in this groove to strip the bent staples from the bending disk.

Background of the invention

This invention relates to staple formation in wire stapling machines particularly adapted for use with high speed rotary presses, and, more particularly, to a novel method of and apparatus for cutting the staple wire into selected lengths and bending the cut lengths to form the staples.

Wire stapling machines of the type to which the invention is directed are used, particularly with high speed rotary printing presses, to staple together superposed webs delivered from the printing press and generally in advance of a folding machine. The operation of such a wire stapling machine may generally be divided into two functions. The first function involves the cutting of a continuous fed staple wire, usually supplied from rolls, into preselected lengths, followed by the bending of these preselected lengths into U-shape staples. In the second function of the wire stapling machine, the formed staples are pierced through copy to be stapled and are then closed by bending inwardly the projecting legs of the staple. The present invention is directed to the first-mentioned function and has substantially no relation to the second-mentioned function of the wire stapling machine.

Such wire stapling machines include a rotating stapling cylinder, which not only cooperates in the formation of the staples but also conveys the formed staples to the position at which they are pierced through the copy to be stapled. In some wire stapling machines the fed continuous wire is cut by means of small knives which are mounted either on the stapling cylinder or directly on a stapling piston which is reciprocable radially in the stapling cylinder. These small knives move past fixed cutting dies. The speed of these knives, relative to the continuous staple wire to be cut, corresponds substantially to the speed of the paper webs delivered from the rotary printing press. In the case of high speed rotary presses, the speed of the knives is also high and the wire is more beaten off than cut off. This has a disadvantageous effect on the subsequent staple formation.

In addition, it is very difficult to bring each knife in precise relation to the cutting die. If the spacing from the cutting die is too great, the wire is cut badly. On the other hand, if the knife grazes the fixed cutting die, heating and seizing take place. The precision must be within limits of at least a half 0.1 mm. Due to the heating up of the wire stapling machine, the optimum distance, as adjusted in the cold state, changes, because relatively large distances of the knives from the axis or the guide bearings of the stapling cylinder are inevitable.

Other wire stapling machines effect cutting of the continuous stapling wire by means of fixedly positioned shears, operatively associated with the fixed cutting dies and controlled by a cam on the rotating stapling cylinder. As the spacing of the stapling piston from the cutting die is only about 4 mm. the available space for a fixed shears is correspondingly very limited. As a matter of fact, the space limitations substantially prevent the the use of shears which are sturdy enough to perform the wire cutting function.

In another known type of stapling machine, the staples are formed by using a stapling horn cooperable with the stapling piston mounted for reciprocation in the stapling cylinder. The stapling horn has substantial disadvantages. Among these disadvantages is the particular one that, at full speed of the rotary press, the staple to be formed is pushed against the fixed stapling horn with the requisite force necessary for bending of the staple wire. Thereby the edges of the stapling horn are subjected to great frictional stress and relatively rapid wear. As a consequence the stapling horn must be hardened and ground, and at relatively great expense. Also it must be made to fit very precisely into the stapling piston fork over its entire length. The resulting grazing between the horn and the piston fork results in heating and seizing. The top of the stapling horn is also very liable to break, in the case of paper stuffers.

In some wire stapling machines, a stapling horn is dispensed with and the staple is formed by a second cylinder supporting controlled rams which push the staple wire between the forks of the stapling piston in the stapling cylinder. This additional cylinder, with the controls required for the ram operation, substantially increases the cost of the wire stapling machine, greatly interferes with access to the stapling cylinder and involves the use of controlled rams which are prone to trouble.

An object of the present invention is to provide, in the formation of staples in a wire stapling machine, an improved method of cutting the fed continuous wire into selected staple lengths.

Another object of the invention is to provide, in the formation of staples in a wire stapling machine, a meth-

od of cutting the fed continuous wire into staple lengths at a cutting speed which is low relative to the circumferential speed of a rotating stapling cylinder.

A further object of the invention is to provide, in the formation of staples in a wire stapling machine, an improved method of cutting the fed continuous wires into staple lengths by revolving knife means in which the circumferential speed of the revolving knife means is synchronized with the angular velocity of the stapling cylinder.

Still another object of the invention is to provide, in the formation of staples in a wire stapling machine, an improved method of bending the cut wire lengths to form the staples.

Yet another object of the invention is to provide, in the formation of staples in a wire stapling machine, a method of bending the cut wire lengths into U-shape in which the speed of the cut wire lengths, relative to a bending means is substantially zero.

A further object of the invention is to provide improved wire cutting means in a wire stapling machine particularly adapted for use with high speed rotary presses.

Still another object of the invention is to provide improved cut wire length bending means in a wire stapling machine particularly designed for use with high speed rotary presses.

