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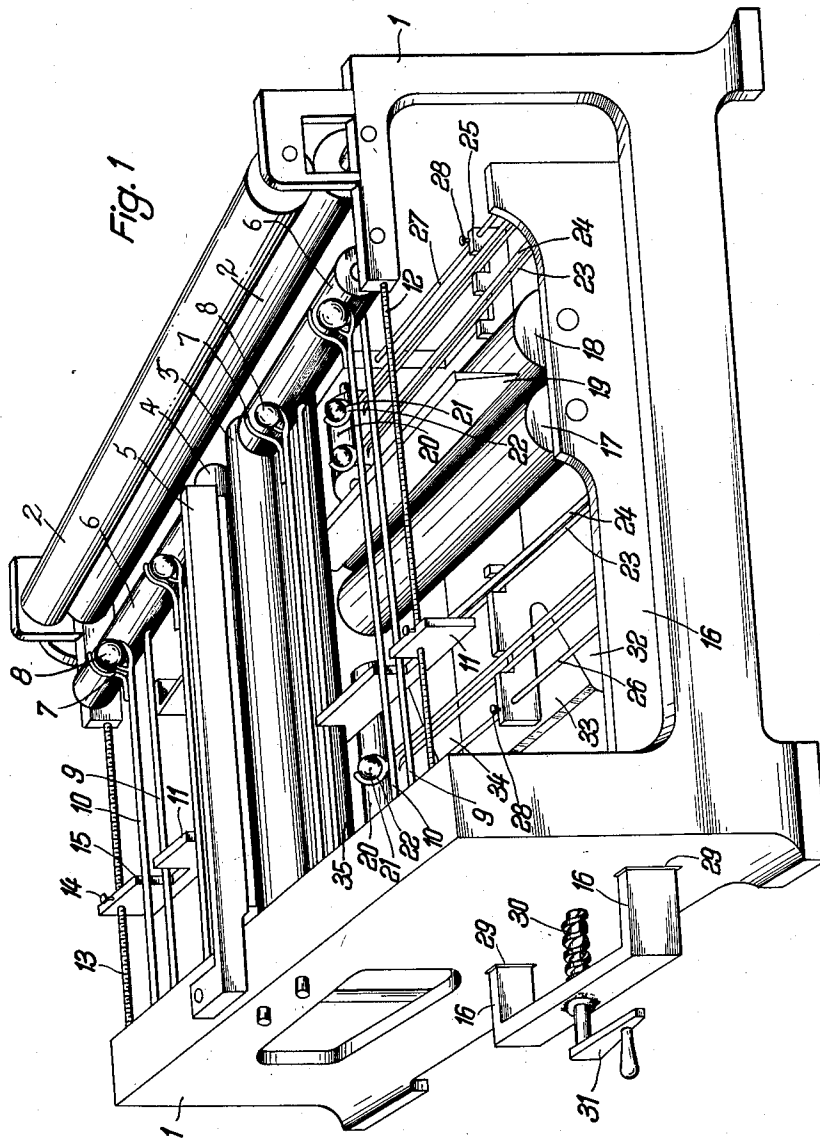
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2,912,238

