Oct. 12, 1965 S. T. STOOTHOFF 3,211,448

SHEET FOLDING APPARATUS

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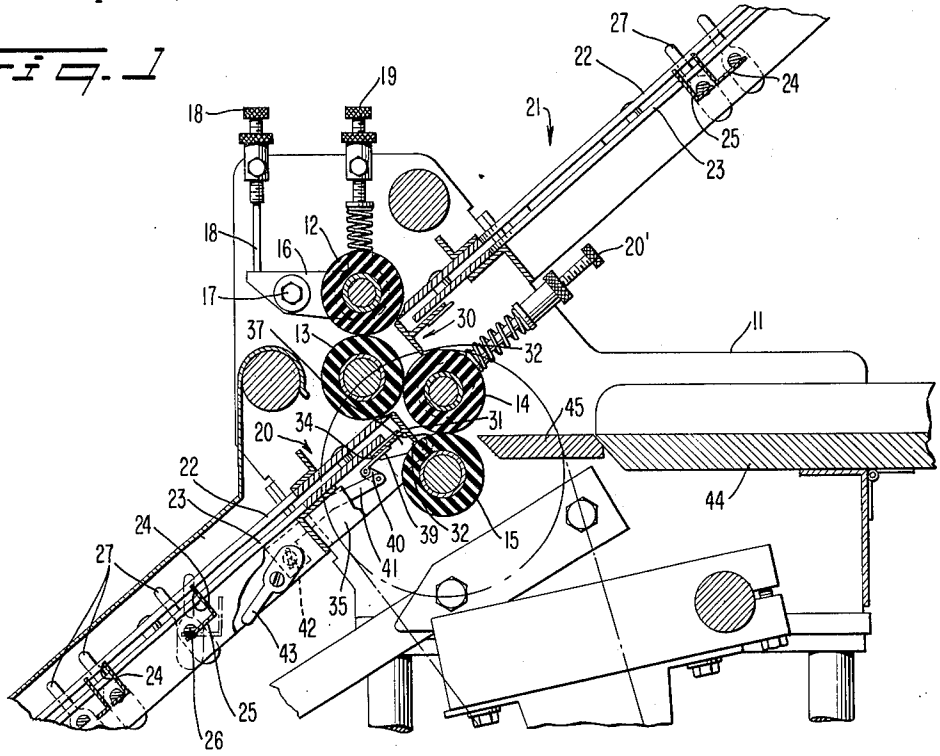
Fig. 1



