

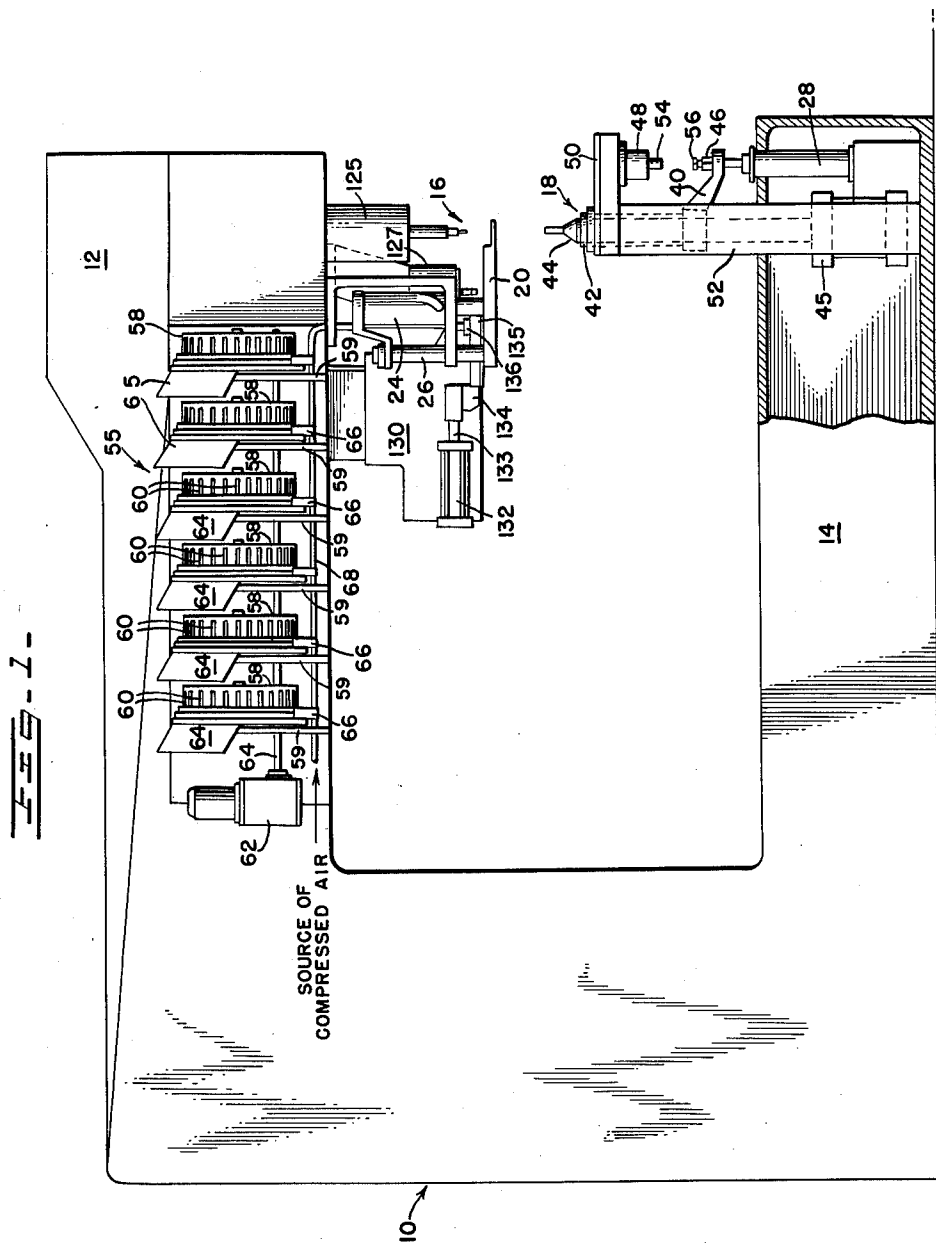
April 24, 1962

A. E. FILANGERI ETAL
RIVETING MACHINE OR THE LIKE

3,030,832

Filed Jan. 23, 1958

