March 18, 1941. H. L. L. JESUS 2,235,484

MACHINE FOR FOLDING FLAT LINEN AND THE LIKE

Filed Jan. 8, 1938 2 Sheets-Sheet 1

Fig. 1

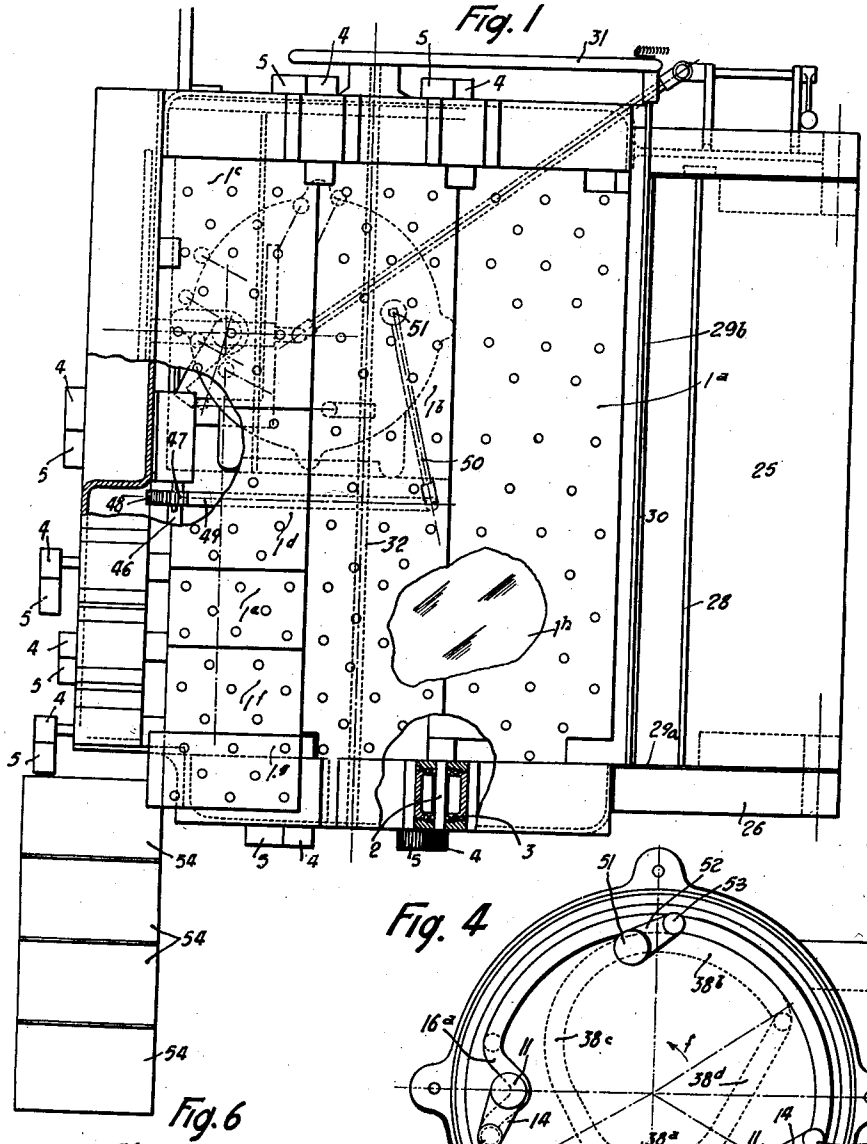


Fig. 4

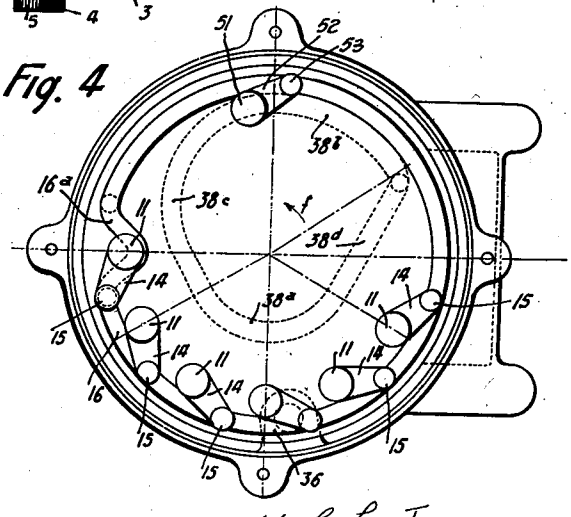
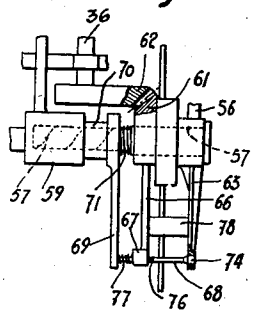