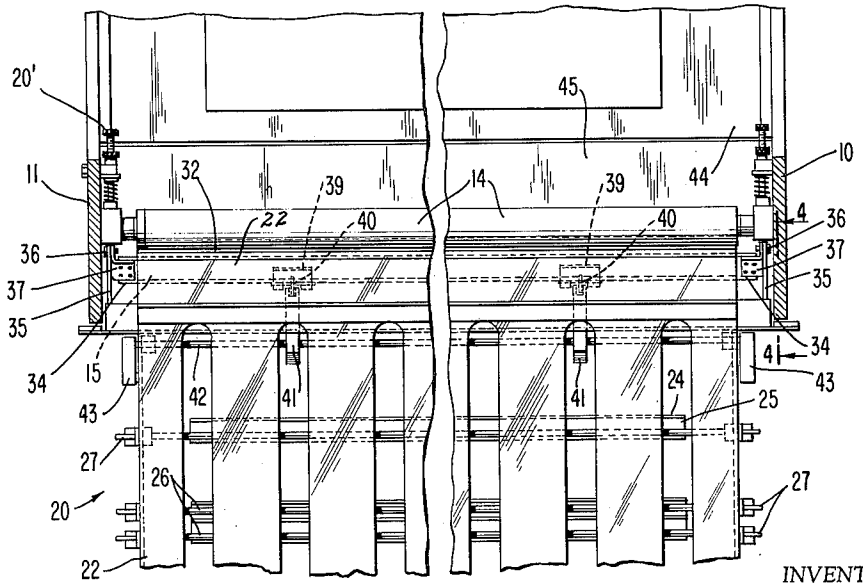


Fig. 2

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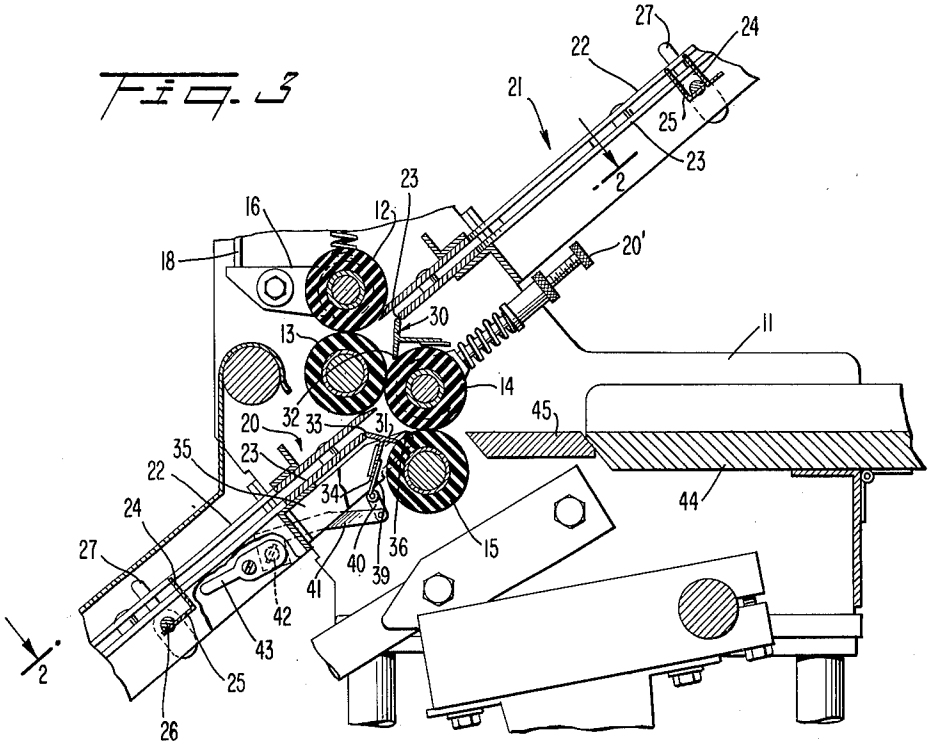
Fig. 3



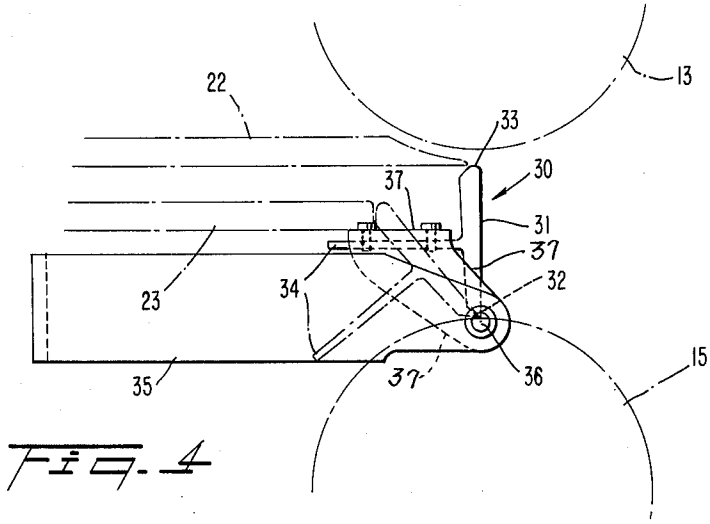


Fig. 4

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3,211,448

SHEET FOLDING APPARATUS

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10 Claims. (Cl. 270—68)

This invention is directed to an apparatus for folding sheets of paper and more particularly to a buckle type folding apparatus.