The apparatus for performing the method of the invention includes a separate rotatable shaft mounted in a fixed support and carrying a disc provided with at least one cutting knife revolvable by the disc in operative association with a fixed cutting die. This shaft is driven positively from the stapling cylinder by means of gears whose gear ratio may be selected according to the desired circumferential speed of the cutting knife or knives. To form the cut wire lengths into staples, the apparatus includes a rotatably mounted bending disc which engages within the fork of the stapling piston which is mounted for radially reciprocation in the stapling cylinder. This disc is driven by the stapling cylinder through the medium of gears, so that its angular velocity is synchronized with that of the stapling cylinder, to the extent that the circumferential speeds of the disk and the cylinder are substantially equal. To prevent adhesion of the formed staples to the bending disc, the latter is formed with an annular groove or channel around its periphery and a stripper is operatively positioned in this annular groove or channel to strip the formed staples from the bending disc.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is a somewhat diagrammatic view of a wire stapling machine embodying the invention;

FIG. 2 is a part vertical elevation and part vertical sectional view, to a larger scale, of a portion of the wire stapling machine shown in FIG. 1;

FIG. 3 is a side elevation view, partly in section, of the wire stapling machine; and

FIG. 4 and FIG. 5 are sectional views taken on the lines I—I and II—II, respectively, of FIG. 2.

FIG. 1 illustrates the general arrangement of a wire stapling machine, the arrangement being examplary only. The paper web from a high speed rotary printing press is illustrated at 1. This web is cut into sheets by knives (not shown) of a rotating cylinder 2. The severed sheets are carried away from the cylinder 2 by a second cylinder 3 having suitable means for retaining the sheets thereon, such as piercing points or grippers. Cylinder 3 transports the cut sheets past the stapling cylinder 4, where the sheets may be stapled together, and to a folding cylinder 5. The folding cylinder 5 delivers the folded copy to a delivery means generally indicated at 6.

The stapling cylinder 4 is rotatably mounted, and, in

the usual manner, is provided with a stapling piston mounted for radial reciprocation therein and having a fork at its operative end. Adjacent cylinder 4 there is provided a cross bar or frame 7 on which is positioned a stationary support 8. Support 8 rotatably supports a shaft 9 which is fixed against axial displacement, this shaft being shown more particularly in FIG. 3. Shaft 9 is driven positively from stapling cylinder 4 through the medium of gears 10 and 11 and a shaft 12, with gear 10 being fixed to rotate with shaft 9 and gear 11 being fixed to rotate with shaft 12. A disc 13 is fixed to the end of shaft 9 and has secured thereon at least one cutting knife 14. The gears 10 and 11, through shaft 9, rotate disk 13 at an angular velocity such that the cutting speed of knife 14 is low relative to the peripheral speed of stapling cylinder 4. The revolving speed of knife 14 relative to the peripheral speed of stapling disk 4 can be made low by virtue of the fact that disk 13 has a relatively small diameter as compared to the diameter of stapling cylinder 4, whereby, for example, disk 13 and stapling cylinder 4 may be rotated at the same angular velocity and in synchronism with each other. Alternatively, and depending upon the number of cutting knives 14 and the number of stapling pistons on cylinder 4, any other speed ratio between disk 13 and stapling cylinder 4 may be selected by proper selection of the gear ratio of gears 10 and 11 to maintain the required low cutting speed of knives 14 relative to the peripheral speed of stapling cylinder 4, while still maintaining synchronism between the angular velocities and relative angular positions of disk 13 and stapling cylinder 4.

Referring particularly to FIG. 3, the continuous staple wire 15 is unwound from a reel or roll 16 by a wire feeding means 17 and delivered through a cutting die 18. Cutting die 18, which is a fixed cutting die, is mounted in a holder 19 which is secured to the fixed support 8. The exit of cutting die 18 is provided with a fixed cutting knife which cooperates with the revolving cutting knife 14 to cut the fed continuous staple wire 15 into selected staple lengths 15*a*.

The cut staple lengths 15*a* are guided between the arcuate surface of a relatively rigid guide 22 and a leaf spring 21, best seen in FIG. 2. Transport of the severed staple wire pieces 15*a* is effected by the forked outer end 28 of a stapling piston 23 which is mounted for radial reciprocation in the stapling cylinder 4. The radially outer ends of the arms of the fork 28 are notched, as at 28*a*, to receive and transport the separate wire piece 15*a* counterclockwise, as viewed in FIG. 2. Stapling piston 23 transports the cut wire lengths 15*a* toward a bending disc 24 which is rotatably mounted in the support 8. Disc 24 is positively driven from stapling cylinder 4 through the medium of gears 25 and 26, the gear 25 being fixed to rotate with disc 24 and the gear 26 being an annular gear secured on stapling cylinder 4. As best seen in FIGS. 3, 4 and 5, disc 24 has its periphery formed as a substantially rectangular cross section annular channel or groove.

