Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 1

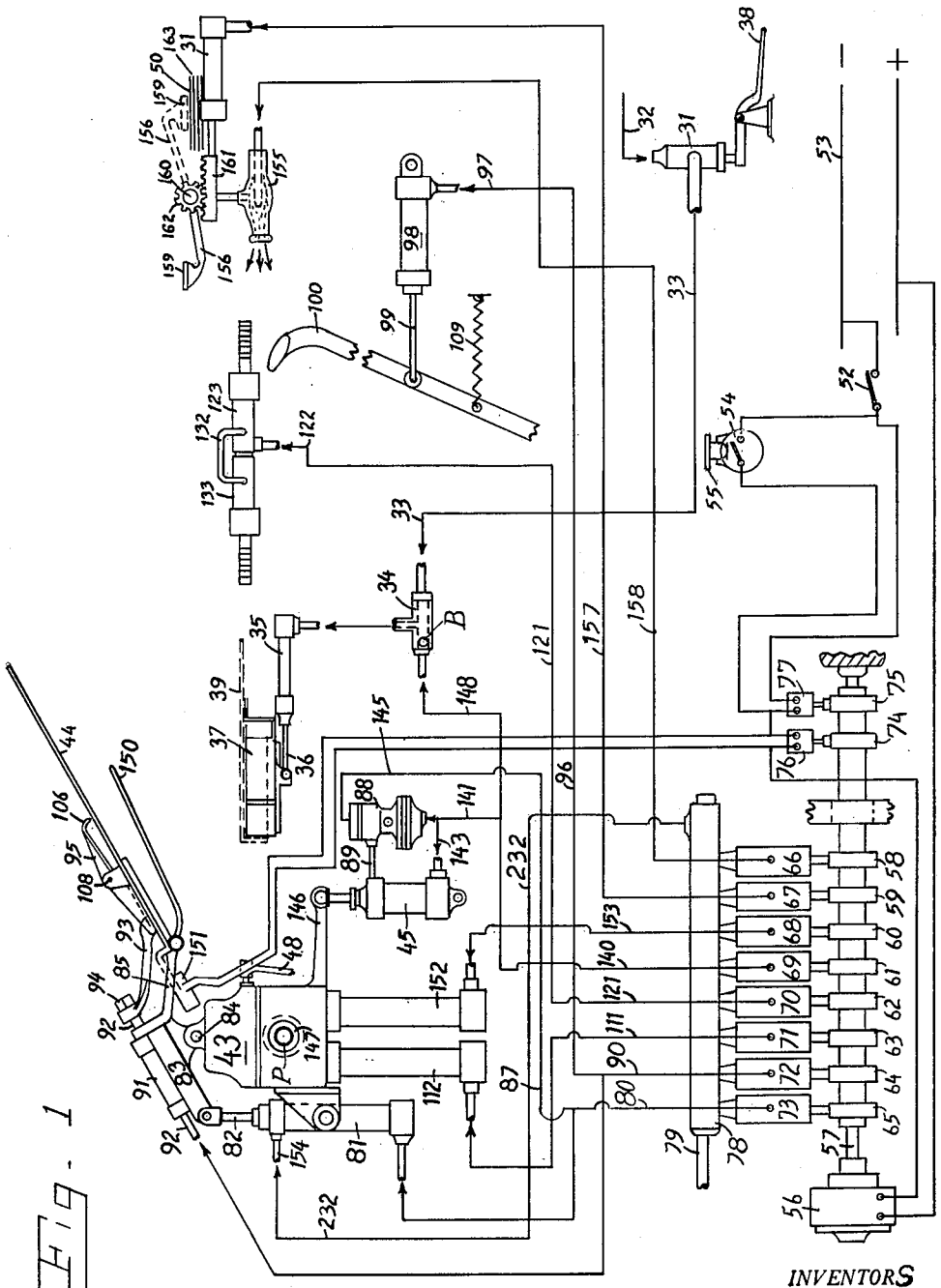


Fig. 1

INVENTORS
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5, 1957 12 Sheets-Sheet 2

