United States Patent [19]
Wueger

[11] 3,831,640
[45] Aug. 27, 1974

[54] PNEUMATIC LOOM

[75] Inventor: Karl W. Wueger, North Brookfield, Mass.

[73] Assignee: Crompton & Knowles Corporation, New York, N.Y.

[22] Filed: July 24, 1972

[21] Appl. No.: 274,687

[52] U.S. Cl. 139/125
[51] Int. Cl. D03j 5/06, D03d 47/24
[58] Field of Search .... 139/116, 122, 125, 126, 139/127 P, 196

[56] References Cited
UNITED STATES PATENTS

3,404,708 10/1968 Wueger 139/125

FOREIGN PATENTS OR APPLICATIONS

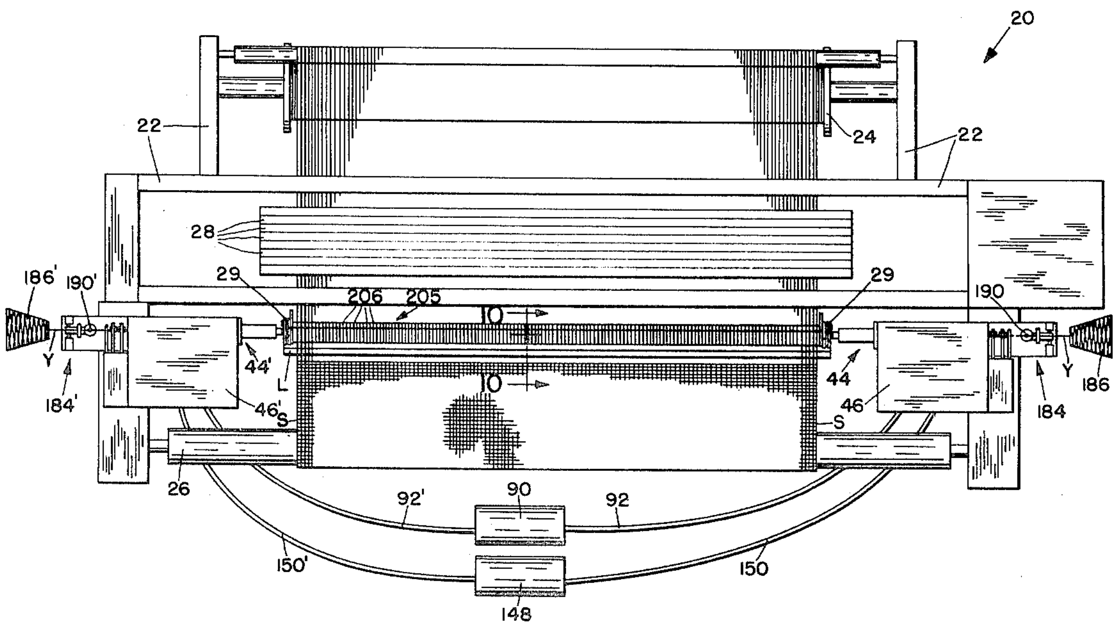
1,098,802 1/1968 Great Britain 139/125
1,076,586 2/1960 Germany 139/116

Primary Examiner—Henry S. Jaudon

[57] ABSTRACT

Improved weft inserting elements for a pneumatic loom in which means are provided for: Inserting at least a portion of a filling pick from an outside supply source within a hollow, projectile; pneumatically propelling the projectile and the remainder of the filling pick through a warp shed; and guiding the projectile in a stabilized and airborne flight through the warp shed.

15 Claims, 22 Drawing Figures



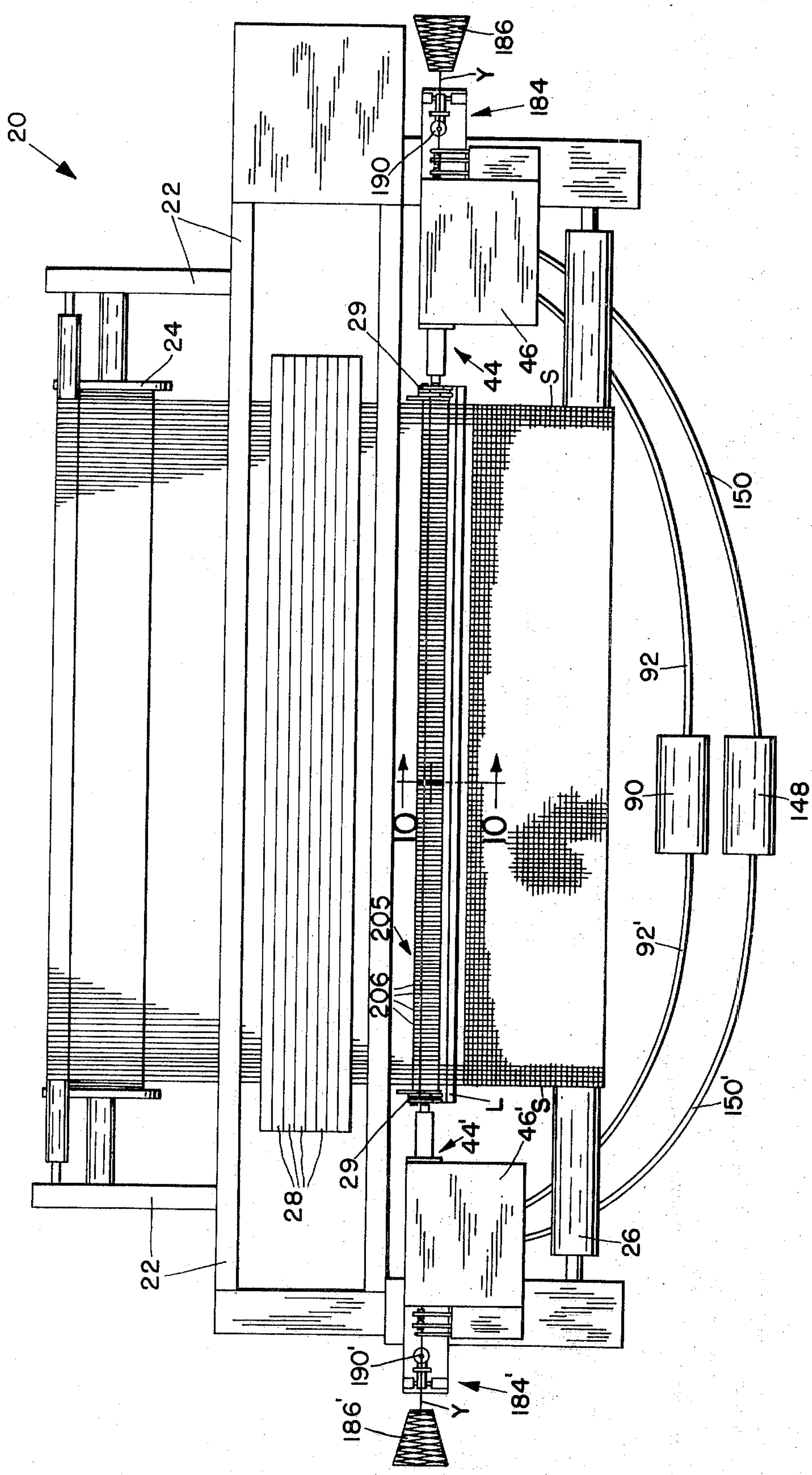

20
22
24
28
29
44
46
S
150
92
90
148
92'
205
206
L
S'
44'
46'
26
150'
184
186
190
Y
190'
184'
186'

