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De Villier et al.

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[54] BINDING STRIP MEASURING AND ASSEMBLY MACHINE

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[52] **U.S. Cl.**.....**29/208 C,** 29/211 D
[51] **Int. Cl.**.....**B23p 19/04,** B23a 7/10
[58] **Field of Search**.....29/211 D, 208 C, 208 D, 200 B

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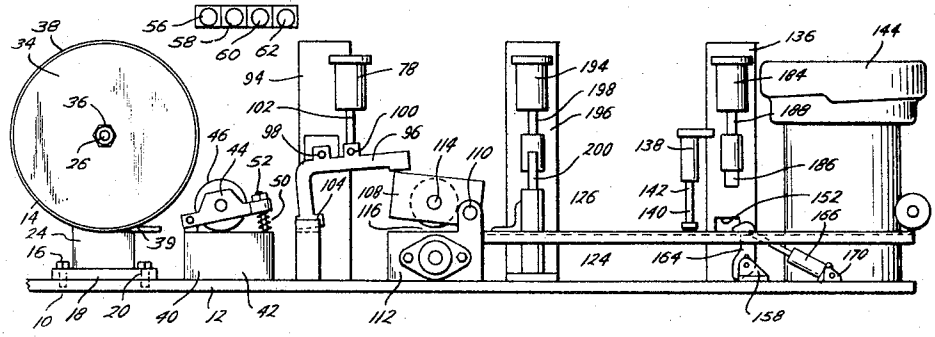
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[57] **ABSTRACT**

A machine for automatically assembling a binding clip to one extremity of a strip of metal material, measuring a desired length of the strip material and severing the desired length of strip material from a storage roll. The machine is provided with a strip guide bar having a strip guide groove formed therein. A brake mechanism, a strip drive mechanism, and a strip extremity immobilizing mechanism, are disposed adjacent the strip guide groove to control movement of the strip material. A strip cutter, a strip binding apparatus, and a clip fastening device are provided adjacent the strip guide groove to perform cutting, bending, and fastening operations on the strip material. A clip orienting and feed device is provided to orient binding clips so that a clip may be connected to the free extremity of the strip material. Control of the entire mechanism is achieved by an adjustable sequence timing control device which is responsive to linear movement of the strip material being driven.

