Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 1

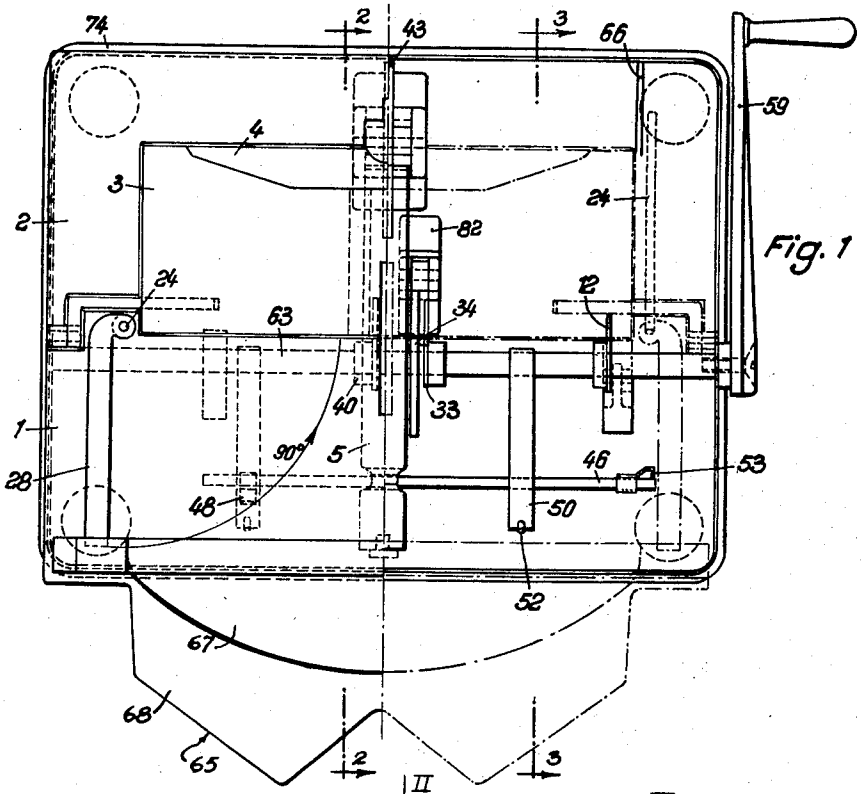


Fig. 1

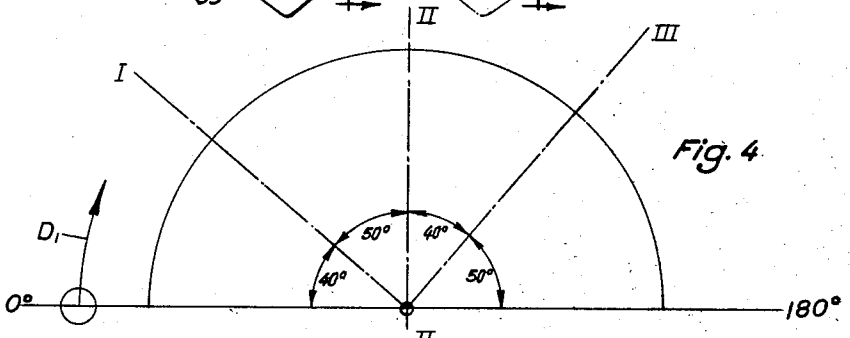


Fig. 4

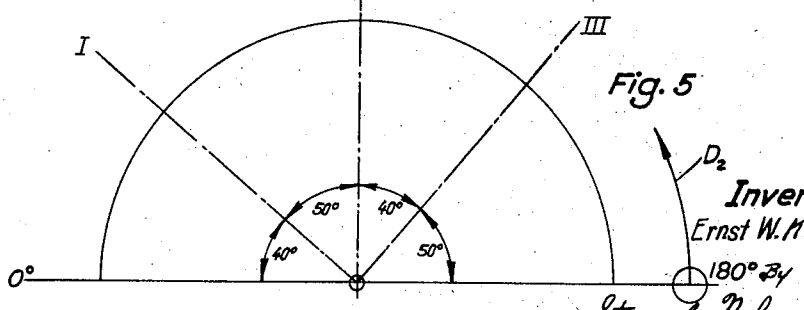


Fig. 5

Inventor:
Ernst W. Kummer
By
Strauch, Nolan & Diggins
Attorneys

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 2

Fig. 2

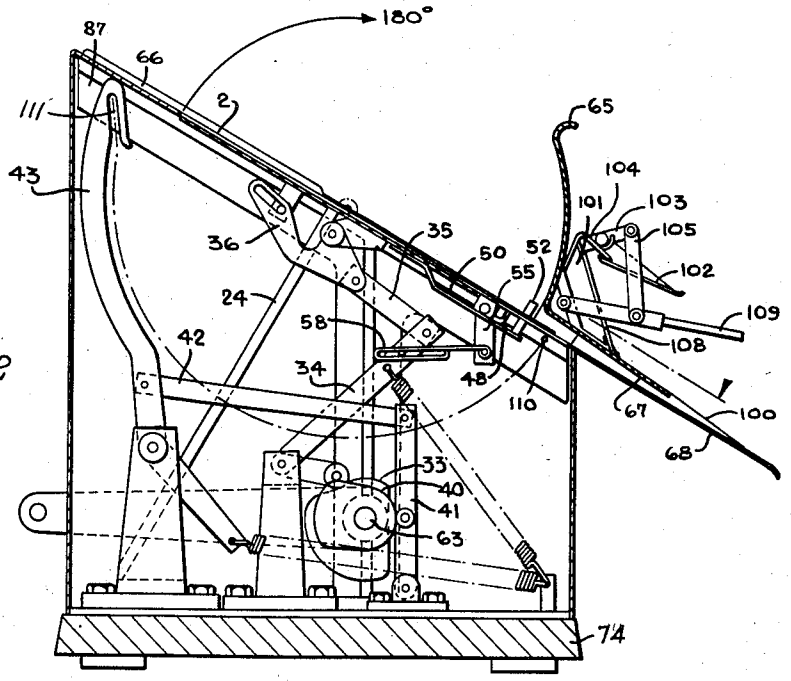
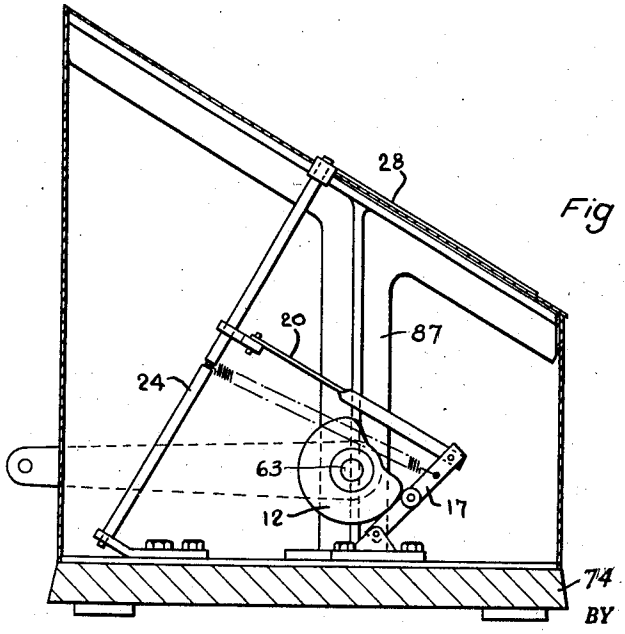