FIG. I

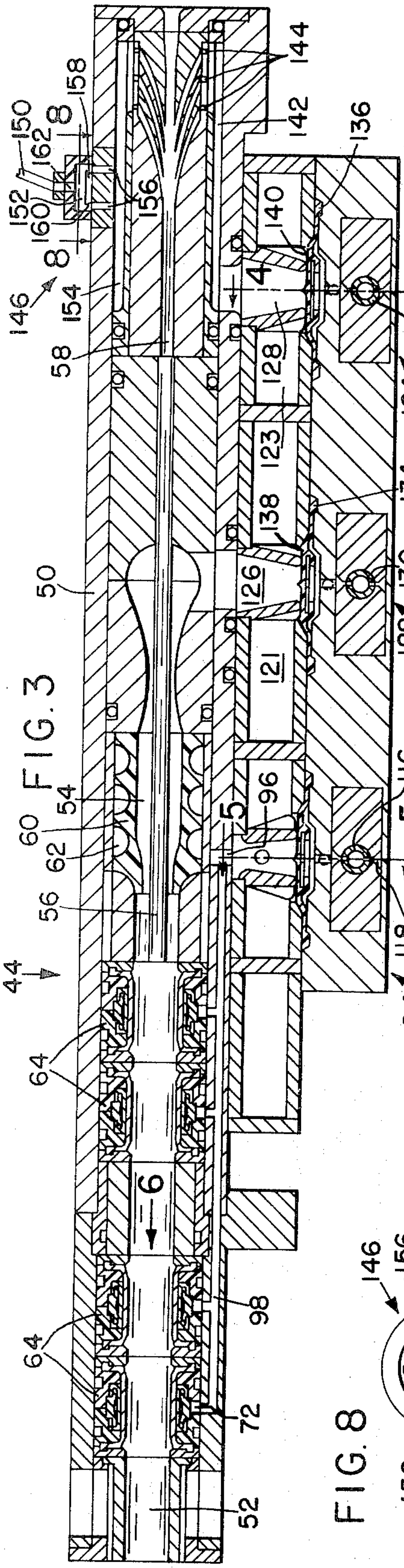


FIG. 3

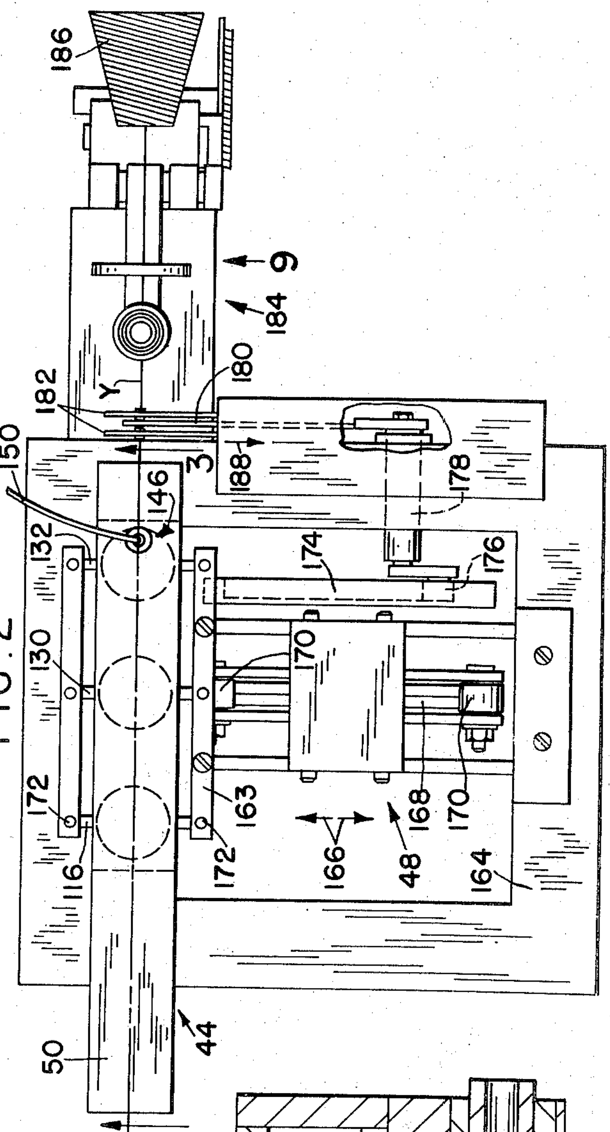


FIG. 2

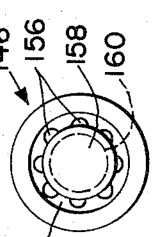


FIG. 8

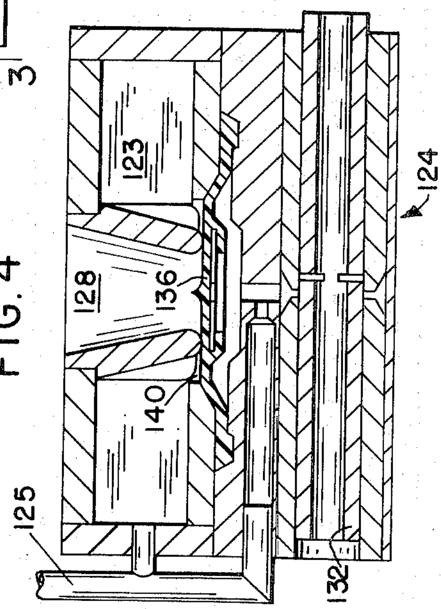


FIG. 4

FIG. 5

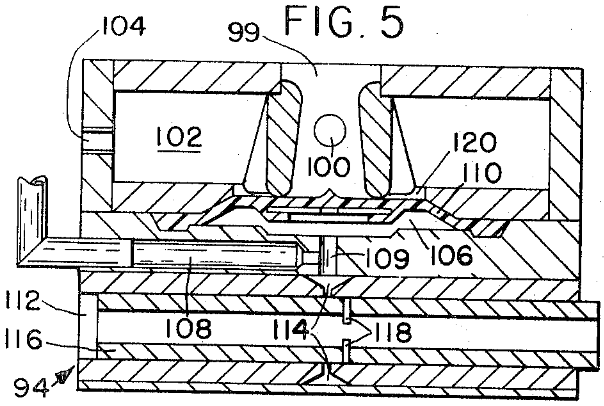


FIG. 7

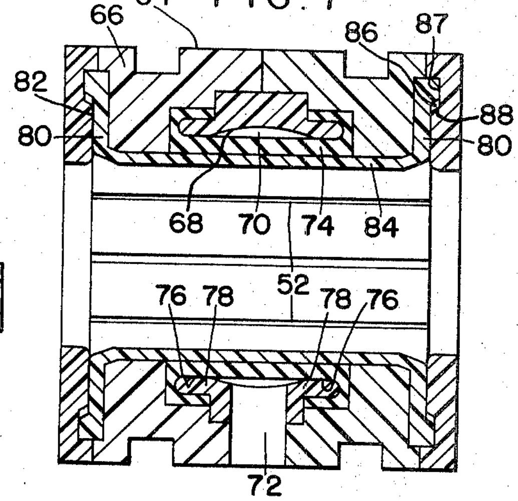