SHEET FOLDING MACHINE WITH SEVERAL FOLDING DEVICES

Filed July 9, 1956

3 Sheets-Sheet 1



Nov. 10, 1959

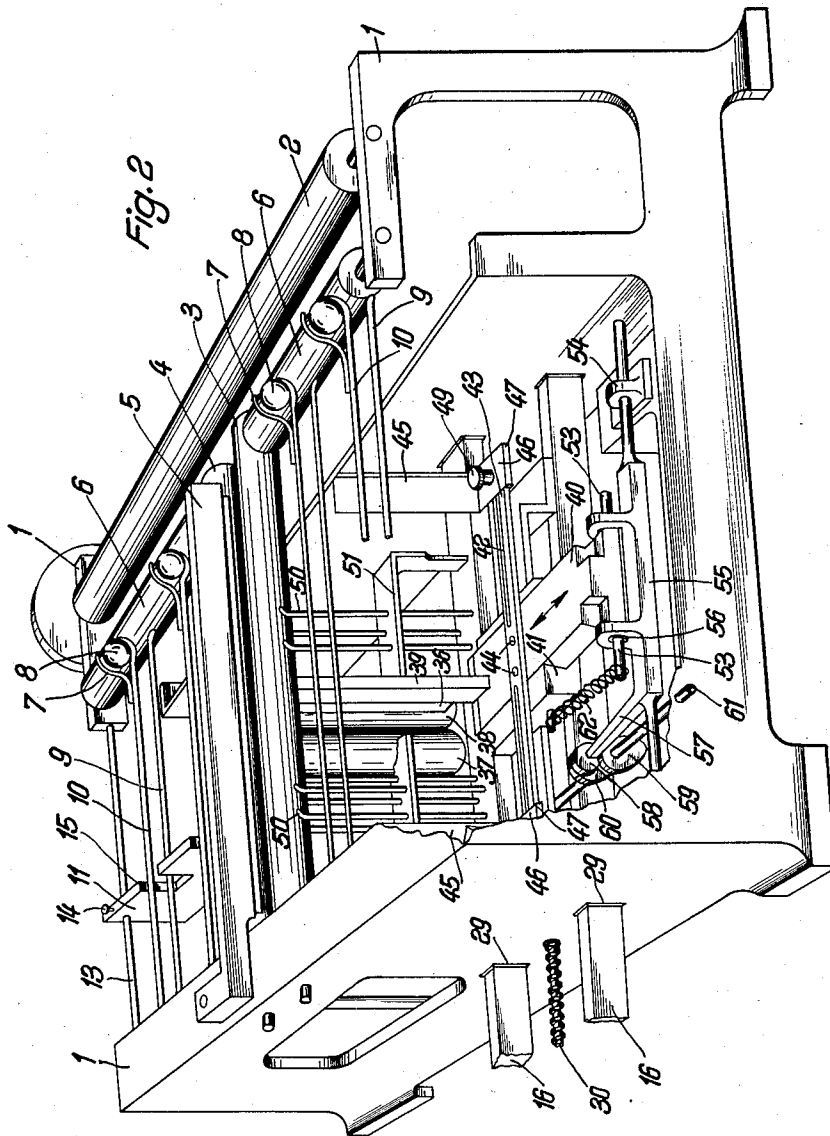
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Nov. 10, 1959

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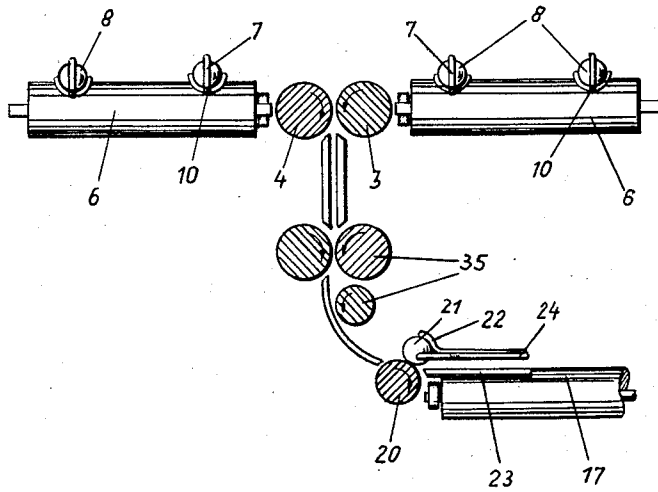
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Filed July 9, 1956

3 Sheets-Sheet 3

*Fig. 3*



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## SHEET FOLDING MACHINE WITH SEVERAL FOLDING DEVICES

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Application July 9, 1956, Serial No. 596,795

10 Claims. (Cl. 270—81)

The invention relates to a sheet folding machine with several folding devices following one after another. The known folding machines of this kind always have supplementary endless tape guides, feed rolls or the like for feeding the sheet to the limit stop of the later folding devices or they make use of the falling weight of the piece to be folded by suitably arranging the folding devices above each other whereby, however, supplementary, intricate and mobile guiding means for the sheets are necessary, which hinder the folding blade of the following folding device and which make its way undesirably long. In case of crossfolding with several sheet folding devices arranged below each other the folding blades of the following blade folding devices are arranged generally in the middle of the largest folding range, so that in case of modification of the size of the sheet the adjustment of the final abutment of the previous folding device has always to be effected from the middle of the folding device ranges. Small sheets can therefore only be folded on these folding machines with the same work speed as large sheets. Besides adjustments of the limits stops for the sheets are difficult and call for particular skill and experience. The construction of the folding machine becomes thus intricate and expensive, whereby the space required for the machine is undesirably large. As far as the work is effected starting from an unadjustable limit stop of the following folding device, the folding machine is not suitable for sheets of different sizes, or otherwise the effect of the machine will be just the same with small sheets folded as with larger sheets to be folded. It is the object of the invention to overcome these disadvantages and to provide a simplified folding machine with versatile possible uses, facilitated manipulation and decreased space required, and further to increase the work speed when smaller sheets have to be folded. This is obtained by arranging a sheet folding machine with several folding devices following one after another comprising a preceding folding device with folding cylinders and a feeding device, which may be a pair of cylinders of a preceding folding device, and a first blade folding device in cooperative connection with and directly disposed behind the preceding feeding device. The blade folding device consists of stationary pairs of parallel guide rods for the sheets to be folded and at least two stationary lateral supporting rods extending altogether parallel to the feeding direction of the sheets, a pair of parallel folding cylinders disposed in the feeding direction of the sheets and an end limit stop for the sheets to be folded adjustably disposed on said lateral supporting rods to be adjusted over the whole range of the first folding device. The feed movement of the sheets into the first folding device is actuated only by the feeding device, e.g. the folding cylinders of a preceding folding device. Solely for preventing rebounding of the sheets to be folded in the blade folding device, braking means for the sheets are provided. Preferably, the limit stop of the last folding device in the series and an end wall of a following folded sheet piling bin behind this last folding device

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form a unit and are simultaneously adjustable. In the further course of the invention, the second blade folding device, disposed directly after the first blade folding device, is arranged in such a way that it can be selectively shifted longitudinally of the first blade folding device and alternatively shifted in or out of operation; the folding blade of the second folding device being adjustably driven and its back part serving as an injector for the sheets coming out of the first folding device when the second blade folding device is disengaged. Other and further objects, features and advantages of the invention will be explained hereinafter, reference being made to the accompanying drawings, and appear in the appended claims forming part of the application.

In the drawings some examples of execution of the object of the invention are schematically shown.

Fig. 1 is a perspective view of an embodiment of the sheet folding machine with folding cylinders of a preceding folding device and two blade folding devices,

Fig. 2 is a perspective view of another embodiment of the folding machine with folding cylinders of a preceding folding device and a disengageable second blade folding device, and

Figure 3 is a schematic partial cross-sectional view of the machine shown in Figure 2 in the direction of the axes of rollers 3 and 4.

1 is the stationary frame of the folding machine, which may be in cooperating connection with a preceding envelope folding device. The work piece in form of a sheet or of a sheet provided with a pocket- or blade-crease is fed to the blade folding device by the folding cylinders 2 of the preceding folding or feeding device. The blade folding device consists of the two blade folding cylinders 3 and 4 arranged with their axes alined in the feed direction of the sheet and a folding blade 5 movable up and down and mounted parallel to the cylinders 3 and 4. In order to avoid the rebounding of the sheets there are provided, on both sides of the folding blade cylinders 3 and 4 transverse cylinders 6 each of which cooperate with counter pressure means freely movable in rings or cages 7. The said counter pressure means have the form of balls 8. Behind the counter pressure means there are arranged parallel guides 9 and 10 for guiding the sheets in sheet feed direction. The upper guide rods 10 carry the cage, rings or yokes 7 for the balls 8. The cylinders 6 are arranged in the mutual axial alinement and they may consist of several short cylinders, rollers, disks or the like. At both sides of the blade folding cylinders 3 and 4 there is furthermore arranged rectangularly to them a common limit stop 11 which is adjustable over the whole range of this blade folding device. The limit stop 11 has the form of a rail, a piece of sheet metal or the like and is guided on two lateral stationary supporting rod 12, 13 disposed parallel to each other and to said guide rods 9, 10 and can be fixed on these supporting rods by means of clamping screws 14 after it has been suitably adjusted. The sheet guide rods 9 and 10 extend through suitable recesses 15 of the limit stop rail 11. Underneath this first blade folding device 1 to 15 there is arranged on a slide-shaped support 16 a second blade folding device with a sheet feed direction rectangular to the feed direction of the first blade folding device. The second folding device is analogous to the first blade folding device with folding cylinders 17, 18, a folding blade 19, cylinders 20, balls 21 as counterpressure means in cages, rings and yokes 22, sheet guide rods 23, 24, a rail-shaped limit stop 25, supporting rods 26, 27 and clamping screws 28. All these parts are arranged in and on the slide shaped support 16. The slide-shaped support 16 is adjustably arranged in guides 29 of the frame 1 and can be adjusted transversely to the longitudinal direction of the folding cylinders 17, 18

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by a threaded spindle 30 with crank handle 31. The stop 25 at the same time forms a unit with an end wall 32 for the pile of the folded sheets arranged underneath it. The said stop 25 and said wall 32 are arranged movably over the whole pile table 33 having a stationary closing end wall 34. Here the entirely folded work pieces in the form of the sheets folded several times can be stored in a pile. With both blade folding devices acting one after the other on the same sheet, the folding procedure begins always at the same point, while the limit stop for the sheet to be folded according to the length of the same can be adjusted in the feed direction over the whole range of the blade folding device. For smaller, respectively shorter work pieces the feed stroke of the work pieces is correspondingly shortened, so that the folding machine can work quicker with small work pieces, which causes an increased output. Below the blade folding cylinders 3, 4 of the first blade folding device there is suitably arranged a further pair of rollers 35, so that the work pieces have to pass through a certain distance when leaving the first blade folding device, before they come into the second blade folding device (Fig. 1). It is also possible to arrange several pairs of cylinders or guide rods, or guide plates to provide a bow shaped way for the sheets between the blade folding cylinders 3, 4 of the first blade folding device and the folding cylinders 17, 18 of the second blade folding device.

In Fig. 2 the corresponding parts of the folding cylinders of the preceding feeding device and the first blade folding devices of the folding machine are designated with the same reference numerals as in Fig. 1. The second blade folding device, arranged as a disengageable blade folding device, comprises the folding blade 36 and the appertaining folding cylinders 37, 38. The back 39 of the folding blade 36 is designed to serve as an ejector for the sheets emanating from the first folding device when the second folding device is disengaged. The folding blade 36 is arranged on a guide and drive device which consists of a fixed part 41 and a mobile part 40 which can be reciprocally moved toward and away from the cylinders 37, 38 and which bears the folding blade 36. On this mobile part 40 there is also fixed a horizontal rail 43 by means of screws 44, said rail being provided with longitudinal slots 42. On the rail 43 there are arranged, parallel to the folding blade 36, auxiliary rails 45, which can be adjusted in their distance from the folding blade 36. The auxiliary rails 45 are used to aid the ejecting operation of the back 39 of the blade 36 for the sheets fed out of the first folding device when the second folding device is disengaged.

The auxiliary rails 45 bear with a rectangular end shank 46 against the slotted rail 43 and with a bent short nose or rim portion 47 against the longitudinal edge of the rail 43 and they are removably connected by threaded bolts and knurled nuts 49 penetrating through the slots 42. After the loosening of the knurled nuts 49 the screws with the auxiliary rails 45 can be adjusted in the slotted rail 43 in its distance from the folding blade 36.

Guide rods 40 are arranged parallel to the cylinder 37, 38 and a paper stop 51 for the sheet to be folded is arranged rectangularly to the cylinders 37, 38.

The mobile part 40 bearing the folding blade 36 of the third folding device is driven through pins or rollers 53 by a bell crank lever 55 pivotally mounted at 54 having slots or longitudinal holes 56 in the parallel shanks of it for engagement with said pins or rollers 53. Another shank 57 of this bell crank lever 55 bears by means of a roller 58 on an eccentric 59 or an adjacent eccentric 60 under the influence of a spring 62 acting upon one of the pins 53. The eccentrics 59, 60 are in driving connection with the shaft 61 but arranged axially adjustable for alternately engaging said roller 58 at the shank 57 of said crank lever 55. The driving eccentrics 59 and 60 have different peripheries with their largest curved radii in opposite directions so that by engagement of the

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eccentric 59 with the roller 58 the folding blade 36 of the second folding device is moved from the position far away from the appertaining folding cylinders 37, 38 towards them in order to execute the folding process. If the other eccentric 60 is brought in engagement with the roller 58, the folding blade 36 is given an oppositely phased motion with a greater range of movement so that the back 39 of the folding blade 36 together with auxiliary rails 45 operates as an ejector for the folded sheets or folded pieces coming out of the second folding device. The folded sheets are then ejected towards the front side of the folding machine, while, if the blade 36 of the third folding device is actuated by the eccentric 59, the sheets leave the folding machine at its back with an additional fold. For all of the folding devices the feed of the sheets from one folding device to the next following device is only effected by means of the folding cylinders of the preceding device without making use of any supplementary feeding means such as cylinders, rollers, ribbons, brushes, or the like.

I claim:

1. A sheet folding machine for successively folding a sheet of material passing therethrough having a plurality of folding devices following one after another including a preceding feeding device, a first blade folding device and a second blade folding device in cooperative disposition; said first folding device comprising a pair of parallel folding cylinders and a folding blade all mounted with their axes oriented in the direction of sheet passage through said preceding feeding device, a plurality of supporting rods disposed parallel to said parallel cylinders and coextensive therewith, an end limit stop member longitudinally slidably supported on said supporting rods transverse to said cylinders, said limit stop member slidably adjustable on said supporting rods through the whole length of said parallel cylinders; said second folding device comprising a pair of parallel folding cylinders disposed beneath and adjacent said first folding device with their axes oriented transverse to the axes of the cylinders of said first folding device, a folding blade in cooperative disposition with said cylinders, guide means disposed to receive sheets emanating from said first blade folding device and to guide said sheets along and adjacent said second pair of folding cylinders between said cylinders and their cooperating folding blade, said second blade folding device mounted on slide support means for adjustably positioning said second folding device longitudinally of said subsequent folding device.

2. A sheet folding machine as in claim 1 and wherein said second folding device includes a plurality of supporting rods disposed parallel to said cylinders of said second folding device and co-extensive therewith, a second end limit stop member adjacent and transverse to said cylinders of said second folding device adjustably supported on said supporting rods for adjustment longitudinally of said cylinders of said second folding device over substantially the full length thereof; a pile storage device disposed below said second blade folding device, said pile storage device comprising a sheet pile table having a stationary closing end wall and an oppositely disposed adjustable end wall above said pile table, said adjustable end wall being rigidly connected with said second end limit stop member of said second blade folding device.

3. A sheet folding machine for successively folding a sheet of material passing therethrough having a plurality of folding devices following one after another including a preceding feeding device, a first blade folding device and a second blade folding device in cooperative disposition; said first folding device comprising a pair of parallel folding cylinders and a folding blade all mounted with their axes oriented in the direction of sheet passage through said preceding feeding device, one end of said parallel cylinders disposed adjacent said preceding folding device whereby sheets to be folded pass from said

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preceding folding device immediately into said first folding device, stationary guide means for receiving and guiding sheets to be folded into said first blade folding device, a plurality of supporting rods disposed parallel to said parallel cylinders and co-extensive therewith, an end limit stop member longitudinally slidably supported on said supporting rods extending transversely of said cylinders, said limit stop member slidably adjustable on said supporting rods through substantially the whole length of said parallel cylinders, said preceding feeding device, said parallel rollers and said stationary guide rods comprising the sole means of effecting movement of sheets to be folded into said subsequent folding device; said second folding device comprising a pair of parallel folding cylinders and a cooperating folding blade all mounted beneath and adjacent said blade folding device and disposed with the axes of said cylinders oriented transverse to the axes of the cylinders of said first folding device, further pairs of stationary guide rods disposed to receive sheets emanating from said first blade folding device and to guide the sheets along and adjacent said second pair of folding cylinders between said cylinders and their cooperating folding blade, a further plurality of stationary supporting rods disposed parallel to said second pair of parallel cylinders and co-extensive therewith, a second limit stop member longitudinally supported on said second supporting rod and intersecting said further pairs of stationary guide rods; said second blade folding device mounted on slide support means adjustably positionable longitudinally of said first folding means.

4. A sheet folding machine for successively folding a sheet of material passing therethrough having a plurality of folding devices following one after another including a first folding device including a pair of folding cylinders, guide means for receiving and supporting a sheet of material adjacent said pair of cylinders of said first folding device, a plurality of stationary supporting rods disposed parallel to said pair of cylinders, an end limit stop member longitudinally slidably supported on said supporting rods and intersecting said guide means, said limit stop member slidably adjustable on said supporting rods over substantially the whole length of said parallel cylinders, a second folding device comprising a pair of parallel folding cylinders and a cooperating folding blade mounted adjacent said first folding device wherein the axes of said cylinders and said folding blade of said second folding device are oriented transverse to the axes of said cylinders of said first folding device, further guide means for receiving and guiding sheets emanating from said first pair of folding cylinders along and adjacent said second pair of folding cylinders, support means adjustable in a direction parallel to the axes of said cylinders of said first folding device, said second folding device mounted on said support means, whereby said end limit stop member and said second folding device may be selectively positioned longitudinally of said first folding device.

5. A sheet folding machine having a plurality of folding devices following one after another for successively folding a sheet of material passing therethrough including a first folding device including a first pair of folding cylinders, guide means for receiving and supporting a sheet of material in said first folding device, an adjustable end stop member adjustably mounted adjacent said first pair of cylinders and adjustable over substantially the full length of said cylinders, a second folding device including a second pair of parallel folding cylinders and a cooperating folding blade mounted adjacent said first blade folding device, said second pair of parallel folding cylinders mounted with one end adjacent said first pair of folding cylinders and with the axes of said second pair of folding cylinders transverse to the axes of said first pair of folding cylinders, further guide means for receiving and guid-

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ing sheets emanating from said first pair of folding cylinders to said second pair of folding cylinders, first support means adjustably mounted for selective positioning in a direction parallel to the axes of said first pair of folding cylinders, said second folding device mounted on said first support means whereby said second folding device may be selectively positioned longitudinally of said first folding device.

6. A sheet folding machine as in claim 5 and including second support means on said first support means for supporting the folding blade of said second folding device for adjustment in a direction toward and away from said cylinders of said second folding device transverse to the axes of said first pair of cylinders whereby a sheet passing through said machine may be selectively passed through said second folding device or bypassed around said second folding device by transverse adjustment of said folding blade, said folding blade having a back part for use as an ejector of sheets bypassing said second folding device.

7. A sheet folding machine as in claim 6 and including cam operated drive means for reciprocating said folding blade of said second folding device transversely of said first pair of folding cylinders.

8. A sheet folding machine as in claim 7 and wherein said cam operated drive means includes a rotatable driving shaft, two cam discs mounted on said driving shaft in spaced relation to each other, said cam discs being axially adjustably secured to said driving shaft in driving connection therewith and movement transmission means in driving connection with said second support means including a cam follower disposed adjacent said cams, said cams being alternatively engageable with said cam follower upon selective axial positioning of said cams, one of said cams designed to position and reciprocate said folding blade for passing sheets to be folded through said second folding device and the other of said cams designed to position and reciprocate said folding blade for ejecting sheets emanating from said first folding device bypassing said second folding device.

9. A sheet folding machine for successively folding a sheet of material passing therethrough comprising, in combination; a preceding feeding device; a first folding device including a pair of parallel folding cylinders, and an end stop member adjustably mounted adjacent said cylinders and adjustable over substantially the full length of said cylinders; a second folding device including a pair of parallel folding cylinders mounted beneath and adjacent said first folding device disposed with their axes oriented transverse to the axes of the cylinders of said first folding device; and means to guide sheets emanating from said first folding device into said second folding device; said second folding device being adjustably mounted for selective positioning in a direction parallel to the axes of said cylinders of said first folding device.

10. A sheet folding machine as in claim 9 and wherein said first and second folding devices are mounted in a common machine casing, and including a movable support device adjustably mounted in said machine casing for selective positioning in a direction parallel to the axes of said cylinders of said first folding device, and wherein said second folding device is supported on said support device whereby said second folding device may be selectively positioned in a direction parallel to the axes of said cylinders of said first folding device.

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