6 Sheets-Sheet 1



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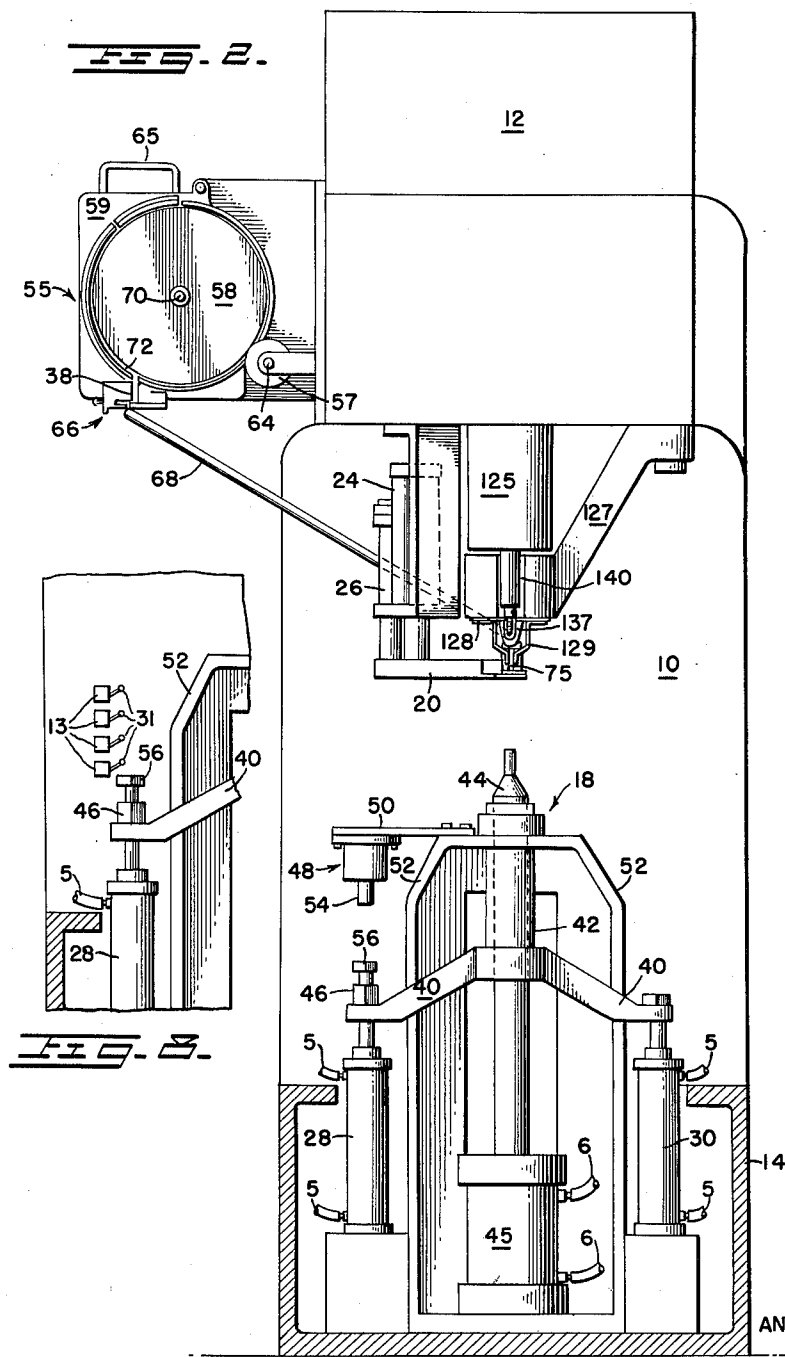