FIG. 6

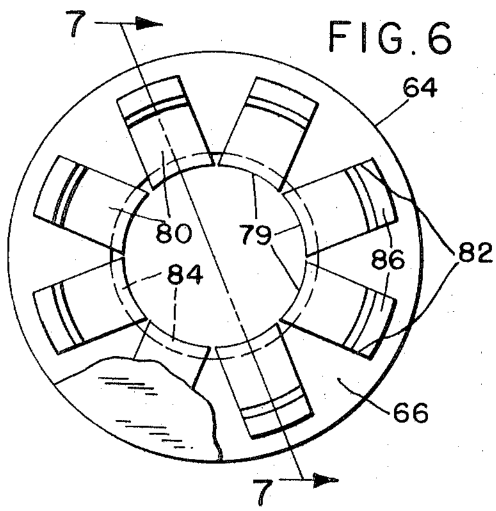


FIG. 9

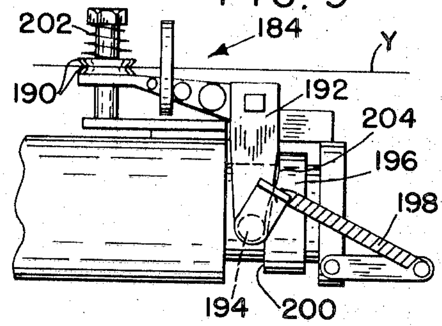


FIG. 12

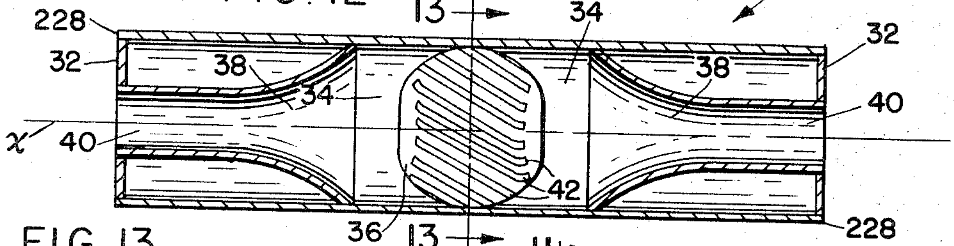


FIG. 13

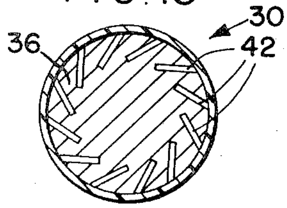


FIG. 10

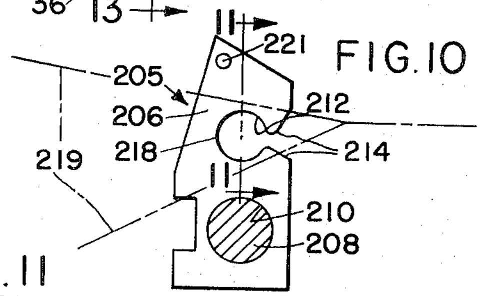
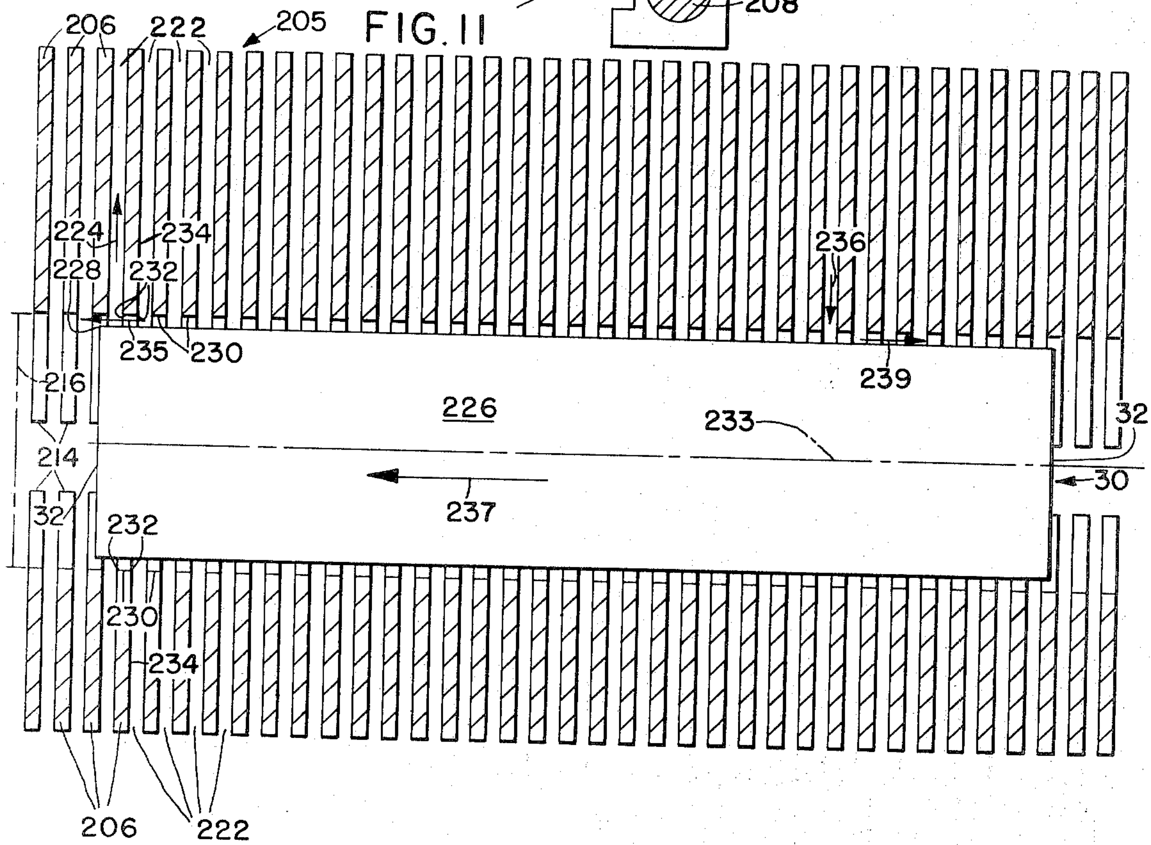