11 Claims, 10 Drawing Figures



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SHEET 1 OF 3

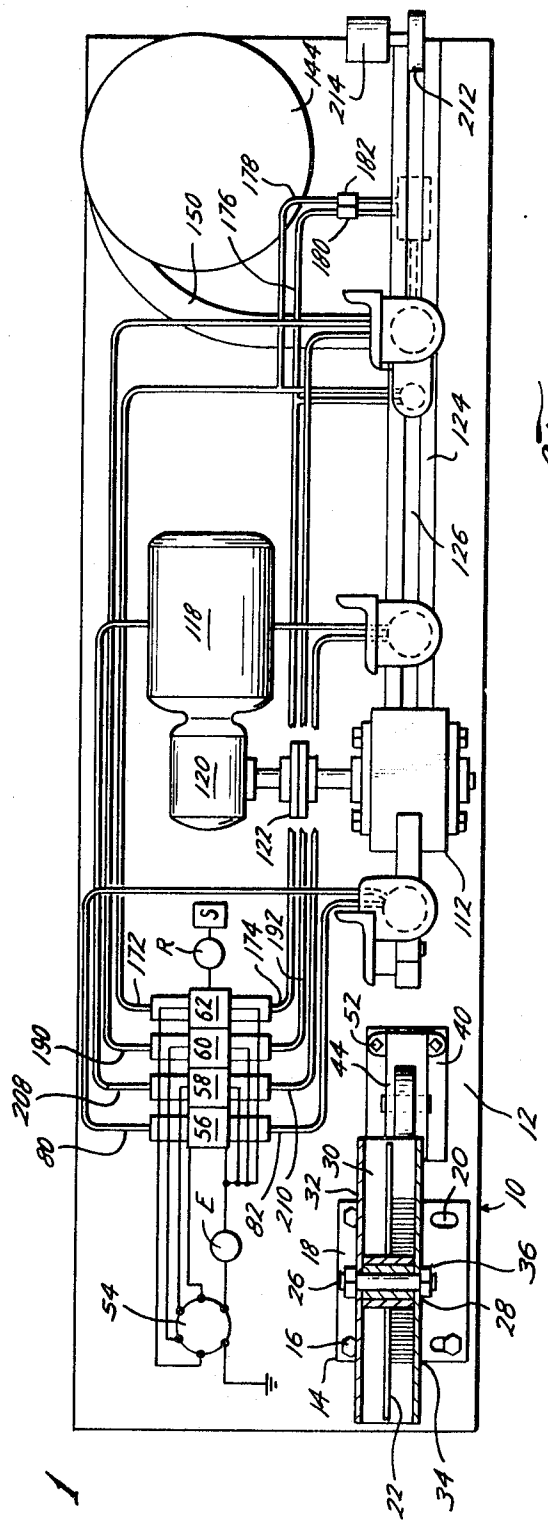


Fig. 1

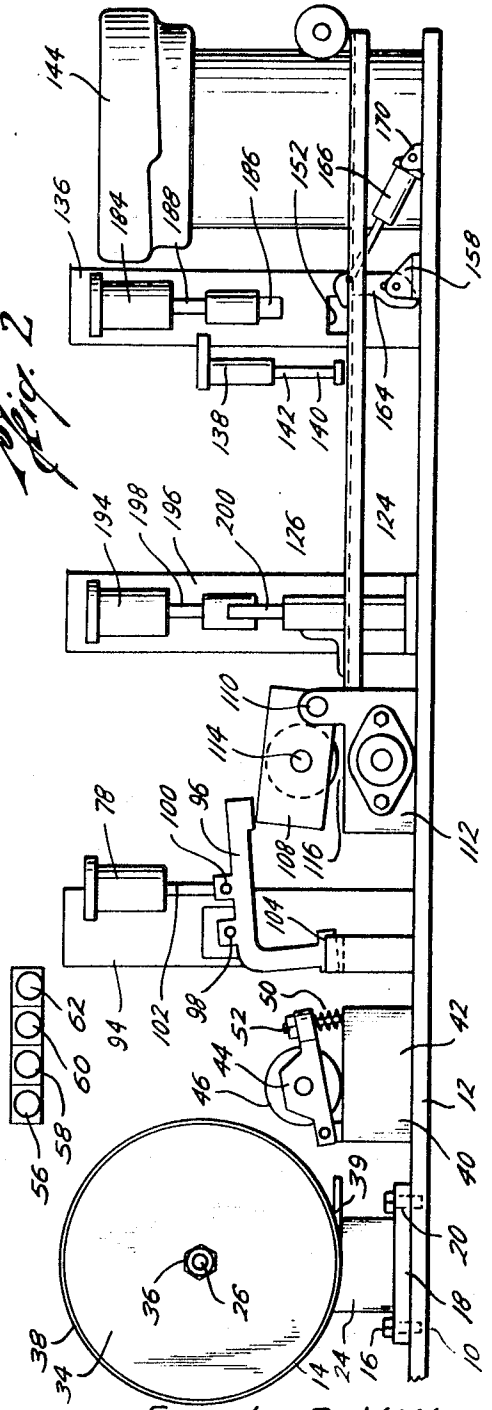


Fig. 2

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Fig. 3

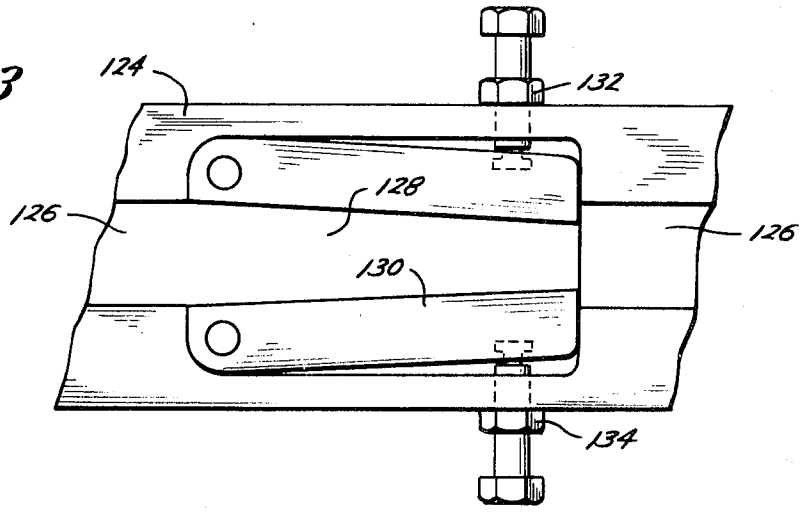
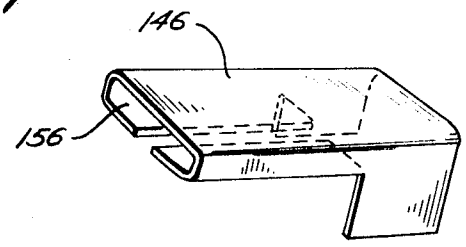