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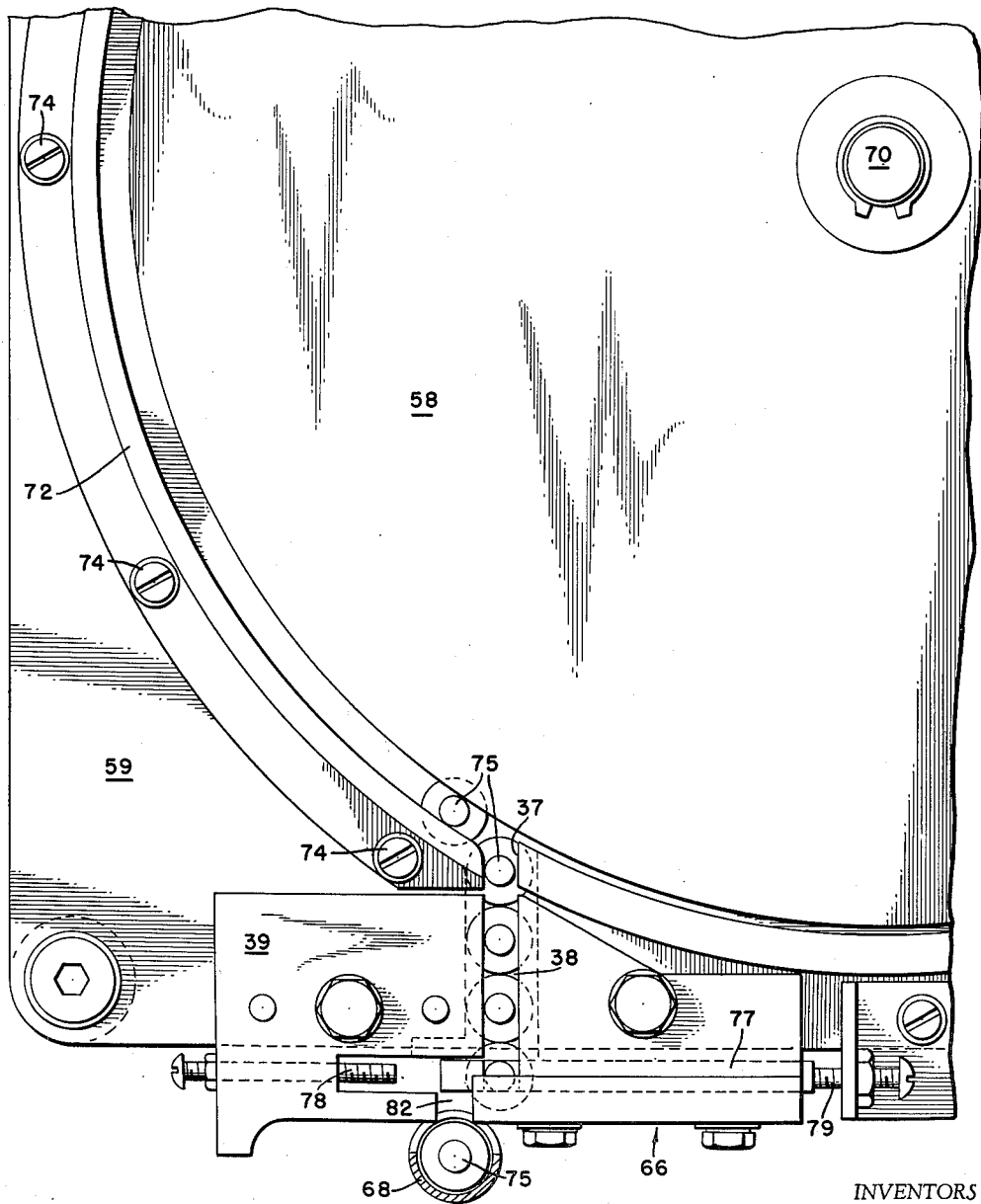
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FIG. 3.