FIG. 11



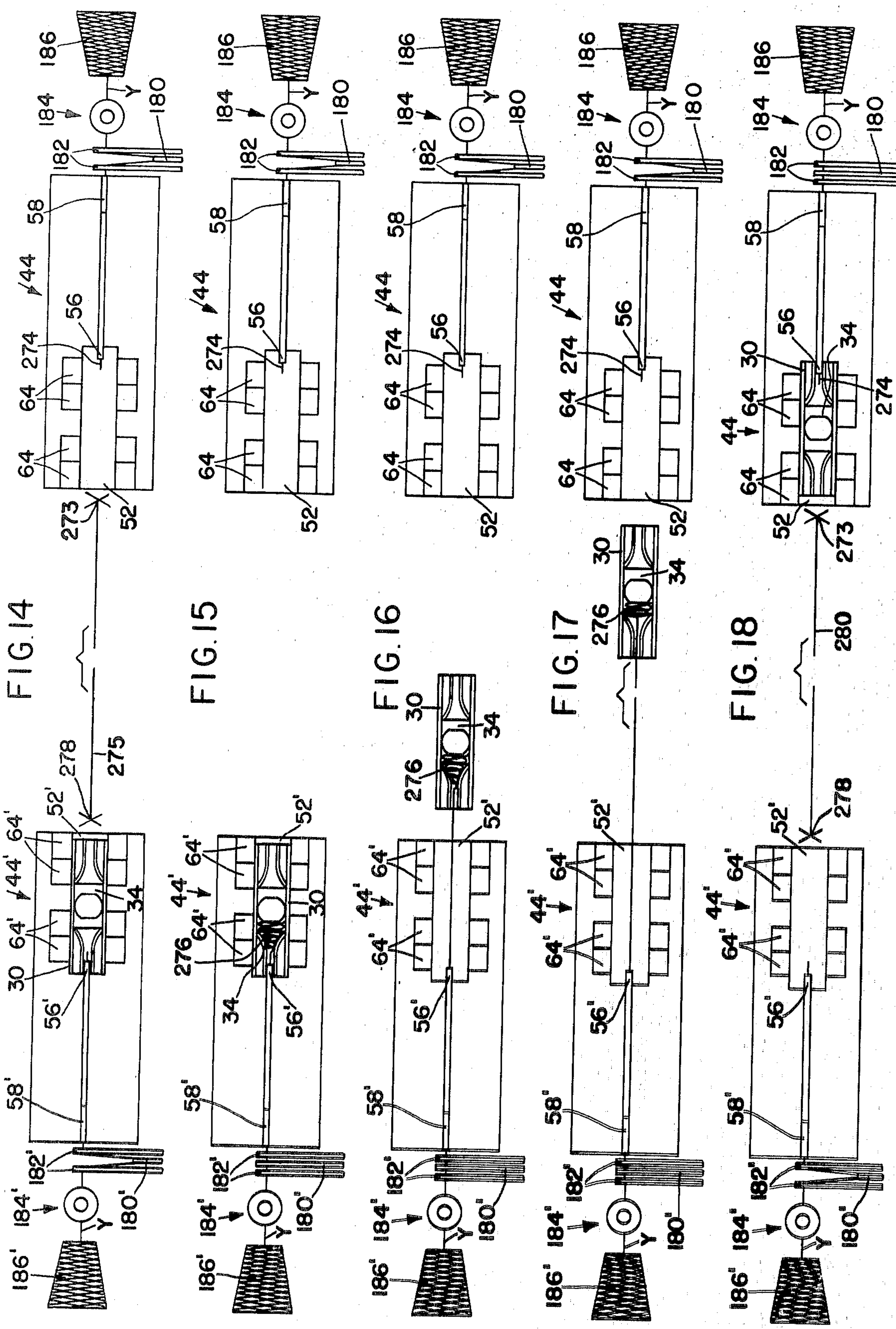


FIG.14
FIG.15
FIG.16
FIG.17
FIG.18

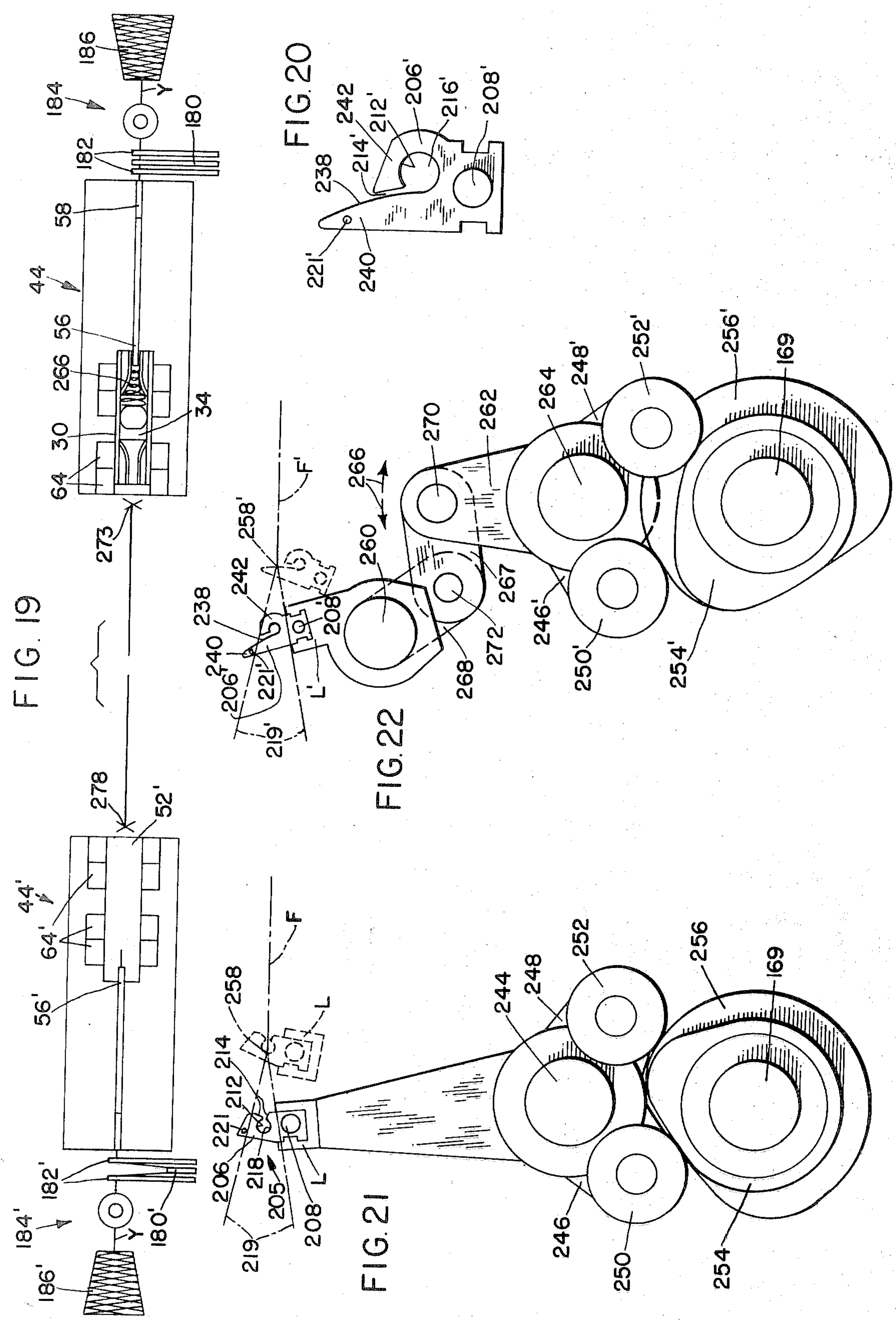


FIG. 19

FIG. 20

FIG. 21

FIG. 22

PNEUMATIC LOOM

BACKGROUND OF THE INVENTION

This invention relates generally to pneumatic filling insertion in a loom wherein the filling is supplied from supply packages located outside of the loom.