Fig 3



INVENTOR:
ERNST W. KUMMER

BY

Strauch, Nolan & Diggins

ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 3

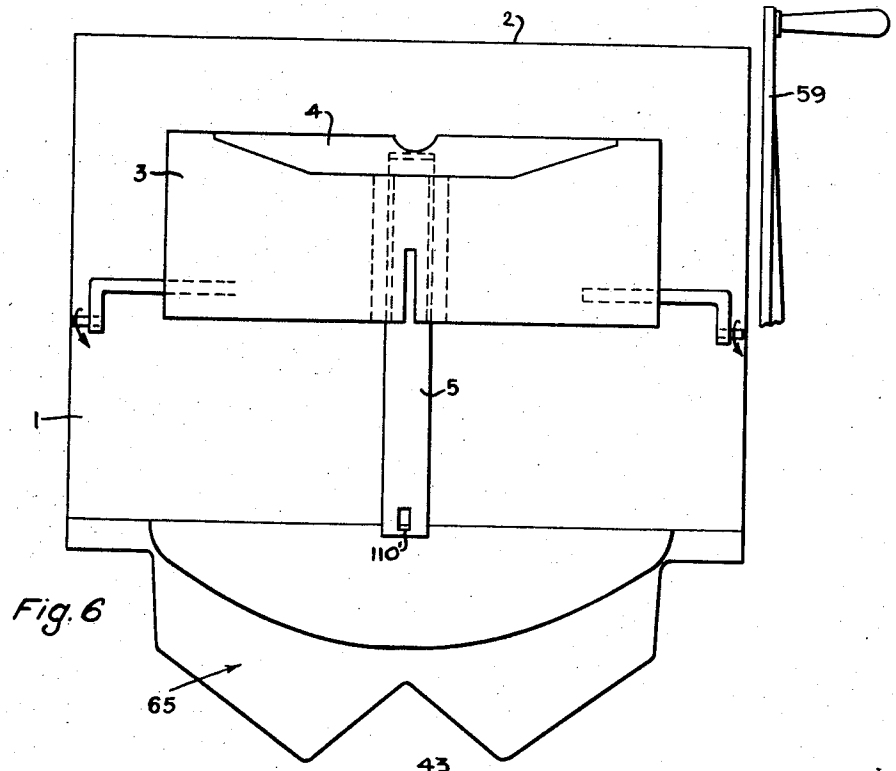


Fig. 6

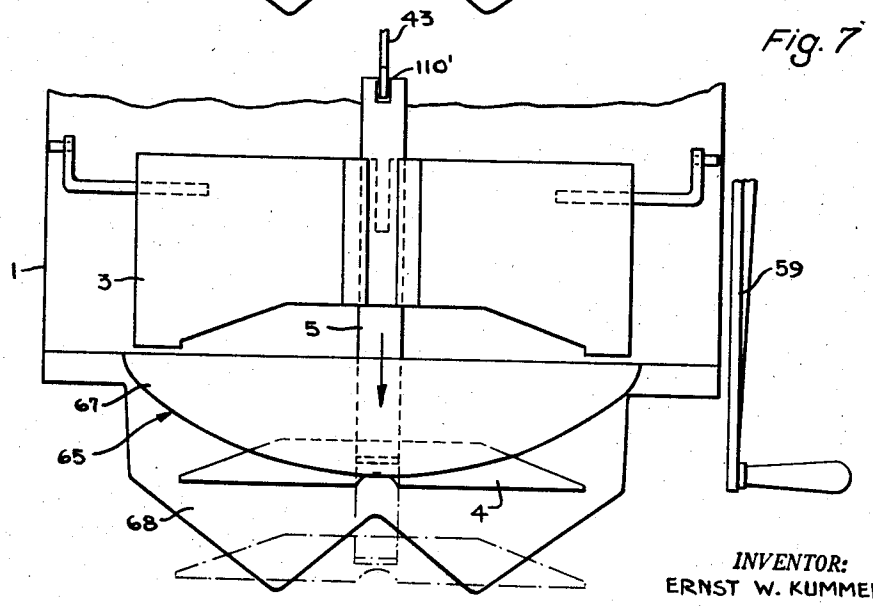


Fig. 7

INVENTOR:
ERNST W. KUMMER,

BY

Strauch, Nolan + Diggins
ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 4

Fig 8

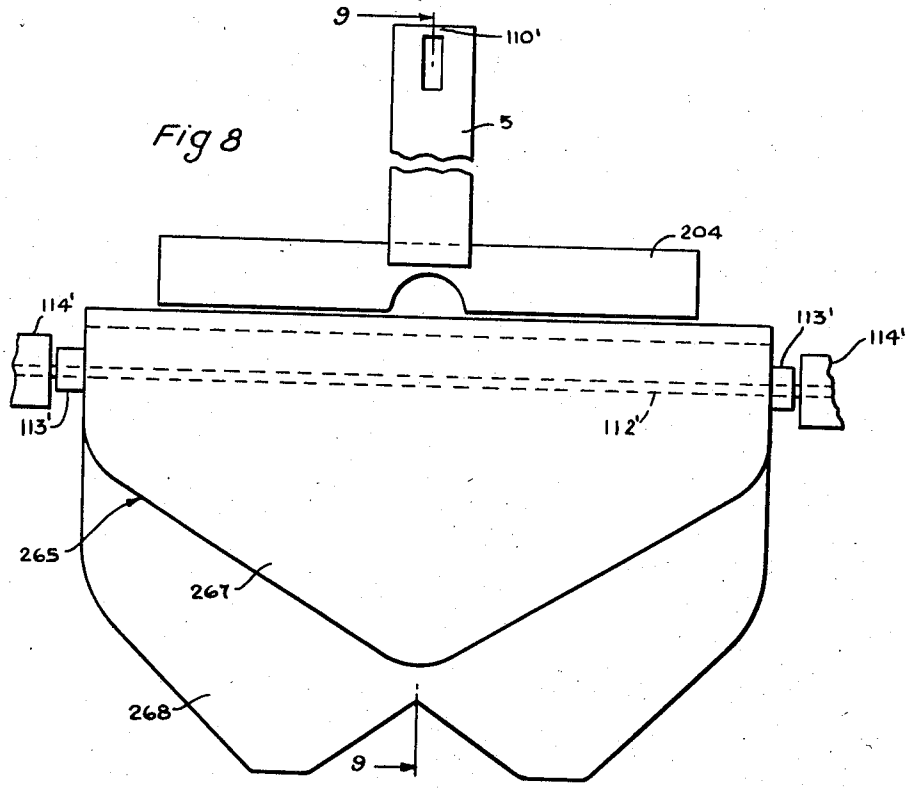


Fig 9

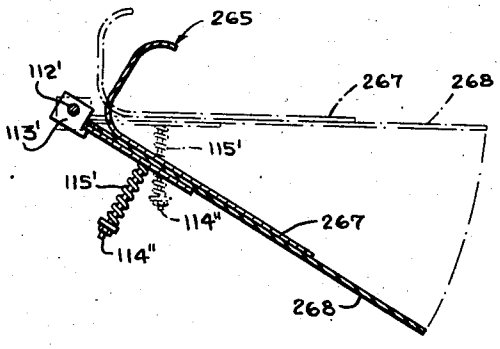
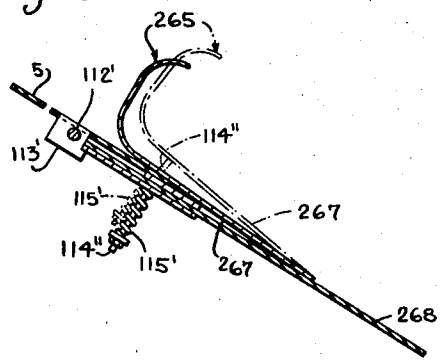


Fig 10



INVENTOR:
ERNST W. KUMMER,

BY

Strauch, Nolan + Diggins
ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 5

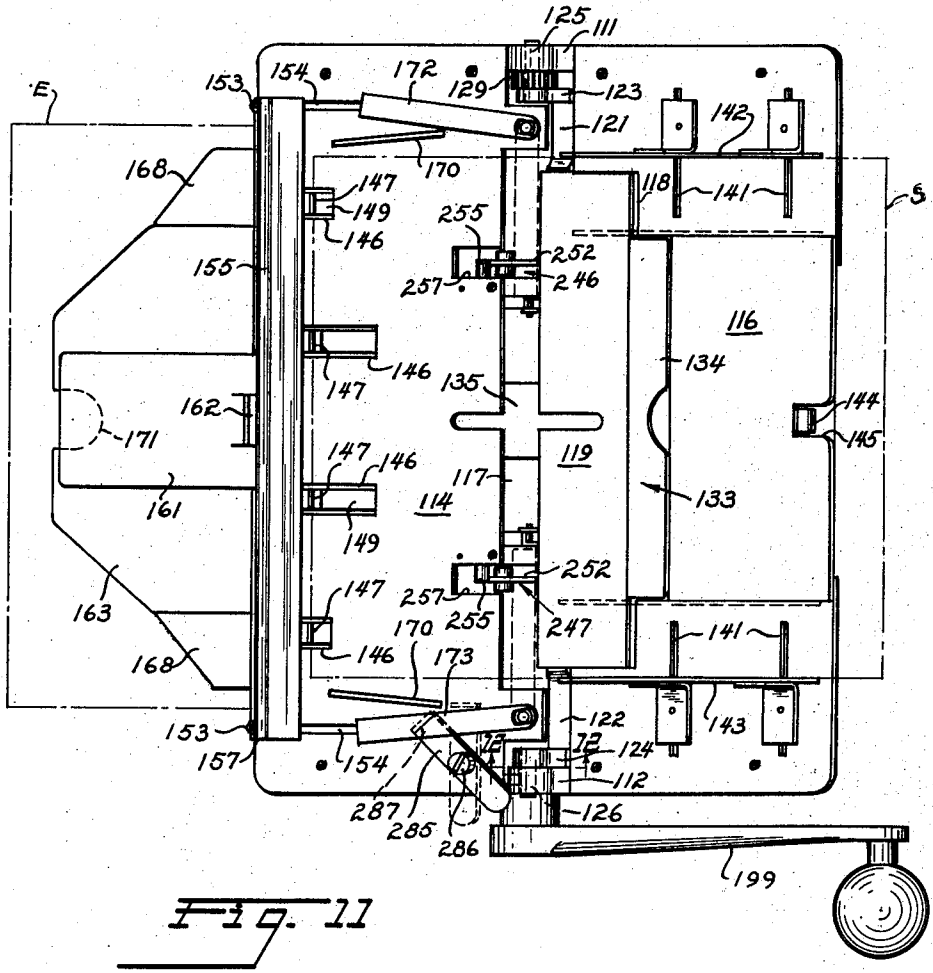


Fig. 11

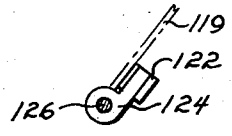


Fig. 12

INVENTOR
ERNST W. KUMMER

BY Strauch, Nolan & Diggins
ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 6