The conventional buckle type of folding apparatus comprises a plurality of fold plates each of which is positioned adjacent a pair of folding rolls. Each fold plate comprises an upper and lower spaced apart plate with a sheet receiving space therebetween. A stop member extends into the sheet receiving space to limit the movement of the leading edge of each fed sheet into said space. When the leading edge of the fed sheet strikes the stop member that portion of the sheet outside the fold plate buckles and is fed toward the bite of the fold rolls where the sheet is folded. The fold rolls then feed the folded edge into the next fold plate. The folding is thus continued through as many folding steps as there are fold rolls and fold plates. Sometimes it is desirable to by-pass certain of the fold plates and sheet guiding means are provided to deflect the leading edge from entering the sheet receiving space in the fold plate and to feed the leading edge into the bite of the next feed rolls and into the next fold plate. In prior buckle type folding machines this sheet guiding means for deflecting the sheet has consisted of means which are lifted into and out of the area immediately in front of the fold plates. Not only have the prior deflecting devices been of complicated construction but they are required to be moved from one location to another which takes time. In the present day high speed folders the speed of operation of the sheet guiding means is important as well as is the accuracy of the positioning of the fold. It is therefore an object of the present invention to provide a fold plate combination having a novel sheet guiding blade which is of simple construction and capable of operation at a high rate of speed.

Another object is to provide a novel sheet guiding blade for use with a fold plate which has a minimum of movement between its deflecting and non-deflecting positions.

Another object is to provide a novel sheet guiding blade for use with a fold plate which is utilized either as a portion of the fold plate or to deflect the sheet from the fold plate.

Another object is to provide a novel sheet folding apparatus having a sheet guiding blade, an edge of which remains stationary and another portion which is selectively operable between a sheet feeding and a sheet deflecting position relative to the fold plate.

Another object is to provide a folding apparatus having a folding plate and a sheet guiding blade which remains in a stationary position relative to sheet feed rolls to selectively either direct the sheet into the fold plate or away from the fold plate.

Another object of the present invention is to form a sheet guiding means as a part of a fold plate thus permitting the fold plates to be positioned closely together to form a more compact unit.

A still further object is to provide a novel fold plate having upper and lower plate members, a portion of the lower plate member being movable to block a sheet from entering between said upper and lower plates.

The above and further objects and novel features of the present invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a cross section elevational view of a folding apparatus embodying the present invention;

FIG. 2 is a top plan view of the folding apparatus taken along line 2—2 of FIG. 3;

FIG. 3 is a partial cross sectional elevational view, like FIG. 1, showing the sheet guiding blade in sheet guiding position; and

FIG. 4 is an enlarged side elevational view taken along line 4—4 of FIG. 2 and showing the means for securing the sheet guiding blade to a pivotal mounting.

Referring now to the drawings, and particularly to FIGS. 1 and 2, a pair of spaced apart side frames **10** and **11** support a series of folding rolls **12**, **13**, **14** and **15**. Rolls **13** and **15** have their ends rotatably mounted in the side frames **10** and **11** in a fixed position. Roll **12** has each end rotatably mounted in one end of a lever **16** and each lever **16** is in turn pivotally mounted at **17** to the side frames **10** and **11** respectively. An adjustable stop member **18** is secured to the side frames **10** and **11** to limit the movement of the outer end of each lever **16** as shown in FIG. 1. An adjustable spring loaded pressure member **19** contacts the inner end of each lever **16** whereby a predetermined pressure is exerted at each end of the roll **12** to force the surface of roll **12** against the surface of roll **13**. An adjustable spring loaded pressure member **20'** is secured to each end of roll **14** whereby the surface of roll **14** is held in contact with the surfaces of rolls **13** and **15** under a selective predetermined pressure. A fold plate **20** is associated with rolls **13**, **14** and **15** and a fold plate **21** is associated with rolls **12**, **13** and **14**. In the embodiment disclosed there are shown two fold plates but it is to be understood that additional fold plates and fold rolls could be employed in accordance with any requirements as to the number and character of the folds that are to be made in the sheets. For example, the fixed roll **13** and resiliently mounted roll **12** are mounted to feed the folded sheet from the last of a series of fold plates to a tray or other suitable collecting apparatus or carry away conveyor. If more than two fold plates are utilized, as shown in the drawings, then roll **12** would be displaced upwardly and another fixed roll and a resiliently mounted roll similar to rolls **13** and **14** would then be interposed in the disclosed manner between rolls **12** and **13**.