Pneumatic looms in the past have consisted of several types; in one type, the filling is blown through the shed. One disadvantage of this type is that the width of cloth which can be woven is limited due to a drop in flow velocity and turbulence of the air stream used to propel the filling. Air turbulence also causes the filling to untwist so that only certain types of filling can be used. Still another disadvantage of this type of pneumatic loom is that proper filling tension is difficult to maintain. The only forces acting on the filling is that of the air stream itself.

Another type of pneumatic loom utilizes a full size bobbin carrying shuttle which is propelled by a blast of air. The disadvantage of this type of pneumatic filling insertion is that the power consumption to propel the shuttle makes the weaving operation impractical.

Still another type pneumatically inserts a length of yarn in a hollow shuttle and propels the shuttle mechanically. Enough yarn is stored for several filling picks. The size of the projectile is still a disadvantage for attaining high speeds and it is a problem to draw out the filling yarn evenly and under uniform tension.

More recent pneumatic looms have utilized a smaller shuttle, more accurately referred to as a projectile, to carry the free end of the filling through the warp shed. The filling end is either clamped within the projectile as shown for example in my U.S. Pat. No. 3,412,763 or blown through a bore in the projectile so that the filling extends around the forward end of the projectile during flight as shown in my U.S. Pat. No. 3,395,737. With this type of pneumatic weft insertion, greater speeds may be obtained, there is a better control of the filling and power consumption is minimized.

BRIEF SUMMARY OF THE INVENTION

The present invention represents an improvement over my two U.S. patents mentioned above wherein there is a more accurate control of the filling length, a more controlled flight of the projectile and improved checking of the projectile at the end of its flight. These improvements are accomplished by providing a novel projectile is which a portion of a filling pick in pneumatically inserted, novel projectile guiding means and novel projectile launching and receiving device within which the projectile is charged with the portion of a filling pick and propelled. This device is also adapted to receive a projectile fired from the opposite side of the loom and also contains pneumatic devices including valves to pneumatically propel the filling behind the projectile during its flight. Means are also provided for cutting and clamping the filling after each pick.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a loom incorporating the present invention;

FIG. 2 is an enlarged plan view of a projectile launching and receiving device;

FIG. 3 is a longitudinal section along line 3—3 of FIG. 2 and looking in the direction of the arrows on a further enlarged scale;

FIG. 4 is an enlarged vertical section taken along line 4—4 of FIG. 3 and illustrating one of the valve units for filling insertion;

FIG. 5 is an enlarged vertical section taken along line 5—5 of FIG. 3 and illustrating the valve unit for operating the pneumatic projectile braking means;

FIG. 6 is an enlarged end view looking in the direction of arrow 6 of FIG. 3 of one of the projectile braking units with portions broken away;

FIG. 7 is a sectional view along line 7—7 of FIG. 6;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 3, illustrating a "poppet" valve;

FIG. 9 is an elevation looking in the direction of arrow 9 of FIG. 2, illustrating the filling clamping means;

FIG. 10 is a section taken along line 10—10 of FIG. 1, looking in the direction of the arrows and illustrating a combined projectile guide and beat-up unit;

FIG. 11 is a vertical section taken along line 11—11 of FIG. 10, looking in the direction of the arrows, showing several projectile guides and beat-up units and the projectile;

FIG. 12 is a longitudinal section of the projectile;

FIG. 13 is a vertical section taken along line 13—13 of FIG. 12 and looking in the direction of the arrows;

FIGS. 14 – 19 are diagrammatic operational views;

FIG. 20 is a view of a modified projectile guide and beatup unit;

FIG. 21 is an end view with portions in section, showing the lay driving mechanism; and

FIG. 22 is a view similar to FIG. 21, showing a modification in the lay driving mechanism to accommodate the modified guide and beat-up unit of FIG. 20.

DETAILED DESCRIPTION OF THE INVENTION

Referring particularly to FIG. 1, there is shown a loom generally indicated by the reference numeral 20 to which the filling inserting mechanism of the present invention is applied.

Loom 20 includes the usual frame members 22, letoff beam 24, takeup roll 26 and heddle frames 28 which are operated by a shedding mechanism, not shown, of a usual type such as a dobby. A lay L supports conventional yarn cutting and clamping units 29 as shown, for example, in U.S. Pat. No. 3,598,158, located to the outside of selvages S.

PROJECTILE

The projectile for guiding the filling through the warp shed is generally indicated by the reference numeral 30, see particularly FIGS. 12 and 13. Projectile 30 is generally cylindrical with substantially flat end surfaces 32 which are at right angles to the longitudinal axis x of the projectile. These end surfaces may even be concave but it is more important that they not be convex to any substantial degree. The reason for this is discussed in more detail in the section entitled PROJECTILE GUIDING MEANS. The central portion of the projectile is generally hollow. This hollow area is divided into two annular chambers 34 by a spherical partition 36. Each chamber 34 has a vortex shaped portion 38 which leads to an opening 40 in its respective end 32.

Partition 36 has a plurality of slots 42 which extend between chambers 34 and are each disposed at an angle to axis x. The function of the slots **42** is to allow air to pass from one chamber to the other and to create a circular air flow within the chambers 34 when air is blown into one of the openings **40.** Portion **38** of the chamber **34** converts this circular air flow into a vortex so that if the free end of a filling is placed in the opening **40** through which air is being blown, it will be drawn therethrough and deposited in the corresponding chamber **34** in loose spinal coils. The mechanism for presenting filling to the openings **40** and blowing air thereinto will be described in the next section.

PROJECTILE LAUNCHING AND RECEIVING DEVICE

Referring to FIG. **1**, there is situated at each end of the loom, right and left hand projectile launching and receiving means generally indicated by the reference numerals **44** and **44'**, respectively. Only one of these devices will be described in detail, namely **44**, since both devices are identical. Comparable portions of device **44'** will bear the same reference numerals as for device **44** with the addition of a prime.

The devices **44** and **44'** are enclosed in covers **46** and **46'**, respectively, but device **44** and the valve control means therefor, indicate generally at **48**, are shown in FIG. **2** on an enlarged scale with the top cover removed.

Referring particularly to FIGS. **2** and **3**, device **44** comprises a housing **50** which has a projectile receiving bore **52**, a firing chamber **54** which is pneumatically connected to the bore **52**, and a nozzle **56** which extends through chamber **54**, into bore **52**. A passage **58** pneumatically connects nozzle **56** to the outside through the opposite end of the housing. A yieldable bumper **60** is located adjacent bore **52** and forms part of chamber **54**. Bumper **60** is made of a resilient material such as rubber and has a series of annular grooves **62** to increase its yieldability in a direction along the longitudinal axis of the chamber **54**.