Fig. 6



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MACHINE FOR FOLDING FLAT LINEN AND THE LIKE

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Fig. 2

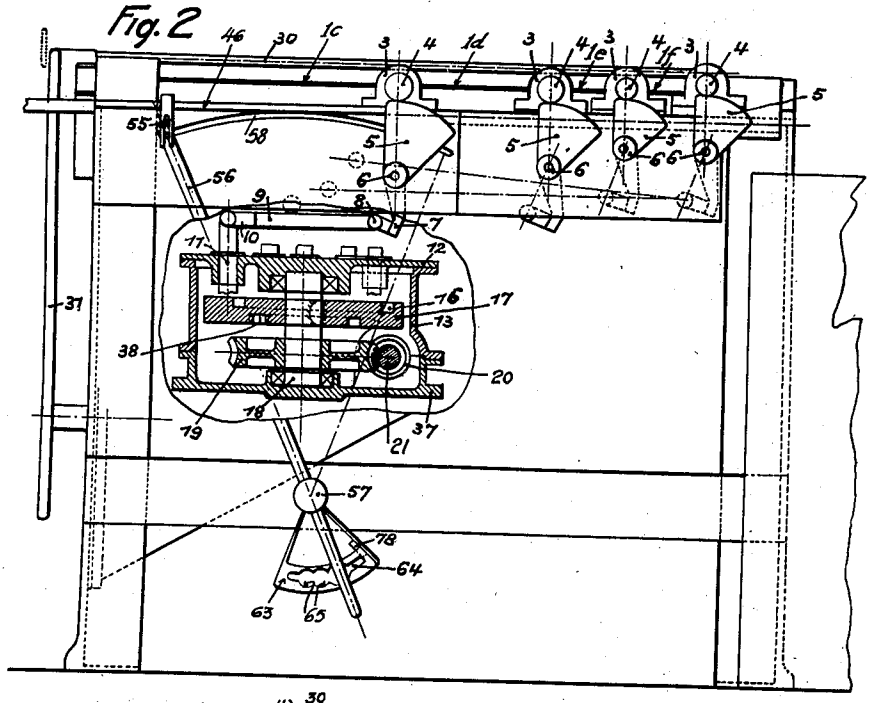


Fig. 3

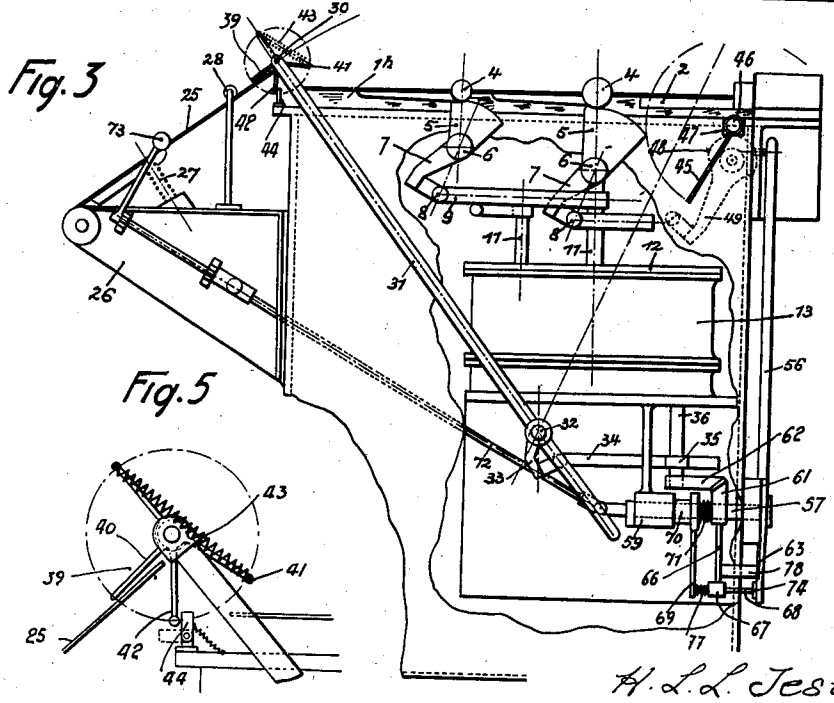


Fig. 5

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UNITED STATES PATENT OFFICE

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MACHINE FOR FOLDING FLAT LINEN AND THE LIKE

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Application January 8, 1938, Serial No. 184,069
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9 Claims. (Cl. 270—61)

The present invention has for its object a machine for folding flat linen and the like and more particularly napkins or dish cloths of the same size or of different sizes.

The machine which is the object of the invention is remarkable in particular by the fact that it has a horizontal table composed of juxtaposed panels of different areas, which are preferably perforated and each of which is pivoted in such a manner that it can be swung down on to the adjacent panels by rotating 180° about an axis which substantially coincides or is parallel with its edge which is in contact with said adjacent panels, the swinging movements of said panels being effected automatically in the desired order by a cam or other mechanism.

It is advantageous that underneath a table composed of said panels there should be another continuous unperforated table on which said panels rest.

The number and the relative arrangement of said panels will of course vary according to the kind of folding to be effected.

Another peculiarity the machine may have consists in an automatic device for feeding each napkin on to the folding table, this feeding device essentially comprising a movable arm which sweeps the entire top of the table, is actuated automatically in conjunction with the other movements of the machine and carries grasping members, advantageously nippers, which are likewise actuated automatically and release the napkin in the desired position on the folding table.