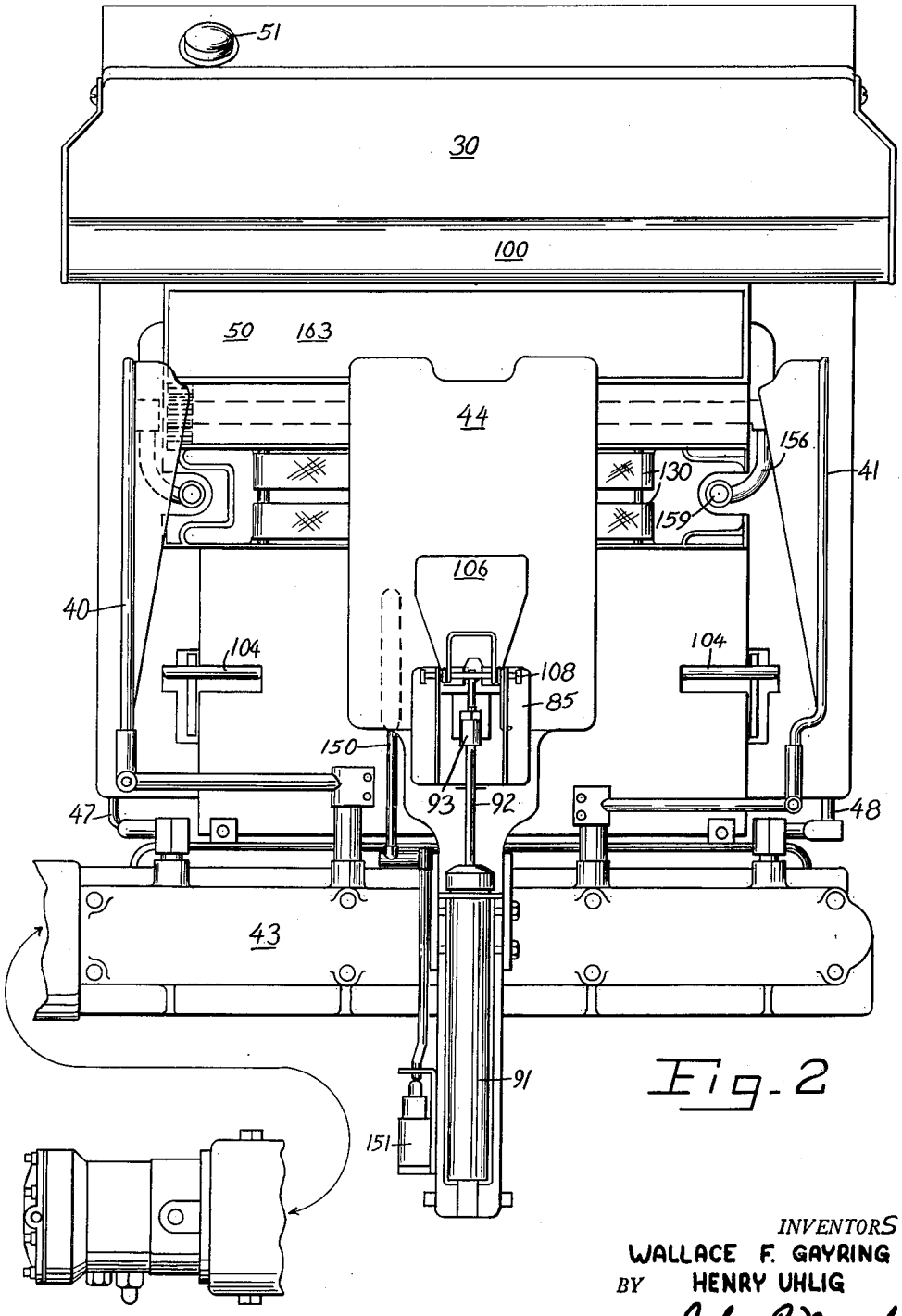


Fig. 2

INVENTORS
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

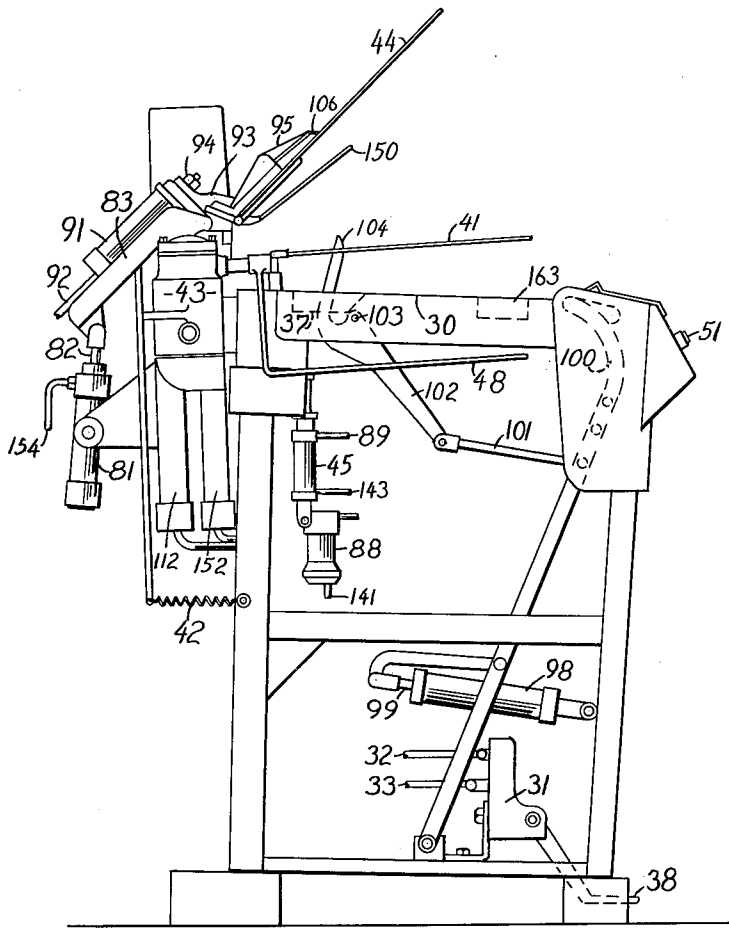


Fig. 2A

INVENTORS
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5, 1957 12 Sheets-Sheet 4

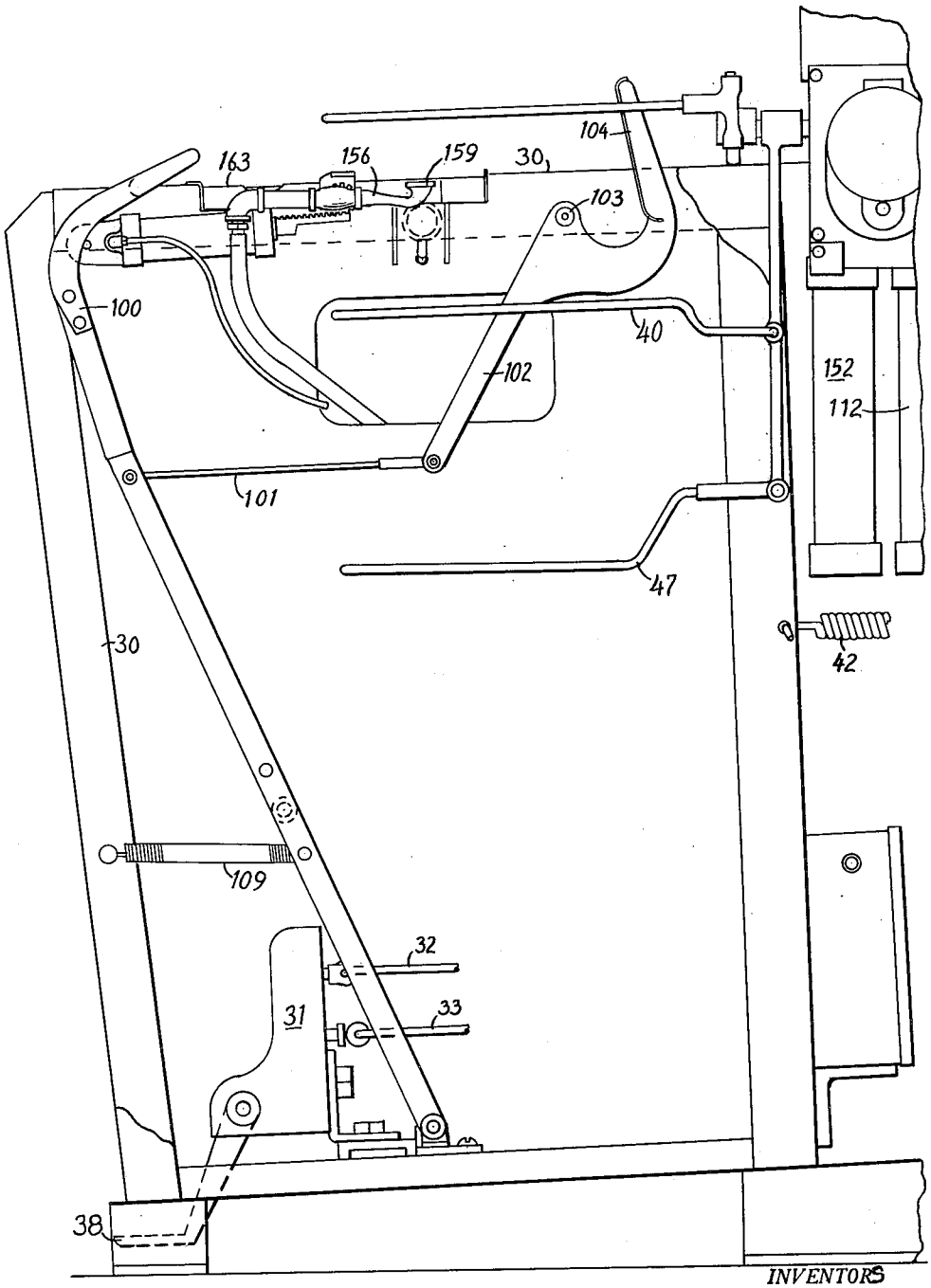


Fig - 3

INVENTORS
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 5

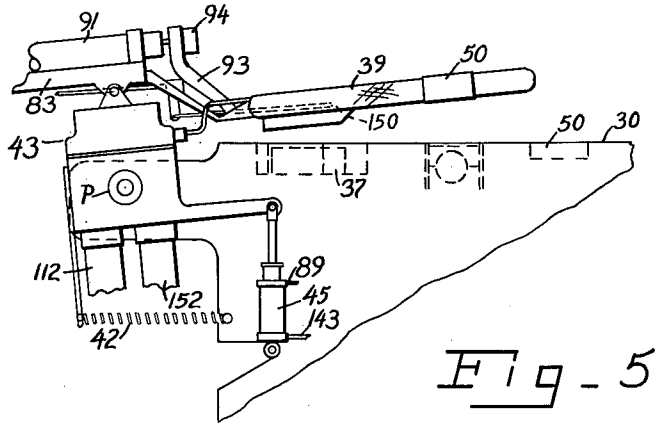


Fig. 5

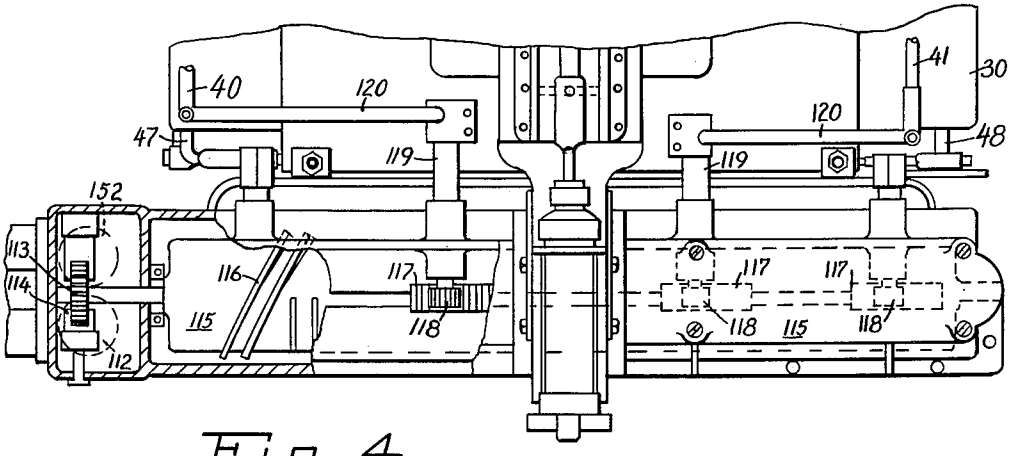


Fig. 4

INVENTORS
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 6

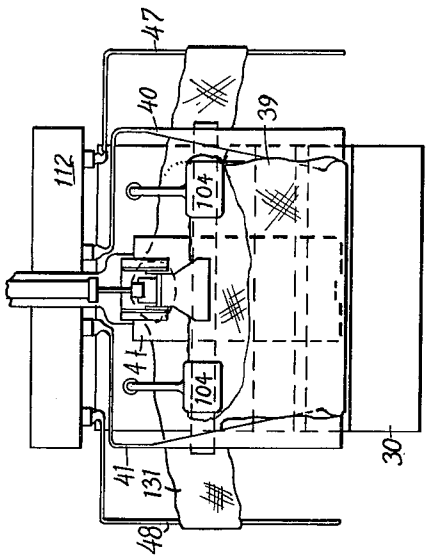


Fig - 8

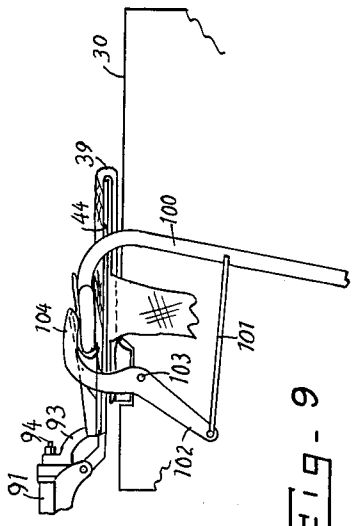


Fig - 9

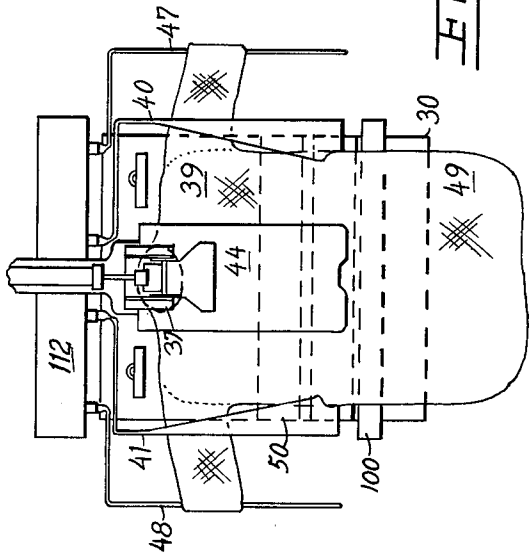


Fig - 6

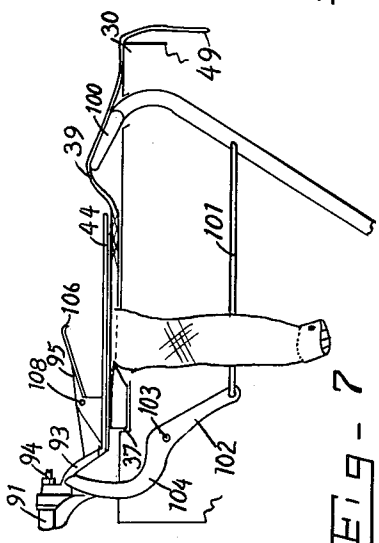


Fig - 7

INVENTORS
WALLACE F. GAYRING
HENRY UHLIG
BY
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 7

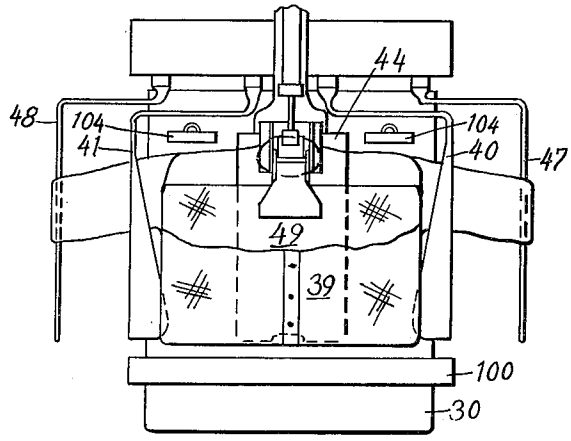


Fig. 10

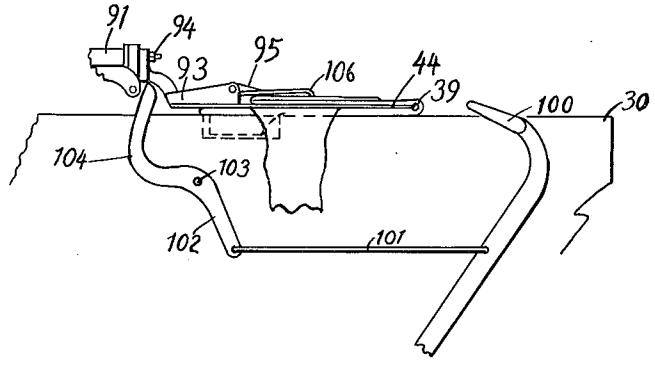


Fig. 11

INVENTORS
WALLACE F. GAYRING
HENRY UHLIG
BY John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 8

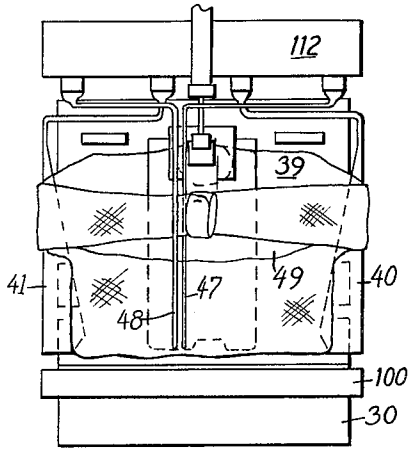


Fig. 12

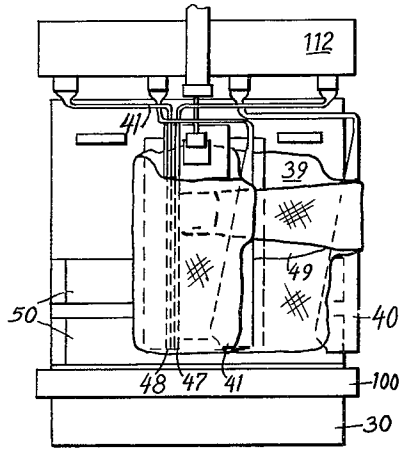


Fig. 13

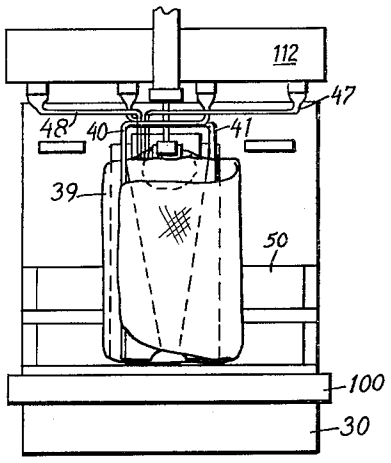


Fig. 14

INVENTORS
WALLACE F. GAYRING
HENRY UHLIG
BY John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5. 1957 12 Sheets-Sheet 9

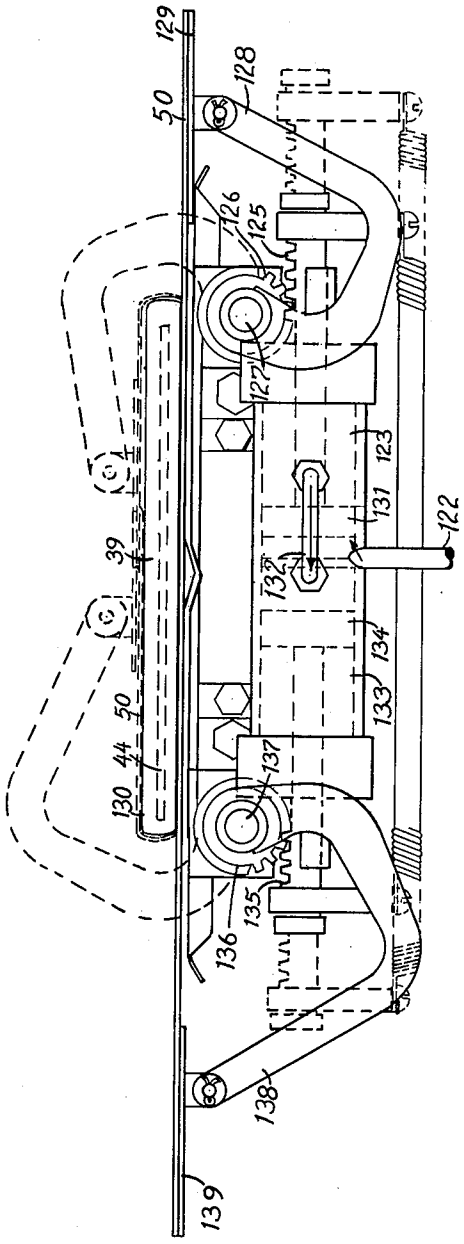


Fig-15-

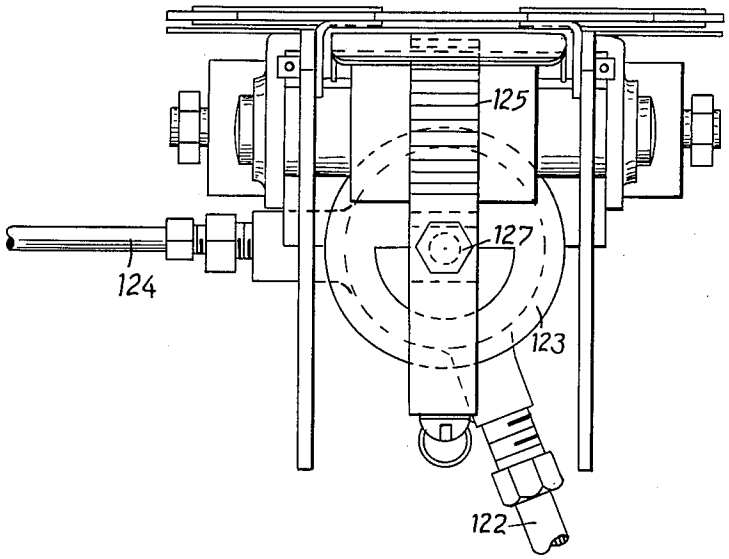
INVENTORS
WALLACE F. GAYRING
HENRY UHLIG
BY John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5, 1957 12 Sheets-Sheet 10

Fig. 16.



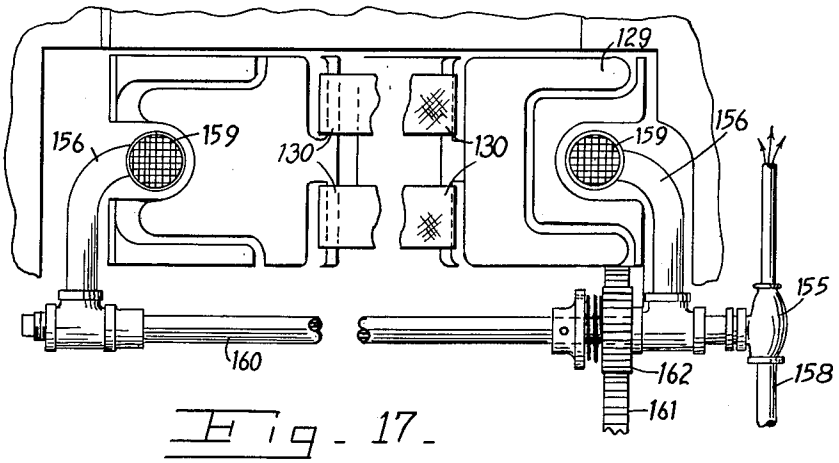


Fig. 17.

INVENTOR.
WALLACE F. GAYRING
HENRY UHLIG
BY John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5, 1957 12 Sheets-Sheet 11

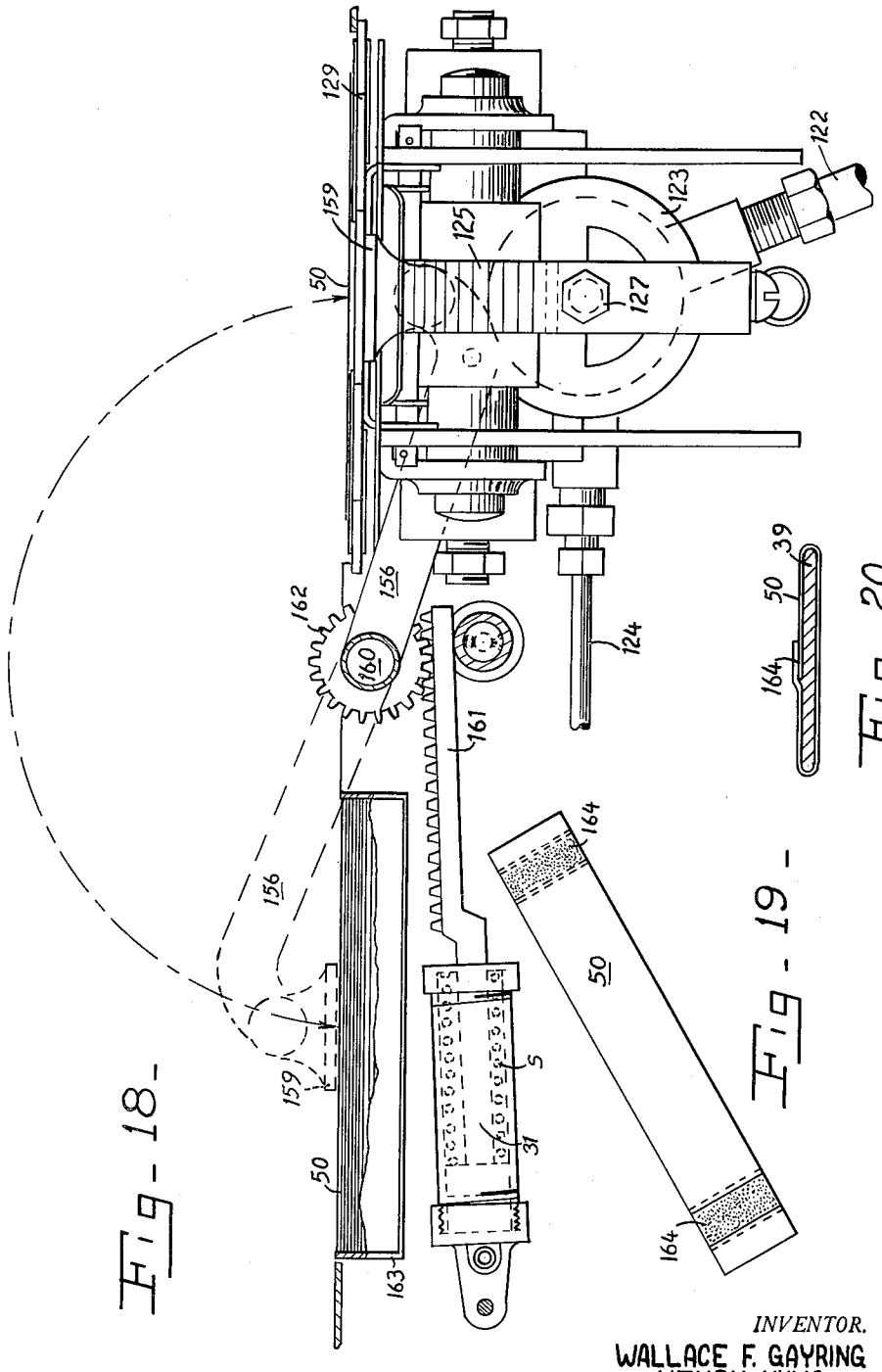


FIG. 18.

FIG. 19.

FIG. 20.

INVENTOR.
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

Oct. 9, 1962 W. F. GAYRING ET AL 3,057,133

SHIRT FOLDING MACHINE

Filed July 5, 1957 12 Sheets-Sheet 12

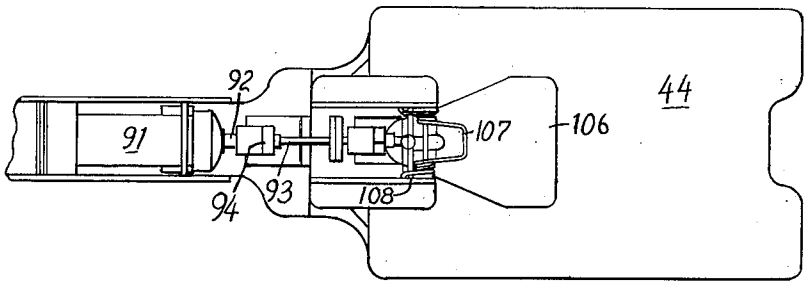


Fig. 21.

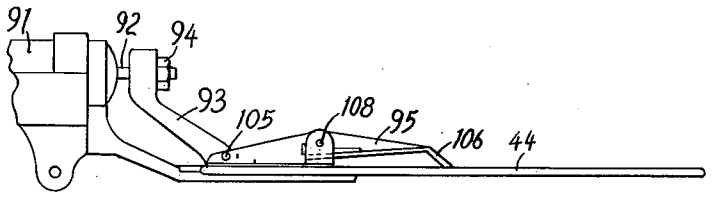


Fig. 22.

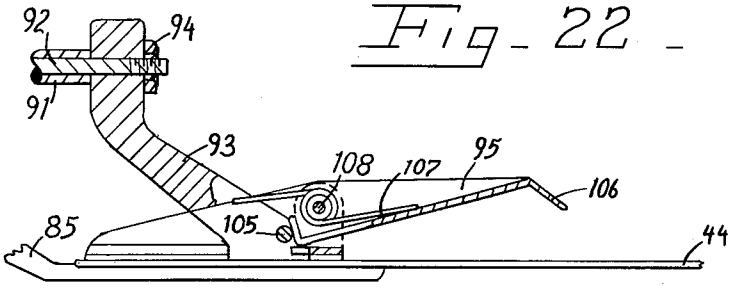


Fig. 23.

INVENTOR.
WALLACE F. GAYRING
BY HENRY UHLIG
John P. Murphy
ATTORNEY

United States Patent Office 3,057,133 Patented Oct. 9, 1962

3,057,133

SHIRT FOLDING MACHINE

Wallace F. Gayring, Minoa, and Henry Uhlig, Bouckville, N.Y., assignors to The Prosperity Company, Division of Ward Industries Corporation, Syracuse, N.Y., a corporation of Delaware

Filed July 5, 1957, Ser. No. 670,131
5 Claims. (Cl. 53—117)

This invention relates to a machine adapted to be employed for completely and automatically folding various articles or materials and to apply wrapping means to the folded article for retaining the thus folded article in its folded form or position. While this machine is adaptable to a multiplicity of uses, it is particularly useful for folding shirts and placing a wrapping or sealing means thereabout for retaining the folded shirts in their intended folded position.

Previously, machines have been presented which accomplish the operations of folding a shirt, each machine accomplishing a given combination of some of the operations required to present a completely, automatically machine-folded and wrapped or otherwise sealed shirt. These machines, however, have left certain manual operations to the operator, such as folding the arms of the shirt or placing a wrapper or sealing band on the machine or shirt. Other machines have required the operator to manually place a cardboard or other insert or form on the shirt for forming the shape of the finished shirt, the insert being left within the finished, folded shirt. Mechanisms performing certain of the folding operations are intricate and complicated in other machines, whereas in this invention, all of the above disadvantages are overcome automatically by the machine in addition to performing other of the operations necessary for presenting a finished, folded and wrapped article of good quality uniformly consistent with the quality of subsequent articles folded and wrapped by the machine.

Accordingly, it is an object of the present invention to provide a machine which accomplishes all of the operations of folding a shirt and placing around the folded shirt a wrapper or other sealing means, completely and automatically.

It is a further object of this invention to provide a machine which obviates the need to place an insert on the shirt for folding therewithin.

In accordance with this invention a machine is provided employing a novel method of folding foldable articles or materials such as garments. A garment, such as a shirt, for example, is placed on the machine. Upon the actuation of the machine, the garment is retained securely in position on the machine, members of the garment are automatically folded into desired form in a timed cycle, and the whole of the garment is folded into a desired unitary position, at which time, a wrapping or other sealing means secures a wrapper about the garment thus folded for retaining the garment in its intended folded shape or form.

A clearer understanding of the foregoing may be had by reference to the following detailed specification when read with reference to the accompanying drawings in which:

FIGURE 1 is a diagrammatic illustration of the control system for the automatic shirt folding machine.

FIGURE 2 is a top plan view of the shirt folding machine illustrating several of the features.

FIGURE 2A is an elevation of the left side of the machine, the shirt form and folding arms being in the raised position.

FIGURE 3 is a side elevation of the right side of the machine cut away in part and with several details omitted, showing the tail folding and clamping construction in detail.

FIGURE 4 is a top view of the machine in part and

partially cut away illustrating the folding arm actuating mechanism.

FIGURE 5 is a side elevation of the machine, in part, illustrating the action of the tilting cylinder.

FIGURE 6 is a top view of the machine with a shirt in position thereon for folding.

FIGURE 7 is a diagrammatic side elevation of the machine with a shirt in position for folding and further illustrating the relationship of the parts as illustrated in FIGURE 6.

FIGURE 8 is a top view of the machine with a shirt thereon partially folded, illustrating the tail folder in operation.

FIGURE 9 is a diagrammatic side elevation further illustrating the features shown in FIGURE 8.

FIGURE 10 is a top view of the machine with a partially folded shirt thereon following the tail folding operation.

FIGURE 11 is a diagrammatic side elevation of the tail folder in position as shown in FIGURE 10.

FIGURE 12 is a top view of the machine with a partially folded shirt thereon illustrating the operations of folding the arms of the shirt.

FIGURE 13 is a top view of the machine as at FIGURE 12 illustrating the folding of the left body portion of the shirt.

FIGURE 14 is a top view of the machine as at FIGURE 13 illustrating the folding of the right body portion of the shirt.

FIGURE 15 is a diagrammatic side elevation showing clearly the operation and construction of the band placing mechanism.

FIGURE 16 is an end elevation of the band placing mechanism, portions of the machine being omitted.

FIGURE 17 is a top plan view in part, of the band pick-up arms and vacuum cups.

FIGURE 18 is a side elevation in part, of the machine showing the band feeding mechanism and the band placing mechanism.

FIGURE 19 illustrates a gummed band as may be used with the present modification of the invention.

FIGURE 20 is a diagrammatic cross section of a folded shirt with a band having been placed therearound.

FIGURE 21 is a top view of the machine in part, showing the shirt form and tail clamp and with associated mechanism for actuation thereof.

FIGURE 22 is a side elevation of the features as in FIGURE 21.

FIGURE 23 is a sectional elevation in part, of the features illustrated in FIGURE 22 and showing the operation thereof.

As to the construction of an embodiment of the present invention, a folding table comprising a frame and surface for receiving a foldable article is constructed so that the surface is dimensionally proportional to the size and shape of the article to be folded, and the surface is of a convenient height from the floor upon which the machine is situated. Thus, a machine for folding a shirt is illustrated with the surface herein referred to as a folding table **30**. In accordance with FIGURE 2A the front of the machine is at the right of the illustration, where the operator stands or is otherwise positioned. In FIGURE 2, the view is from the back of the machine, the operator thereby being positioned at the opposite end facing the viewer.

A shirt form **44** is supported by its mechanism and adapted to be automatically lowered into position for forming a substantially rectilinear shape of a shirt being folded therearound. This form **44** is pivotally mounted at the head of the machine and may be raised or lowered by the action of piston rod **82** in cylinder **81**, the cylinder **81** being operated by air pressure. This cylinder **81** and other

cylinders to be described are all actuated by air pressure in a timed cycle which will be more fully described.

An arm folding unit 43 is disposed at the head of the table 30 and is pivotally mounted at P, FIGURE 1. Arm folding unit 43 includes a pair of inner fin-shaped folding arms 40 and 41, and a pair of outer folding arms 47 and 48. Arms 40, 41, 47, and 48 are actuated by a gear 118 being rotated by a rack 117 sliding transversely or laterally. An air cylinder 112 moves a rack 114 for rotating a gear 113. Gear 113 is rigidly fastened to a shaft 147 having a cam track mechanism 115 thereon. Cams 116, being in the general form of guide tracks are disposed in predetermined disposition on the cam track mechanism 115 and in relationship with each other for operating the folding arms in a predetermined timed cycle or order when the shaft 147 is rotated by the action of gear 113. When rack 114 has been moved its full length, air is automatically shut off at cylinder 112 and, in cycle, supplied to cylinder 152. Cylinder 152 has a rack corresponding to rack 114 for reversing the direction of rotation of gear 113 and thus shaft 147 for returning the folding arms 40, 41, 47, and 48.

It is to be understood that all operations herein described are performed in a predetermined order and cycle so that separate operations and moving parts of the machine do not interfere one with another.

A tail clamp 106 is pivotally fastened to the bracket which holds the shirt form 44. Clamp 106 is spring loaded and is pivoted by the action of cylinder 91. Piston rod 92 has a bracket 93 held to the end thereof by a nut 94. When cylinder and piston rod 92 are actuated, the clamp 106 is pivoted by bracket 93 and moves downwardly after the tail portion of a shirt has been folded up over the shirt form 44, thus clamp 106 holds the tail portion of the shirt in place.

In the surface of the folding table 30 and substantially toward the head of the table and substantially under the head end of the shirt form 44 is a conventional collar holder 37. This is of the expander type conventionally utilizing expansible blocks and associated mechanism spring loaded and adapted to be expanded inside a shirt collar for forming the collar and holding the shirt in position on the folding table 30 while the folding operation is performed. The collar holder 37 is diagrammatically represented in FIGURE 1 as expanded by piston rod 36 of cylinder 35 receiving air from shuttle valve 34. Located at the base of the machine and in a position convenient to the operator is a foot pedal 38 for operating an air valve 31. Air under pressure enters the valve 31 through line 32 and, upon opening of the valve 31, the air passes through line 33 to the shuttle valve 34, the operation of which will be more fully described.

Shuttle valve 34 comprises a substantially T-shaped chamber having a ball check B within. The ball check B is slidably disposed in the chamber and adapted to be transferred to either end of the long side of the chamber by the force of air under pressure entering the opposite end. The ball B thus is seated against the inlet pipe at one end of the chamber, thence sealing that end. Air entering the shuttle valve 34 from line 33 forces the ball check B to the opposite end of shuttle valve 34 against and sealing the inlet pipe 148, allowing air to pass through the valve 34 into cylinder 35, thus to contract the collar former or holder 37. When the foot pedal 38 is released, air pressure no longer holds the collar holder 37 in a contracted position, and the spring action of the collar holder mechanism expands the collar holder 37 for holding a shirt collar thereon. Air pressure entering shuttle valve 34 from line 148 actuates the ball check B to shut off line 33, thus actuating the shuttle valve 34 and the cylinder 35 to contract collar former 37 in the same manner as actuated by the foot pedal 38.

Located or positioned at the opposite end of the machine from the head end, a tail folder bar 100 is disposed substantially transversely across the width of the machine, and adapted to pivot at substantially the base of the machine. The folder bar 100 is retained in its position by a suitable spring 109, suitably held in place by screws or the like. Spring 109 can be any coil type tension spring. Located at either side of the collar holder 37 and substantially even with the plane of the collar holder 37 are tail retaining levers 104, pivotally mounted below the surface of the folding table 30. The lower extremities of the tail retaining levers 104 are designated at 102, and are connected by means of suitable links 101 to the tail folding bar assembly, 100. The levers 104 are pivoted at point 103 on suitable axial means. A cylinder 98 receives air under pressure through line 97 in timed order from a valve 72, later to be described. Upon actuation by this air under pressure, the piston rod 99 of cylinder 98 moves tail folder 100 towards the head of the folding table 30, the link 101 moving the lower end 102 of the tail retaining lever 104 forwardly, thus pivoting the lever at 103. The lever 104 thus is moved downwardly to substantially the level of the surface of table 30. At approximately the same time, air is passed through line 92 to cylinder 91, moving piston rod of cylinder 91 outwardly. This actuates a tail holding clamp assembly for holding the tail of a shirt. This tail holding clamp assembly 95 includes a clamp 106, and a spring 107, pivotally mounted on pin 108, and actuated by bracket 93 which is fastened by nut 94 to the piston rod of cylinder 91. The sequence of operation will be described hereinafter. This tail holding clamp 106 is located on the top of the shirt form 44 and at the head end of the form 44 on a bracket lever 83, the operation of which is hereinbefore described. The bracket and clamp 106 are adapted to tilt as a single unit.

A lever 150 is pivotally mounted to lie substantially directly under the shirt form 44 at a plane between the shirt form 44 and a garment being folded on the folding table 30. The other end of the pivotally mounted lever 150 is adapted to actuate a micro switch 151, to be more fully described.

An air cylinder 45 receives air from a control valve 88 to operate the entire folding arm unit 43 with the shirt form 44 and related assembly. The unit 43 is tiltably pivoted at P and is held in a normal position by a spring 42. After a garment is folded and it is desired to remove the garment from the shirt form, the cylinder 45 tilts the unit 43 so that the shirt form 44 is raised from the plane of the table enabling the operator to remove the folded shirt therefrom.

As shown in FIGURE 1, a timing motor 56 has a shaft 57 extending outwardly with cams 58—65 thereon. Air valves 66—73 respectively, are mounted in alignment with cams 58—65, and actuated thereby. A manifold 78 receives air from the main air supply 79 and distributes this air to the valves 66—73. When the machine is started in operation, the timing motor 56 turns shaft 57, thus rotating cams 58—65 and opening valves 66—73 in a predetermined, timed order to provide air under pressure for the various cylinders throughout the machine for performing the folding operations in a desired sequence. Cams 74 and 75 operate micro swithces 76 and 77 respectively for controlling the supply of electrical current to the timing motor 56.

Positioned at substantially the center of the folding table 30 is a band placing mechanism which is best illustrated in FIGURES 16, 17, and 18, with reference to FIGURE 1. Directly adjacent the band plasing mechanism is a supply stack 163 of bands 50. Bands 50 are herein shown in FIGURE 19 as a flexible strip of suitable material having a gummed area substantially at each end of the band and on opposite sides as indicated by the numeral 164. The location of the gummed areas 164 is such that, when a band is wrapped around a garment so that one end of the band overlaps the othe rend, the gummed areas 164 will lie one directly over the other and, upon pressing together with a slight pressure, will adhere to each other for securing the band 50 around the

folded garment. It is understood that the gummed band herein shown is merely illustrative, as any form of wrapping adapted to be used in conjunction with this invention may be employed. The construction of the band placing mechanism is best shown diagrammatically in FIGURE 1 wherein is illustrated a vacuum cup **159** on a vacuum pick up arm **156** fastened to an axial pipe **16** having a vacuum within. Referring to FIGURE 18, pipe **160** is shown having a gear **162** mounted therearound, and engaging with a rack **161**. Rack **161** is located in operable position on the end of a piston rod **31** in an air cylinder. The piston is spring-loaded by spring S within the cylinder to maintain the vacuum pick up arms **156** in the normal position indicated by the solid lines in FIGURE 18, the dotted lines indicating the position of the cups **159** and arms **156** when picking up a band **50** from stack **163** for placing in position. When air enters the cylinder for actuating the piston rod **31**, the rack **161** rotates gear **162**, pivoting the vacuum pick up arms **156** to place vacuum cups **159** over a band **50** on the stack of bands. A vacuum creating means **155** comprises a special fitting having air flowing past an opening, thus creating a low pressure area at the opening. The opening is connected to pipe **160**, and due to the low pressure area at the opening in the vacuum creating means **155**, air flows from the atmosphere into the cups **159**, through the arms **156** and into the pipe **160**, thus causing a partial vacuum at the cups **159**. Thus, as diagrammatically shown in FIGURE 1, a cup placed over a band **50** is adapted to hold the band by the vacuum, and upon release of the pressure to the cylinder the spring S will expand, and cause the cups to return to the normal position. The band **50** thus retained on the cups **159** is held in position directly over the normal position of the cups **159**.

A banding mechanism is illustrated in FIGURES 15 and 16 as comprising elastic webs **130** which are adapted to have the band **50** positioned directly thereabove by the band placing mechanism already described. Arms **128** and **138** are attached to gears **126** and **136** mounted on shafts **127** and **137** respectively, to be actuated by racks **125** and **135** fastened to piston rods **131** and **134** in cylinders **123** and **133**, all of the above respectively. The cylinders are in one single unit receiving air through line **122** entering the side of the cylinder between the pistons **131** and **134**. The ends of the elastic webs **130** are attached to banding plates **129** fastened to the ends of the arms **128** and **138**. Substantially in the center of the cylinder unit is a dividing wall, and the air line **122** enters on the right side of this wall, actuating the arm **128** in the direction shown by the dotted lines, thus placing the right end of a band **50** around and over the folded shirt **39**. As the piston **131** passes the port line **132**, air is allowed to bypass the dividing wall or partition to the left side, actuating piston **134** in cylinder **133** for moving arm **138**. This action carries the left end of the band **50** around and upwardly over the folded shirt **39** so that the left end of the band is placed directly over the already positioned right end of the band **50** and the left plate **129** presses the ends of the band **50** together so that the gummed portions **164** of the bands are caused to adhere. A spring or other suitable means is adapted to cause the arms **128** and **138** and associated mechanism to return to a normal position upon release of air pressure through line **122**.

The operation of the shirt folding machine is as follows:

The machine is substantially in the position as indicated in FIGURE 2A, a gummed band having already been placed on the table in position after the previous operation. A shirt **39** is placed face down on the table with the collar button fastened, so that the button strips are in alignment as desired so that the shirt, when folded will present a neat appearance. The operator depresses the foot pedal **38**, contracting the collar holder **37** as hereinbefore described, placing the collar of the shirt **39** over the blocks, not shown, of the collar holder **37**. The operator then releases the pedal **38**, allowing air to escape from the holder **37** and thence expanding the blocks to hold the collar securely in place. This also serves to mold or form the collar in the desired natural shape as well as holding the shirt **39** in position on the folding table **30**.

For a clearer understanding of the following operations, cross reference from FIGURE 1 to the FIGURES 6–14 should be taken.

With the shirt **39** in the position illustrated in FIGURE 6, and the main switch **52** closed, the operator presses button **51**, closing micro switch **54**. This supplies current through micro switches **77** and **76** to the timing motor **56**, thus turning shaft **57** with the cams **58**—**65** thereon. Valve **73** is thus opened, supplying air to cylinder **81** and control valve **83**. Valve **83** lets air into the top of cylinder **45**, actuating lever **146**, placing the arm folding unit **43** in position for the folding operations. At substantially the same time, the shirt form **44** is lowered to the shirt **39** with the lever **150** thus placed therebetween, maintaining the micro switch **151** in the normally closed position so that current continues to the timing motor **56**. The shirt form **44** is thus positioned over the shirt **39** to ensure the rectilinear shape of the finished, folded shirt. Valve **72** then supplies air to the cylinder **98** for actuating the tail folding bar **100** as hereinbefore described. The tail folder bar **100** picks up the tail portion **49** of the shirt **39**, FIGURES 7 and 9, placing this portion **49** up over the shirt form **44** toward the head end of the machine. Air supplied to cylinder **91** then actuates the tail clamp assembly **95**, causing clamp **106** to clamp the tail portion **49** of shirt **39** securely to the top of the shirt form **44**. The tail retaining levers **104** momentarily retain the tail portion **49** of the shirt **39** while the tail folding bar **100** retracts, the levers **104** then retracting.

As the cams on shaft **57** are rotated to engage the valves in their intended order, valve **71** supplies air under pressure to cylinder **112**, which is the folding arm cylinder. This cylinder actuates rack **114** turning gear **113** which in turn rotates shaft **147**. Cam track mechanism **115** is mounted to rotate with shaft **147** so that the cams **116** engage the racks **117** in their proper sequence for actuating gears **118** for causing the folding arms **40**, **41**, **47**, and **48** to fold the shirt portions in the intended folded position. FIGURE 4 best illustrates the mechanism of the foregoing description. With the tail portion **49** of shirt **39** folded and the members of the machine in the relative positions illustrated in FIGURES 10 and 11, reference is now made to FIGURE 12. Folding arm **47** has folded the right sleeve upwardly over the folding arm **40**, placing the cuff over the body of the shirt **39** and over the shirt form **44**. Folding arm **48** has then folded the left sleeve in a like manner so that the cuffs of the shirt lie substantially over the central back portion of the shirt **39**. In the case that a shirt has French cuffs, the operator places the cuffs before starting the machine in operation, thus the automatic cycle of the machine will not have to be interrupted. The folding arms **40**, **41**, **47**, and **48** are adapted to rotate about axes **119**, FIGURE 4, through levers **120** to cause the folding arms to swing in a desired manner as actuated by the cam mechanism **115**. In FIGURE 13, after the sleeves have been folded, the fin shaped folding arm **41** picks up the left body portion of the shirt **39**, folding it over the central body portion of the shirt, the left edge of the shirt form **44** creating the neat straight fold desired at the side of the folded shirt. This having been accomplished, the fin-shaped folding arm **40** then picks up the right body portion of shirt **39** and folds it over the central body portion, so that the right body portion of the shirt lies on top of the body portion previously folded when the shirt **39** is face down on the

table 30. FIGURE 14 thus shows a folded shirt ready to be wrapped or banded.

Timing motor 56 continues to rotate shaft 57 so that cam 62 opens valve 70, supplying air pressure through line 121 to line 122 into cylinder 123 of the banding mechanism. With reference to FIGURE 15, and as hereinbefore described, the right end of the band is placed by arm 128 lifting plate 129 in an arcuate direction. The elastic webs 130 being attached to plate 129 are also lifted, and a band 50 being previously positioned on the webs 130 is thus wrapped around the folded shirt. As the right arm 128 places the right end of the band 50, it is seen that the end of the band projects beyond the plate 129 with the gummed portion 164 of the band 50 facing upwardly. While arm 128 is bringing the end of the band around the folded shirt 39, the arm 138 is actuated by cylinder 133 receiving air pressure through port line 132, so that plate 139, being attached to the opposite end of webs 130 brings the left end of the band 50 around the shirt and places the left end over the right end of the band in overlapping relationship. The gummed portion 164 on the left end of band 50 is thus placed directly on the gummed portion 164 of the right end of the band 50 so that the ends adhere to each other. As cam 62 continues to rotate, valve 70 is closed, releasing air from cylinders 123 and 133, allowing the arms 128 and 138 to return to the normal position substantially flush with the plane of the folding table 30. The shirt is thus banded as shown in the diagrammatic cross sectional view of FIGURE 20.

Shaft 57 continues to rotate, bringing cam 61 into position for opening valve 69. Air is then supplied to the collar holder through shuttle valve 34. The ball check B is moved to the right end of the shuttle valve 34, sealing the input line 33, and allowing air to pass to cylinder 35, which contracts the collar holder 37. The holder 37 no longer holds the collar of shirt 39. Substantially at the same time that the collar holder 37 releases the collar, air is supplied to the bottom portion of control valve 88 through line 141. Control valve 88 then releases the air pressure in line 89 to the top portion of cylinder 45, and air is supplied to the bottom portion of cylinder 45 through line 143, thus lifting arm lever 146. The entire folding arm unit 43 with the shirt form 44 having the completely machine-folded and wrapped shirt 39 thereon is tilted around the pivot P, so that the shirt form 44 with the folded shirt 39 enclosing the folding arms therein is lifted above the surface of the folding table 30, as shown in FIGURE 5.

The shirt form 44 with the shirt 39 thereon being thus in the up position, cam 74 on shaft 57 comes into engagement with micro switch 76, opening the switch and cutting off current to the timing motor 56, thus stopping the turning of shaft 57 and ceasing all operations of the machine. The operator then grasps the shirt and pulls it towards the front of the folding machine 30, thus removing the shirt 39 from the shirt form 44 and releasing lever 150. Lever 150 drops downwardly and closes switch 151, which again supplies current to the timing motor 56, causing shaft 57 to again rotate. This foregoing action thus bypasses the open micro switch 76. Cam 61 releases valve 69, releasing air pressure from the bottom portion of cylinder 45 and control valve 88. Air in the top portion of cylinder 45 then actuates the lever 146 downwardly, lowering the shirt form and folding arms to the table surface 30 by tilting the folding arm unit 43 around the pivot P and shaft 147.

Cam 60 then opens air valve 68, passing air pressure to cylinder 152, which is the folding arm opening cylinder. This cylinder 152 also actuates rack 114, turning gear 113. It is seen that gear 113 is turning in the opposite direction to that of the gear 113 when actuated by cylinder 112. The cam track mechanism 115 is thus reversed, opening the folding arms 40, 41, 47, and 48 so that they are returned to the normal position shown in FIGURES 2A and 6.

Cam 59 then opens valve 67, being next in sequence on shaft 57. Before this can take place, the shirt form 44 must be raised from the table so that a band 50 may be placed thereunder. Cam 65 releases or closes valve 73 and air is released from the bottom of cylinder 81. Air line 232 which continuously supplies air from manifold 73 to the top of cylinder 81 causes the piston rod 82 of cylinder 81 to move downwardly, pivoting bracket 83 around axle 84, whereupon the shirt form 44 and assembly is tilted upward as shown in FIGURE 2A. Simultaneously, air is released from cylinder 45, allowing spring 42 to tilt the arm folding unit 43 upwardly slightly as also shown in FIGURE 2A.

As shown in FIGURE 1, cams 58 and 59 operate valves 66 and 67 respectively. As hereinbefore described, vacuum means 155 is operated, and the band pick up arms 156 with vacuum cups 159 thereon are operated by cylinder 31. This action picks up a band 50 from the supply stack 163 and places the band 50 in position over the elastic webs 130, the vacuum creating means 155 continuing to maintain a vacuum in cups 159 to hold the band 50 in place while a shirt is laid over band 50 and moved about during the folding operation. The vacuum pick up arms and cups are then in the normal position.

In the last step of the sequence of operation, cam 75 opens micro switch 77 which cuts off the current to the timing motor 56, concluding the operation of the shirt folding machine.

It is herein seen that a band has been placed in position and the shirt form 44 and folding arms 40, 41, 47, and 48 are in position for the operator to place another shirt to be folded in position on the table 30. It should be further pointed out that each folding arm has its separate cam track 116 and moves independently of the other arms. The fin shaped folding arms 40 and 41 serve also as holders for the central body portion of the shirt 39 being folded. Clamps 104 serve the purpose of preventing the tail of the shirt 39 from being thrown too far forward by the tail folding bar 100, and act to retard the tail portion 49 as the bar 100 is retracted, also providing the double fold in the tail portion 49.

It is thus seen that the present invention of a shirt folding machine provides a completely automatic machine adapted to receive a foldable garment thereon and perform all of the necessary operations of completely and automatically folding the garment without necessitating any intermediate manual operations. Further, the machine is also adapted to place a suitable wrapping or sealing means around the folded garment for retaining the folded garment in its intended folded position. This is accomplished by a machine which is necessarily complex to a degree, yet relatively simple in construction and operation. The machine is adapted to employ existing sources of power found in commercial establishments such as compressed air and electricity.

Having thus described one modification of the present invention as illustrated in the accompanying drawings, it is to be understood that changes may be made from time to time which do not depart from the true spirit and scope of the invention as defined in the appended claims.

We claim:

1. An automatic shirt folding machine comprising a table for receiving a shirt to be folded, a collar holder for retaining said shirt securely in position on said table, a shirt form pivotally mounted, said shirt form being adapted to be lowered into position over said shirt to be folded for shaping the folds of said shirt, outer folding arms for folding the sleeves of said shirt over the central body of said shirt, inner folding arms for folding the side body portions of said shirt over the central body portion of said shirt, a tail folding assembly for folding the tail portion of said shirt over the central

body portion of said shirt, a tail clamping assembly for retaining said tail portion of said shirt in folded position, a timing means for actuating the foregoing operations in a predetermined order, means for automatically stopping said machine, an automatic air operated means for placing a wrapping in position on said machine for being placed around said shirt, an automatic air operated means for wrapping said wrapping securely around said shirt after said shirt is automatically folded, whereupon said wrapping being placed in said position on said shirt folding machine, said shirt being placed on said table for folding, said tail folding assembly being actuated, said tail clamping assembly retaining said tail portion of said shirt in position, said outer folding arms folding said sleeves of said shirt, said inner folding arms folding said side body portions of said shirt, said wrapping being wrapped securely around said shirt, said shirt is thereby automatically completely folded and automatically wrapped.

2. In an automatic shirt folding machine according to claim 1, said automatic air operated means for placing a wrapping in position on said table having vacuum means for maintaining said wrapping in said position while said shirt is being folded, said automatic air operated means removing a single wrapping from a supply stack of wrappings placed on said machine.

3. In an automatic shirt folding machine according to claim 1, said sleeves being folded in predetermined order automatically, said outer folding arms being actuated automatically by said automatic timing means.

4. In an automatic shirt folding machine according to claim 1, said shirt form forming a substantially rectilinear shape of said shirt, said shirt being folded therearound, said shirt form being lowered automatically into position over said shirt when said shirt is placed on said folding machine.

5. An automatic shirt folding machine comprising a table for receiving a shirt to be folded, a collar holding means for retaining said shirt on said table, means for folding the sleeves of said shirt, tail folding means, a tiltably mounted shirt form for shaping the folds of said shirt, air operated vacuum means for taking a single wrapping from a supply stack and placing said wrapping in position prior to placing a shirt on said table, wrapping means comprising webs on which a wrapping is positioned and air operated means connected to said webs for placing the ends of a wrapping around a folded shirt, and timing means for actuating all of the foregoing means in predetermined order.

References Cited in the file of this patent

UNITED STATES PATENTS

956,994	Peck	May 3, 1910
1,042,621	Terrill et al.	Oct. 29, 1912
2,155,641	Buser	Apr. 25, 1939
2,362,976	Cooper	Nov. 21, 1944
2,737,765	Reid	Mar. 13, 1956
2,741,958	Bridge	Apr. 17, 1956