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FIG. 4.

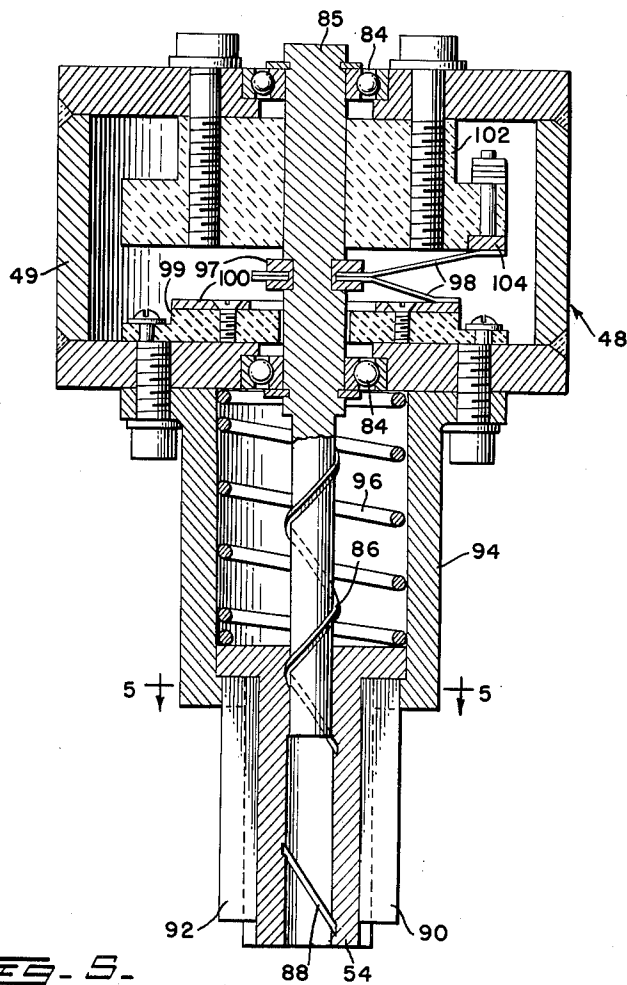
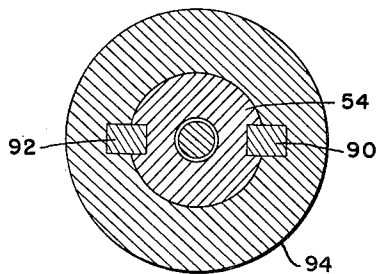


FIG. 5.