A still further feature of the machine consists in an engaging table formed by a surface which directs the napkin towards the grasping members when the movable arm is in its position for grasping the napkins, with a device which determines the correct position to be given the napkin on said surface. Preferably said device consists of two guides arranged perpendicular to each other. Preferably again this directing surface is formed by a plane which is inclined from front to rear and from bottom to top towards the grasping members, is pivoted on a horizontal pin at its lower part and can be swung downwards by pressing on same against an opposing force, a spring for example, which holds it lifted and presses same against a fixed horizontal roller.

The machine preferably also has an automatic device for removing and classifying the folded napkins. Said device may in particular consist of a swinging conveyor flap which receives the napkin ready folded from the last folding flap and then automatically effects in front of classifying pigeon holes a travel of which the amplitude can be controlled at will by the operator by means of a lever or other control member.

Preferably the operation of removal and of classification of the napkin is effected at the same time as the feed of the napkin to the machine and the return of the feed arm to its grasping position. Preferably also the movements of the folder-flaps are entirely desmodromic.

In a particular embodiment of the machine according to the invention, all the movements are operated by mechanical controls from a central movement box and all the folder-flaps are controlled by a single cam of said box.

By way of example, an embodiment of a machine according to the invention has been shown in the accompanying drawings, said machine having the whole of the hereinbeforementioned features as well as other remarkable peculiarities which are also part of the invention.

In said drawings:

Fig. 1 is a plan view of the whole of the machine;

Fig. 2 is a partly broken away elevational view from behind;

Fig. 3 is a side view of the right side;

Fig. 4 is a plan view of the movement box with the cover removed;

Fig. 5 is a view on a larger scale of the grasping nippers, and

Fig. 6 a view on a larger scale of a detail.

In the exemplary embodiment shown in the drawings, the machine comprises a plane horizontal table composed of six flaps *1a*, *1b*, *1c*, *1d*, *1e*, *1f* which are juxtaposed and contacting, each provided with perforations which have the effect of preventing the linen from remaining adhering to the flap. The number of flaps has been determined by the kind of folding for which the machine is intended, which folding in this case has to have two longitudinal folds to fold the napkin in three, then three other successive transverse folds.