Fig. 5



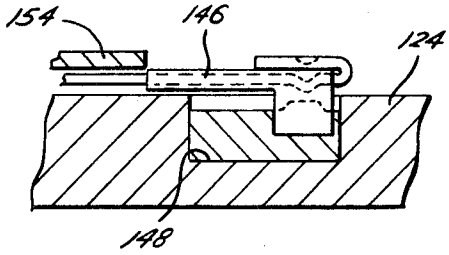


Fig. 4

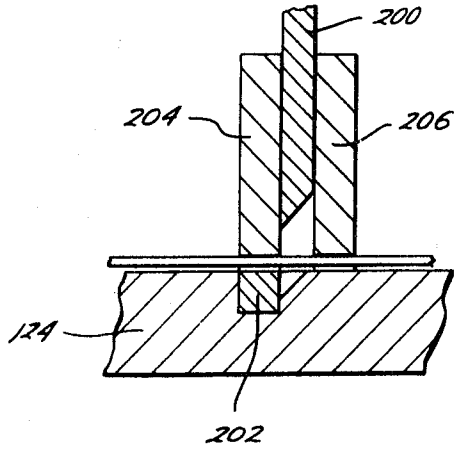


Fig. 6

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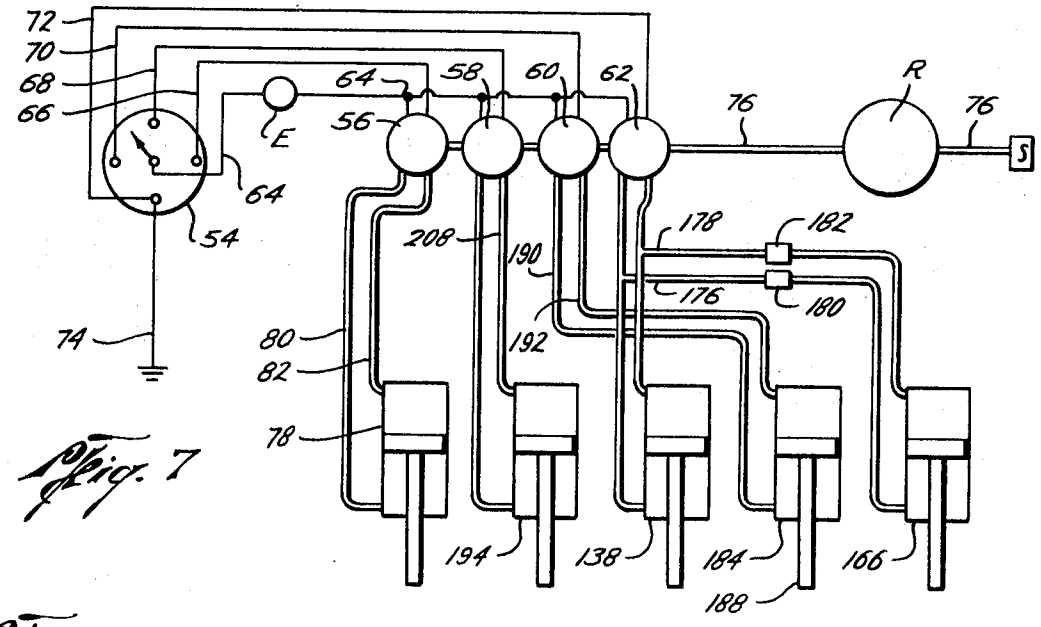
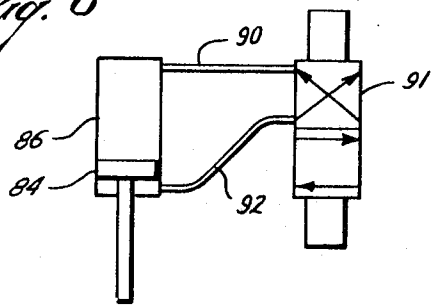


Fig. 7

Fig. 8



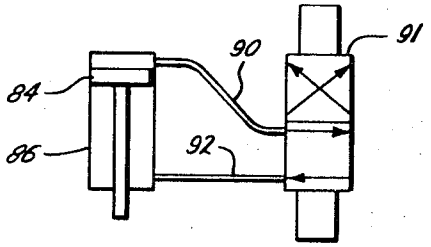


Fig. 9

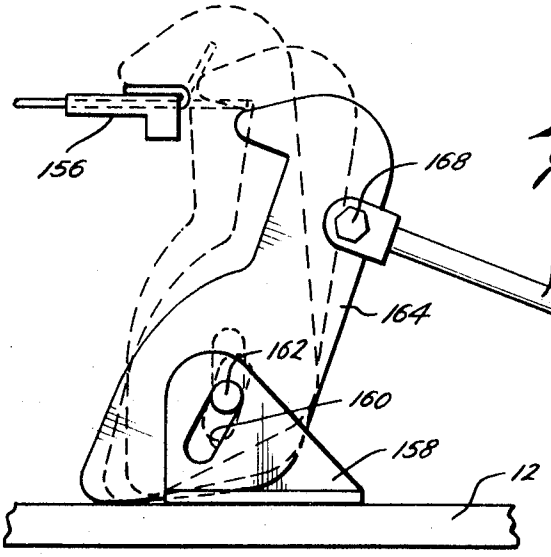


Fig. 10

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BINDING STRIP MEASURING AND ASSEMBLY MACHINE

BACKGROUND OF THE INVENTION

The invention is related generally to strip material used for binding and more particularly to a machine for automatically providing measured strips of the binding material having a binding clip securely fastened to one extremity thereof. The strip material is generally composed of metal and has numerous binding uses including binding of bales of material and binding insulation material about heated pipelines and the like as is frequently done in processing industries. The strip material may be composed of various acceptable plastic material or any other suitable material.