There is a plurality of annular pneumatic braking units **64** along the bore **52**. These units form part of the wall of the bore and one of them is shown in greater detail in FIGS. **6** and **7**. Since units **64** are identical, only one of them will be described in detail. Each unit **64** includes a housing **66** having an annular inner wall **68**, an annular groove **70** in wall **68** and an aperture **72** which extends from the outside of the housing **66** into groove **70.** An annular resilient liner **74** is positioned against inner wall **68** so that groove **70** is completely enclosed except for aperture **72.** Liner **74** has a pair of inner grooves **76** for mounting on a pair of flanges **78.**

There is a plurality of U-shaped braking segments generally indicated at **79**. Each segment **79** includes a pair of end portions **80** which are slidably mounted in radial slot **82** near the ends of housing **66.** Each segment **79** has an intermediate portion **84** which extends between end portions **80** and lies against liner **74.**

When pressurized air is applied to aperture **72**, the entire groove **70** becomes pressurized and causes liner **74** to deflect inwardly which in turn moves segments **79** inwardly. Each end portion **80** has a shoulder **86** which extends into an annular groove **87** and engages a shoulder **88** to limit the inward motion of the segment. Segments **79** are made of a material suitable for braking purposes and are effective, upon pressurization of groove **70**, to engage the projectile when it is in the bore **52.** Braking units **64** are effective to decelerate a projectile propelled from the opposite side of the loom almost to the point of stopping it. The bumper **60** acts as the final stopping element for the projectile. This is to insure that the projectile will be positioned against the bumper each time it enters bore **52** so that nozzle **56** will be inserted into opening **40.**

Pressurized air is supplied to the braking units **64** from a high pressure source such as a pressure tank **90** indicated in FIG. **1.** Pressurized air from tank **90** is supplied through supply line **92** to a diaphram valve **94.** When valve **94** is in the "closed" condition, pressurized air will be supplied to a port **96** adjacent the valve. Port **96** pneumatically connects the apertures **72** of each brake unit **64** through a conduit **98** in the housing.

Referring particularly to FIG. **5**, valve **94** is shown in the "closed" position wherein units **64** are in the braking condition. Valve **94** has a supply port **99** which is pneumatically connected to port **96.** Pressurized air from source **90** is supply to port **99** by a conduit **100** to maintain units **64** in the braking condition. An annular discharge chamber **102** surrounds port **99** and is pneumatically connected to the atmosphere by a conduit **104.** Pressurized air from source **90** is also supplied to a stabilizing chamber **106** by conduit **108** and passageway **109.** Chamber **106** is separated from port **99** by a diaphram **110.** Valve **94** has a bore **112** which is pneumatically connected to conduit **108** through an annular slot **114.** A hollow slider **116** is slidably mounted within bore **112** and is effective to seal slot **114** from bore **112,** at least when it is in the position shown in FIG. **5.** Slider **116** has a slot **118** which extends from the outside of the slider to the open interior thereof. When the slider is moved to the left as shown in FIG. **5** so that slot **118** is aligned with slot **114**, air from stabilizing chamber **106** will escape through passageway **109** into slots **114** and **118** into the interior of slider **116** and out into the atmosphere. This reduces the pressure in stabilizing chamber **106** so that the pressure in supply port **99** forces the diaphram **110** away from port **99** and allows pressurized air to escape from port **99** into discharge chamber **102** through an annular port **120.** Since pressurized air from port **99** can now escape into the atmosphere through conduit **104**, all of the grooves **70** in units **64** are depressurized and these units are reduced to their non-braking state. This allows a projectile within bore **52** to be propelled without hindrance as will be explained in more detail.

Referring again to FIG. **3**, there are two more diaphram valves indicated generally at **122** and **124** which are similar to valve **94.** One major difference is that valves **122** and **124** have larger supply ports indicated at **126** and **128**, respectively which taper toward their respective diaphrams **134** and **136.** Also, pressurized air is supplied to annular discharge chambers **121** and **123** respectively from conduits **125**, one of which is shown in FIG. **4** and not to ports **126** and **128.** Valves **122** and **124** have sliders **130** and **132**, respectively, which are effective to allow pressurized air in discharge chambers **121** and **124**, respectively, to deflect diaphrams **134** and **136**, respectively.

At the moment that diaphram **134** breaks the seal at the lip of the supply port **126**, the air within the chamber **121** discharges through annular port **138** very rapidly and develops a pressure wave which travels with supersonic velocity. This pressure wave is directed into chamber **54** and is effective to propel a projectile in bore **52** with high acceleration.

Valve 124 operates in the same manner as valve 122 and air is discharged into port 128 through annular port 140 and is directed along a passageway 142 to a series of annular jets 144 which open into passage 58. A filling extending from a supply package, not shown, into passage 58 and through nozzle 56 is propelled through bore 52 and into the warp shed.

Located on the opposite side of housing 50 from valve 124 is a "poppet" valve 146 which is connected to a low pressure source such as tank 148 through a supply line 150, see FIG. 1. Valve 146 includes a chamber 152 which communicates with a channel 154 in housing 50 by means of a plurality of apertures 156 which are arranged in a circle as shown in FIG. 8. Channel 154 is pneumatically connected to jets 144. Valve 146 also includes a free floating "poppet" or flat disc 158 which has an annular edge 160 which tapers inwardly toward apertures 156. Pressure in the chamber 152 maintains poppet 158 against apertures 156 but the lower surface of the poppet is not large enough to cover the apertures entirely.

Pressurized air from supply line 150 is allowed to enter channel 154 through valve 146 and be directed into passage 58 from jets 144. The purpose of valve 146 is to direct a low pressure air flow through channel 58 and nozzle 56 so that a filling yarn disposed therein will be deposited into a projectile when it is in bore 52. Nozzle 56 will extend into opening 40 of a fully positioned projectile and the filling will be deposited in the projectile in the manner set forth in the previous section describing the projectile. When the projectile is fired and the filling propelled behind the projectile, the high pressure air from valve 124 will enter channel 154. High pressure air coming up through apertures 156 will overcome the low pressure air in chamber 152 and force "poppet" 158 in sealing engagement against an opening 162 through which low pressure air from supply line 150 enters chamber 152. In this way, high pressure air will not enter the low pressure line. The shape of poppet 158 presents a relatively small surface against the openings of apertures 156 to allow low pressure air to enter these apertures but the tapered edge 160 overlaps apertures 156 and allows poppet 158 to be pushed against opening 162 by the high pressure air.

Referring particularly to FIG. 2, the valve control means 48 comprise a carriage 163 slidably supported in a frame 164. Sliders 116, 130 and 132 extend through their respected diaphram valves as described and are supported by the carriage 163. Carriage 163 is reciprocated in the directions of arrows 166 by a "constant diameter cam" 168 which bears against a pair of followers 170 operatively attached to the carriage 163. Cam 168 is driven from the main drive shaft 169, see FIG. 21, in timed relation with other loom components. Sliders 116, 130 and 132 are moved simultaneously by cam 168. The sliders are adjustably mounted on carriage 163 by set screws or the like 172 so that the sequence of operation of their respective valves may be adjusted as desired. The exact sequence of operation will be described in a later section. Still referring to FIG. 2, a track cam 174 is also driven from the main shaft and is effective through a follower 176 and the linkage 178, to operate a yarn takeup lever 180. The filling yarn, indicated at Y, extends from housing 50 and is threaded through a pair of stationary guides 182, through a tension clamp 184 and back to the supply cone 186. Filling Y is also threaded through takeup lever 180 which extends between guides 182. Normally, the filling yarn extends through guides 182 and lever 180 in a straight line but at the proper time in the weaving sequence, cam 174 will be effective to pull lever 180 in the direction of arrow 188 to "takeup" a section of filling yarn for a purpose to be described.