As stapling piston 23 comes into operative relation with disc 24, the disc enters into the fork 28 of the stapling piston. The cut wire length 15*a* is thus bent into a U-shape, as illustrated at 15*b* in FIG. 5. Due to the inherent elasticity of the cut wire length, which is still present after the bending, the bent wire length 15*b* is frictionally held in inwardly diverging dovetail grooves 27 of the fork 28, the frictional clamping engagement of the bent piece 15*b* in these grooves being sufficient to restrain the piece 15*b* from being thrown off by centrifugal force.

Stapling piston 4 is provided with an arcuate bridge member 30 which extends through the fork 28 of stapling piston 23, and bridge 30 is formed with a groove 29 extending transversely of its exterior surface. The formed staple 15*b* has its bight portion engaged in the groove 29, with its legs engaged in the grooves 27 of the stapling piston fork 28, and is thus transported by the stapling cylinder 4. A stripper 31 extends into the channel groove

of the rotating disc 24 and thus strips the formed staple 15*b* from the disc 24. Stripper 31 extends far enough to make certain that the formed staple 15*b* is completely disengaged from the rotating disc 24.

By virtue of the mentioned clamping and holding of the staple 15*b*, the latter now remains with its legs engaged in the grooves 27 of the stapling piston 28, and with its bight engaged in the transverse groove 29 of bridge 30, until the closing of the staple takes place in a known manner at the point of contact of cylinders 3 and 4. The stripper 31 may be extended to a point closely adjacent this contact point to prevent throwing off of the staple when inferior staple wire is used. It will be understood that the disc 24 and the stripper 31 may be used for formation of staples in other types of wire staple machines, and the disc 24 may be driven or not.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. In the method of formation of staples in a wire stapling machine for stapling superposed sheets, and in which a fed continuous wire is cut into selected staple lengths by revolving knife means cooperable with fixed die means, and the cut staple lengths are transported past bending means at which the cut staple lengths are then bent to form staples, the improvement comprising: cutting the continuous wire into staple lengths at a cutting speed which is low relative to the transport speed of the cut staple lengths; and, while so transporting the cut staple lengths, bending the latter into staple form while maintaining their speed, relative to the bending means, at substantially zero.

2. In the method of formation of staples in a wire stapling machine for stapling superposed sheets, and in which a fed continuous wire is cut into selected staple lengths by revolving knife means cooperable with fixed die means, and cut staple lengths are transported by a rotating stapling cylinder past bending means at which the cut staple lengths are then bent to form staples, the improvement comprising: cutting the continuous wire into staple lengths at a cutting speed which is synchronized with the angular velocity of the rotating cylinder and is low relative to the peripheral speed of the stapling cylinder; and, while so transporting the cut staple lengths, bending the latter into staple form while maintaining their speed, relative to the bending means, at substantially zero.

3. In a wire stapling machine including a rotatable stapling cylinder, a stapling piston on said cylinder reciprocable radially of said cylinder, a fixed cutting die, and means for feeding a continuous staple wire through said die, the improvement comprising: revolving knife means cooperable with said die to cut the staple wire into selected staple lengths; and driving means interconnecting said stapling cylinder and said knife means and revolving said knife means to cut the continuous wire at a cutting speed which is low relative to the circumferential speed of the stapling cylinder.

4. In a wire stapling machine, the improvement claimed in claim 3, including said driving means positively interconnecting said stapling cylinder and said knife means and revolving said knife means at a circumferential speed synchronized with the angular velocity of said stapling cylinder.

5. In a wire stapling machine including a rotatable stapling cylinder, a stapling piston on said cylinder reciprocable radially of said cylinder, a fixed cutting die, and means for feeding a continuous staple wire through said die, the improvement comprising: revolving knife means cooperable with said die to cut the staple wire into selected staple lengths; said piston having a forked outer end projectable beyond the periphery of said cylinder to pick up and transport the cut staple lengths; and bending means, cooperable with said stapling piston, operable to bend the cut staple lengths transported by the latter into staple form at a speed of said cut staple lengths relative to said bending means, which is substantially zero; driving means interconnecting said stapling cylinder and said knife means and revolving said knife means to cut the continuous wire at a cutting speed which is low relative to the circumferential speed of said stapling cylinder.