In order to perform binding operations generally a crew of men is provided, one of whom serves to cut the strip material into measured lengths. The other workers take the measured lengths of material and a number of standard binding clips to the work site. As each strip of material is selected for installation a clip is threaded onto one extremity of the strip material and a short length of strip material is bent about the clip by the workman. The worker cutting the measured lengths of material may also manually fix the clips to the lengths of material. The operation of transporting clips to the work site and installing them on the strip material by hand obviously results in considerable loss of time by the worker performing the binding operation. A considerable amount of time is also involved in cutting the strip material to measured lengths. Accordingly, it is a primary object of this invention to provide a novel machine for automatically assembling a binding clip to one extremity of metal strip material, measuring a desired length of the strip material, and severing the desired length of material from a storage roll.

It is a further object of this invention to provide a novel machine for automatically assembling a binding clip to metal strip material and which may be adjusted to sever any desired length of strip material.

Among the several objects of this invention is contemplated the provision of a novel binding clip assembly machine which positively secures a clip to the free extremity of the strip material in such manner as to prevent separation thereof.

It is an even further object of this invention to provide a novel machine for producing measured strips of binding material having binding clips securely attached at one extremity thereof and which is simple in nature, reliable in use, and low in cost.

The above and other objects and novel features of the instant invention will be readily apparant from the following description taken in conjunction with the accompanying drawings. It is to be expressly understood that the drawings are for the purpose of illustration and are not intended to define the limits of the invention, but rather to merely illustrate a preferred embodiment and structure incorporating the features of the instant invention.

In the accompanying drawings forming a part of this specification and wherein like reference numerals are employed to designate like parts:

FIG. **1** is a plan view of a machine constructed in accordance with the spirit and scope of the instant invention.

FIG. **2** is an elevational view of the mechanism of FIG. **1**.

FIG. **3** is a fragmentary plan view of the strip guide structure illustrating adjustability of the strip guide structure to compensate for strip material of various widths.

FIG. **4** is a fragmentary elevational view of the strip guide structure illustrating the clip securing station and showing strip material bent back upon itself about a binding clip.

FIG. **5** is an isometric view of a binding clip of the type utilized by the machine of this invention.

FIG. **6** is a fragmentary elevational view in section illustrating the cutter mechanism of FIG. **2** in detail.

FIG. **7** is a schematic view illustrating electrical and pneumatic circuitry of the machine of this invention.

FIGS. **8** and **9** are schematic views illustrating double actuation of the pneumatic cylinders utilized for control of the mechanism.

FIG. **10** is an operational view in elevation illustrating bending of the free extremity of the strip material about a binding clip.

Briefly the machine of this invention includes a pair of drive rollers capable of receiving metal strip material therebetween and driving the strip material linearly from a storage housing for strip material. A strip brake member is provided adjacent the drive rollers and cooperates with the drive rollers in order to secure the strip material against linear movement as desired. The drive rollers and the brake member are simultaneously controlled by a solonoid mechanism actuated by linear movement of the strip material. Accurate measurement is accomplished by cooperative interrelation of the drive rollers and brake mechanism. The machine is provided with a clip work station where metal binding clips are automatically fed into a clip orienting recess provided therefor. Apparatus is provided at the clip work station for bending the free extremity of the strip material about the binding clip and securely fastening the strip material to the binding clip to prevent subsequent disassembly thereof. After the strip material has been properly measured the strip material is severed by a strip cutter provided therefor and a strip removing device very rapidly extracts the finished strip and clip assembly from the machine and feeds it into a storage receptable provided therefor.

