July 29, 1958 R. S. GAMBLE ET AL 2,845,265

CLOTH FOLDING MACHINE

Filed Dec. 12, 1955 3 Sheets-Sheet 1

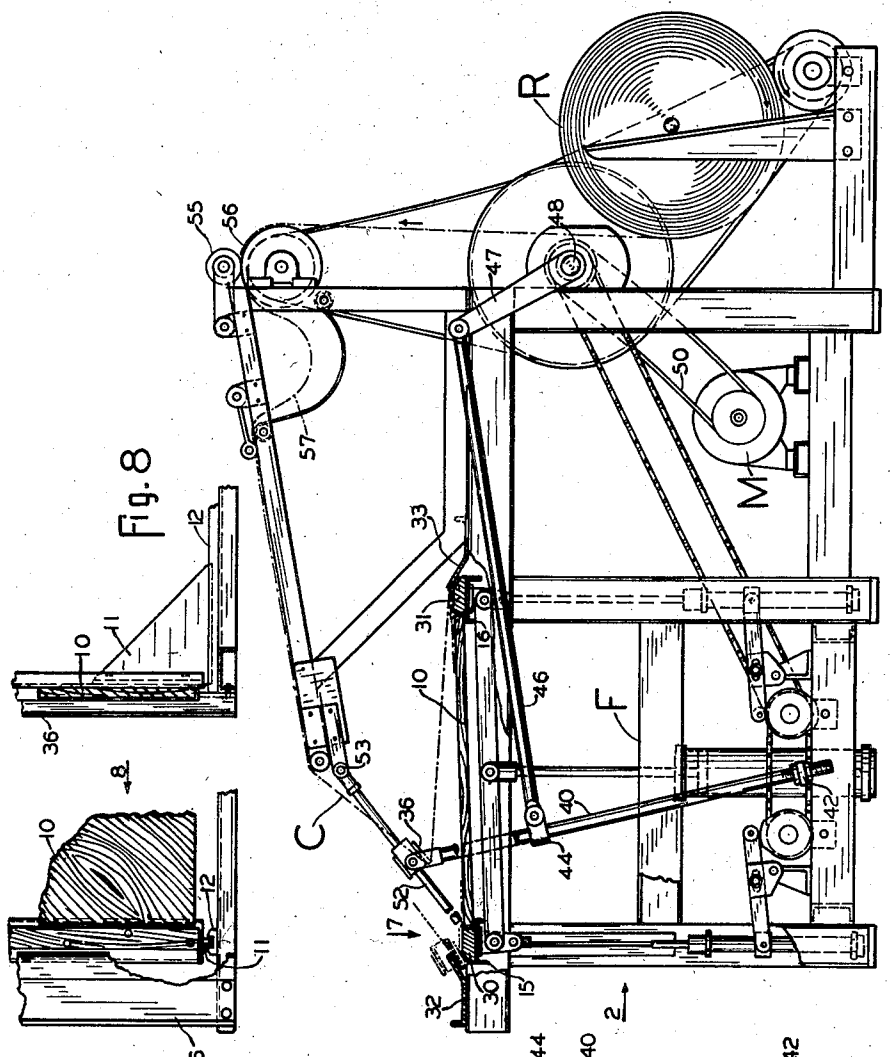


Fig. 1