Each of the flaps *1a*, *1b* is carried by two opposite trunnions **2** resting in ball bearings **3** and having a horizontal axis located in the extension of one side of the flap so that the latter can rotate 180° about said axis and swing down on to the adjacent flap or flaps; the flaps of smaller area *1c*, *1d*, *1e*, *1f*, are mounted with overhang on a single trunnion and these various trunnions are offset in height as shown in the upper right-hand corner of Fig. 2 so as to compensate the increasing thickness of the napkin as it is folded. Below the surface thus formed by said flaps, is arranged another table *1h* which is continuous and preferably faced with felt which serves as a bearing surface for said flaps. At the end of each trunnion **2** is keyed a pinion **4** meshing with a toothed quadrant **5** of much larger diameter and on the spindle **6** of which is keyed an arm **7** which is coupled through the intermediary of a Cardan joint **8** to a bar **9** which is connected by another Cardan joint to an arm **10** fixed on a vertical pivot **11** passing through the cover **12**

of a movement box 13. Each vertical pivot 11 carries within the box another arm 14 which is terminated by a roller 15 engaged in a groove 16 forming a cam and provided on one of the faces of a horizontal plate 17 which is keyed on a central vertical spindle 18. On this same spindle is keyed a worm wheel 19 meshing with a worm 20 fast on a drive shaft 21.

The groove 16 is circular in its greater part but has a part 16a which is formed in such a manner as to produce a quick to and fro swinging through about 45°, of each pivot 11 when the corresponding roller 15 passes over said part 16a during the rotation of the plate 17 which is actuated by the worm wheel 19, the worm 20 and the shaft 21. This pivoting movement of each pivot 11 is transmitted by the arm 10, the bar 9 and the corresponding arm 7 to the shaft 6 to which said bar is coupled and the alternate rotation of the shaft 6 which ensues therefrom is amplified by the system comprising the quadrant 5 and pinion 4 into a quick downward swing through 180° of the corresponding flap followed by the return of same to its initial position. Of course the various rollers 15 corresponding respectively to the various flaps are arranged in the groove 16 in such a manner that they are encountered by the part 16a in the desired order for the successive swinging down of the flaps, that is to say in the order 1a, 1b, 1c, 1d, 1e, 1f.

In front of the first flap 1a is an engaging table formed by a plane surface 25 which is inclined from front to rear and from bottom to top and is pivoted at its lower horizontal edge on a bracket 26 fixed on the frame of the machine. A spring 27 pushes said inclined plane 25 upwards and presses same against a small horizontal transverse roller 28. It is on said engaging table that the operator places the napkin to be folded sliding same under the roller 28 by downward pressure on the table 25 against the action of the spring 27. A guide 29a, 29b formed by the two sides 29a, 29b of a reference square determines the correct position of the napkin on said engaging table whatever may be the size of the napkin. Preferably said square is fixed on the frame and only projects above the engaging table when the latter is depressed against the action of the spring 27.

Between the engaging table 25 and the first flap 1a is interposed a horizontal arm 30 carried by an oscillating arm 31 keyed on a shaft 32 on which is also fixed a crank 33 connected by a connecting rod 34 and cardan joints to a crank 35 keyed on a vertical shaft 36 passing through the bottom 37 of the movement box inside of which it carries a horizontal crank terminated by a roller which is engaged in a groove 38 forming a cam provided in the under face of the plate 17. The groove 38 has two circular portions 38a and 38b forming different angles at the centre and having different diameters, and two portions 38c and 38d of different lengths connecting said two circular portions to each other. In this manner, when the groove 38 effects a complete revolution it produces a complete oscillation of the arm 30 causing same to pass, by the action of its portion 38c, from the grasping position, near the engaging table, to the position of release of the napkin on the side of the folding table opposite the engaging table and after a short stop caused by the portion 38b, immediately bringing said arm back by the action of the portion 38d to the grasping position where it remains stationary throughout the folding operation, which corresponds to the portion 38a of the cam. As the portion 38d is shorter than the portion 38c, the return of the arm empty is effected faster than the forward movement. The arm 30 carries on the other hand grasping members 39 in the shape of nippers which engage in notches of the engaging table 25 and of the guide 29. Each nipper has a fixed jaw 40 and a pivoting jaw 41 which is secured to a finger 42 and is connected by a spring 43 to a fixed point of the arm 31. In the path of the finger 42 in the oscillating movement of the arm 31 and near the table 25 is arranged a spring-pressed stop 44 which is retracted under the thrust of the finger 42 when the arm 30 returns to its grasping position and on the contrary prevents the arm 30 from passing when same moves away from said position, which causes a rotation of the finger 42 and of the jaw 41 until the instant when the point of fixing of the spring on the jaw 41 passes beyond the position in which it is in a straight line with the centre of rotation of the jaw 41 and the other point of fixing of the spring, at which instant said spring causes the jaw 41 to close abruptly. When the arm 30 is in its position of release of the napkin, the finger 42 is located in the path of a pivoting arm 45 mounted on a shaft 46 carrying a pinion 47 which meshes with a toothed quadrant 48 connected by means of a crank, cardan joints and a connecting rod 49, to a crank 50 having a shaft 51 (Fig. 4) which passes through the cover of the movement box and carries on the inside a crank 52 terminated by a roller 53 which is engaged in the groove 16. When the portion 16a of the groove 16 acts on the roller 53 corresponding to the crank 50 an oscillation of the shaft 46 occurs which causes the finger 45 to move the finger 42 and opens the nipper until the spring 43 comes into a position in which it holds said nipper open, then the finger 45 is retracted again under the action of the cam. The shaft 51 is located in such a manner that this action of the finger 45 takes place at the instant when the arm 30 has completed its forward movement.