Referring now to the drawings for a more detailed description of the instant invention, a machine, illustrated generally at **10** in FIGS. **1** and **2**, is provided with a generally planer elongated base **12** to which a strip storage housing **14** is attached by means of bolts **16**. The storage housing **14** is provided with a support base **18** having a plurality of elongated openings **20** formed therein. The elongated openings **20** receive the bolts **16** and allow the base member **18** to be shifted linearly within limits defined by the length of the elongated openings **20**. Lateral shifting of the base member allows proper positioning of a roll of strip material in registry with strip measuring and driving apparatus described in detail hereinbelow. The bolts **16** are maintained sufficiently tight to restrain movement of the housing by vibration but readily allow the housing to be shifted laterally either manually or mechanically without adjustment of the bolts **16**. A friction pad or compression spring may be interposed between the bolt head and the base of the storage housing to provide the restraining force. The storage housing **14** is provided with an intermediate partition **22** securely fixed to the support portion **24** of the storage housing. A support shaft **26** extends through an aperture provided in a centrally located guide **28** secured to the partition **22**. Rolls of strip material **30** may be placed about the guide bushing **28** on each side of the central partition **22** and are enclosed within the storage housing **14** by cover plates **32** and **34**. The cover plates are retained in assembly with the support shaft **26** by nut members **36**. A cylindrical protective member **38** is secured to the partition **22** in order to enclose the peripheral portion of the storage housing **14** and is provided with an outlet opening **39** in order to allow exit of the strip material from the storage housing.

During operation of the machine the storage housing **14** will be shifted to one extremity of its linear travel thereby allowing one of the storage rolls of strip material to be properly disposed in registry with a strip measuring device **40** secured to the base plate **12** immediately adjacent the outlet opening **39**. While the machine is in operation and strip material is being withdrawn from one of the storage rolls **30** personnel controlling the machine will be allowed to refill the other side of the storage housing with a fresh roll of strip material thereby allowing production to continue as rapidly as is feasible. After a roll of strip material has been depleted by the machine the storage housing **14** may be shifted to the other extremity of its linear movement thereby registering the fresh roll of strip material with the measuring device **40** and allow-

ing the machine operating personnel to remove the opposite cover plate **32** or **34** and replace the depleted storage roll with a fresh roll of strip material.

The strip measuring device **40** includes a base block **42** to which is pivotally connected a timing roller support member **44**. A timing roller **46** is rotatably carried by the member **44** and is biased into engagement with the base block **40** by a spring member **48** disposed about an adjustment bolt **50**. The tension spring is adjusted by a nut member **52** secured to the bolt member **50**. As illustrated in broken lines in FIG. **1** the timing roller **46** is connected to a timing mechanism **54** being in turn electrically connected to four solonoid energized control valves **56, 58, 60,** and **62** as illustrated in detail in FIG. **7**. The timing mechanism **54** is adjustable in order to allow the length of the strip material to be infinitely varied as desired. Any one of a number of acceptable commercially available timing mechanisms may be successfully employed for the purposes set forth herein. The timing mechanism **54** includes a power conductor **64** communicating with a source E of electrical energy. The power conductor **64** is connected to each of the solonoid valves **56, 58, 60,** and **62** as illustrated in FIG. **7**. Ground conductors **66, 68, 70,** and **72** are connected respectively to the electrical circuitry of the control valves **56, 58, 60,** and **62** and are connected through the timer mechanism **54** to a common ground conductor **54**.

Pneumatic fluid is conducted from a fluid supply source S through a pressure regulating dewatering and lubrication mechanism R to the solonoid energized control valves **56, 58, 60,** and **62**. Pneumatic fluid is conducted from the control valve **56** to an associated pneumatic linear motor **78** by a pair of fluid transfer conduits **80** and **82**. Each of the linearly actuated fluid motors of this invention is constructed and functions in the manner illustrated in FIGS. **8** and **9**. A piston member **84** is movably disposed within a cylinder **86** to which is communicated a pair of pneumatic fluid supply conduits **90** and **92**. Each of the double acting control valves is adapted to supply pneumatic pressure to one extremity of the cylinder **86** and to exhaust pneumatic fluid from the other extremity thereof. As illustrated in FIG. **8** pneumatic fluid is being exhausted from the lower portion of the cylinder **86** through the conduit **92** and is being introduced through the supply conduit **90** into the upper portion of the cylinder **86** thereby positively forcing the piston member **84** downwardly. After the control valve structure **91** has been shifted by solenoid energization from its FIG. **8** position to the FIG. **9** position thereof, the internal passage configuration of the control valve **91** causes pressurized pneumatic fluid to be introduced through the conduit **92** into the lowermost portion of the cylinder **86** and simultaneously allows exhausting of pneumatic fluid from the upper portion of the cylinder **86** through the conduit **90**. This causes the piston to be forcibly urged upwardly. It is seen therefore that each of the linear pneumatic motors will be forcibly urged by the pressurized pneumatic fluid to each of the two operating positions thereof thereby assuring rapid positive actuation in both directions and positive maintenance of piston position in each of the operative positions.