Referring to FIGS. 1 and 9, there is a yarn clamp 184 at each side of the loom. Each clamp 184 comprises a pair of flat discs 190 supported on one arm of a bellcrank lever 192. The other arm of lever 192 supports a cam follower 194 which bears against a face cam 196 driven in timed relation with other loom components. A spring 198 maintains follower 94 against cam surface 200 of cam 196. A compression spring 202 bears against flat discs 190 to maintain tension against filling yarn Y which extends between the discs. When follower 194 rides on low portion 204 of cam 196, lever 192 is rocked counterclockwise by spring 198 and allows discs 190 to move downwardly releasing the tension of spring 202 against the discs. Filling yarn Y is no longer clamped between the discs and can be drawn freely from the supply cone 186.

PROJECTILE GUIDE AND BEAT-UP MEANS

Referring to FIGS. 1, 10, and 11, the projectile guide and beat-up means is indicated generally at 205 and comprise a plurality of spaced individual guides or plates 206 which are fastened to the lay L and supported on rod 208 which extends through holes 210 in the plates.

Each guide 206 has a circular aperture 212 which has a slightly larger diameter than the projectile 30 as illustrated in FIG. 11. A slot 214 extends forwardly from aperture 212 to the outside thereof.

The apertures 212 of guides 206 collectively form a guide channel for the projectile. This guide channel is shown in FIG. 11 and indicated by the reference numeral 216. Once the projectile is propelled through guide channel 216 and a filling pick is inserted therein, the lay moves forwardly to the beat-up position and the rear surfaces 218 of guides 206 beat the filling into the fell. The lay then moves rearwardly and the filling which has just been "beaten-in" remains in the beat-up position and the opening 214 passes freely by, thereby releasing the filling from opening 212. A rod 221 extends through holes in the upper portion of each guide 206 to keep the warp yarns in their proper places between the guides.

The various loom components are so timed and the guides 206 are so positioned on the lay that apertures 212 will be within the shed opening at the time the projectile is propelled. The shed opening is indicated by dot and dash lines 219.

Guides 206 and projectile 30 are so constructed that they cooperate to create an aerodynamic effect which enables the projectile to be propelled through channel 216 in a stabilized and suspended state.

The projectile is propelled at a subsonic velocity above 90 F.P.S. The actual projectile speed will depend on the width of the loom, weaving speed and other practical considerations. This projectile velocity is sufficiently high so that as the projectile travels through channel 216, there is a pressure zone or a build-up of pressure in front of the flat leading surface 32. This air in front of the projectile is at super-atmospheric pressure and escapes into spaces 222 between guides 206 in the direction of arrow 224. End surfaces 32 intersect the circumferential surface 226 of the projectile to form substantially sharp annular edges 228. Guides 206 have inner annular surfaces 230 which are parallel to the longitudinal axis 233 of the channel 216 and form sharp annular edges 232 with the flat surfaces 234 of the guides 206. As long as the leading edge 228 of projectile 30 is located between edges 232 along the longitudinal axis 233 of channel 216, air can escape into spaces 222 generally in the direction of arrow 224. When the leading edge 228 is aligned with the leading edge 232 of one of the guides 206, the flow of air is restricted and there is an instant change in the direction of air flow in the direction of arrow 235. This flow gradually changes to the direction of arrow 224 until edge 228 becomes aligned with the leading edge 232 of the next guide. This relationship between the moving projectile and the guides creates a pulsating air flow around the edge 228 of the projectile which stablizes the front end of the projectile and maintains it in a central position in channel 216 throughout its flight through the warp shed. The end surfaces 32 need not be absoultely flat as shown but may be concave or slightly convex near the center as long as the surface is effective to create a pressure zone in front of the projectile and forms a substantially sharp edge where it intersects surface 226.

The trailing end of the projectile 32 is also stabilized because of the partial vacuum and backflow created behind the projectile. This is a well-known phenomena in aerodynamics of a moving body. This effect commonly referred to as "drag" will occur if the surface 32 is substantially flat or concave.

As the projectile advances through the channel 216 in the direction of arrow 237, air is forced into the spaces 222 but then returns to the channel in the direction of arrow 236 because of the sub-atmospheric pressures created along the circumferential surface 226. Air returning through spaces 222 causes a dynamic pressure build-up of air all along surface 226. Ther is also a "boundary layer" of turbulent air along surface 226 which flows in the same direction as the projectile but relative to the projectile in the direction of arrow 239. This "boundary layer" is reinforced by air escaping from the pressure zone in front of the projectile through the space between the projectile and channel 216. The pressure build-up from air flowing through spaces 222 together with the boundary layer are effective to support the projectile within channel 216 away from inner surfaces 230 of guides 206.

The above aerodynamic effects enable the projectile to be propelled and guided through the warp shed in an exact trajectory without frictional losses from the guiding means.

The above aerodynamic effects depend on many variables. Any change in one variable necessitates a change in the other. The variables are the size and weight of the projectile, the size of channel 216 or clearance between the projectile and surfaces 230, the thickness of each guide 206, the distance between guides 206 and the velocity of the projectile. There are many combinations of variables which will produce this aerodynamic effect. An example of one combination of variables which will produce the above aerodynamic effects is as follows:

Projectile velocity — 165 F.P.S.
Weight of projectile — 1.7 grams
Length of projectile — 1.5 inches
Diameter of projectile — 0.380 inches
Diameter of guide channel 216 — 0.388 inches
Thickness of guides 206 — 0.015 inches
Distance between guides 206 — 0.016 inches

MODIFIED PROJECTILE GUIDE AND BEAT-UP MEANS

Referring to FIG. 20, there is shown a modified guide 206′ which is fastened on lay L and supported by rod 208′. Guide 206′ has a circular aperture 212′ and a slot 214′ which extends from aperture 212′ to the outside thereof. Aperture 212′ forms part of a guide channel 216′ for the projectile in the same manner as aperture 212. The rearward edge 238 of slot 214′ is formed by an upwardly extending portion 240. After the filling is inserted within guide channel 216′, the lay moves forwardly and the filling is cammed upwardly along surface 238 through slot 214′. As the lay reaches the beat-up position a forwardly extending portion 242 which forms the forward edge of slot 214′ passes beneath the fell line or beat-up position and the upper portion of surface 238 which extends above slot 214′ is effective to beat in the filling. A rod 221′ passes through guide 206′ to restrain the warp yarns.