Fold plates **20** and **21** each comprise grid-like upper and lower plates **22** and **23** secured together in spaced relation to form a sheet receiving space therebetween and supported in a suitable manner between frames **10** and **11**. Each fold plate is provided with a plurality of sheet stops **24** spaced along the fold plate to selectively determine the distance that the leading edge of the fed sheet can enter said sheet receiving space and thus to determine the width of the fold to be made. Thus, if a sheet of paper were to be folded into three parts it would necessitate two folds. Knowing in advance the total length of the sheet to be folded, the appropriate sheet stops would be actuated to limit the movement of the leading edge of the sheet into the sheet receiving space of the fold plate to form a buckle in the sheet adjacent the fold plate and to feed the buckled portion to the bite of rolls **13** and **14**. Each of the sheet stops comprises an L-shaped member **25** secured at one end to a rod **26** positioned below the lower plate and rotatably mounted therein. A lever **27** is secured to the outside end of rod **26** whereby rotation of the rod may be effected. The lower plate has suitable openings to permit the outer end of the L-shaped member **25** to move into operative posi-

tion between the upper and lower plates **22** and **23** upon rotation of rod **26** as described above.

A sheet guiding blade **30** has a sheet guiding surface **31**, a lower edge **32**, an upper edge **33**, and a rearwardly extending ledge **34**. Blade **30** is mounted for pivotal movement about lower edge **32** by the following construction. As more clearly shown in FIGS. 2 and 4 a bracket **35** is positioned adjacent each end of the blade **30**. Each bracket **35** has its inner ends secured to the frame portion of the lower plate **23** and each has a pivot point **36** at its outer end. A blade supporting arm **37** is secured to each end of the blade **30**. Each of the arms **37** is secured at one end to the under surface of the rearwardly extending ledge **34** of blade **30** and pivotally mounted at the other end to the pivot point **36**. The lower edge **32** of blade **30** is in axial alignment with the pivot point **36** so that this edge of the blade remains stationary at all times. In FIG. 1 the blade **30** is shown in position to deflect sheets away from the fold plate having been pivoted about edge **32**. In FIG. 3 there is shown the position of the blade **30** whereby blade edge **33** is in contact with the end of the lower plate **23** so that the sheet guiding surface **31** of blade **30** forms an angular continuation of the upper surface of the lower plate **23** to direct the leading edge of each sheet into the sheet receiving space of the fold plate. The mechanism for operating the pivotally mounted blade **30** comprises a pair of link hinge mechanisms **38** spaced along the rearwardly extending ledge **34** of blade **30**. Each of the link hinge mechanisms comprises a hinge **39** which is secured to the ledge **34** of blade **30** and is pivotally connected to one end of a connecting link **40**. The other end of link **40** is pivotally connected to one end of a lever **41**. The other end of lever **41** is fixedly secured to a shaft **42** which extends transversely of the fold plate and has its ends mounted in suitable bearing surfaces in the fold plate frame. The ends of shaft **42** extend beyond the fold plate and have secured to them actuating levers **43** for effecting the rotation of shaft **42**. Thus, by means of the operating levers **43** the blade **30** is selectively moved from its first position where the sheet guiding surface **31** forms an extension of the lower plate **23** to its second position where the sheet guiding surface **31** is approximately at right angles to the top surface of the lower plate **23** and serves to deflect the leading edge of each sheet fed between rollers **14** and **15** and to direct said leading edge into the bite of rolls **13** and **14**.

In operation, a sheet of paper to be folded is fed by manual or automatic means along the top surface of a bridge **44** and into the bite of rolls **14** and **15**. As shown in FIG. 3, blade **30** is positioned so that its sheet guiding surface **31** directs the sheet of paper into the fold plate **20** against a stop **24** whereby the sheet will be buckled and folded between rolls **13** and **14** and the folded edge will then be fed upwardly into the fold plate **21** where the sheet will again be buckled and folded between rolls **12** and **13** in a manner well understood in the art. If it is desired not to utilize the fold plate **20**, the lever **43** is moved in a counterclockwise direction as shown in FIG. 3 which through the lever **41** and linkage **40** causes the blade **30** to pivot around its lower edge **32** to the position shown in FIG. 1 whereby the sheet guiding surface **31** deflects the leading edge of the sheet and directs it into the bite of rolls **13** and **14**. The fold plate **21** has associated with it an identically constructed and operated sheet guiding blade **30**.

If desired the shaft **42** of the link hinge mechanism **38** may be operated by a conventional solenoid to effect the movement of said blade between its deflecting and sheet guiding positions. Likewise, the operation of each of the stop members **24** in the fold plates may be operated by means of a conventional solenoid which replaces the operating lever **27**. In such an embodiment the solenoid is connected in such a manner as to effect a partial rotation of rod **26** to selectively move each stop member into and out of operative position. An embodiment utilizing solenoids permits the proper selection of the fold plate stops and the use or by-passing of each fold plate from a central position by means of suitable control buttons and electrical wiring. Furthermore, the use of solenoids makes it possible to feed an assortment of different sheet lengths to said folding apparatus. By providing a sensing means on the feed table **44** to measure the length of each sheet the stops **24** and blades **30** may be placed in proper position for folding the measured sheet length just prior to the time that the measured length is fed into the first fold plate.

While the description and accompanying drawings set forth with more or less particularity one embodiment of the invention, it is to be expressly understood that said invention is not limited to said embodiment. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. In an apparatus for folding paper the combination of a pair of spaced apart roll members rotatively mounted in fixed positions, a roll member resiliently mounted between said pair of rolls, means to press said resiliently mounted roll into contact with each of said pair of rolls, a fold plate positioned opposite said resiliently mounted roll, said fold plate comprising spaced apart upper and lower plates forming a sheet receiving space therebetween, a sheet guiding blade having a sheet guiding surface being pivotally mounted in operative relationship with one end of said lower fold plate, means to move said sheet guiding surface of said blade between a first position forming an extension of said lower fold plate and a second position for deflecting sheets from entering said space between said upper and lower plates.

2. In an apparatus for folding paper the combination of a pair of spaced apart roll members rotatively mounted in fixed positions, a roll member resiliently mounted between said pair of rolls, means to press said resiliently mounted roll into contact with each of said pair of rolls, a fold plate positioned opposite said resiliently mounted roll, said fold plate comprising spaced apart upper and lower plates forming a sheet receiving space therebetween, a sheet guiding blade having a sheet guiding surface positioned in operative relationship with one end of said lower fold plate, means for mounting said blade for pivotal movement about one edge of said blade, and means to actuate said pivotal mounting means whereby said sheet guiding surface of said blade is selectively movable between a first position forming an extension of said lower fold plate and a second position to deflect sheets from entering said space between said fold plates.

3. In an apparatus for folding paper the combination of a pair of spaced apart roll members rotatively mounted in fixed positions, a roll member resiliently mounted between said pair of rolls, means to press said resiliently mounted roll into contact with each of said pair of rolls, a fold plate positioned opposite said resiliently mounted roll, said fold plate comprising spaced apart upper and lower plates forming a sheet receiving space therebetween, a sheet guiding blade having a sheet guiding surface operatively positioned adjacent one end of said lower fold plate, means for mounting said blade for pivotal movement about a fixed line extending through one edge of said blade, and means to actuate said pivotal mounting means whereby said sheet guiding surface of said blade is selectively movable between a first position forming an extension of said lower fold plate and a second position to deflect sheets from entering said space between said fold plates.

4. In an apparatus for folding paper the combination of a fold plate and a sheet guiding blade, said fold plate comprising an upper plate and a spaced apart lower plate forming a sheet receiving space therebetween, said blade positioned in operative relationship with one end of said lower plate, said blade comprising a guiding surface on

one side thereof and first and second edges, means for mounting said blade for pivotal movement about said first blade edge remote from said one end of the lower plate, and means to actuate said pivotal mounting means whereby said blade is selectively movable between a position whereby said second blade edge is adjacent said one end of the lower fold plate and whereby said guiding surface forms an extension of said lower plate and a position whereby said second blade edge is spaced from said one end of the lower fold plate and said guiding surface obstructs entry of a sheet into said sheet receiving space between said upper and lower plates.

5. In an apparatus for folding paper the combination of a fold plate and a sheet guiding blade operatively associated therewith, said blade comprising a guiding surface and first and second edges, an arm at each end of said blade, a fixed support at each end of said blade, each of said arms pivotally mounted at a pivot point on one of said fixed supports, said pivot points at each end of said blade being in alignment with the first blade edge, a lever for moving said blade about said pivot points, a linkage connecting said blade with one end of said lever, the other end of said lever secured to a shaft, and means to rotate said shaft through a predetermined angular movement whereby said blade guiding surface is selectively moved between a first position whereby said surface is operatively connected with said fold plates and a second position whereby said surface is substantially at right angles to said fold plates.

6. In an apparatus for folding paper the combination of a fold plate and a sheet guiding blade, said fold plate comprising an upper and a spaced apart lower plate forming a sheet receiving space therebetween, said blade positioned in operative relationship with one end of said lower plate, said blade comprising a guiding surface and first and second edges, an arm and a fixed support at each end of said blade, each said arm pivotally mounted at said pivot point on a fixed support, said pivot points at each end of said blade being in alignment with the first blade edge, means secured to said blade for moving the same about said pivot points, and means to actuate said blade moving means for movement between a first position whereby said guiding surface forms an extension of said lower fold plate and a second position whereby said guiding surface is substantially perpendicular to said lower fold plate.

7. In an apparatus for folding paper the combination of spaced apart first and second roll members rotatively mounted in fixed positions, a roll member resiliently mounted between said first and second roll members and contacting said first and second roll members, a fold plate positioned opposite said resiliently mounted roll, said fold plate comprising spaced apart upper and lower plates forming a sheet receiving space therebetween, a sheet guiding blade positioned in operative relation with one end of said lower plate, said blade having a sheet guiding surface and first and second edges, means for mounting said blade for pivotal movement about a fixed line extending through said first blade edge and positioned adjacent

the point of contact between said first roll and said resiliently mounted roll, and means to actuate said pivotal mounting means whereby said sheet guiding surface of said blade is selectively movable between a first position whereby said sheet guiding surface is operatively associated with said sheet receiving space and a second position whereby said sheet guiding surface is operatively associated with the point of contact between said second roll and said resiliently mounted roll.

8. In an apparatus for folding sheets, the combination of a sheet-feeding roll, a fold plate, a sheet-guiding blade, said fold plate comprising an upper plate and a spaced-apart lower plate forming a sheet-receiving space therebetween, said blade having a sheet-guiding surface on one side thereof and positioned in operative relationship with one end of said lower plate and the surface of said roll, means for mounting said blade for pivotal movement about one edge of said blade on an axis parallel with and adjacent to the surface of said roll, and means to actuate said pivotal mounting means whereby said sheet-guiding surface of said blade is selectively movable between a first position forming an extension of said lower plate to guide sheets fed by said roll into said sheet-receiving space and a second position to deflect sheets from entering said space between said upper and lower plates.

9. In an apparatus for folding sheets, the combination of a fold plate, a sheet-guiding blade, said fold plate comprising an upper plate and a spaced-apart lower plate forming a sheet-receiving space therebetween and said blade having a sheet-guiding surface on one side thereof and being positioned in operative relationship with one end of said lower plate, means for mounting said blade for pivotal movement about a fixed axis extending through one edge of said blade remote from said one end of the lower plate, means for feeding sheets edgewise against said guiding surface adjacent said one edge of the blade, and means to actuate said pivotal mounting means whereby said sheet-guiding surface of said blade is selectively movable between a first position forming an extension of said lower plate to guide sheets into said sheet-receiving space and a second position wherein the other edge of the blade is adjacent said upper plate to deflect sheets from entering said space between said upper and lower plates.

10. An apparatus as defined in claim 9 wherein said sheet-guiding surface of the blade is a substantially plane, flat surface.

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