As illustrated in FIG. **2** the pneumatic linear motor **78** is secured to a support post **94** carried by the base plate **12**. A strip brake and drive actuating lever **96** are secured by pivot **98** to the post **94** and are secured by a second pivot **100** to the actuating stem **102** of the linear motor **78**. The actuating lever **96** is provided with a brake foot **104** that is forced downwardly into braking engagement with the strip material as the linear motor **78** is actuated to move the stem **102** upwardly. As the actuating stem **102** is moved downwardly by the linear motor **78** the brake foot **104** is moved upwardly thereby releasing the strip material and a drive arm **106** of the lever **96** simultaneously moves an idler roller housing **108** about its pivotal connection **110** with a drive roller base **112** secured to the base plate **12**. This movement brings an idler roller **114** into driving engagement with a drive roller **116** rotatably journaled within the drive roller base **112**. The drive roller **116** is continuously rotated by an electrically energized rotary drive motor **118** through a reduction gear mechanism **120** and a clutch structure **122**. The clutch structure **122** prevents damage to the drive roller or other structure of the machine in the event the drive roller should become jammed.

With reference now to FIGS. **1** and **2** an elongated strip guide bar **124** having a strip guide groove **126** formed therein is supported in generally paralleled spaced relation with the base plate **12**. The strip guide groove **126** receives the strip material as it is fed from the strip drive mechanism. As illustrated in FIG. **3** the strip guide groove **126** is of sufficient width to receive the widest strip material accepted by the machine and is provided with a pair of adjustable strip guides **128** and **130** being pivotally connected to the guide bar **124**. A pair of adjustment members **132** and **134** is connected to the guide bar **124** and engages the adjustment members **128** and **130** in such manner as to allow proper centering of narrow strip material. This feature allows utilization of strip material of various widths by the same machine simply by adjusting the machine to accept the selected width of strip material.

A support post **136** is secured to the base plate **12** and supports a linear fluid motor **138** having a brake foot **140** secured directly to the actuating stem **142** thereof and disposed immediately above the strip guide groove **126**. Upon being energized downwardly the brake foot **140** engages the strip material to completely immobilize the free extremity of the strip material within the strip guide groove **126**.

A vibrating clip orienting and feeding apparatus **144** of conventional nature is secured to the base plate **12** and is adapted to feed binding clip members, such as that illustrated at **146** in FIG. **5**, into a clip recess **148** formed in the strip guide bar **124**, as illustrated in detail in FIG. **4**. The clip orienting and feed apparatus **144** is provided with a feed chute **150** for the purpose of transporting the clip members **146** through an opening **152** formed in the post **136** and into the clip recess **148**. A cover plate **154** is secured to the strip guide bar **124** and cooperates with the strip guide groove **126** to thread the free extremity of the strip material through an elongated opening **156** formed in the clip member **146**.

For the purpose of bending the strip material about the clip member **146** a support member **158** is secured to the base plate **12** as illustrated in detail in FIG. **10**. The support member **158** is provided with an elongated aperture **160** which cooperates with a bolt **162** to retain a strip bending manipulator **164** in movable assembly with the support member **158**. The actuating stem **164** of a linear pneumatic motor **166** is pivotally connected by a bolt **168** to the strip bending manipulator. As the linear motor **166** is actuated the manipulator is rotated about the bolt **162** and the elongated aperture **160** cooperates with the bolt **162** causing the manipulator to be moved both upwardly and laterally from full line position through the dash line positions thereby causing the manipulator to fold the free extremity of the strip material about the binding clip as illustrated in the operational views in FIG. **10**. The lower extremity of the fluid motor **166** is pivotally secured to a support member **170** fixed to the base plate **12**.

As illustrated in the schematic view in FIG. **7** the pneumatic motors **138** and **166** are energized through actuation of the solonoid control valve **62**. The pneumatic motor **138** is connected directly to the fluid supply source through control conduits **172** and **174** while pneumatic fluid is supplied to the fluid motor **166** through branch conduits **176** and **178** connected respectively to the conduits **172** and **174**. A pair of fluid restrictors **180** and **182** is interposed in the conduits **176** and **178**, respectively, and serves to restrict the flow of pneumatic fluid to the motor **166** thereby causing the motor **166** to be delayed slightly in its movement to the operative position thereof. The delayed movement is provided to allow the foot member **140** of the fluid motor **138** to immobilize the strip material before the strip bending manipulator **164** is moved to cause bending of the free extremity of the strip material about the binding clip. This feature precludes the strip bending manipulator from moving the strip material rearwardly as it is actuated through its bending movement.

The binding clip is securely fixed to the strip material after the bending operation by simultaneously deforming the assembled clip and strip material as illustrated in FIG. 4. This feature is accomplished by means of a linear pneumatic motor **184** secured to the support post **136** and which motor is provided with a dimple forming tool **186** at the lower extremity of the actuating stem **188** thereof. As is illustrated in FIG. 7 the linear fluid motor **184** is energized by the control valve **60** causing the flow of pneumatic fluid through the fluid supply conduits **190** and **192**.

After the binding clip **146** has been securely fastened to the free extremity of the strip material the fluid motor **78** is energized causing the brake foot **104** to release the strip material and simultaneously causing the idler roller **114** to be moved into binding engagement thereby causing the continuously rotating drive roller **116** to drive the strip material to its properly measured length. The timing mechanism actuates the linear pneumatic motor **78** upon reaching the measured length thereby again causing the brake foot **104** to secure the strip material and allowing the idler roller **114** to be biased upwardly releasing driving engagement of the strip drive mechanism. The strip material is then severed by energization of a linear pneumatic motor **194** that is secured to a support post **196** fixed to base plate **12**. The actuating stem **198** of the motor **194** is connected to a strip shear member **200** illustrated in detail in FIG. **6**. A portion of the strip guide bar is cut away as illustrated in FIG. **6** to define a groove receiving a hardened shear base **202**. The movable shear member **200** is received between shear guide members **204** and **206** that maintain proper orientation between the shear members **200** and the shear base **202**. Actuation of the shear member is controlled by the solenoid control valve **58** which controls the supply of pneumatic fluid through the control conduits **208** and **210**.

A completed measured strip of binding material with a binding clip attached is removed from the mechanism of this invention by a continuously rotating friction brush or wheel **212** that is driven by a rotary motor **214**. A storage bin, not shown, may be placed at the end of the strip guide bar to receive completed pieces from the machine.

OPERATION

After the strip material has been severed at the end of a preceding operation the timing mechanism, which is energized sequentially with the strip shearing mechanism, actuates the control valve **56** causing the linear pneumatic motor **78** to be energized in such manner as to force the actuating stem downwardly thereby causing simultaneous releasing of the brake foot **104** and energization of the strip drive mechanism and causing the strip material to be driven until the free extremity thereof has been threaded through a binding clip member **156** that has been fed automatically into the clip receiving recess at the clip securing station. At this time the linear motor **78** is actuated in reverse manner by the control valve **56** thereby releasing the drive mechanism and causing the brake foot **104** to secure the strip material against further movement. The control valve **62** is then energized allowing the flow of pneumatic fluid into the conduits **172** and **174** and allowing restricted flow of pneumatic fluid into the conduits **176** and **178**. This causes sequential actuation of the linear fluid motors **138** and **140** to first actuate the brake foot **140** to immobilize the free extremity of the strip material and to cause the strip bending manipulator **164** to be rotated from its full line position as shown in FIG. **10** through the broken line positions to bend the free extremity of the strip material about the clip member **156**. After the linear motor **166** has withdrawn the strip bending manipulator **164** clear of the clip member **156** the linear fluid motor **184** is energized causing the dimpling tool **186** to engage and deform the bent portion of the strip material and the clip member thereby positively and permanently securing the clip member into assembly with the strip material. The linear motor **78** is then again energized causing the strip driving mechanism to be actuated and causing the brake foot **104** to be simultaneously disengaged from the strip material. The strip driving mechanism then drives the strip material a sufficient distance to cause the measuring roller **46** to rotate the timing mechanism to a preselected position. Upon reaching the preselected position the timing mechanism again energizes the linear fluid motor **78** causing upward movement of the actuating stem **102** and again causing the driving mechanism to disengage and the brake foot **104** to secure the strip material. At this time the control valve **58** is energized causing the linear motor **194** to move downwardly causing the shear member **200** to sever the length of strip material. When this has been accomplished the continuously rotating friction drive roller **212** drives the severed strip material outwardly into a receiving bin provided therefor. After the strip material has been removed the clip feeding mechanism feeds a clip member downwardly and into the clip recess provided therefor. Further operational sequences of the machine then may proceed accordingly.

In view of the above it is obvious that we have provided a novel machine for automatically assembling a binding clip to one extremity of metal strip material, measuring the strip material to a desired length, and severing the measured length of strip material from a storage roll thereof. The machine of our invention may be easily adjusted to provide a similar function on strip material of various widths. Virtually continuous production is made possible through use of the apparatus of our invention since operating personnel may replace a depleted roll of strip material on one side of the storage housing while the machine is producing measured strips of material from a storage roll located on the other side of the storage housing. When the second roll of strip material is depleted it is simply necessary to shift the storage housing laterally into proper alignment with the strip measuring roll and the strip guide groove. The machine of our invention utilizes very few parts and is extremely durable in service thereby providing a machine that is low in cost as well as being extremely reliable in use. It is apparent therefore that the machine of our invention effectively accomplishes all of the objects and advantages hereinabove set forth together with other objects and advantages which are inherent in the structure of our invention.

Having thus described our invention in detail we now hereby respectfully claim:

1. An assembling and securing machine for assembling and securing a binding clip to one extremity of metal strip material, measuring the strip material to a desired length and severing the measured length of strip material, said machine comprising storage housing means for said strip material, elongated strip guide means extending in linear alignment with said storage housing, timing sequence means measuring strip material driven from said storage housing, strip drive means responsive to said timing sequence means for driving lengths of strip material from said storage housing along said guide means, brake means responsive to said timing sequence means for securing measured strips of material against inadvertent movement, an elongated strip receiving recess formed in said guide means, a clip receiving station located in linear registry with said strip receiving recess means feeding binding clips into said clip receiving station in alignment with said strip guide means, strip bending means disposed adjacent said guide means and being operative to bend the free extremity of said strip material about a binding clip, means immobilizing the free extremity of said strip material during bending of said strip about said binding clip, means for deforming said strip material subsequent to said bending of said strip material about said binding clip to secure the clip in assembly with said strip material.

2. An assembling and securing machine for assembling and securing a binding clip according to claim **1**, said storage housing having two storage compartments each capable of retaining a roll of strip material, said storage housing being capable of selective lateral movement to align either of said rolls of strip material with said elongated strip recess.

3. An assembling and securing machine for assembling and securing a binding clip according to claim 1, said strip drive means having counterrotating drive roller means receiving said strip material therebetween, said rollers being normally biased to the nondriving position thereof, motor means being actuated responsive to said measuring means for moving said drive roller means into driving relationship.

4. An assembling and securing machine for assembling and securing a binding clip according to claim 3, motor means driving said drive roller means, clutch means interposed between said motor means and said drive roller means to prevent damage to said motor means or drive roller means in the event jamming of said drive roller means occurs.

5. An assembling and securing machine for assembling and securing a binding clip according to claim 1, said brake means comprising a brake arm pivotally mounted above said strip receiving recess and having a brake foot engaging the strip material in said recess in the braking position thereof, said brake arm being pivotally moved into braking position simultaneously with movement of said drive means to the nondriving position thereof.

6. An assembling and securing machine for assembling and securing a binding clip to one extremity of a strip of binding material, measuring the strip material to a desired length and severing the measured length of material, said machine comprising a storage housing for a roll of strip material and having an exit opening through which said strip material extends from said storage housing, said mechanism having a timing sequence control means being actuated responsive to linear movement of said strip material as the strip material is withdrawn from said storage housing, strip drive and brake means receiving strip material from said housing and being operative in one position thereof to stop linear movement of said strip material and in the other position thereof to drive said strip material linearly from said storage housing, said strip drive and brake means being actuated responsive to said timing sequence control means, an elongated strip guide means extending beyond said strip brake and drive means, a clip assembly station provided on said strip guide means, means orienting and feeding binding clips to said clip assembly station and positioning the binding clips in registry with said strip guide means, strip immobilizing means disposed adjacent said assembly station and being operative responsive to said timing sequence control to immobilize the free extremity of the strip material, strip bending means disposed at said work station and being operative responsive to said timing sequence control to bend the free extremity of said strip material about said binding clip, means responsive to said timing sequence control for deforming said clip and said free extremity of said strip material to positively secure the same in assembly, means responsive to said timing sequence control for severing measured lengths of said strip material and means for removing said severed lengths of material from said mechanism.

7. An assembling and securing machine for assembling and securing a binding clip according to claim 6, said storage housing having a plurality of receptacles for rolls of strip material, said storage housing being readily movable to align either of said rolls of strip material with said strip guide means.

8. An assembling and securing machine for assembling and securing a binding clip according to claim 6, said timing sequence control means having a plurality of electric control circuits, a plurality of solenoid actuated valves being connected to said electric control circuits, linear fluid motor means being connected to said solenoid actuated valves, operations of said mechanism responsive to said timing sequence control means being accomplished by said linear fluid motor means.

9. An assembling and securing machine for assembling and securing a binding clip according to claim 8, said means for immobilizing the free extremity of said strip material and said means for bending the free extremity of said strip material being accomplished by electrical actuation of a single control valve, means to delay actuation of said bending means until said strip material has become immobilized.

10. An assembling and securing machine for assembling and securing a binding clip according to claim 6, said strip drive means comprising a pair of opposed rollers normally biased apart, means rotatably driving at least one of said rollers, said strip material being received between said rollers, a linear fluid motor connected to one of said rollers and upon being energized responsive to said timing sequence control causing movement of said one roller toward the other roller causing binding between said rollers and said strip material and thereby resulting in linear movement of said strip material.

11. An assembling and securing machine for assembling and securing a binding clip according to claim 10, said brake means located adjacent said strip drive means, said linear fluid motor being connected to said brake means and upon moving said one roller toward the other causing movement of said brake means away from the braking position thereof and upon moving said one roller away from the other causing movement of said brake means toward the braking position thereof.

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