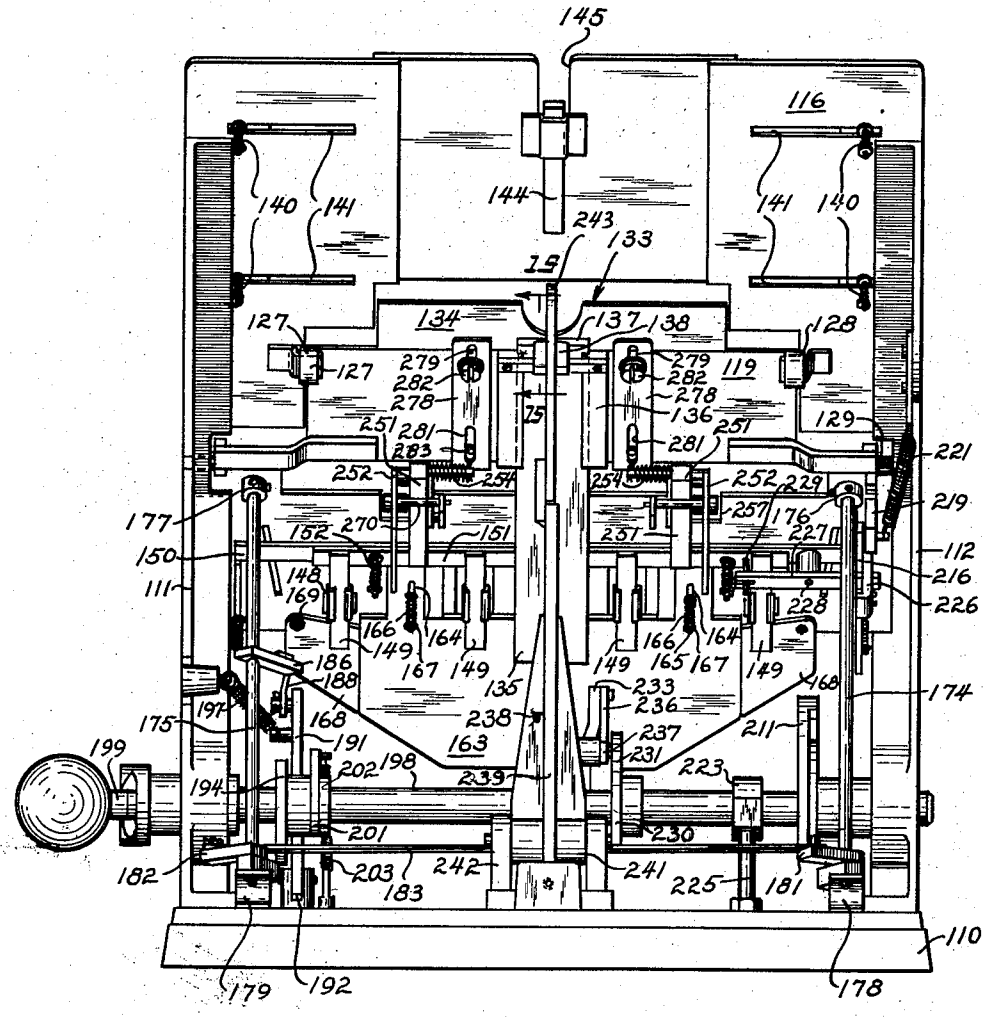


Fig. 13

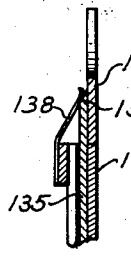


Fig. 15

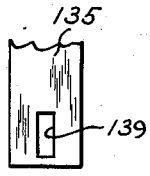


Fig. 14

INVENTOR

ERNST W. KUMMER

BY Strauch, Nolan & Diggins

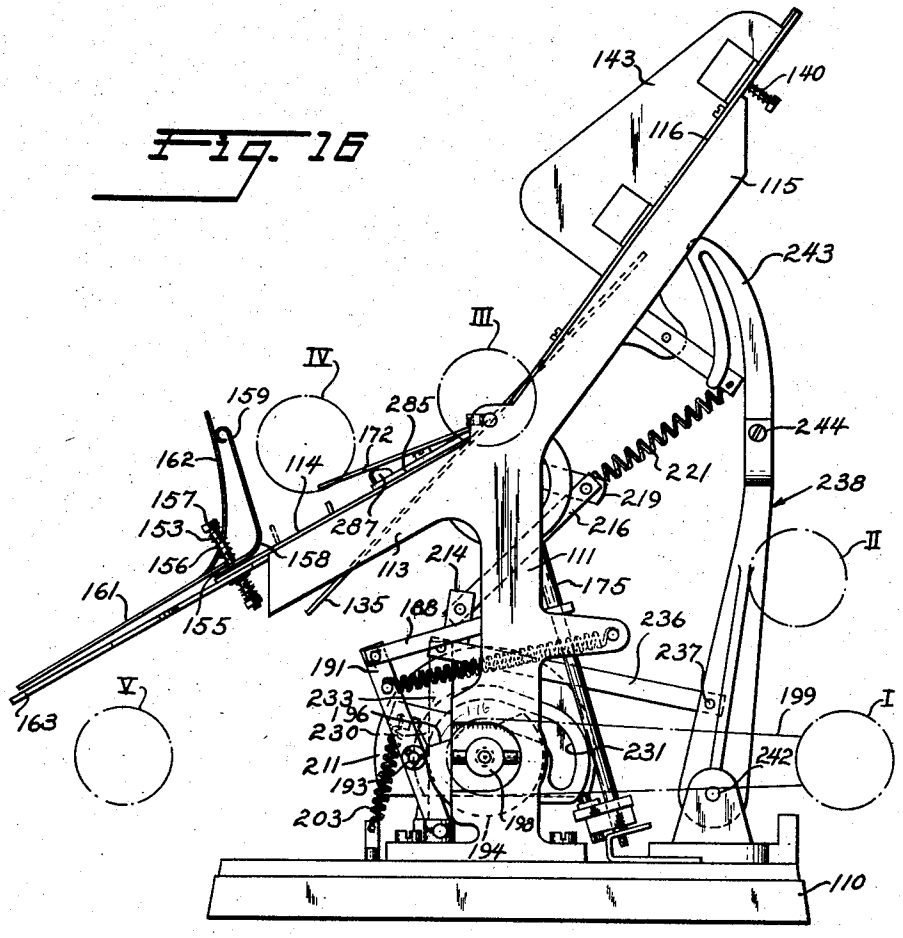
ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 7

Fig. 16



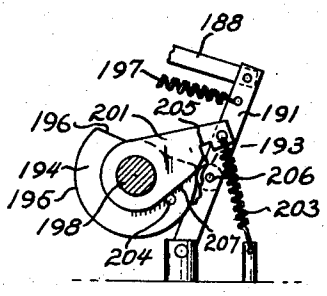


Fig. 17

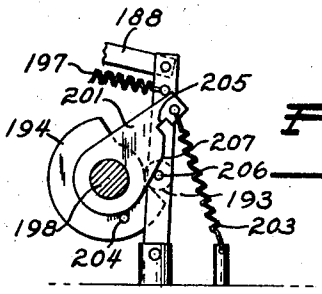


Fig. 18

INVENTOR

ERNST W. KUMMER

BY Strauch, Nolan & Diggins

ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 8

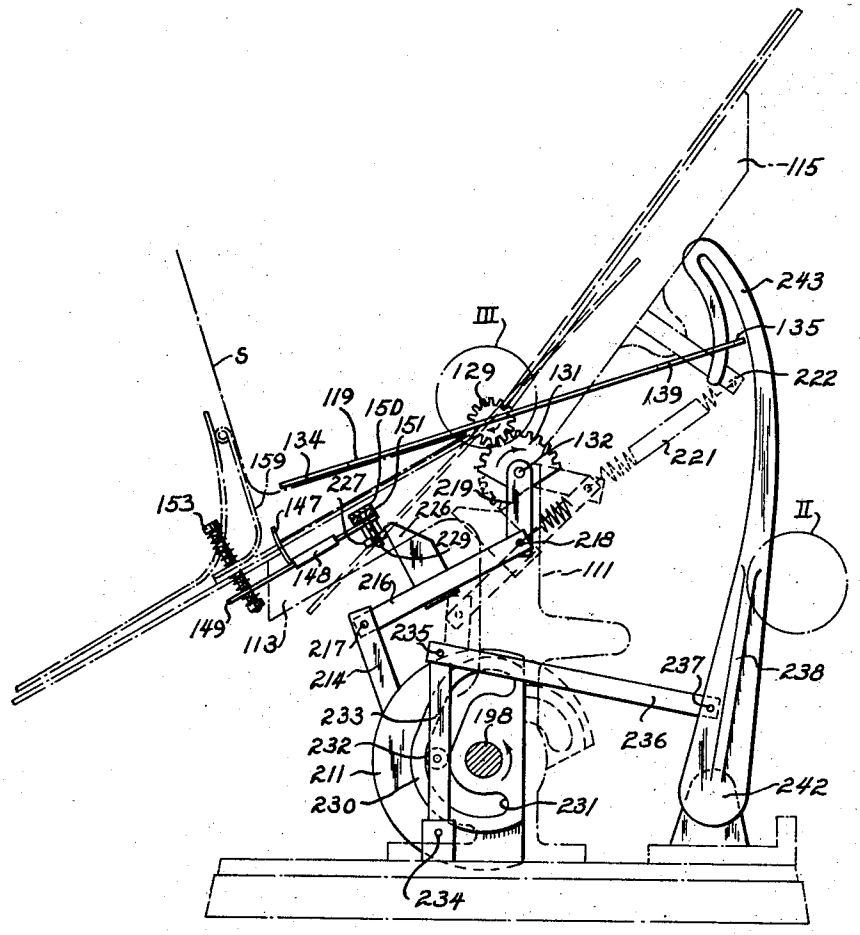


Fig. 19

INVENTOR

ERNST W. KUMMER

BY Strauch, Nolan & Diggins

ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 9

Fig. 20

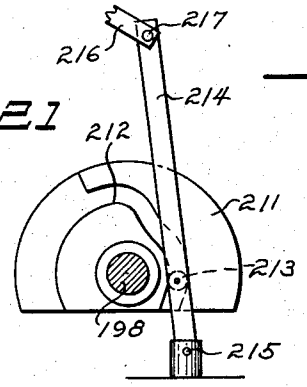


Fig. 21

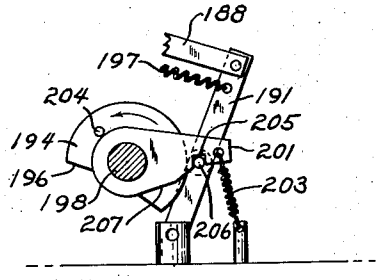


Fig. 22

INVENTOR
ERNST W. KUMMER

BY Strauch, Nolan & Diggins
ATTORNEYS

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 10

Fig. 23

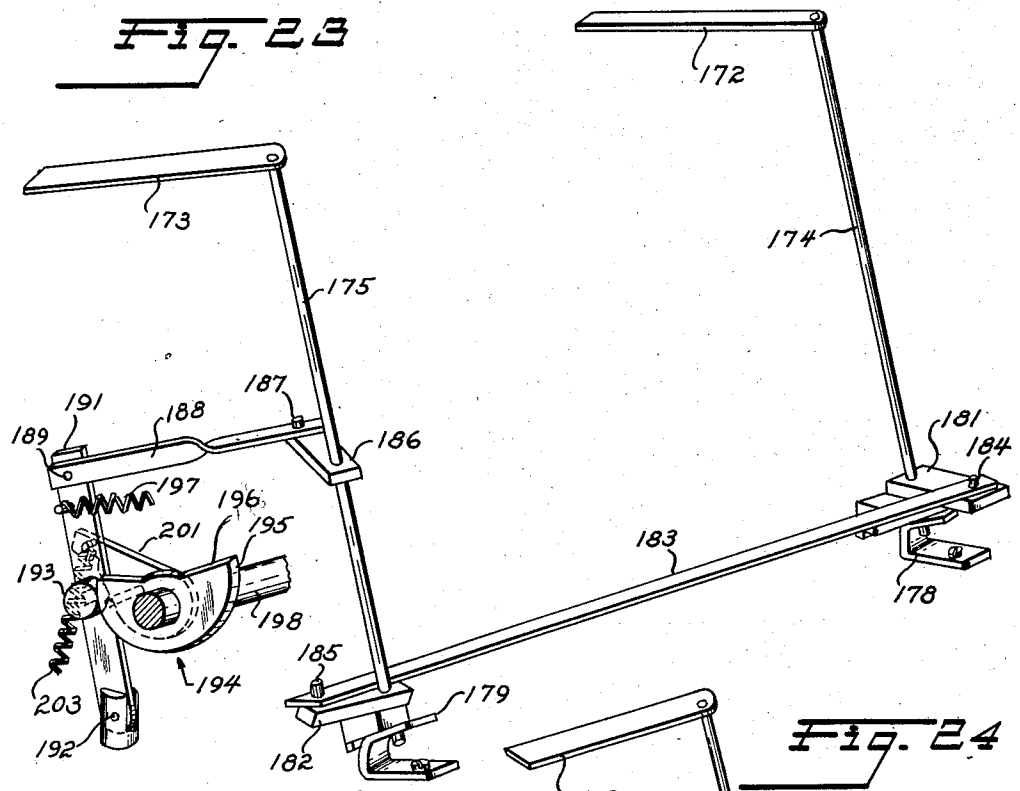
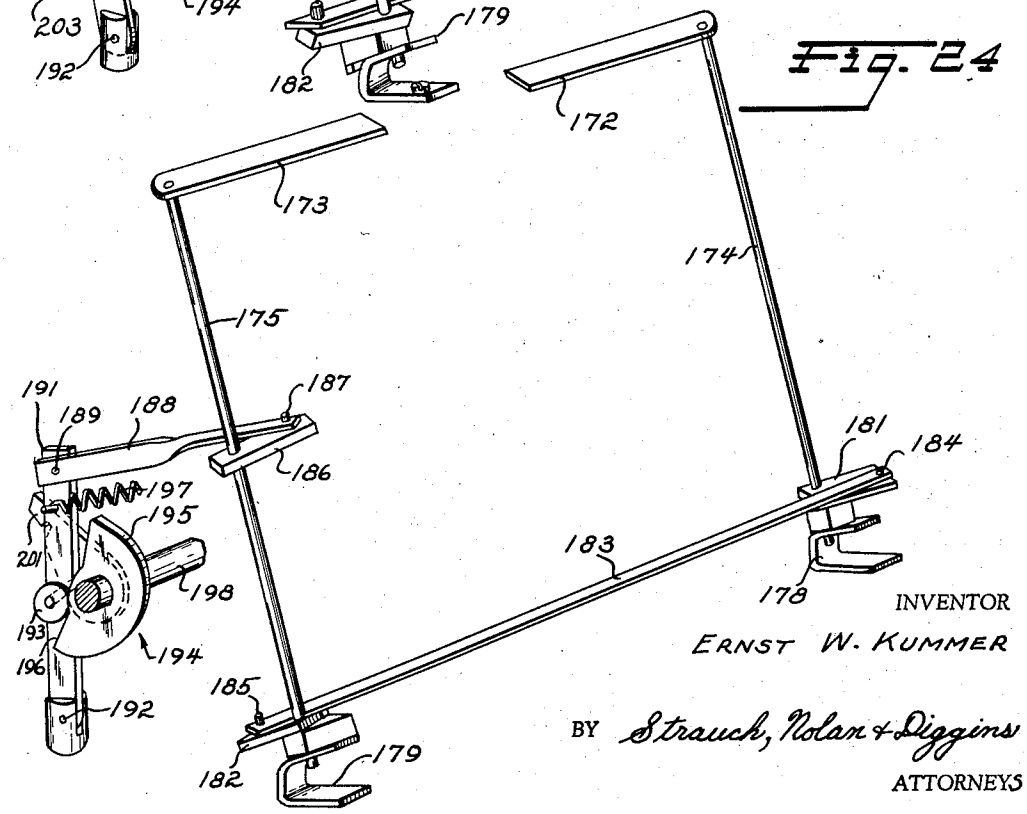


Fig. 24



INVENTOR
ERNST W. KUMMER

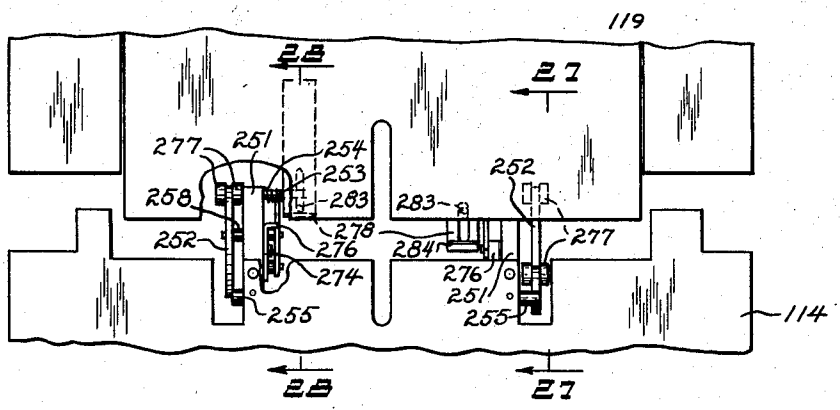
BY Strauch, Nolan & Diggins
ATTORNEYS

Nov. 17, 1959 E. W. KUMMER 2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Filed Dec. 27, 1954 11 Sheets-Sheet 11

Fig. 25



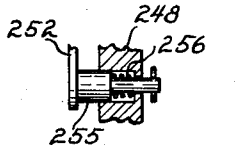


Fig. 26

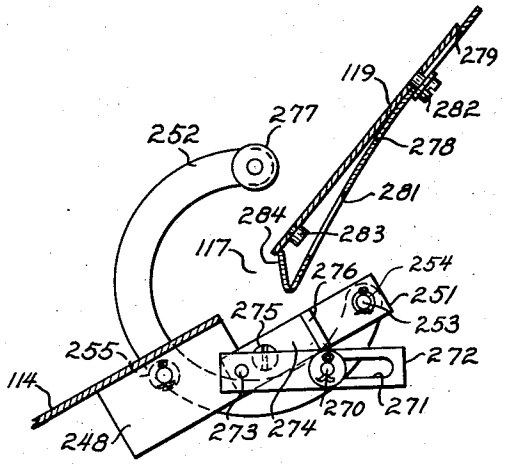


Fig. 28

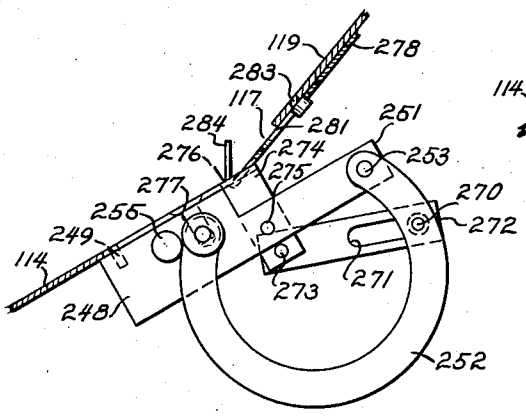


Fig. 27

INVENTOR
ERNST W. KUMMER

BY Strauch, Nolan & Diggins
ATTORNEYS

United States Patent Office 2,912,807 Patented Nov. 17, 1959

2,912,807

SHEET FOLDING AND ENVELOPE FILLING MACHINE

Ernst W. Kummer, Berlin, Germany

Application December 27, 1954, Serial No. 477,872

34 Claims. (Cl. 53—117)

The invention relates to sheet folding and envelope filling machines with devices for folding and putting the letter into the envelope. This is a continuation-in-part of my application Serial No. 161,357 filed May 11, 1950, now forfeited.

The manufacture and sale of such machines are hindered by the fact that the sizes of sheets and envelopes and also the kinds of fold are very different from one another within a single economic sphere and especially within different countries.

For the folding operation, there are known especially the so-called compressing method and also the knife method or the combination of both methods. Both methods give a very sharp fold. The filling of the envelopes with the letters so folded is usually effected by conveying rollers. These machines work very rapidly but are costly to manufacture and are accordingly expensive. They are specially intended for dealing with large quantities of postal matter, for example, with printed matter.

According to the invention, a flat envelope-filling passageway or funnel, on one end of which an envelope can be fitted, and a pushing device fitting into the other end of the filling funnel and slidable into the said funnel are provided and the letter sheet is taken by the pushing device in such a position in front of the pushing-in end (mouth) of the filling funnel that the letter sheet is folded and pushed into the envelope by the sliding of the pushing device in the filling funnel. This operation may be carried out by preliminarily folding the letter by an additional folding device, the letter sheet then being taken in front of the filling funnel by the pushing device in such a position that a completion of the folding of the preliminarily folded letter sheet is effected on pushing the letter into the filling funnel. The preliminarily folded letter sheet is therefore obtained solely by stamping or bending and is pushed, in such a manner, through one or more flat filling passage defining members by means of a special pusher, into the envelope which has previously been fitted on the filling funnel, that the folding is completed only by this pushing-in operation.

A special feature of the invention is the formation of the flat funnel, one wall of which forms a whole with or a substantial continuation of the face that supports the letter sheet or lies in the same line therewith and terminates in one or more obtuse-pointed ends, whilst the other wall is slightly rounded and is shorter and terminates in a kind of upper lip which may be of different sizes. A device for moistening the flap of the envelope may be provided at the top as well as a device for automatically feeding from the pile, in the known manner, the device for laying on sheets. The operation may be carried out by hand by means of levers as in the case of adding machines, or by means of cranks by rotating them or electrically, continuously or intermittently, by means of a pushbutton and a small motor.

Examples of embodiments of a hand operated apparatus, constructed in accordance with the invention, such

an apparatus for lever operation and folding of letters into long envelopes (English or American size) is represented and described.

It is therefore the major object of the present invention to provide a novel mechanically simple and inexpensive machine for folding sheets such as letters and inserting the folded sheets into envelopes ready for closure and mailing.

A further object of the invention is to provide a novel machine and mode of operation whereby a letter sheet or the like is subjected to reverse folding culminating in an envelope inserting movement along with the final folding operation.

A further object of the invention is to provide a sheet folding apparatus having a novel combination of parts that finish fold the sheet and thrust it into an envelope substantially with the same motion.

It is a further object of the invention to provide a novel sheet folding apparatus having a special pusher device for accomplishing one folding operation.