Fig. 8

Fig. 7

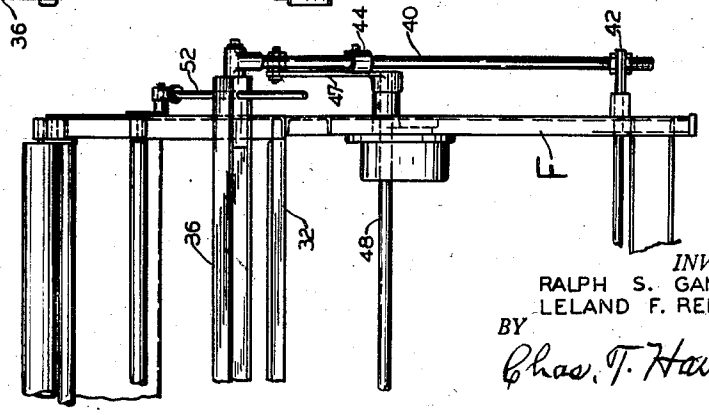


Fig. 2

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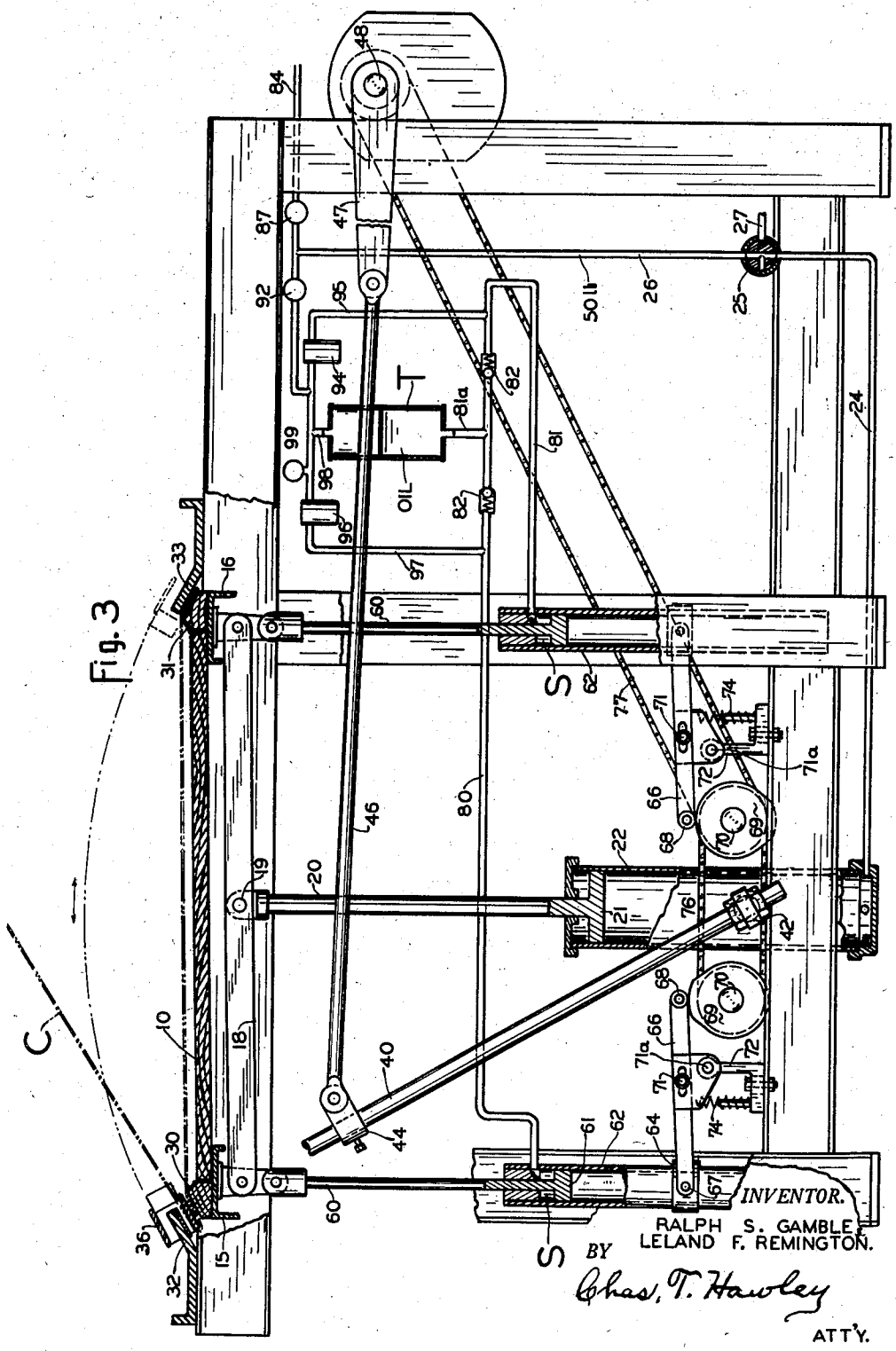