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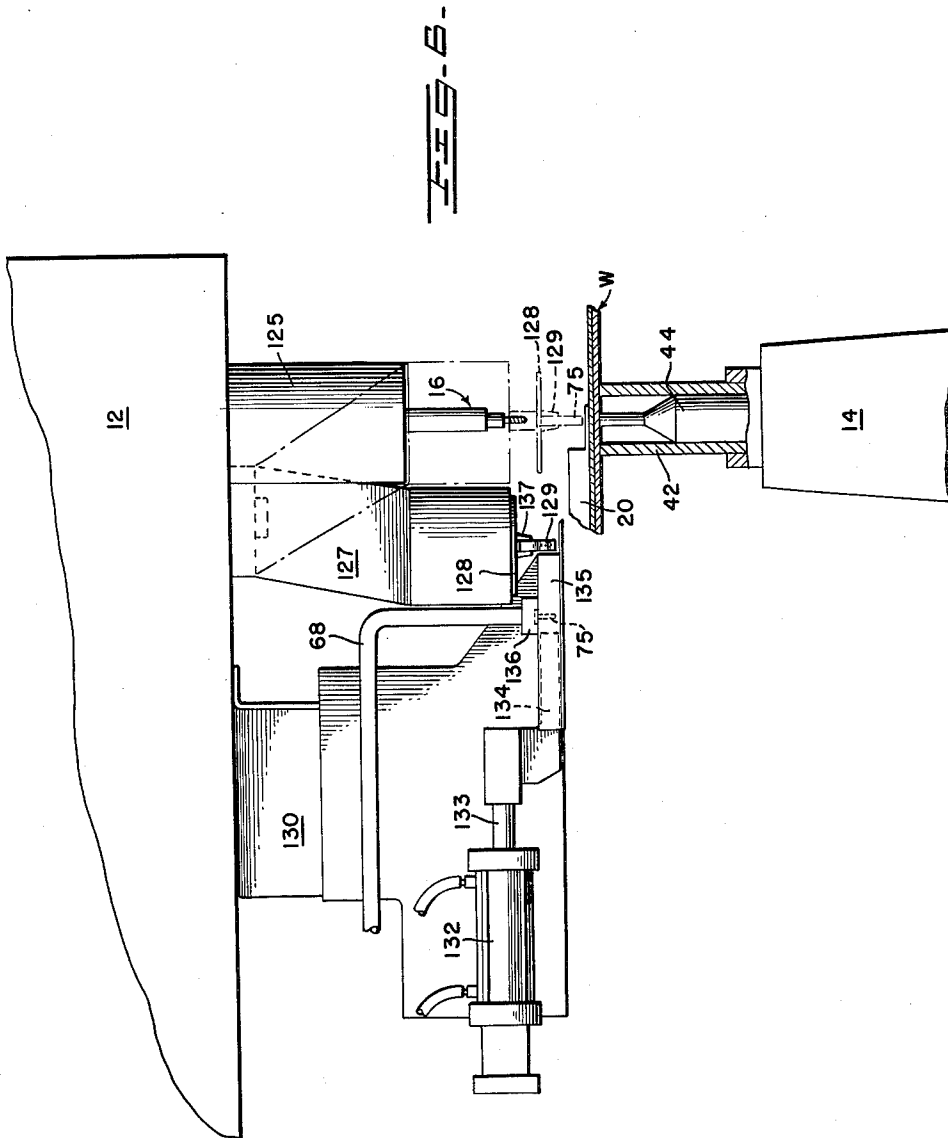
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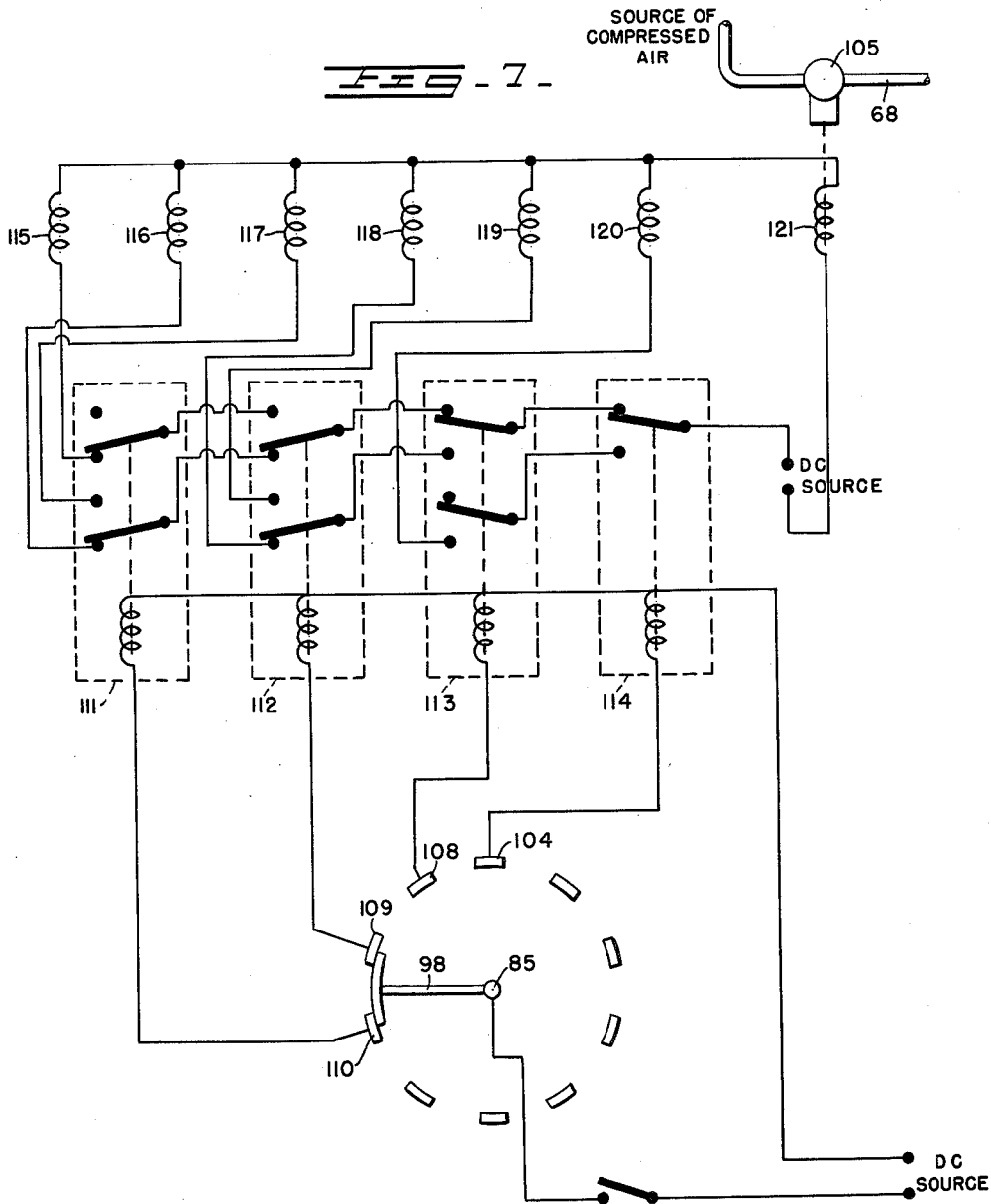
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3,030,832