A further object of the invention is to provide a novel funnel or passage defining structure in an envelope filling apparatus.

It is a further object of the invention to provide a novel sheet folding apparatus embodying special adjustments to accommodate the apparatus to different sheet and/or envelope sizes.

A further object of the invention is to provide a novel sheet folding and envelope stuffing apparatus wherein special cam controlled linkages move the parts in sequential relation.

A further object of the invention is to provide a novel sheet folding apparatus wherein the first folding operation is accomplished by a swinging movement of part of the sheet support.

It is a further object of the invention to provide a novel envelope mounting and filling funnel having resiliently coupled upper and lower throat defining members.

A further object is to provide a novel short sheet folding adapting arrangement for the foregoing.

Further objects of the invention will appear as the description proceeds in connection with the appended claims and the annexed drawings wherein:

Figure 1 is a top plan view of the apparatus according to an embodiment of the invention, parts of the supporting plate and of the filling funnel having been omitted in order to show interior details of the apparatus;

Figure 2 is a section on line 2—2 of Figure 1;

Figure 3 is a section on the line 3—3 of Figure 1;

Figure 4 diagrammatically shows the angular division of the path of the crank for the different operations of the apparatus on filling envelopes;

Figure 5 diagrammatically shows the angular division of the path of the crank on returning the apparatus into original condition;

Figure 6 is a schematic plan view showing a detail of Figure 1 with some parts in normal position;

Figure 7 is a schematic plan view similar to Figure 6, but showing the said parts in two further, letter-pushing positions;

Figure 8 is a large scale fragmentary plan view of parts of the machine shown in Figure 1 and including a modified filling funnel;

Figure 9 is a sectional view taken on line 9—9 of Figure 8;

Figure 10 is a sectional view similar to Figure 9 but illustrating the position during letter passage;

Figure 11 is a top plan view of a further practical embodiment of the machine of the invention which incorporates added features for handling different sized sheets and envelopes;

Figure 12 is a fragmentary section on line 12—12 of Figure 11;

Figure 13 is a rear elevation of the machine of Figure 11 showing machine details;

Figure 14 is a fragmentary view of the slotted end of the pusher;

Figure 15 is a fragmentary section on line 15—15 of Figure 13;

Figure 16 is a side elevation of the machine of Figure 11 with the side plates removed to show the mechanism and support frame;

Figures 17 and 18 are fragmentary side views partly in section showing two different operational positions of the first fold element control cam and associated linkage;

Figure 19 is a side elevation partly in section along a medial line of the machine illustrating the pusher, control cam and linkage after it has moved from the Figure 16 position to the first fold position;

Figure 20 is a side elevation partly in section similar to Figure 19 illustrating the pusher, control cam and linkage after the pusher has accomplished the second fold and pushed the sheet into the envelope;

Figure 21 is a fragmentary side elevation of the first fold control cam and linkage;

Figure 22 is a fragmentary side elevation of the first folding element control cam and the lock lever for the folding element in the position that lever occupies during the second phase of the pusher stroke;

Figures 23 and 24 are generally perspective views illustrative views of the first fold elements and their manner of actuation and control;

Figure 25 is a fragmentary top plan view of the machine of Figure 11 showing the short sheet holding hooks in their operative positions;

Figure 26 is a fragmentary detail in section showing a hook stop; and

Figures 27 and 28 are fragmentary sectional side views showing the sheet holding hooks and associated details, on lines 27—27 and 28—28 respectively of Figure 26.

The apparatus consists substantially of an oblique supporting plate 1, 2, a rotary plate 3 with a pushing plate 4 slidably mounted on its rear side, and a pusher bar 5 operatively connected to the plate 4, of the funnel arrangement 65 and the moistening device consisting of parts 101, 102, 103, 104, 105, 108 and 109 as seen in Figure 2 arranged thereon. There is also to be seen the base plate 74 with the two T-shaped brackets 87 on which the divided supporting plate 1, 2 is fixed. The bearings of the driving members are arranged on the base plate 74 and those of the main shaft 63 are arranged on the T-shaped main brackets 87.

The method of operation is as follows: The letter sheet to be inserted in an envelope is laid on the supporting plate 1, 2 and pushed to the bottom stop pins 52 and to the lateral stop strip 66. At the same time, the envelope, in this example, is pushed from below by hand onto the filling funnel 65 constructed according to the invention (the gummed flap being turned up to open position). The operating lever 59 is now in the 0° position of Figure 4 and ready to move in the direction of the arrow D_1. By turning the operating lever 59 through 180°, the letter is preliminarily folded by the folding and pushing plate 3 being folded out from the letter-sheet supported surface, the letter being folded around the spring folding strips 28 that have been swung onto and above the letter and being pushed into the envelopes by means of the pushing plate 4, so that the folding of the preliminarily folded letter is completed in the filling funnel or as the letter is being pushed into the envelope. When the letter sheet is first-folded by the swinging of plate 3, the folded over part of the sheet engages and lies along the upright funnel wall indicated at 65 in Figure 1, so that the pusher gives it a reverse fold. At the same time, the gummed

edge of the open flap of the envelope is moistened. The individual mechanical operations are spread over 180° and can be seen from Figures 4 and 5; by pulling the operating lever 59 to 40° to position I of Figure 4, the two folding strips 28 (Fig. 1) are swung in through 90° by the shafts 24 (Fig. 3) through the shaft 63 (Fig. 1), the cam disc 12 and the levers 17 and 20, so that the folding strips 28 slide inwardly over the letter sheet to be folded and become so positioned that they form the folded edge to the first fold of the sheet (see arrow 90°, Fig. 1).

On shifting lever 59 through a further 50° in the same direction to position II of Figure 4 (operating lever 59, shaft 63), the folding plate 3 is moved through 180° (in the direction of the arrow 180°, Fig. 2), so that the first fold of the sheet is made over the said folded edges. In order to carry out this movement of the folding plate 3, the cam disc 33 is employed, which is mounted on the shaft 63, as well as the levers 34, 35 and 36. In the last stage of this movement, the stirrup 58 (Figure 2) and, consequently, the lever 55 are driven by the lever 34, and the shifting member 48 presses the leaf springs 50 downwards and pulls the stop pins 52 down through the supporting plate 1, 2 in such a manner that it becomes free to insert a letter sheet and the pushing member into the filling funnel 65. The lever 34 is mounted on the shaft 46 on which the resilient stop 53 (Figure 1) is fixed in such a manner that, on pulling the stop pin 52 down, it is turned out and up through the slot in the supporting plate 1 and forms a stop for the folding strips 28 in order that the latter should not be able to swing in on returning the operating lever 59.

The plate 4 is connected to the pusher bar 5, and the latter is in sliding engagement with the bottom of the plate 3 (Figs. 1, 6 and 7). When the folding plate 3 is swung from the normal position through 180° (Fig. 2), the pusher bar 5 is swung also for 180°, as shown at "A" in Fig. 2, until the pin 110' engages the slot 111' of the lever 43. Subsequently, the lever 43 will impel the pusher bar 5 to move the pushing plate 4 for completing the accordion fold of the letter and to push the same into the envelope held on the outside of the filling funnel 65.

On shifting the hand lever 59 through a further 40° in the same direction to position III of Figure 4, the spring folding strips 28 are brought back—over the stop spring 53 that is now retracted—through 90° into their original position, through the shaft 63, the cam disc 12, the levers 19 and 20 and the shaft 24.

During the last movement of the operating lever 59 through the last 50° in the same direction to the 180° position of Figure 4, the pushing plate 4 is pushed into the filling funnel 65 through the shaft 63, the cam disc 40 and the levers 41, 42 and 43 and the pusher bar 5 which has become operatively connected with the lever 43 during the final portion of the swinging movement of the folding plate 3 through 180° and, consequently, the second or final fold is completed and the letter is pushed into the envelope.

On the top flat wall 67 of the filling funnel 65, the lip of which is advantageously made specially large, the moistening device 101 to 109, which is represented by way of example, can be arranged so that the moistening by pressing the gummed flap on a sponge is assisted by means of a manually operated lever 109 or in conjunction with automatic pressing with the main lever shaft. The moistening device consists of the container 101, the pressing plate 102, the levers 103, 105 and 109, the spring 104 and the leaf springs 100.

On pushing the envelope onto the filling funnel 65, its gummed flap slides over the leaf springs 100 until it is over the moistening sponge 108; when this has been effected, the lever 109 is pressed down with the thumb, so that the pressing plate 102 presses the gummed flap of the envelope onto the moistening sponge 108 and moistens it. Before pulling the envelope off the funnel or filling

funnel 65, the thumb releases the lever 109, and the spring 104 returns the pressing plate 102 to its initial position.

The discharge end of the filling funnel 65, on which there is to be fitted the envelope to be filled, is specially formed according to the invention. In order to facilitate the pushing on and the pulling off of the envelope, the bottom end 68 of the discharge part of the filling funnel is cut to a W-shape, whilst the opposite top tongue of the filling funnel is made V-shaped, as shown at 267 in Figure 8, or rounded, as shown at 67 in Figure 1, and stands back somewhat in relation to the W-tongue 68. The V-shaped tongue of the filling funnel may be made tiltable in relation to the bottom W-shaped tongue; if required, the two tongue ends may be swingable together, so that the supporting surfaces for fitting the envelope on are hingedly arranged on the filling funnel.

These modifications are illustrated in Figures 8–10. The filling funnel, that is generally indicated at 265, has a lower tongue 268 that has a W-shape and is secured to an elongated member 113'. The member 113' is journalled on a shaft 112, and the entire funnel 265 is tiltable with the member 113' about the axis of said shaft 112'. Bearing structures 114' are provided for the shaft 112'.

An upper tongue 267 that has a V-shape is movably connected to the lower tongue 268, and is tiltable relative thereto, as best shown in the embodiment of Figure 10, during letter insertion when the pushing plate 204 pushes an accordion-folded letter through the funnel 265, whereby the letter will pass through the funnel mouth between the upper tongue 267 and lower tongue 268. The upper tongue 267 is tiltably connected to the lower tongue 268 by means of a rod 114'' that is tensioned by a spring 115' towards a normal position shown in Figure 9. Rod 114'' is fixed at one end to upper tongue 267 so as to provide a variable width mouth for the funnel during letter insertion, this mouth being resiliently biased closed by spring 115'. During letter passage, the upper tongue 267 will lift and tilt against the power of the spring 115 (Fig. 10). The entire funnel 265, including the lower tongue 268 and the upper tongue 267 may together be tilted, for instance manually, from the normal letter passage position (shown in solid lines in Fig. 9) about the axis of the shaft 112' to an upper position (shown in broken lines in Fig. 9).

On returning the operating lever 59 as shown in Fig. 5, all the swung-out folding members and the pushing plate 4, as well as the pusher bar 5, are brought back into their initial position and the machine is again ready for receiving the next letter sheet or envelope. During the return movement of lever 59 in the direction of arrow D_2 of Figure 5, it passes through position III to withdraw pusher plate 4 back into folding plate 3 and swings folding plate 3 back to its original location by the time position II is reached. During this return movement the strips 28 do not move, since their actuation linkage is such that they are swung only when lever 59 is moving in the direction D_1. On returning the operating lever, the filled envelope is, at the same time, pulled off by hand, with the moistened gummed flap open, so that the latter is then correctly turned down, and the envelopes are then pressed several at a time superposed upon one another. The notch in the pushing plate or in the pusher bar 5 is used for this purpose.

Referring to Figures 11–28 that machine, stripped of protecting cover plates, comprises a table base 110 upon which is secured rigid upright side frames 111 and 112. Each side frame (Figure 16) comprises a front downwardly projecting portion 113 supporting opposite ends of an inclined fixed flat plate 114 and an upwardly projecting rear portion 115 supporting opposite ends of a more steeply inclined fixed flat upper plate 116, the two plates being spaced by an open region indicated at 117 in Figure 11 but effectively providing substantial smooth surface continuations.

The lower end of upper plate 116 is recessed to provide an opening generally indicated at 118 which is effectively a continuation of space 117 and in which a flat surfaced pivoted plate 119 normally lies substantially coplanar with plate 116.

Plate 119 at opposite sides has rigid arms 121 and 122 fixed upon the outer ends of levers 123 and 124 freely pivoted coaxially on the side frames on pins 125 and 126 respectively. Normally plate 119 rests upon resilient pads 127 and 128 (Figure 13) mounted on the back of plate 116. These pads prevent counterclockwise rotation of plate 119 out of the plane of plate 116. Pivot pin 125 has rigid therewith a small gear 129 constantly meshed with a segmental gear 131 (Figure 19) likewise pivoted on the side frame 111 upon pin 132, for a purpose to be later described.

A generally T-shaped pusher 133 comprising a head plate 134 and a rigid flat leg 135 (Figure 13) is slidably mounted on plate 119. A slide guide track assembly 136 is provided on the back of plate 119 to confine leg 135 and limit it to straight line reciprocation. Normally head plate 134 abuts the upper edge of plate 119, being coplanar therewith, and leg 135 is provided with an inclined face 137 coacting with a spring clip 138 (Figure 15) on plate 119 to resiliently releasably hold the pusher in the illustrated retracted position of Figure 13. The lower end of leg 135 is slotted at 139 (Figure 14) for a purpose to appear.

Plate 116 is formed with a series of transverse slots 141 for laterally slidably mounting sheet side guides 142 and 143 to accommodate any desired width of the paper sheet to be folded. Spring holding assemblies 140 on the guides maintain them in adjusted position. These side guides (Figure 16) extend a considerable distance above the sheet carrying surface of plate 116 and thereby also act of directional guides during the first fold of the sheet as will appear. A sheet top edge engaging stop tab 144 is frictionally reciprocably mounted for adjustment on the back of plate 116 (Figure 13) and projects through slot 145.

Lower plate 114 has a series of parallel slots 146 through which project stop tabs 147 to at times be disposed above the level of plate 114. Tabs 147 are preferably longitudinally slidably mounted as by the slide guide structures indicated at 148 on parallel arms 149 that are rigid with a transverse bar 151 which in turn is resiliently pivoted as by means illustrated at 152 upon a longer transverse bar 150 rigidly secured upon the back of lower plate 114. The resilient means 152 normally bias bar 151 toward the position where the tabs 147 project above the plate 114, and the operation of this feature in association with the rest of the machine will be described below.

Adjacent opposite lower corners of plate 114 are disposed upright posts 153 which are slidably mounted for adjustment along parallel slots 154 respectively. The adjacent upper surface of plate 114 serves as the bottom of a transverse funnel throat and a transverse sheet metal element 155 which serves as the upper funnel part overlies the lower end plate 114 and is resiliently urged thereagainst by compression springs 156 disposed between adjustable stops 157 on the tops of posts 153 and element 155.

Forwardly of the posts 153 is provided an integral extension of element 155 which consists of a smoothly upwardly curved section 158 that provides a flared entrance for the funnel and a smooth upright wall 159 generally normal to plate 114. A flat envelope engaging sheet metal plate 161 is rigidly secured to element 155. An integral envelope flap engaging tab 162 upstands from the rear of plate 161 and also serves as a flat spring bearing against the upper end of the wall 159.

A plate 163 is mounted on the lower end of plate 114 to extend beneath plate 161. Plate 163 is formed with parallel slots 164 (Figure 14) by which is slidably mounted on downwardly projecting posts 165 rigid with

plate 114. Compression springs 166 extending between adjustable stops 167 and plate 163 resiliently releasably hold plate 163 in adjusted position.

At opposite sides of plate 163, wing plates 168 are pivoted at 169 upon plate 114 so as to be outwardly swingable in the plane of plate 114.

Two slots 170 slightly converging from top to bottom are provided in plate 114 as shown in Figure 11.

The foregoing structure on plate 114 provides a smooth surfaced funnel having a variable size throat at 155 to automatically controllably expand open and pass folded sheets and included inserts of different thicknesses. The location of this throat is adjustable in the direction of sheet feed by shifting element 155. The wall 159 has a definite function in the sheet folding second phase as will appear. The plates 161 and 163, with wing plates 168, function as an envelope mount which is also adjustable in the sheet feed direction by the adjustment of plate 163. The lower edge of plate 163 is notched at 171 for a purpose to appear.

Swingable over the upper surface of plate 114 are stop strips 172 and 173 which are normally in the retracted positions shown in Figure 11. These strips are rigidly secured upon the upper ends of parallel rods 174 and 175 respectively that are journalled in plate 114 at their upper ends at 176 and 177 (Figure 13) and at their lower ends in base brackets 178 and 179. Levers 181 and 182 are secured to the lower ends of the rods, and a transverse tie bar 183 is pivotally connected at opposite ends at 184 and 185 to these levers.

Midway between the ends of rod 175 is fixed a lever 186 to which is pivoted at 187 a link 188 having its other end pivoted at 189 to a cam actuated arm 191 that is pivoted on the base at 192. Arm 191 carries a freely rotatable cam follower roller 193 that coacts with a cam 194 having a cylindrical face 195 and a recessed face 196. A tension spring 197 is connected between arm 191 and the side frame 111 and urges roller 193 against the cam. Figure 23 illustrates the parts as they are related before the first fold operation starts, with the cam roller 193 on the cam surface 195 and the fold strips 172 and 173 retracted in the full line position of Figure 11.

Cam 194 is fixed upon a transverse rotatable shaft 198 that is journalled in the side frames and is formed at both ends for attachment of an operating handle 199.

A latch lever 201 (Figures 13 and 17) is freely pivoted on shaft 198 and axially held between the hub of cam 194 and a collar 202 pinned to the shaft. A spring 203 anchored on the base 110 biases lever 201 clockwise in Figure 17 and in the starting position of the parts of Figure 17 urges lever 201 against a pin 204 projecting from the side of cam 194. Lever 201 is also formed with a lower edge notch 205 which at the end of the first fold operation and during the second fold phase locks with a latch pin 206 projecting from lever 191 on the other side from and coaxial with cam roller 193. The purpose of latch lever 201 is to lock the fold stop strips 172 and 173 in inoperative retracted position (Figure 22) during the second fold operation accomplished by the pusher. Between the Figure 17 and 22 locations, the position of lever 201 is governed by engagement of its camming surface 207 with latch pin 206 as shown in Figure 18.

Fixed upon the end of shaft 198 remote from the folding strip control cam 194 is a first fold control cam 211 that (Figure 21) has a cam groove 212 in which is disposed a freely rotatable follower roller 213 mounted upon a lever 214 pivoted at its lower end at 215 on the base. A link 216 is pivoted at 217 to the upper end of lever 214 and extends rearwardly to pivotal connection at 218 (Figure 19) to an arm 219 rigid with segment gear 131. A spring 221 anchored to the frame at 222 is connected to pivot 218 and biases the gear counterclockwise in Figure 19.

When handle 199 rocks shaft 198 counterclockwise in Figure 19, as it does during the first fold operation, the coaction of cam 211, lever 214 and link 216 rocks gear 131 in the direction of the arrow in Figure 19 for a purpose to appear.

Near cam 211, a stop arm 223 is fixed to shaft 198 (Figures 13 and 20), and this arm coacts with rigid posts 224 and 225 upstanding from the base to limit rotation of shaft 198 to 180°.

Referring to Figures 19 and 20, link 216 has affixed thereon a lug 226 which as link 216 moves to the left as shaft 198 rotates is adapted to engage one end of a lever 227 pivoted at 228 (Figure 13) on stationary bar 150. The other forked end of lever 227 is slidably pivotally connected to a pin 229 rigid with pivotally mounted bar 151. Thus as lug link 216 moves to the left in Figure 20, lug 226 engages lever 227 and turns it to cause rocking of the transverse bar 151 and the stop tabs 147 secured to it counterclockwise between the Figure 19 and Figure 20 positions down out of the sheet support table.

Intermediate its ends shaft 198 has secured thereon a pusher control cam 230, shown in the starting position of the parts in Figure 16, having a control track groove 231 in which moves a follower roller 232 (Figure 20) on a lever 233 pivoted at 234 upon the base. Pivoted to the upper end of lever 233 at 235 is a link 236 having its other end pivoted at 237 to a hook assembly 238.

Referring to Figure 13 the hook assembly 238 comprises a bar 239 having a hub 241 at its lower end journalled upon a fixed axis frame pivot assembly 242. At its upper end bar 239 has a hook element 243 removably secured thereon as by screw 244. Referring to Figures 14 and 19, the pusher leg slot 139 couples to hook 243 during operation of the apparatus for activating the pusher to accomplish the second fold operation as will appear.

Referring now to Figures 11, 13 and 25–28, the short sheet stop and retainer feature is there illustrated. Two retainer assemblies 246 and 247 are provided. They are identical preferably and the same reference characters are used. Each comprises (Figures 27 and 28) a support block 248 fixed upon the bottom of plate 114 at the edge of space 117, as by a screw 249. Block 248 has an arm 251 that extends across under space 117 to a point beneath the edge of plate 119 (Figure 27). An arcuate stop member 252 is pivoted on pin 253 journalled in arm 251 and normally urged to rotate clockwise in Figures 27 and 28 by a torsion spring 254 (Figure 25). Member 252 is adapted to assume either of the full line positions of Figure 27 or 28.

Normally member 252 is latched in the position of Figure 27. This is accomplished by a latch plunger 255 that in its extended position of Figure 11 and the right side of Figure 25 engages member 252 and resists the effort of torsion spring 254 to displace it toward the Figure 28 position. Plunger 255 is slidably mounted on block 248 (Figure 26) for movement at right angles to the path of movement of stop member 252 and is biased by spring 256 toward its extended Figure 11 position.

When it is desired to place member 252 in its operative position, the operator simply inserts a finger or tool through slots 257 of plate 114 and displaces plungers 255 out of the path of members 252 whereupon springs 254 rotate members 252 above the sheet support surface to the operative position of Figure 28, and during and after this motion the flat ends of retracted plungers 255 merely ride along the flat sides of members 252 as shown in Figure 26. When it is desired to make a member 252 inoperative it is pushed down through slot 257 until it clears plunger 255 which automatically extends under spring pressure to latch it.

Near pivot 253 a lateral pin 270 is fixed to member 252 to be pivotally and slidably received in a slot 271 in a link 272 pivoted at 273 to an arm 274 that is pivoted at 275 on block 248. At its upper end arm 274 is formed with an integral right angle lip 276 the upper surface of which is flush with plate 114 when the member 252 is in

its retracted position of Figure 27. When member **252** is in its operative position of Figure 28, the coaction pin **270**, link **272** and arm **274** swings lip **276** to an inoperative position parallel to block extension **251**, where it serves as a stop to prevent further clockwise movement of lever **272** and thereby member **252** in Figure 28.

The upper end of member **252** has mounted on it a freely rotatable axle having small smooth faced sheet contacting rollers **277** on opposite sides of member **252** for a purpose to be described.

On the rear surface of pivoted plate **119** (Figure 13) are mounted two spring metal strips **278** each slotted at **279** and **281**. The slot **279** is to slidably and pivotally mount the strip on a pivot pin **282** so that the strips may be moved to an inoperative Figure 28 position or at an angle to that shown in Figure 13. The slot **281** is to interfit with a fixed pin **283** on plate **119** which holds the strip against rotation and parallel to the direction of sheet movement when it is in the operative position of Figures 13 and 27.

At its free end strip **278** is formed with an upturned stop lip **284** which in the operative position (Figure 27) projects above the surface of plate **119** to provide a sheet stop when short sheets are folded, and slots **279** and **281** permit friction and spring held adjustment of these stop lips into proper sheet edge contacting position. These stops **284** are used only in association with retainer members **252** for short sheets.

Referring to Figure 11, a latch bar **285** is pivoted on plate **114** at **286** and formed with an upturned flange **287** which in the dotted line position of Figure 11 hooks over strip **173** to prevent the strips **172** and **173** from swinging inwardly upon rotation of shaft **198**. This is done when short sheet stops **246** and **247** are projected above the sheet support surface. Since strip **173** is fixed upon rod **175**, the latch prevents lever **191** from following cam **194** under the urge of spring **197**. In its inoperative full line position of Figure 11, latch **285** is disposed under strip **173** which simply slides over it.

In operation of the embodiment shown in Figures 11–28 a sheet S (Figure 16) to be folded is placed on the surface that essentially consists of plates **114**, **116** and **119** and pusher head **134**. This surface is smooth and the adjustments of funnel member **155**, edge stops **147** and side stops **142**, **143** have been preliminarily made to suit the sheet size. The stops **246**, **247** are latched down in inoperative position, and the stops **284** are behind plate **119** when normal sizes of sheets are used. At this time if desired any enclosures may be placed on the sheet to be folded into it.

Starting with the parts in the Figure 16 position, the handle **199** is moved counterclockwise. The first function that takes place is that strips **172** and **173** are swung toward each other into the aligned dotted line position of Figure 11 to overlie sheet S, the distance between edge stops **147** and strips **172**, **173** is about one-third the length of the sheet S. Movement of strips **172**, **173** into this position takes place as soon as cam roller **193** drops onto the face **196** which is immediately after shaft **198** starts to rotate. This permits spring **197** to act through lever **191**, link **188** and the mechanism of Figures 23 and 24 to accomplish this action by the time handle **199** reaches the position II of Figure 16.

Next cam **211** becomes active to swing lever **214** which acts through link **216**, arm **219** and gears **131** and **129** to rock plate **119** counterclockwise out of the support surface as indicated in Figure 19 and by the time handle **199** reaches position III in Figure 16 plate **119** has been turned through about 180° and overlies the sheet to accomplish the first fold of the sheet about the upper edges of strips **172**, **173**. Thus about two-thirds of the sheet S is folded over by this movement of plate **119** and the folded over part lies against wall **159** to effectively locate it for the subsequent reverse fold function.

Upon further rotation of shaft **198**, usually just before plate **119** reaches its final position overlying the partially folded sheet, cam surface **195** again assumes control of lever **191** and the strips **172**, **173** are rocked back to the full line position of Figure 11, which they attain when the handle reaches the IV position of Figure 16. Also lug **126** has engaged lever **227** to move sheet edge stops **247** down below the surface of plate **114**.

By this time the rocking of plate **119** has resulted in slot **139** of the pusher bar **135** becoming hooked at **243** to the pusher arm assembly which has remained stationary, and the pusher head **134** remains locked to the plate **119**, effectively acting as a part of plate **119** up until this time, by the clip shown in Figure 15. Further rotation of shaft **198** results in cam **230** becoming active through lever **233** and link **237** to pull the pusher arm **238** counterclockwise with enough force to separate head **134** from spring clip **138** and plate **119** and move the pusher head **134** into and through the funnel until the shaft **198** has rotated to its 180° limit position with the handle at V.

During this movement of head **134** it accomplishes the second or reverse fold of sheet S (Figure 20) and also pushes the folded sheet into the funnel on which the open envelope E has been placed by the operator. The notch **174** enables the operator to grasp the envelope and contents tightly and pull it off the funnel ready for sealing and mailing.

After the envelope containing the accordion or Z-folded sheet has been removed the operator rocks the handle **199** and shaft **198** back through 180° to the I position, and the cams on shaft **198** act in reverse. First the pusher arm **238** pulls the head **134** out of the funnel until it latches to plate **119** as in Figure 15, and then the plate **119** is rocked back into the plane of plate **116** and the parts go back to the Figure 16 position ready to fold another sheet.

The stop assemblies **246**, **247** and the stops **284** are used to adapt the apparatus where short sheets are to be folded once, and when they are used the latch **285** is moved to the dotted line Figure 11 position to keep fold strips **172**, **173** inactive. With a short sheet in place on surface **119** resting against edge stops **284**, the shaft **198** is rotated counterclockwise by handle **199** and after position II is reached plate **119** starts to rock as before and the sheet is kept from falling away from the plate **119** by contact with retainer rollers **277** which maintain light pressure contact with the sheet under the influence of spring **254** until the sheet is at the same time folded and pushed into the funnel. During the rocking of plate **119** the short sheet effectively turns about its lower edge in stops **284**. The free end of the turned over short sheet moves against upright surface **159** and the pusher accomplishes the folding operation like in Figures 19 and 20. Upon return rocking of plate **119** into the plane of plate **116**, rollers **277** merely follow the plate **119** under the force of spring **254** as retainer members **252** go back to their Figure 28 position.

Since these shorter sheets usually require smaller envelopes, this can be accommodated by adjustment of plate **163** and wings **168** may be swung out of the way to permit a small envelope to be mounted upon the funnel.

It will be noted that when the retainer members **252** are moved to inoperative position such automatically moves the lips **276** up to align and form effective continuations of the surface of plate **114** to partially bridge gap **117** and aid in proper folding of larger sheets.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A letter-folding and envelope-filling machine comprising a letter-sheet supporting element having part thereof in the form of a folding plate swingable therefrom and adapted to fold preliminarily a letter sheet lying on said supporting element, a flat envelope-filling funnel, on one end of which an envelope can be fitted, and a pushing device carried by said folding plate adapted to fit into said funnel and being slidable relative to the bottom of said folding plate and movable into and from said funnel, upon swinging of said folding plate, and adapted to take a preliminary folded letter sheet in such a position in front of said other end of said funnel that said letter sheet is accordion folded and pushed into the envelope by the sliding movement of said pushing device in said funnel, and means for actuating said swingable and slidable elements.

2. A letter-folding and envelope-filling machine according to claim 1, comprising folding strips arranged on said supporting element, swingable onto a letter sheet lying on said supporting element and adapted to have said letter sheet folded around themselves by said folding plate.

3. A letter-folding and envelope-filling machine according to claim 1, said pushing device being arranged on said folding plate on the surface that is opposite to the one for supporting the letter sheet and being adapted to be brought, by the swinging movement of said folding plate, into such a position in front of the said other end of said funnel that the preliminarily folded letter sheet is taken by said pushing device and folded by the pushing of the letter sheet into said funnel.

4. A letter-folding and envelope-filling machine according to claim 1, the funnel discharge end of said supporting element being in the form of a W-shaped tongue, the opposite end of said supporting element having a tongue that is substantially V-shaped and stands back somewhat in relation to said W-shaped tongue and is tiltable in relation thereto.

5. A letter-folding and envelope-filling machine according to claim 1, the funnel discharge end of said supporting element being in the form of a W-shaped tongue, the opposite end of said supporting element having a tongue that is substantially V-shaped and stands back somewhat in relation to said W-shaped tongue, the said two tongues being tiltable together.

6. A letter-folding and envelope-filling machine comprising a letter-sheet supporting element having part thereof in the form of a folding plate swingable therefrom and adapted to fold preliminarily a letter sheet lying on said supporting element, a flat envelope-filling funnel, on one end of which an envelope can be fitted, and a pushing device carried by said folding plate adapted to fit into the other end of said funnel, slidable with relation to the bottom of said folding plate into said funnel and adapted, when said folding plate has been swung through 180°, to take a preliminarily folded letter sheet in such a position in front of said other end of said filling shaft that said letter sheet is folded and pushed into the envelope by the sliding movement of said pushing device in said funnel, said machine also comprising folding strips arranged on said supporting element, swingable onto a letter sheet lying on said supporting element and adapted to have said letter sheet folded around themselves by said folding plate, and a rotary shaft having cams thereon actuatable for controlling the swinging movement of said folding strips and the pushing-in movement of said pushing device as well as their return movement, and means operable to actuate said swingable and slidable elements.

7. A sheet folding and envelope-filling machine comprising means defining a sheet support surface having part thereof in the form of a folding plate swingable therefrom and adapted to fold preliminarily a sheet lying on said support surface, an envelope-filling funnel on one end of which an envelope can be fitted, and a pushing device adapted to fit into the other end of said funnel and being slidable on said machine relative to said folding plate and movable into and from said funnel, means for shifting said pushing device into and out of said funnel after said swinging of said folding plate, said pushing device being adapted to take a preliminarily folded sheet in such a position in front of said other end of said funnel that said sheet is accordion folded and pushed into the envelope by the sliding movement of said pushing device into said funnel, and means for actuating said swingable and slidable parts in timed relation.

8. A sheet folding and envelope-filling machine comprising means defining a sheet supporting surface having part thereof in the form of a folding plate swingable therefrom and adapted to fold preliminarily a sheet lying on said supporting surface, an envelope-filling funnel, on one end of which an envelope can be fitted, and a pushing device slidably mounted in said machine adapted to fit into the other end of said funnel slidable beyond said folding plate into said funnel shaft and adapted, after said folding plate has been swung through about 180°, to take the preliminarily folded sheet in such a position in front of said other end of said funnel that said sheet is folded and pushed into the envelope by the sliding movement of said pushing device in said funnel, said machine also comprising folding members mounted to be swingable onto a sheet lying on said surface and adapted to have said sheet folded over them by said folding plate in the preliminary folding operation, and means comprising a rotary shaft having cams thereon operatively connected for controlling the swinging movement of said folding members and the pushing-in movement of said pushing device as well as their return movements in timed relation.

9. In combination in a sheet folding and envelope-filling machine, a support, means providing an upwardly facing surface on said support for underlying a sheet to be folded, means on said support for folding a sheet placed on said surface, means on said support for positioning an open envelope to receive the folded sheet and defining an aligned open throat at the adjacent end of said surface through which the folded sheet is inserted into the envelope, and means for pushing the folded sheet along said surface through said throat into said envelope.

10. In the combination defined in claim 9, movably mounted sheet edge stops projecting above said surface above said throat, and means synchronized with said folding and pushing means for displacing said stops below said surface prior to actuation of said pushing means.

11. In the combination defined in claim 10, said sheet edge stops being adjustable in the direction of sheet movement along said surface.

12. In combination in a sheet folding and envelope-filling machine, a support, means providing an inclined upwardly facing surface on said support for receiving a sheet to be folded, retractable sheet edge stops projecting above said surface, means on said support for folding a sheet placed on said surface, means on said support for positioning an open envelope to receive the folded sheet and defining an aligned open throat at the lower end of said surface below said stops and through which the folded sheet is inserted into the envelope, and means for retracting said stops below said surface and pushing the folded sheet along said surface through said throat into said envelope in timed relation.

13. In the combination defined in claim 12, laterally adjustable sheet side guide means on said support projecting above said surface.

14. In combination in a sheet folding and envelope-filling machine, a support, means providing an upwardly facing surface on said support for underlying a sheet to be folded, means on said support for folding a sheet placed on said surface, means on said support for posi-

tioning an open envelope to receive the folded sheet and defining an aligned open throat at the adjacent end of said surface through which the folded sheet is inserted into the envelope, means for pushing the folded sheet along said surface through said throat into the envelope, and means for adjusting the location of said throat along said surface in the direction of sheet movement.

15. In the combination defined in claim 14, means for adjusting said envelope receiving means in said direction of sheet movement.

16. In combination in a sheet folding and envelope-filling machine, a support, means on the support defining an inclined smooth surface for receiving a sheet to be folded, means on said support for folding a sheet placed on said surface, means on said support for positioning an open envelope at the lower end of said surface to receive the folded sheet, means for moving the folded sheet along said surface for inserting the folded sheet into said envelope positioning means, a sheet stop projecting above said surface adapted to be contacted by the lower edge of a sheet placed on said surface to locate the sheet for proper folding, and means synchronized with said sheet folding and inserting means for displacing said sheet stop below said surface prior to insertion of the folded sheet into the envelope.

17. In the machine defined in claim 16, means on said support mounting said sheet stop for adjustment in the direction of sheet movement.

18. In the machine defined in claim 16, means on the support mounting said envelope positioning means for adjustment in the direction of sheet movement.

19. In combination in a sheet folding and envelope-filling machine, a support, plate means providing a surface on said support for underlying a sheet to be folded, an upright stop member adjacent an end of said surface, a section of said plate means being pivotally mounted, means for pivoting said plate section for providing a first fold in said sheet and for positioning the free end of the folded over part of said sheet against said stop member, means on said support adjacent said stop member for positioning an open envelope to receive the folded sheet and defining an open throat through which the folded sheet is inserted into the envelope, and means movable in timed relation past said pivoted plate section for engaging said folded over part of said sheet and pushing the sheet through said throat and at the same time providing a reverse fold in said folded over part of said sheet, whereby an accordion folded sheet is thrust into said envelope.

20. In combination in a sheet folding and envelope-filling machine, means providing an envelope mounting funnel having spaced upper and lower members defining a flared entrance mouth and a generally upright section above said mouth, a sheet supporting table adjacent said funnel mouth, means for first folding a sheet lying on said table by folding over the major portion of said sheet remote from said mouth to lie against said upright section, and a reciprocable pusher actuated in timed relation to said first folding means so as to be movable over and against said folded over sheet portion and into said funnel, said movement of the pusher providing a second fold in said sheet which is at the same time pushed into said funnel to be disposed within an envelope mounted on said funnel.

21. In a sheet folding and envelope-filling machine, spaced members providing at one end an entrance mouth for folded sheets and providing a guide and support for mounting an open envelope to be filled over the other end, and means providing a generally upright sheet stop and fold control surface above said funnel mouth.

22. In a sheet folding and envelope-filling machine, spaced plates defining a flat funnel having an open sheet inserting mouth at one end and defining a support and guide for mounting an open envelope to be filled over the other end, said upper plate at said one end curving smoothly upwardly to provide a flared entrance mouth for the funnel and extending above said mouth to provide a sheet stop effective during the sheet folding operation.

23. In a sheet folding machine, means defining a sheet supporting surface and having a pivoted portion, means for pivoting said portion for first folding a major portion of the sheet over upon itself, a stop adapted to be engaged by the folded over portion of said sheet for maintaining the free end of the latter generally upright, and a slidable pusher actuated in timed relation with said pivoting means for engaging said folded over portion of said sheet and coacting with said stop to form a second reverse fold in said sheet.

24. In a sheet folding machine, means defining a sheet support surface and comprising a pivoted plate, means for swinging said plate through a wide angle to form a first fold in said sheet, a pusher slidably mounted on the bottom of said plate, a releasable connection normally securing said pusher to said plate, and means operated in timed relation with said plate swinging means for releasing said connection and advancing said pusher with respect to said plate to perform a second fold in said sheet.

25. In the machine defined in claim 24, said pusher having a head portion that is a substantial continuation of the plate surface when said pusher and plate are secured together by said connection.

26. In a sheet folding machine, means defining a sheet support surface and comprising a pivoted plate, sheet fold elements movable to a position overlying a sheet on said surface, means for swinging said plate through a predetermined angle, said plate coacting with said elements to form a first fold in the sheet, an envelope mounting funnel, a slidable pusher, means for advancing said pusher to effect a second fold in said sheet and at the same time thrust the folded sheet into said funnel, and means for sequentially moving said elements to overlie said sheet, pivoting said plate to effect said first fold, withdrawing said elements and then advancing said pusher.

27. In a machine defined in claim 26, latch means for holding said fold elements in withdrawn inoperative position.

28. In a sheet folding machine, a sheet support surface comprising a pivoted fold forming plate, a fold forming pusher slidably mounted on said plate, means for actuating said pusher, and means for establishing an operative connection between said actuating means and said pusher only after said plate has been pivoted to fold forming position.

29. In the machine defined in claim 28, said pusher actuating means comprising a pivoted arm actuated in timed relation with said plate pivoting means, and said operative connection comprising a slot and pin connection between the arm and the pusher.

30. In a sheet folding machine, spaced sheet support plates one of which is stationary and the other pivoted about a transverse axis, means for swinging the pivoted plate through a wide angle toward overlying relation with respect to said stationary plate, and resiliently pivoted means extending from the stationary plate for engaging a sheet on the folding plate with a light retaining pressure during said swinging movement.

31. In the sheet folding machine defined in claim 30, sheet edge contacting stops on the edge of said pivoted plate in the space between said plates.

32. In the machine defined in claim 30, means for latching said pivoted sheet retaining means in inoperative position below the surface of said stationary plate.

33. In the machine defined in claim 30, means automatically moved into the space between said plates for added sheet support when said sheet retaining means has been moved to latched position.

34. In the machine defined in claim 30, said pivoted retaining means comprising an arm mounted on one end on a fixed axis spring biased pivot and having sheet contacting rollers on its other end, and said latch means comprising a spring biased plunger coacting with said arm.

References Cited in the file of this patent

UNITED STATES PATENTS

1,046,707	Young	Dec. 10, 1912
1,094,304	Causey	Apr. 21, 1914
1,245,421	Amberg	Nov. 6, 1917
1,641,406	Alden	Sept. 6, 1927
1,720,699	Stevens	July 16, 1929
1,779,105	Price	Oct. 21, 1930
2,673,016	Gerbe	Mar. 23, 1954