Beyond the flap 1f is provided another flap 1g on to which the flap 1f turns the completely folded napkin. Said flap 1g is fixed on the shaft 46 which can slide in its bearings and thereby move the flap 1g in front of a series of classifying pigeon holes 54. The shaft 46 carries a fork 55 in which is engaged the pin of a crank 56 loosely mounted on a horizontal shaft 57 which is arranged at the lower part of the frame and outside this latter, the pin passing through the wall of the frame in an arc-shaped slot 58 of said wall. Said shaft 57 is supported by a bearing 59 which is suspended from the movement box and by another bearing at its point of issue from the frame. On said shaft 57 is keyed a bevel pinion 61 which meshes with another bevel pinion 62 keyed on the vertical shaft 36. The crank 56 is extended beyond the shaft 57 by a quadrant 63 having an arc-shaped slot 64 with spaced notches 65. On the other hand the pinion 61 carries a finger 66 in the path of which is located a block 67 mounted on a rod 68 which is fixed to an arm 69 carried by a bushing 70 which is slidably mounted on the shaft 57 against the action of a spring 71. At its end, said bushing is connected through the intermediary of a cardan joint to a rod system 72 which is terminated by a handle 73 within reach of the operator and which enables said bushing 70 to be slid

and rotated on the shaft 57. Furthermore the rod 68 carries a bulged head 74 which engages in the notches 65 but which is released therefrom when the bushing 70 is pushed against the action of the spring 71 thereby to permit the rod 68 to be displaced in the slot 64. On the other hand the block 67 can rotate on the rod 68 and it is normally held pressed against a projection 76 forming a stop, by a torsion spring 77.

It is obvious that when the vertical shaft 36 effects a complete oscillation under the action of the cam 38 in order to displace the feed arm 31, it also causes the pinion 61 and its finger 66 to oscillate which finger starts by striking the block 67 and presses same on the stop 76 so that said finger imparts its oscillatory movement to said block and with it to the rod 68, the arm 69 and the quadrant 63 which is secured to the crank 56 which consequently effects a half oscillation of which the amplitude depends on the initial position of the finger 66 and of the block 67, that is to say the position of the head 74 on the quadrant 63. In the half oscillation of the finger 66 in the opposite direction, said finger leaves the block 67 and strikes a fixed stop 78 provided on the quadrant 63 so that it always brings this latter back to the same position. The oscillatory movement of the crank 56 is transmitted by its pin and the fork 35 to the shaft 46 which slides longitudinally by an amount which is dependent on the amplitude of the oscillation of the crank 56 and brings the classifying flap 1*g* opposite a pre-determined pigeon hole 54. The stopping position of the classifying flap 1*g* is varied by varying the amplitude of the oscillation of the crank 56 by engaging the head 74 of the rod 68 in any one of the notches 65 or by placing the rod 68 at the left hand end of the slot 64 by means of the handle 73, the corresponding positions of which are marked (not shown). If, owing to an excessive time taken to accomplish this operation the finger 66 should move the block 67 while the head 74 of the rod 68 is not engaged in a notch 65, the rod 68 comes to the end of the slot 64 and moves the quadrant 63; the napkin then falls into the first pigeon hole 54. If the finger 66 should pass in front of the block 67 and encounter same during a return half oscillation, it causes same to swing against the action of the spring 77, without moving the quadrant 63 and falls down on the correct side of said block.

When the classifying flap 1*g* arrives opposite the pre-determined pigeon hole, and this occurs at the same time as the grasping and the feeding of the napkin to the folding table owing to the arrangement of the cams, the shaft 46 pivots and the flap 1*g* swings down on to said pigeon hole where it leaves the folded napkin.

The utilization and the operation of the machine as a whole are as follows:

The operator takes a napkin from a pile place within her reach, examines same and places it in position on the engaging table 25 by sliding it along the guide 29*a* until the edge abuts against the guide 29*b* which is visible owing to the sinking of the table 25 under the effect of the pressure of the operator on said table; the edge of the napkin is then engaged by the nippers of the grasping arm. At this instant the members of the machine are in the position shown in Fig. 1. By rotating in the direction *f*, the cam-plate 17 starts by causing the portion 38*c* of the groove 38 to act on the crank of the shaft 36, which has the effect of causing the arm 31 to oscillate, the grasping members 39 of said arm closing on the napkin which is thus conveyed above the folding table until the instant when the arm 31 stops under the action of the portion 38*b* of the groove 38 and said members 39 open automatically responsive to the action of the finger 45, as described above, and leave the napkin in the required position on the table. During this time, the portion 16*a* of the groove 16 has not encountered any roller 15. The portion 38*d* of the groove 38 then becomes operative and sharply returns the arm 31 and the members 30—39 to the grasping position near the engaging table 25. The folding table is then free and the portion 16*a* of the groove 16 successively encounters the different rollers 15, thereby producing the successive swinging down of the various flaps 1*a* to 1*f* in the required order.

The presence of the continuous table underneath the perforated flaps has the advantage of preventing the air from being sucked in through the flap during the return movement of a flap and thereby causing waves in the napkin which produce creases. During this time, the arm 31 remains stationary owing to the fact that the corresponding roller is in the circular portion 38*a* of the groove 38.

The completely folded napkin is then located on the classifying flap 1*g*. Meanwhile, the operator has actuated the handle 73 in order to adjust the classifying mechanism so that the flap 1*g* shall stop in front of a predetermined pigeon hole. At the instant when the portion 38*c* of the groove 38 starts a second revolution, the portion 16*a* of the cam 16 acts on the corresponding roller of the ejecting mechanism, which successively causes the shaft 46 to slide through the intermediary of the crank 56 and of the fork 55, this same shaft to rotate through the intermediary of the pinion and the corresponding toothed quadrant, and the folded napkin is thrown into the pigeon hole which the operator intended.

Of course, the invention is in no way limited to the details of the embodiment illustrated and described which has only been given by way of example. Thus for example many of the movements could be electrically controlled, through the instrumentality of electro-magnets.

On the other hand, the essential mechanism of the machine which is the object of the invention can advantageously be combined with a drying and ironing device the folding and classifying device forming in that case an integral part of same.

What I claim is:

1. A machine for folding flat linen such as napkins and dish cloths, comprising a plurality of panels of different areas juxtaposed to form a substantially horizontal table, each of which panels is pivoted about a horizontal axis extending close to and along one of its edges, means adapted to reciprocate separately each of said panels through about 180 degrees according to a predetermined sequence, an engaging table inclined from front to rear and from bottom to top towards the panels and pivoted at its lower part about a horizontal axis, a stationary horizontal roller above said table, and spring means constantly urging upwards said table and pressing it against said roller.

2. A machine for folding flat linen such as napkins and dish cloths, comprising a plurality of panels of different areas juxtaposed to form a substantially horizontal table, each of which

panels is pivoted about a horizontal axis extending close to and along one of its edges, means adapted to reciprocate separately each of said panels through about 180 degrees according to a predetermined sequence, an engaging table inclined from front to rear and from bottom to top towards the panels and pivoted at its lower part about a horizontal axis, a stationary horizontal roller above said table, spring means constantly urging upwards said table and pressing it against said roller, and guide means adapted to determine the position to be given to a piece of linen upon said engaging table, said guide means including two substantially perpendicular rectilinear surfaces, one of which is directed towards the panels and the other transversely to the path of the piece of linen from said table to the panels, said latter surface being underneath the upper surface of the table when the latter engages said roller but is adapted to project above the table when the latter is depressed against said spring means, and means for grasping a piece of linen placed in the correct position defined by said guides and forwarding it to the folding table.

3. A machine for folding flat linen such as napkins and dish cloths, comprising a plurality of panels of different areas juxtaposed to form a substantially horizontal table, each of which panels is pivoted about a horizontal axis extending close to and along one of its edges, means adapted to reciprocate separately each of said panels through about 180 degrees according to a predetermined sequence, a plurality of pigeon holes, a conveyor flap adapted to come close to the last folding flap to receive therefrom the piece ready folded and to be moved in front of said pigeon holes, means to operate said conveyor in a proper sequence with the other operations of the machine, means adapted to vary the stroke of said conveyor, a control-member within easy reach of the operator to operate said last named means, and ejecting means to remove said folded piece from said conveyor into one of said pigeon holes at the end of the conveyor stroke.

4. A machine for folding flat linen such as napkins and dish cloths, comprising a plurality of panels of different areas juxtaposed to form a substantially horizontal table, each of which panels is pivoted about a horizontal axis extending close to and along one of its edges, means adapted to reciprocate separately each of said panels through about 180 degrees according to a predetermined sequence, travelling grasping means adapted to grasp the linen to be folded, means adapted to reciprocate said grasping means between a grasping position and a delivery position where the linen is in folding position upon the folding panels, a plurality of pigeon holes, a conveyor flap adapted to come close to the last folding flap to receive therefrom the linen ready folded and to be moved in front of said pigeon holes, means adapted to vary the stroke of said conveyor, a control-member within easy reach of the operator to operate said last named means, ejecting means to remove said folded linen from said conveyor into the pigeon hole in register with said conveyor flap at the end of its stroke, and means including timing means and adapted to move said grasping means and to operate said conveyor and ejecting means in a predetermined sequence such that the conveyor and ejecting means will be operated during each reciprocal stroke of the grasping members.

5. A folding machine for flat linen such as napkins and dish cloths, including a plurality of panels of different areas juxtaposed to form a substantially horizontal table, each of which panels is pivoted about a horizontal axis extending close to and along one of its edges, means adapted to reciprocate separately each of said panels according to a predetermined sequence, and a stationary substantially air impervious underlayer provided underneath at least some of said panels, extending upon substantially the whole area of the latter and in engagement therewith when they are in their rest position.

6. In a folding machine for flat linen such as napkins and dish cloths, including a plurality of rotatable folding panels juxtaposed together to form a horizontal table when they are in their rest position and each pivoted about an axis extending close to and along one of its edges, and the pivoting axes of the panels for longitudinal folding of the linen being perpendicular to the pivoting axes of the panels for transverse folding, said panels for transverse folding being placed side by side to form one row on one side of said table along the pivoting axis of the last operated panel for longitudinal folding supporting shafts for said panels for transverse folding and bearing means for said shafts, said panels being in overhang position with respect to the associated bearing means and the pivoting axes of at least some of said panels in overhang position being offset in height above the pivotal axis of the panels for longitudinal folding.

7. In a folding machine for flat linen such as napkins and dish cloths, including a plurality of rotatable folding panels juxtaposed together to form a horizontal table when they are in their rest position and each pivoted about an axis extending close to and along one of its edges, the pivoting axes of the panels for longitudinal folding of the linen being perpendicular to the pivoting axes of the panels for transverse folding, said panels for transverse folding being placed side by side all along the pivoting axis of the last operated panel for longitudinal folding to form one row the length of which is equal to the common length of the panels for longitudinal folding.

8. In a folding machine as in claim 7, said panels for transverse folding being all arranged to be rotatable in the same direction from their rest position and actuating means connected to said longitudinal and transverse folding panels to successively reciprocate them and designed to actuate first all the panels for longitudinal folding, and then all the transverse folding panels in their order of succession from one end of said row to the other end.

9. A folding machine as in claim 7 wherein said transverse folding panels include at least two panels of different lengths, and are all arranged to be rotatable in the same direction from their rest position, the transverse folding panel of greater length being situated at one end of said row, and actuating means connected to said various longitudinal and transverse folding panels are designed to actuate first the panels for longitudinal folding and then all the transverse folding panels in their order of succession from the said end of the row to the other.

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