RIVETING MACHINE OR THE LIKE

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Filed Jan. 23, 1958, Ser. No. 710,705
13 Claims. (Cl. 78—48)

This invention relates to a system for sensing a characteristic of materials handled by automatic machinery; and more particularly relates to a system which automatically senses the aggregate thickness of materials to be joined one to another and selects and transports a joining device of proper length to the materials from a supply of devices of various dimensions.

Riveting machines have generally been built to perform a specific function, i.e., fashioned to drill or punch holes of a given diameter and to release a rivet of a given length and cross section to the workpiece. Normally a rivet hopper is provided containing rivets of a single preselected length and diameter. The size in each case is determined by the dimensions of the aperture formed in the workpiece and the thickness of the materials which are expected to be encountered by the machine. When materials of varying thicknesses are to be riveted together or if the workpiece per se varies in cross section as for example the airfoil section of an aircraft wing, then the operator of the machine must either take the work to a machine having different sized rivets or must remove the rivets resting in the rivet hopper and replace them with rivets of the desired dimension as the rivet row progresses.

As will be pointed out in the more detailed description appearing hereinafter, the instant invention, summarily stated, comprises a system wherein a riveting machine element automatically senses the thickness of materials presented to the working position and initiates the selection and feeding of a rivet of the proper dimensions to the workpiece whereby an operator may continuously pass a variable thickness workpiece through the machine and thereby complete an entire run without the necessity of moving from machine to machine or stopping the riveting cycle to select different sized rivets.

It is accordingly a broad object of this invention to provide a workpiece thickness sensing and fastener selecting system for use with automatic machinery.

It is a further object of this invention to provide a system to automatically sense the thickness of a workpiece and to select and feed a fastening device of proper dimension to the same.

It is a yet further object of this invention to provide a system wherein the thickness of a workpiece is discerned at the point wherein an aperture is to be formed and a properly dimensioned rivet is selected and transported to the aperture for the heading operation.

It is a still further object of the invention to provide a riveting machine wherein a workpiece may be presented at a working position and an element of the machine, movable in dependence upon the thickness of the workpiece, actuates a rivet selection and feeding system.

It is a yet still further object of this invention to provide a riveting machine to secure together workpieces of varying thicknesses wherein one machine element determines a plane of reference for the workpieces and another machine element is movable relative to such plane to actuate a rivet selection and feeding system.

It is yet another object of this invention to provide a system whereby one of a plurality of rivets of different lengths are placed in working position in material to be riveted depending on the thickness of the material as a characteristic to be sensed by the system.

With the foregoing and other objects in view, the in-

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vention includes the novel combination and correlation of elements described below and illustrated in the accompanying drawings, in which:

FIG. 1 is a side elevation partly in section showing the preferred embodiment of the sensing and selecting system as applied to a riveting machine.

FIG. 2 is a front elevation partly in section showing the positioning of the invention on a riveting machine.

FIG. 3 is a fragmentary elevation showing a portion of the rivet hopper and gate.

FIG. 4 is an enlarged elevation in section showing the details of the selector unit, per se.

FIG. 5 is a view taken on lines 5—5 of FIG. 4 and looking in the direction of the arrows.

FIG. 6 is a fragmentary side elevation showing some of the details of the rivet feeding structure.

FIG. 7 is a schematic wiring diagram showing the relay system used in the instant invention, and

FIG. 8 is a fragmentary elevation illustrating another species of the selector unit usable in the system.

As shown in FIG. 1, the machine comprises a body frame 10 of general C shape having an upper leg 12 and a spaced lower leg 14, thereby forming the work-receiving throat of the machine. In the usual apparatus of this type the forward end of the upper leg carries the drilling or punching spindle 16 and the lower leg supports the riveting and stripping unit. Here, a clamping shoe 20 depends from the upper leg 12 and is fixed against motion after initial excursion to form a reference plane in working position. A stack of workpieces to be fastened together are inserted into the throat of the machine in abutting relationship against the underside of the shoe 20 and a stripping unit is elevated and is thus brought into contact with the underside of the workpieces as is best seen in FIG. 6. The workpieces are held in this position in the usual automatic machine while the drilling or punching operation is performed through an aperture in shoe 20. The above described operations are standard in the art and reference is made to Patent No. 2,488,645 issued to T. H. Speller et al. for an example of the electrical and hydraulic circuits used in a typical machine to elevate the stripper against the underside of the workpieces while an aperture is formed therein to receive a rivet. Once the shoe 20 has determined the plane of reference and the workpiece has been stationed under it, then as will later be pointed out, the motion of the stripper moving member from rest position is utilized to actuate a sensing member to initiate a rivet selecting and feeding cycle.

A member 48 which will be described in detail in connection with FIGS. 4 and 5 is disposed adjacent to the stripper supporting structure and a portion is moved thereby in accordance with the magnitude of vertical stripper motion. Since the clamping arm is fixed in the working position the displacement of the member is directly proportional to the excursion of the stripper and hence of the thickness of the workpiece; and a sensing system is connected to the member and is responsive to actuation thereof to energize one gate of a series of rivet hoppers to release a properly sized rivet to the working position.

Taking FIGS. 1 and 2 together to thereby obtain a composite representation of the structure, clamping shoe 20 is moved by hydraulic cylinder 24 down to a locked position which is determined as a standard plane of reference for the entire cycle and there awaits the insertion of the workpiece against its underside. Guide member 26 insures that the shoe does not move laterally. In the lower leg 14 (FIG. 2) a pair of spaced hydraulic cylinders 28 and 30 having conduits 5 extending between them bridge 40 which carries cylindrical stripper 42. A

riveting anvil 44 extends coaxially within the stripper and is moved vertically by hydraulic cylinder 45 having conduits 6.