Fig. 3

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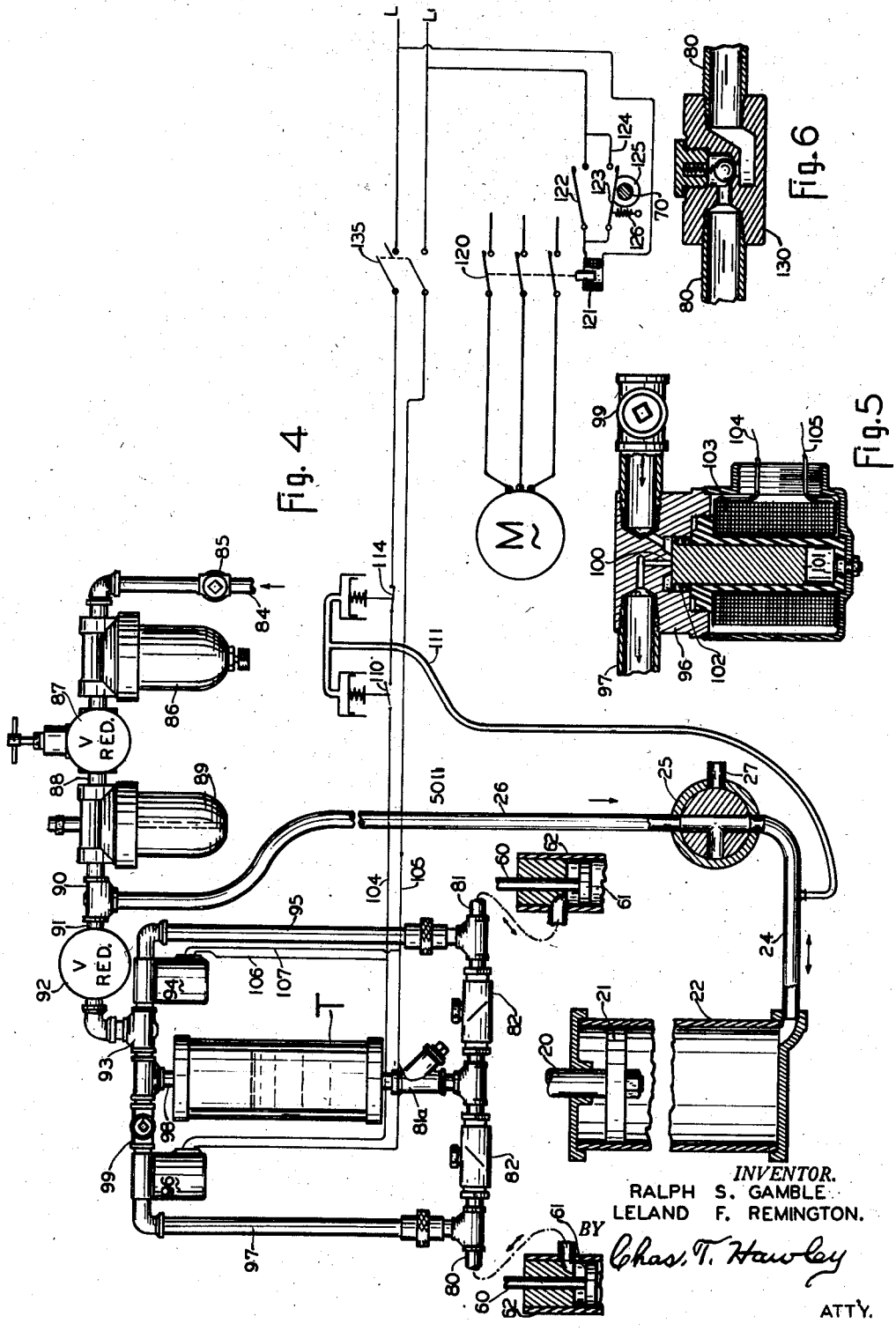


Fig. 4

Fig. 6

Fig. 5

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CLOTH FOLDING MACHINE

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7 Claims. (Cl. 270—79)

This invention relates to machines for folding long pieces of cloth in superposed layers. Such folding is commonly accomplished by means of a folding blade which presents the folded edges of the cloth to opposed pairs of clamping jaws alternately.

Each pair of clamping jaws comprises an upper fixed jaw and a lower movable jaw, and the movable jaws are yieldingly pressed against the fixed jaws by suitable air pressure. The air pressure on each lower jaw is momentarily overcome each time that a new fold of cloth is presented thereto.

An important feature of our invention relates to the provision of improved means for maintaining the desired clamping pressure on the superposed folds, while at the same time accommodating an increasing height or thickness of folded cloth. In the preferred construction, this progressive adjustment to cloth load is very simply effected by hydraulic means.

Another object of the invention relates to the provision of means for causing the machine to stop only at a predetermined point in the folding cycle.

Our invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claims.

A preferred form of the invention is shown in the drawings, in which:

Fig. 1 is a side elevation of our improved folding machine, with certain parts shown in section;

Fig. 2 is a partial front elevation, looking in the direction of the arrow **2** in Fig. 1;

Fig. 3 is an enlarged elevation, partly in section, and showing our improved operating and control mechanism;

Fig. 4 is an enlarged and partly diagrammatic side elevation of the pneumatic and hydraulic control mechanism and associated parts, and with certain parts shown in section;

Fig. 5 is a sectional side elevation of a solenoid-operated valve;

Fig. 6 is a sectional side elevation of a check valve;

Fig. 7 is a detail plan view of a portion of the cloth table and its supporting structure, looking in the direction of the arrow **7** in Fig. 1; and

Fig. 8 is a detail side elevation, looking in the direction of the arrow **8** in Fig. 7.

Referring to Figs. 1 and 2, our improved folding machine comprises a frame F having a cloth table **10**, the transverse edges of which are supported on cross-bars **15** and **16** (Fig. 3). The cross-bars **15** and **16** have brackets **11** (Figs. 7 and 8) which are slidable in vertical fixed and grooved guide-bars **12**.

The cross-bars **15** and **16** are pivotally connected to the opposite ends of a supporting lever **18**, which lever in turn is pivoted at **19** to the upper end of a piston rod **20**. The rod **20** has a piston **21** (Fig. 3) vertically slidable in a pivoted cylinder **22** which is supplied with air under pressure through a feed pipe **24**, shut-off valve **25**, and supply pipe **26**. The valve **25** also has a vent or waste-pipe **27** and may be foot-operated.

The cross-bars **15** and **16** are provided with movable lower clamping jaws **30** and **31** which press the folded edges of the cloth upward against fixed upper clamping jaws **32** and **33**.

The cloth C is threaded through a folding blade **36** clearly shown in section in Fig. 3. The blade **36** has swivel bearings at the upper ends of a pair of supporting arms **40** mounted to swing about swivel bearings **42** in the frame F. A collar **44** is fixed at an intermediate point on each supporting arm **40**, and each collar **44** is connected by a link **46** (Fig. 3) to a crank arm **47** mounted on a crankshaft **48**.

The crankshaft **48** is continuously rotated by a motor M connected thereto by a belt or chain **50**. As the crankshaft rotates, the folding blade **36** is oscillated between predetermined limits. As the blade **36** is oscillated, it is also swiveled by guide-rods **52** (Fig. 1) which swing freely about fixed pivots **53**. The cloth is supplied to the folding blade from a rotated cloth roll R through feed rolls **55** and **56** and a scray **57**.

The parts thus far described are in general of the usual construction, and the only novel feature thus far involved is the attachment of the collars **44** (Fig. 3) at intermediate points on the swinging arms **40**, rather than at the extreme upper ends as has been the previous practice. An easier and more uniform motion of the folding blade **36** is thus attained.

Each cross-bar **15** and **16** is pivotally connected at the center of its length to the upper end of a piston rod **60** (Fig. 3) which is connected to a piston **61** mounted in a vertically slidable cylinder **62**. Special provision is made for supplying oil to the space S between each piston **61** and the upper end of the associated cylinder **62**, as will be hereinafter described.

A collar **64** (Fig. 3) is clamped to each cylinder **62** intermediate its ends, and a cam lever **66** is pivoted at **67** to each collar **64**. At its opposite end, each cam lever **66** is provided with a roll **68** engaged by a cam **69** mounted on a cam shaft **70**. Each cam lever **66** is adjustably secured at **71** to a bracket which is pivoted at **71***a* to a fixed stand **72**. Each lever **66** is yieldingly pressed upward by a coil spring **74**.

The cam shafts **70** have sprocket-and-chain connections **76** with each other and also have a chain connection **77** with the crankshaft **48**. The cam shafts **70** and crankshaft **48** thus rotate in unison and at the same speed, but the two cams **69** are mounted 180° apart, so that they alternately lift the rolls **68** on the levers **66**, and alternately depress the associated movable lower clamping jaws **30** or **31**.

As each spring **74** moves the associated cyinder **62** upward, the piston rod **60** and piston **61** will be moved upward with the table **10** by the air pressure in the cylinder **22**. When a cam **69** operates a lever **66**, the associated cylinder **62** is moved positively downward and forces the piston **61** and piston rod **60** downward, due to the fact that oil is trapped in the space S. This depresses the associated lower jaw **30** or **31**.

The amount of oil in each space S must be progressively increased as the pile of cloth on the table **12** increases in thickness, in order to maintain normal operation and pressure relief for cloth insertion.

For this purpose, the space S at the upper end of each cylinder **62** is connected by a pipe **80** or **81** and a branch-pipe **81***a* to a tank or reservoir T containing oil under low pressure, as five pounds. Check valves **82** are provided in the pipes **80** and **81** and permit passage of oil toward each cylinder **62** but not in a reverse direction.

As the thickness of cloth on the table **10** increases, the upward travel of the piston **61** will be stopped at progressively lower levels, while the upward travel of the

associated cylinder **62** will continue to a fixed upper limit. This will increase the depth of the space S and a corresponding amount of make-up oil will be forced into this increased space from the tank T through one of the check valves **82** and the pipe **80** or **81**. The space S is thus kept constantly full of oil, and the piston **61** and associated clamping jaw **30** or **31** is drawn downward a uniform and desired distance at each revolution of the associated cam **69**.

The locus of travel of the cross-bar **15** or **16** and of each lower clamping jaw **30** or **31** may thus be progressively shifted downward, while at the same time the relief of pressure for cloth insertion is uniformly maintained.

The control mechanism and connections through which the described results are attained are best shown in Figs. 4 to 6.

Air under substantial pressure is supplied from a pipe **84** (Fig. 4) through a manual shut-off valve **85**. The air passes through a suitable strainer **86** to a pressure-regulating valve **87** which is commonly set to provide approximately fifty pounds pressure in the distribution pipe **88**. This air then passes through a suitable air-lubricating device **89** to a T **90** to which the air cylinder supply pipe **26** is connected.

Air under relatively heavy pressure is thus supplied through the valve **25** to the air cylinder **22**.

A pipe **91** connects the T **90** through a pressure-regulating valve **92** to a second tee **93**. The regulating valve **92** is set to deliver air at relatively low pressure, which may be on the order of five pounds.

The T **93** is connected through a normally-closed shut-off valve **94** and pipe **95** to the pipe **81** which supplies oil to the space S in one of the cylinders **62**, and the T **93** is similarly connected through a normally-closed shut-off valve **96** and a pipe **97** to the pipe **81** which supplies oil to the space S in the other cylinder **62**.

The T **93** is also connected through a branch pipe **98** to the upper end of the tank T, and a safety and filler valve **99** may be provided adjacent the solenoid-operated shut-off valve **96**.

One of the shut-off valves, as **96**, is shown in detail in Fig. 5 and is to be inserted between the upper end of the pipe **97** and the safety valve **99**.

The valve **96** comprises a port **100** normally closed by a solenoid plunger **101** forced upward to close the port by a coil spring **102**.

The details of the valve **96** form no part of the present invention.

The plunger **101** is drawn downward to open the valve **96** when the solenoid coil **103** is energized. The coil **103** is connected to line wires **104** and **105** (Fig. 4) to which branch wires **106** and **107** from the solenoid-operated shut-off valve **94** are also connected.

Whenever a circuit is completed through the wires **104** and **105**, the shut-off valves **94** and **96** are simultaneously opened, but otherwise they are normally closed.

A normally-open pressure-operated switch **110** in the wire **104** is connected by a pipe **111** to the pipe **24** leading to the air cylinder **22**. A normally-closed pressure-operated switch **114** in the wire **104** is also connected to the pipe **111**.

When air is admitted to the air cylinder **22** to raise the table at the start of a folding operation, the pressure will rise slowly and air under five pounds pressure through the pipe **111** will close the switch **110** and thus open the valves **94** and **96**. This permits oil to return from the spaces S in the oil cylinders **62** to the oil tank T, and permits the pistons **61** and the associated lower jaws **30** and **31** to be moved upward with the table **10** to their extreme upper or starting positions.

As the pressure in the air-cylinder **22** rises, it moves the lever **18** (Fig. 3) and connected pistons **61** more strongly upward and overcomes the normal five-pound pressure in the tank feed pipe **98**.

As soon as the table reaches its extreme upward position, the air pressure will build up in the pipe **24** and cylinder **22** to the regulated high pressure, as fifty pounds.

The pressure-operated switch **114** will then be opened to break the solenoid valve circuit.

The solenoid valves then close, so that no further escape of oil from the spaces S in the cylinders **62** can take place, but make-up oil can thereafter be supplied to the spaces S through the check valves **82** previously described.

The motor M is controlled by a main switch **120** (Fig. 4) adapted to be closed by a solenoid **121** when the solenoid circuit is closed by a switch **122**. A second switch **123** in a shunt circuit **124** is normally open when the machine is at rest. The switch **123** overlies a collar **125** mounted on or associated with the shaft **70** (Fig. 3) which supports one of the cams **69**.

The collar **125** normally engages and closes the switch **123** but has a flat side at one point in its periphery. At this point, the switch **123** will be opened by a spring **126** and the motor M will stop.

If now the switch **122** is closed, the main switch **120** will be closed and the motor will again operate as long as the switch **122** remains closed. When it is desired to stop the machine, the switch **122** is opened but the collar **125** will hold the switch **123** closed unless and until the flat side of the collar is uppermost.

The parts are so associated that the flat side will be uppermost when the folding blade **36** is in mid position and is moving away from the front clamping jaws **30** and **32**. It is found that the cloth can be most conveniently cut and removed from the table **10** when the folding blade is stopped in the described position.

Any suitable brake mechanism may be provided for the motor M, so that the machine will stop promptly when the switch **123** is opened.

In Fig. 6, we have shown a ball-type check valve **130** which may be substituted for the more conventional check valves **82** shown in Fig. 3.

The general operation is believed to be clearly apparent from the foregoing detailed description. The shut-off valve **85** is opened to admit air to the regulating valves **87** and **92** and a double switch **135** is closed in the line wires L and L'. The air valve **25** is then opened to connect the air supply to the table-lifting cylinder **22**. The solenoid-operated valves **94** and **96** are energized by the closing of the switch **110** at relatively low pressure and this vents the spaces S at the upper ends of the cylinders **62**, as described. As this venting operation is completed, the increasing air pressure in the air system opens the switch **114** and thus allows the valves **94** and **96** to close and to thereafter remain closed during the operation of the machine.

The motor M is then started by the switch **122** and operates the folding machine in the usual manner, and make-up oil is promptly supplied to the spaces S as the pile of cloth on the table **10** increases in thickness.

Having thus described our invention and the advantages thereof, we do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what we claim is:

1. In a cloth folding machine, a depressible cloth table having spaced edge portions, a pair of fixed upper cloth-clamping jaws and a pair of movable lower cloth-clamping jaws, all associated with said spaced edge portions, a cloth-folding blade mounted to swing back-and-forth over said table and from edge to edge thereof, means to continuously oscillate said blade from one edge portion to the other of said table in a folding cycle effective to fold and deposit the cloth in superposed layers on said table and to insert the edges of the cloth folds between said upper and lower clamping jaws, means to normally and yieldingly maintain said table edge portions and said lower clamping jaws in elevated cloth-clamping position, a separate hydraulic device operatively con-

nected to each lower clamping jaw and to the associated table edge portion and effective to depress said jaw and said edge portion a predetermined distance, control mechanism therefor effective to selectively activate each hydraulic device separately and alternatively to depress the associated table edge portions and movable clamping jaws to release the associated cloth edge portions to permit insertion of additional cloth folds, and means to progressively shift downward the locus of the lower limit of depression of each movable clamping jaw and associated table edge portion as the thickness of the load of folded cloth increases.

2. The combination in a cloth folding machine as set forth in claim 1, in which a container for make-up oil under pressure is connected to each hydraulic device, and in which means is provided to intermittently admit relatively small portions of said make-up oil to each hydraulic device to offset the increasing thickness of the pile of folded cloth on the associated edge portions of the table.

3. The combination in a cloth folding machine as set forth in claim 2, in which means is provided to release said make-up oil from said hydraulic device in order to permit the lower jaws to return to initial raised position, and in which said releasing means is automatically operative to release the make-up oil from said hydraulic device after a load of folded cloth is removed from the table and prior to a new folding operation.

4. The combination in a cloth folding machine as set forth in claim 2, in which means is provided to release said make-up oil from said hydraulic device in order to permit the lower jaws to return to initial raised position, and in which said releasing means is automatically operative to release the make-up oil from said hydraulic device after a load of folded cloth is removed from the table and prior to a new folding operation, and in which the means to admit and to thereafter release the make-up oil for each hydraulic device comprises a separate branched pipe circuit for the make-up oil, which circuit has a check valve in one branch thereof opening towards said device only, and having a normally-closed valve in the other branch.

5. The combination in a cloth folding machine as set forth in claim 2, in which means is provided to release said make-up oil from said hydraulic device in order to permit the lower jaws to return to initial raised position, and in which said releasing means is automatically operative to release the make-up oil from said hydraulic device after a load of folded cloth is removed from the table and prior to a new folding operation, and in which

the means to admit and to thereafter release the make-up oil for each hydraulic device comprises a separate branched pipe circuit for the make-up oil, which circuit has a check valve in one branch thereof opening towards said device only, and having a normally-closed valve in the other branch, and in which automatic means is provided to briefly open said normally-closed valve on initially starting said machine, and in which additional automatic means is provided to promptly thereafter close said valve.

6. In a cloth folding machine, a depressible cloth table having spaced edge portions, a pair of fixed upper cloth-clamping jaws and a pair of movable lower cloth-clamping jaws, all associated with said spaced edge portions, a cloth-folding blade mounted to swing back-and-forth over said table and from edge to edge thereof, means to continuously oscillate said blade from one edge portion to the other of said table in a folding cycle effective to fold and deposit the cloth in superposed layers on said table and to insert the edges of the cloth folds between said upper and lower clamping jaws, means to normally and yieldingly maintain said table edge portions and said lower clamping jaws in elevated cloth-clamping position, and electric means to drive said folding machine which comprises a branched control circuit for said electric means, a manually operable stop switch in one branch of said circuit which is closed to maintain the folding operation active and which is opened to stop the machine, a second switch in the second branch of said control circuit which provides a shunt operating control for said electric means and which maintains said electric means operative after said first switch is opened until said second switch is also opened, and means to open said second switch at a predetermined point only in each folding cycle of the machine, and said point being determined by engagement of said second switch by a moving part of the machine which has predetermined and timed relation to the cloth folding cycle.

7. The combination in a cloth folding machine as set forth in claim 6, in which the moving part for opening the second switch comprises a cam continuously rotated in predetermined timed relation to the oscillation of the folding blade.

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