6. In a wire stapling machine including a rotatable stapling cylinder, a stapling piston on said cylinder reciprocable radially of said cylinder, a fixed cutting die, and means for feeding a continuous stapling wire through said die, the improvement comprising; revolving knife means cooperable with said die to cut the staple wire into selected staple lengths; said piston having a forked outer end projectable beyond the periphery of said cylinder to pick up and transport the cut staple lengths; bending means cooperable with said stapling piston, operable to bend the cut staple lengths transported by the latter into staple form at a speed of said cut staple lengths, relative to said bending means, which is substantially zero; driving means positively interconnecting said stapling cylinder and knife means and revolving said knife means at a circumferential speed synchronized with the angular velocity of said stapling cylinder.

7. In a wire stapling machine including a rotatable stapling cylinder, a stapling piston mounted on said cylinder and reciprocable radially of said cylinder, a fixed cutting die, and means for feeding a continuous staple wire through said die, the improvement comprising: a rotatably mounted disc adjacent said die; and at least one cutting knife mounted on said disc for revolving thereby and cooperable with said die to cut the staple wire into selected staple lengths; said piston having a forked outer end projectable beyond the periphery of said cylinder to pick up and transport the cut staple lengths.

8. In a wire stapling machine, the improvement claimed in claim 7 including a shaft having said disc mounted thereon; means rotatably supporting said shaft; and driving means interconnecting said stapling cylinder and said shaft to revolve said cutting knife at a circumferential speed synchronized with the angular velocity of said stapling cylinder.

9. In a wire stapling machine, the improvement claimed in claim 7 including a shaft having said disc mounted thereon; mean rotatably supporting said shaft; and gearing interconnecting said stapling cylinder and said shaft for positive driving of said disc by said stapling cylinder to revolve said cutting knife at a circumferential speed synchronized with the angular velocity of said stapling cylinder.

10. In a wire stapling machine, the improvement claimed in claim 9 including said gearing having a reduction ratio selected in accordance with the desired relation of the circumferential speed of said cutting knife to the angular velocity of said stapling cylinder.

11. In a wire stapling machine including a rotatable stapling cylinder, a stapling piston mounted on said cylinder and reciprocable radially of said cylinder, a fixed cutting die, and means for feeding a continuous staple wire through said die, the improvement comprising: revolving knife means cooperable with said die to cut the staple wire into selected staple lengths; a bending disc rotatably mounted adjacent said stapling cylinder for rotation about an axis parallel to the axis of rotation of said stapling cylinder, the periphery of said bending disc being substantially tangent to the periphery of said stapling cylinder; said bending disc being spaced, in the direction of rotation of said stapling cylinder, from said knife means; said piston having a forked outer end projectable beyond the periphery of said cylinder to pick up and transport the cut staple lengths past said bending disc; said bending disc engaging with the fork of said stapling piston to bend the cut staple lengths into staple form.

12. In a wire stapling machine, the improvement

claimed in claim **11** including gearing interconnecting said stapling cylinder and said bending disc for positive driving of said bending disc by said stapling cylinder at a peripheral speed substantially equal to that of said stapling cylinder.

13. In a wire stapling machine, the improvement claimed in claim **11** including said bending disc having a channel shaped groove extending around its periphery; and a stripper engaged in said groove and effective to strip the formed staples from said bending disc.

14. In a wire stapling machine, the improvement claimed in claim **13** including the inner surfaces of the legs of the forked outer end of said stapling piston each having a groove extending inwardly from the outer end of said stapling piston, said grooves increasing in cross sectional area inwardly of said forked outer end.

15. For use with a wire stapling machine including a rotatable stapling cylinder, a stapling piston mounted on said cylinder and reciprocable radially of said cylinder, means for feeding a continuous staple wire, and means for cutting the continuous staple wire into selected staple lengths: improved bending means comprising, in combination, said piston having a forked outer end projectable beyond the periphery of said cylinder to pick up and transport the cut staple lengths; and a bending disc rotatably mounted adjacent the periphery of said stapling cylinder for engaging cut staple lengths transported on the surface of said stapling cylinder by the forked outer end of said stapling piston; said bending disc engaging with said forked outer end to deform the cut staple lengths to form staples; said bending disc having a channel groove extending around its periphery; and a stripper engaged in said groove to strip formed staples from said bending disc.

References Cited

UNITED STATES PATENTS

89,985	5/1869	Gray	83—161
2,341,956	2/1944	Staude	83—161
2,634,576	4/1953	Seibel	59—76
3,017,634	1/1962	Hauck	59—76
3,104,579	9/1963	Blankenship	83—580
3,276,304	10/1966	Gilbert	83—158

FOREIGN PATENTS

1,008,637	5/1957	Germany.

CHARLES W. LANHAM, *Primary Examiner.*

GENE P. CROSBY, *Assistant Examiner.*