LAY DRIVE

Referring to FIG. 21, the lay L which supports the projectile guide and beat-up means 205 is pivoted at 244. The lower part of lay L is bifurcated into two extending arms 246 and 248. Followers 250 and 252 are attached to arms 246 and 248, respectively and are engaged by a pair of conjugate cams 254 and 256, respectively. The cams are designed to reciprocate the lay between the full and dotted line positions and to provide a substantial dwell in the back position shown in full lines. The lay remains in the back position during filling insertion. As the lay moves into the front position, slots 214 of the guides 206 allow the fell 258 of the fabric F to enter openings 212 and allows rear surfaces 218 to beat-up the inserted filling.

Referring to FIG. 22, there is shown a modified lay drive similar to that shown in FIG. 21 but modified to accommodate modified guides 206′. The lay in this modification is indicated at L′. Lay L′ is pivoted closer to the fell than lay L at 260. The power to drive the lay L′ comes from the pair of conjugate cams 254′ and 256′ which engage a pair of followers 252′ and 250′ located on a pair of arms 246′ and 248′, respectively. Arms 246′ and 248′ extend from a lever 262 pivoted at 264. Lever 262 is reciprocated in the direction of arrows 266 by the cams. This motion is transmitted through a link 267 to a lever 268 which is fixed to pivot 260 and extends below pivot 260. Link 267 is pivotally attached to levers 262 and 268 at points 270 and 272, respectively. Guides 206′ are mounted on the top of lay L′ so that openings 212′ are within shed 219′ and drops below the fell 258′ at the front position. The short lay pivot at 260 enables the guides 206′ to drop very quickly. As the lay moves toward the front position, the filling is cammed up along rearward edge 238 and is beaten into the fell 258′ by the rearwardly extending portion 240.

GENERAL OPERATION

Referring to FIGS. 14 – 19, a filling inserting cycle is diagrammatically illustrated.

In FIG. **14**, the projectile **30** has just been received in the bore **52'** of projectile launching and receiving means **44'**. At this time, takeup lever **180'** is in the retracted position. The filling which has just been inserted from cone **186** is cut and clamped by right-hand unit **29** at point **273** and takeup lever **180** moves to its retracted position. The cut end **274** which extends back to the yarn package **186** is pulled back to the mouth of nozzle **56**. The lay advances to the front position to beat-in the filling which is indicated at **275** and the clamp in right-hand unit **29** is opened to release the filling end at point **273**.

Takeup lever **180'** is then moved from the retracted position and the tension on clamp **184'** is eased to allow yarn to be blown into the left-hand chamber **34** of projectile **30** in loose spiral coils indicated at **276**, see FIG. **15**. This is accomplished through poppet valve **146** and the low pressure air system as previously described.

The valves associated with projectile launching and receiving means **44'** are operated so that after a portion of a filling pick is inserted in one of the chambers **34** of the projectile as shown in FIG. **15**, the brakes **64'** are released. The projectile is then propelled and the filling from supply package **186'** is aerodynamically propelled behind the projectile as shown in FIG. **16**.

The loom is timed so that when the projectile reaches a certain point in its flight through the warp shed, clamp **184'** is actuated to clamp the filling. The projectile continues its flight but the coiled portion **276** of the filling unwinds as shown in FIG. **17**. If the clamp **184'** is actuated at the proper time, the leading end of portion **276** will be dropped at point **273** where the previous filling pick **275** was cut as shown in FIG. **18**. Before the projectile enters bore **52** of projectile launching and receiving means **44**, the brakes **64** are actuated to stop the projectile. The yarn which has thus been inserted is cut at point **278** to become the next filling pick, indicated at **280** in FIG. **18**.

After the yarn is cut at point **278**, yarn takeup lever **180'** is retracted and the cut end of the yarn extending from package **186'** is pulled back to the mouth of nozzle **56'** as shown in FIG. **19**. Projectile launching and receiving means **44'** is now in condition to again receive projectile **30** from **44**. Another filling pick will be inserted from package **186** when projectile **30** is propelled from **44** to **44'** in the same sequence of operation as previously described for the flight of the projectile from **44'** to **44**.

What is claimed is:

1. A projectile for use in a loom in which filling picks are inserted from an outside supply source comprising:

a. a cylinder having a peripheral surface extending parallel to its longitudinal axis, an annular edge at at least one end of said cylinder coincident with said peripheral surface and lying in a plane which intersects said longitudinal axis at a right angle;
b. a chamber within said cylinder for storing at least a portion of a filling pick;
c. a passageway connecting said chamber to the outside of said cylinder; and
d. a surface at said end of said cylinder, a substantial poriton of which lies in said plane.

2. The projectile as described in claim **1** wherein each end of the cylinder has an annular edge and an end surface as set forth therein.

3. The projectile as described in claim **2** wherein the tapered portion of said chamber has the shape of a vortex.

4. The projectile as described in claim **1** wherein said chamber is circular in cross section and has a first portion, a second portion with a larger diameter than said first portion and a third portion connecting said first and second portions, said projectile comprising means for creating a circular air flow within said chamber upon application of sub-atmospheric of super-atmospheric pressure to said passageway.

5. The projectile as described in claim **4** wherein said means for creating a circular air flow in said chamber comprises:

a. a partition which forms the inner end wall of said chamber, said partition having perforations which extend through said partition at an angle to the longitudinal axis of said projectile; and
b. a second passageway which connects said perforations to the outside of said projectile

6. The projectile as described in claim **5** wherein the tapered portion of said chamber has the shape of a vortex.

7. The projectile as described in claim **4** wherein the surface of said partition which faces said chamber is convex.

8. The projectile as described in claim **4** wherein there is a chamber as described at each end of the projectile which are separated by said partition whereby said projectile may be used in a loom in which filling picks are inserted alternately from side of the loom.

9. The projectile as described in claim **4** wherein said partition is spherical.

10. A projectile for use in a loom in which filling picks are inserted from an outside supply source comprising:

a. a body having a chamber which is circular in cross section and a passageway which connects said chamber to the outside of said body, said chamber having a first portion, a second portion with a larger diameter than said first portion and a third, tapered portion connecting said first and second portions; and
b. means for creating circular air flow within said chamber upon application of sub-atmospheric of super-atmospheric pressure to said passageway.

11. The projectile as described in claim **10** wherein said means for creating a circular air flow in said chamber comprises:

a. a partition which forms the inner end wall of said chamber, said partition having perforations which extend through said partition at an angle to the longitudinal axis of said projectile; and
b. a second passageway which connects said perforations to the outside of said projectile.

12. The projectile as described in claim **11** wherein said perforations are slots, the cross section of which extend along cords of a circle generated around the longitudinal axis of said projectile within said partition.

13. The projectile as described in claim **11** wherein the surface of said partition which faces said chamber is convex and wherein said slots are located closer to the circumference of said chamber than to the central axis thereof.

14. The projectile as described in claim **11** wherein there is a second chamber, identical to said first chamber, on the opposite side of said partition from said first chamber whereby said projectile may be used in a loom in which filling picks are inserted alternately from each side of the loom.

15. The projectile as described in claim **14** wherein said partition is spherical.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,831,640 Dated August 27, 1974

Inventor(s) Karl W. Wueger

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 10, the word "of" second occurrence should read -- or --

Column 10, line 28, the word - - each - - should appear after the word "from".

Column 10, line 41, the word "of" second occurrence should read -- or --.

Signed and sealed this 19th day of November 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents