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PAPER FOLDING MACHINE

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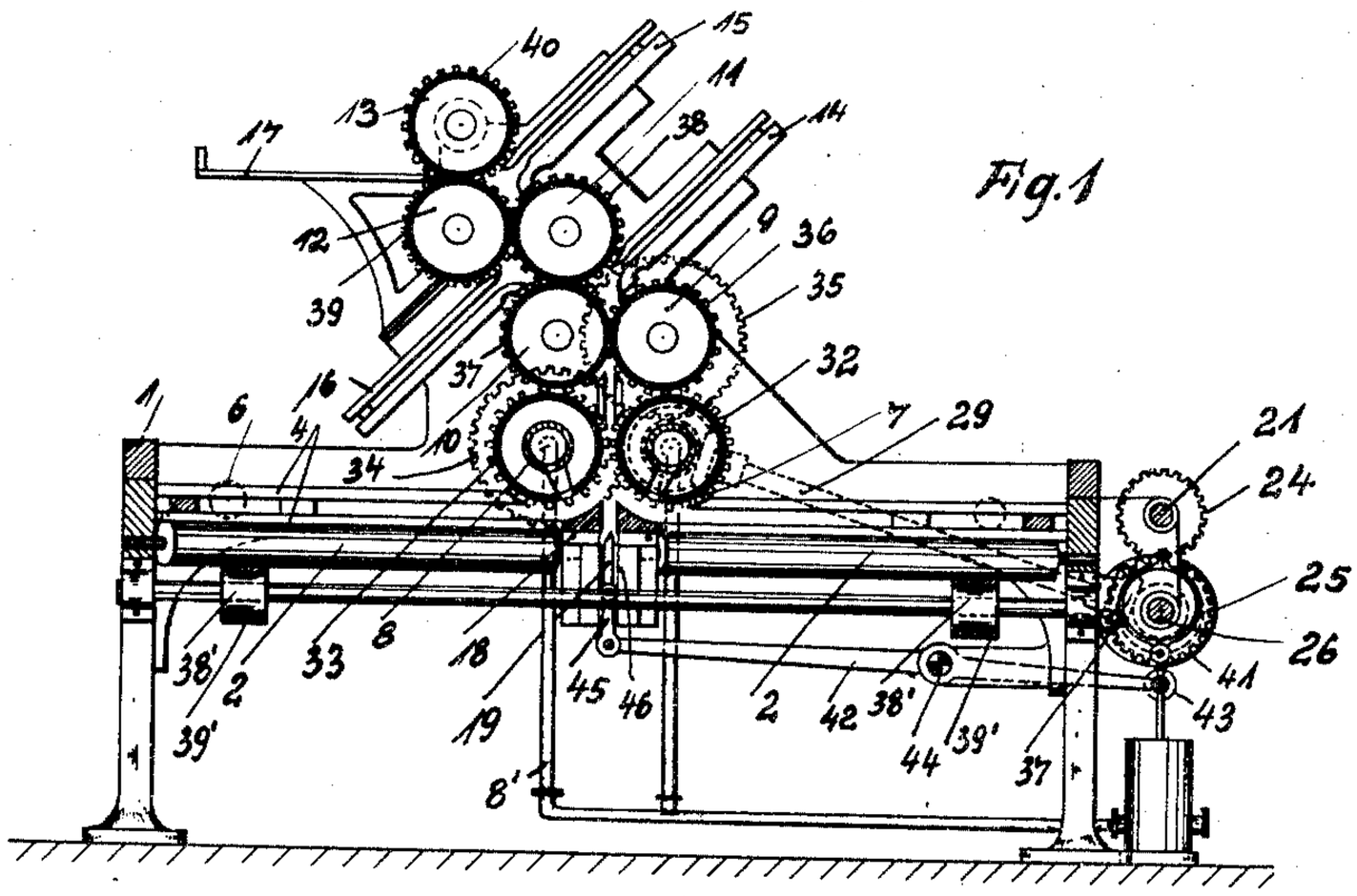

Fig. 1

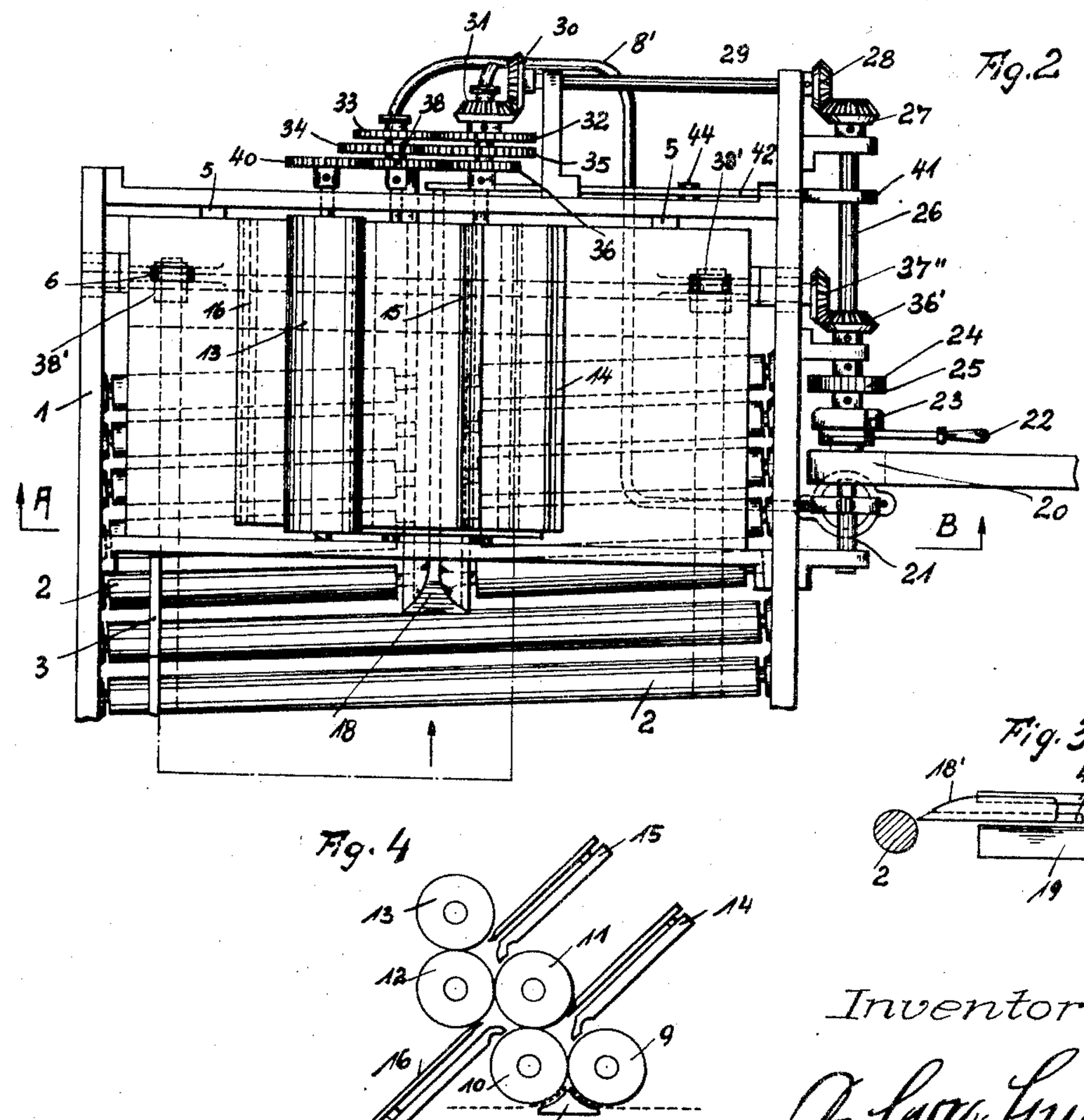

Fig. 2

Fig. 3

Fig. 4

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PAPER FOLDING MACHINE

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The present invention relates to a paper folding machine. In the known paper folding machines a table is provided from which the sheets of paper to be folded are fed to the folding mechanisms. The folding mechanisms are arranged either below or above the table and the sheets are conveyed to the folding mechanisms by mechanical feeding means, for example by conveying rollers which grip the sheets by friction and move them onwards, or by means of reciprocating friction rollers. The feeding of the sheets by means of friction rollers is not entirely free from objection. Sometimes the friction between the sheets which are to be fed and the friction rollers is too small, in which case stoppages in the feeding of the sheets take place. On the other hand it is possible that the friction rollers may press too hard on the sheets, in which case several sheets will adhere to one another and will be gripped simultaneously. Moreover, as a result of the mechanical action of the friction rollers on the sheets the danger arises that the latter may become damaged, especially if they are very thin. Furthermore, if the friction rollers have to reciprocate between the feed table and the folding mechanisms or if reciprocating grippers are provided then the extent to which the output can be increased is limited, inasmuch as the velocity of the reciprocating parts cannot be increased, as desired, indefinitely. In addition to this, if grippers are provided the folding mechanisms and the feeding devices take up a comparatively large space.

The present invention aims at providing a paper folding machine which is so constructed that the sheets are gripped with certainty and passed onwards without damage, and that the folding mechanisms are arranged so close to one another that the paths which have to be covered by the sheets to be folded are as short as possible.

The paper folding machine according to the invention is principally characterized by the provision of folding mechanisms arranged one above the other above paper feeding means, such as a feed table, each of which folding mechanisms comprises three rollers mounted so that the plane passing through the axes of two of said rollers is substantially at right angles to the plane passing through the axis of one of the two rollers and that of the third roller and a pocket, two of the rollers of each folding mechanism constituting at the same time two of the rollers of the next succeeding folding mechanism. A further feature of the invention resides in the provision of suction rollers arranged above the feed table, which raise the sheet to be folded from the table and convey it to the lowest folding mechanism. In the arrangement of the folding mechanisms according to the invention these latter are located so close to one another that the space which they require is as small as possible and that the path through which the sheets to be folded have to pass in the folding mechanisms is as short as possible. The employment of suction rollers for feeding the sheets ensures that the sheets are conveyed accurately and reliably, inasmuch as the suction action of the suction rollers can be adjusted in known manner so exactly that the sheets do not adhere either too little or too much to the said suction rollers and inasmuch as the conveying of the sheets by suction action does not result in damage to the latter.

The efficiency of the folding machine according to the invention is greater than that of the known machines inasmuch as the speed of the suction rollers can be increased to any desired extent without detrimentally affecting the feeding action, and inasmuch as the paths through which the sheets have to pass in the folding mechanisms are as short as possible.

Two preferred constructional forms of a folding machine according to the invention are illustrated by way of example on the accompanying drawing, in which:

Fig. 1 shows a folding machine in one constructional form according to the invention, in section taken on the line A—B of Fig. 2,

Fig. 2 shows the said folding machine in plan,

Fig. 3 shows a detail of the said machine, and

Fig. 4 shows diagrammatically in side view a modified constructional form of the roller mechanisms.

Referring to the drawing:

In a framework 1 feed rollers 2 are mounted which constitute in known manner the feed table or track along which the individual sheets are fed to the folding mechanisms. The feed rollers 2 are rotated in the same direction by means of a driving gear which is hereinafter described. The sheets are conveyed to the feed rollers by means of a sheet feeding device of known kind (not shown on the drawing) or are placed on the feed rollers by hand. The sheets are fed in the direction of the arrow in Fig. 2 along a registering guide 3 into a pocket 4 of known kind provided with registering stops 5 which arrest the movement of the sheets. By means of the registering stops 5 and a lateral pulling device of a kind known per se indicated at 6, the sheet which

is foremost at any given time is exactly registered.

Above the feed table the folding mechanisms and the means for lifting the sheet to be folded from the feed table and conveying it to the folding mechanism are arranged. The conveying means are constituted by two suction rollers 7 and 8 mounted parallel to the feed table 2 in the framework 1, the said suction rollers being constructed in a manner known per se. The suction rollers are driven by means of a driving gear hereinafter described and consist in known manner of hollow cylinders in which suction nozzles are arranged. The suction nozzles are connected to a suction conduit 8. As the construction of sheet conveying devices provided with suction rollers is known per se, these parts are merely indicated on the drawing.

Above the feed table 2 the folding mechanisms are arranged. Three folding mechanisms are provided which consist of the folding rollers 9, 10, 11, 12 and 13 and the three folding pockets 14, 15 and 16. The two folding rollers 9 and 10 are mounted immediately above the suction rollers 7, 8 in the framework 1. Above the folding roller 10 the folding roller 11 is arranged in such manner that the plane passing through the axes of the rollers 9, 10 forms a right angle with the plane passing through the axes of the rollers 10, 11. The three folding rollers 9, 10, 11 and the folding pocket 14 constitute the first folding mechanism. The second folding mechanism is constituted by the said rollers 10, 11 and a third roller 12 together with the folding pocket 16. The folding roller 12 is mounted with regard to the rollers 10 and 11 in such manner that the plane passing through the axes of the rollers 10 and 11 forms a right angle with the plane passing through the axes of the rollers 11 and 12. The aforesaid rollers are mounted immediately adjacent to one another without the interposition of any other parts whatever. Above the second folding mechanism a third folding mechanism is provided which is made up of the two rollers 11 and 12, the roller 13 mounted above the roller 12 and the folding pocket 15. The rollers are again arranged in such manner that the plane passing through the axes of the rollers 11 and 12 forms a right angle with the plane passing through the axes of the rollers 12 and 13. In the constructional form of the folding mechanisms described each folding mechanism is provided with three rollers but adjacent folding mechanisms have two folding rollers in common. In this way it is rendered possible to construct the folding mechanisms with a small number of rollers. Moreover, the paths through which the sheets to be folded have to pass in the folding mechanisms are kept as small as possible. The sheet is pushed forward on the feed table 2 in such manner that the suction rollers, the pneumatic action of which is controlled, lift it from the feed table and draw it in between themselves thereby imparting to it a preliminary fold. The sheet thus provided with a preliminary fold is moved vertically upwards and brought between the rollers 9 and 10 which convey it into the folding pocket 14. The sheet is then drawn out of the folding pocket by the rollers 10 and 11 and is moved onwards in a horizontal direction so that it finally passes into the folding pocket 16. The rollers 11 and 12 grip the folded sheet and pass it onwards in a vertical direction to the uppermost folding mechanism into the folding pocket 15 of which it is introduced and from which it is discharged by the rollers 12 and 13 in a horizontal direction and delivered on to a table 17 or the like. The paths of entry and emergence through which the sheets pass during their introduction into and discharge from the individual folding mechanisms in the constructional form illustrated form a right angle with one another and are as short as possible. The constructional form shown renders it possible to feed the sheets in transverse form.

In the constructional forms illustrated in Figs. 1 and 2 the suction rollers 7 and 8 constitute conveying means which convey the sheet from the feed table 2 to the folding mechanisms, meanwhile imparting to it a preliminary fold. In certain circumstances the suction rollers may be omitted and the folding mechanisms may be mounted correspondingly lower down so that the folding mechanisms 9 and 10 are located at the place where in the constructional forms shown in Figs. 1 and 2 the suction rollers 7 and 8 are arranged. In this case the folding rollers themselves are constructed in the form of suction rollers. A construction of this kind is shown in Fig. 4.

In order that the sheet may be gripped with certainty by the suction rollers 7, 8, it is creased whilst it is still on the feed table. For this purpose a raised shaping member is provided which is illustrated in the form of a batten 18. The part of the sheet which is first to be gripped by the suction rollers 7, 8 lies in a raised position on the shaping batten which is so constructed that the sheet has a slight crease imparted to it at the part at which it is to be folded. In this way the gripping of the sheet by the rollers 7, 8 is facilitated. In addition to this a folding or creasing blade 19 of a kind known per se is provided which moves intermittently in a vertical direction through a gap provided in the shaping batten 18 and lifts the sheet resting on the latter in order to feed it to the suction rollers 7, 8.

The drive of the suction rollers 7, 8 and of the folding rollers 9–13 as also of the conveying or feed rollers 2 is derived from a motor or the like (not illustrated on the drawing) which through the medium of a belt pulley 20 turns a shaft 21 upon which the said pulley is fixed. The shaft 21 drives through the medium of a coupling 23, operable by means of a hand lever 22, a transmission gear 24, 25 by which a shaft 26 is rotated which drives a shaft 29 through the medium of bevel wheels 27, 28. The shaft 29 drives through the medium of bevel wheels 30, 31 the pinions 32–40, which are mounted on the axles of the suction rollers 7, 8. The suction rollers 7, 8 are thus caused to rotate in opposite directions. To the pinion 33 a pinion 34 is rigidly connected which engages a pinion 35 rigidly connected with the folding roller 9. The folding roller 9 drives the other folding rollers through the medium of the other pinions.

On the shaft 26 a bevel wheel 36′ is likewise provided which is in engagement with a bevel wheel 37′ mounted on a shaft 37″. On the shaft 37″ two pulley wheels 38″ are fixed over which belts 39′ run which are in contact with all the feeding rollers 2 and thus cause the rotation of the latter.

The folding mechanism 19 is controlled by means of a cam disc 41 which is mounted on the shaft 26 and against which a roller 43 provided on a double-armed lever 42 rests continuously. The double-armed lever 42 swings about a pivot pin 44 provided on the machine frame-

work 1. The creasing blade 19 is connected with the double-armed lever 42 by means of a link 45. The creasing blade 19 is also guided in such manner as to allow of vertical movement in a guide 46. The guide is constructed so as to constitute a bearing for the feed rollers 2 which are divided beneath the shaping batten.

In order that the sheet which is to be fed up to the shaping batten 18 by the rollers 2 should not strike against the batten and become crumpled, the shaping batten is bevelled off at its front end at 18, 10 (Fig. 3) so that its lower edge is located beneath the upper level of the rollers 2. The sheet therefore contacts with the inclined surface of the bevelled portion and is pushed forwards by the rollers 2 along the said inclined surface without becoming crumpled or crushed.

I claim:

1. A paper folding machine, comprising in combination: a framework; paper feeding means arranged on said framework; folding mechanisms arranged on said framework one above the other above said paper feeding means and each comprising three rollers mounted so that the plane passing through the axes of two of said rollers is substantially at right angles to the plane passing through the axis of one of the two rollers and that of the third roller, and a pocket; two of the rollers of each folding mechanism constituting at the same time two of the rollers of the next succeeding folding mechanism; suction rollers arranged between the lowest of said folding mechanisms and said feeding means, for lifting the sheet of paper to be folded from said feeding means and conveying it to said lowest folding mechanism; and a raised shaping member which is arranged on said paper feeding means opposite to said suction rollers and on which the part of the sheet of paper to be folded is raised and creased.

2. A paper folding machine, comprising in combination: a framework; paper feeding means arranged on said framework; folding mechanisms arranged on said framework one above the other above said paper feeding means and each comprising three rollers mounted so that the plane passing through the axes of two of said rollers is substantially at right angles to the plane passing through the axis of one of the two rollers and that of the third roller, and a pocket; two of the rollers of each folding mechanism constituting at the same time two of the rollers of the next succeeding folding mechanism; suction rollers arranged between the lowest of said folding mechanisms and said feeding means, for lifting the sheet of paper to be folded from said feeding means and conveying it to said lowest folding mechanism; and a raised shaping batten which is arranged on said paper feeding means opposite to said suction rollers and on which the part of the sheet of paper to be folded is raised and creased.

3. A paper folding machine, comprising in combination: a framework; paper feeding means arranged on said framework; folding mechanisms arranged on said framework one above the other above said paper feeding means and each comprising three rollers mounted so that the plane passing through the axes of two of said rollers is substantially at right angles to the plane passing through the axis of one of the two rollers and that of the third roller, and a pocket; two of the rollers of each folding mechanism constituting at the same time two of the rollers of the next succeeding folding mechanism; suction rollers arranged between the lowest of said folding mechanisms and said feeding means, for lifting the sheet of paper to be folded from said feeding means and conveying it to said lowest folding mechanism; a raised shaping batten which is arranged on said paper feeding means opposite to said suction rollers and on which the part of the sheet of paper to be folded is raised and creased.

4. A paper folding machine, comprising in combination: a framework; paper feeding means arranged on said framework; folding mechanisms arranged on said framework one above the other above said paper feeding means and each comprising three rollers and a pocket, all of said rollers being so arranged that the plane passing through the axes of any of two succeeding rollers is substantially at right angles to the plane passing through the axis of one of said two rollers and the axis of the next succeeding roller, whereby the paths of entry and emergence of the paper into and out of any of the said folding mechanisms are located substantially at right angles to one another, two of the rollers of each folding mechanism constituting at the same time two of the rollers of the next succeeding folding mechanism; suction rollers arranged between the lowest of said folding mechanisms and said feeding means, for lifting the sheet of paper to be folded from said feeding means and conveying it to said lowest folding mechanism; a raised shaping batten which is arranged on said paper feeding means opposite to said suction rollers and on which the part of the sheet of paper to be folded is raised and creased; and a creasing blade reciprocating through said shaping batten for lifting a sheet of paper from said feeding means and presenting it to said suction rollers.

5. A paper folding machine, comprising in combination: a horizontal paper feed table; folding mechanisms arranged one above the other above said paper feed table; each folding mechanism comprising two rollers mounted in parallel relationship to said paper feed table equidistant therefrom and adapted to feed and fold the sheets, and a pocket adapted to receive the sheets, one roller of each folding mechanism being arranged above one roller of the preceding folding mechanism and being adapted to co-operate with the last named roller, the pocket of the lowest folding mechanism being arranged above one roller of the said folding mechanism and the said rollers of the said lowest folding mechanism being adapted to lift the sheets directly from the paper feeding table; the uppermost last folding mechanism comprising a pocket arranged on that side of the rollers of the preceding folding mechanism which is opposite to the pocket of the said preceding folding mechanism and a roller arranged laterally of the said pocket of the said uppermost folding mechanism and adapted to co-operate with one roller of the preceding folding mechanism; and means for delivering the folded sheets.

6. In a paper folding machine, the combination of: means for feeding paper to the machine; a horizontal feed table; a folding mechanism arranged above said feed table and comprising two rollers arranged in parallel relationship to the said paper feed table and equidistant therefrom, and a pocket arranged above one of the said rollers; a third roller arranged above the other

one of the said rollers and a fourth roller; the third and the fourth rollers being arranged in parallel relationship to the first named rollers and equidistant from the surface of the paper feed table; a second pocket co-operating with the said first-named rollers to constitute a second folding mechanism; a fifth roller and a third pocket co-operating with the rollers of said second folding mechanism to constitute a third folding mechanism; means arranged between said first-named folding mechanism and said paper feeding table, for lifting a sheet of paper from the latter and conveying it to the said first-named folding mechanism; and means for delivering the folded sheets.

7. A paper folding machine, comprising in combination: a horizontal paper feed table; folding mechanisms arranged one above the other above said paper feed table; each folding mechanism comprising two rollers mounted in parallel relationship to said paper feed table and equidistant therefrom and adapted to feed and fold the sheets, and a pocket adapted to receive the sheets, one roller of each folding mechanism being arranged above one roller of the preceding folding mechanism and being adapted to co-operate with the said roller, the pocket of the lowest folding mechanism being arranged above one roller of the said folding mechanism; and two suction rollers, arranged below the rollers of the said lowest folding mechanism and above the said paper feed table and being adapted to lift the sheets directly from the paper feed table; a final folding mechanism comprising a pocket arranged on that side of the rollers of the preceding folding mechanism which is opposite to the pocket of the said preceding folding mechanism and a roller arranged laterally of the said pocket of the said final folding mechanism and adapted to co-operate with one roller of the preceding folding mechanism; and means for delivering the folded sheets.

8. A paper folding machine, comprising in combination: a horizontal paper feed table; folding mechanisms arranged one above the other above said paper feed table; each folding mechanism comprising two rollers mounted in parallel relationship to said paper feeding table equidistant therefrom and adapted to feed and fold the sheets, and a pocket adapted to receive the sheets, one roller of each folding mechanism being arranged above one roller of the preceding folding mechanism and being adapted to co-operate with the said roller, the pocket of the lowest folding mechanism being arranged above one roller of the said folding mechanism and the said rollers of the said lowest folding mechanism being adapted to lift the sheets directly from the paper feed table; a final folding mechanism comprising a pocket arranged on that side of the rollers of the preceding folding mechanism which is opposite to the pocket of the said preceding folding mechanism; a roller arranged laterally of the said pocket of the said final folding mechanism and adapted to co-operate with one roller of the said preceding folding mechanism; and means for delivering the folded sheets, all the said rollers being constituted by suction rollers.

9. In a paper folding machine, the combination of: means for feeding paper to the machine; a horizontal feed table; a folding mechanism arranged above said feed table and comprising two rollers arranged in parallel relationship to the said paper feed table and equidistant therefrom, and a pocket arranged above one of the said rollers; a third roller arranged above the other one of the said rollers; and a fourth roller, the third and the fourth rollers being arranged in parallel relationship to the first named rollers and equidistant from the surface of the paper feed table, and a second pocket co-operating with the said first-named rollers to constitute a second folding mechanism; a fifth roller and a third pocket co-operating with the rollers of said second folding mechanism to constitute a third folding mechanism; and two suction rollers, arranged below the rollers of the said lowest folding mechanism and above the said paper feed table for lifting a sheet of paper from the latter and conveying it to the said first-named folding mechanism and delivery means.

10. In a paper folding machine, the combination of: means for feeding paper to the machine; a horizontal feed table; a folding mechanism arranged above said feed table and comprising two rollers arranged in parallel relationship to the said paper feed table and equidistant therefrom, and a pocket arranged above one of the said rollers; a third roller arranged above the other one of the said rollers; and a fourth roller; the third and fourth rollers being arranged in parallel relationship to the first named rollers and equidistant from the surface of the paper feed table; a second pocket co-operating with the said first-named rollers to constitute a second folding mechanism; and a fifth roller and a third pocket co-operating with the rollers of said second folding mechanism to constitute a third folding mechanism; all the said rollers being constituted by suction rollers.

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