Upright pin member 46 is secured to one end of bridge 40 and is vertically aligned with a sensing member 48 which is fixed by arm 50 to stanchion 52. The details of sensing member 48 will be more fully explained in connection with FIGS. 4 and 5 but it is sufficient for the present to state that a plunger 54 is arranged to telescopically move within the unit upon engagement thereagainst by head 56 of pin 46. Thus it will be seen that motion of bridge 40 by cylinders 28 and 30 carries with it pin 46 and engagement of head 56 against plunger 54 moves the same vertically. Referring now to the upper leg 12 an assembly of rivet hoppers 55 is there shown. Each hopper has a rotatable rivet storage drum 58 provided with longitudinally extending, circumferentially spaced apertures 60, all drums arranged to be rotated by motor 62 and shaft 64 which drives a spaced series of rubber wheels 57 engaging against the outer periphery of each hopper. A funnel shaped receptacle 65 is provided at the top of each hopper assembly to receive the rivets and guide them into the respective drums as is known in the art. At the bottom of each hopper assembly is a rivet release gate 66 which will hereinafter be more fully explained. The gates connect the drum to a chute or track 68 which is arranged to have a source of air pressure connected at one end and terminates at the other end adjacent a push rod; whereby a rivet is dropped into a chute by the action of a selected gate, the air flow transporting the rivet to the end of the chute where it is received by a sliding system to be applied into the workpiece ready for the heading operation. It is within the purview of this invention to provide a system wherein the proper hopper is selected depending on the thickness of the workpieces presented into the working position.

Referring now to FIG. 3 wherein an enlarged fragmentary detail of the rivet hopper is shown, the rotating drum 58 is supported on frame 59 by shaft 70 and has a guide rim 72 mounted in concentric spaced relation by screws 74. The drum is adapted to hold the quantity of rivets fed from receptacle 65 and is turned in a clockwise sense by motor 62 shaft 64 and wheel 57 (FIG. 2) whereby the rivets 75 pass through apertures 60 in the drum periphery and engage in the space between the outer diameter of drum 58 and the inner radius of rim 72. The rivets are aligned with their shafts parallel to the axis of the drum and their heads behind rim 72 substantially as shown. A gate, shown generally as reference character 66, comprises a body 39 having a channel 38 extending therethrough and aligned with a port 37 formed in guide rim 72. Tongue 77 shown in dotted outline is slidable between travel limiting screws 78 and 79 and has a rivet receiving aperture formed therein and aligned with the bottom of channel 38 in the normal position. When the tongue is in the position there shown the bottom rivet falls into the aperture and when a rotary solenoid (not shown) is energized the tongue 77 is slid horizontally thereby positioning the rivet over aperture 82 which permits the same to fall into tube 68 for conveyance to the workpiece. It is thus seen that at all times an assemblage of rivets lies in aligned relationship awaiting the triggering of the solenoid to permit them to drop in turn into the chute for further conveyancing. As previously mentioned tube 68 is maintained at a pressure above ambient. Horizontal motion of tongue 77, then, effectively closes the bottom of channel 38 and there can be no flow of air upward against the rivet to prevent its free fall into the tube.

The details of the thickness sensing unit 48 are revealed in FIGS. 4 and 5, taken together. Housing 49 has a pair of roller bearings 84 in the upper and lower end-walls supporting a shaft 85 extending longitudinally through the unit and having threads 86 to cooperate with internal threads 88 formed on plunger 54. The plunger

has a pair of keys 90 and 92 slidable in keyways formed in boss 94 so that telescopic motion of plunger 54 into boss 94 against the urging of spring 96 causes threads 86 and 88 to cooperate and rotate shaft 85. Fixed onto shaft 85 is an insulator 97 carrying a bifurcated spring arm 98 substantially as shown. Disposed below the spring arm is insulator 99 and copper ring 100 for engagement by the lower fork of the arm. In the upper part of the unit is fixed an insulator 102 carrying a concentric series of individual contacts one, 104, of which is there shown for engagement by the upper fork of the arm. It will be seen that rotation of shaft 85 carries the arm 98 therewith and moves it in a circle whereby electrical energy may be transmitted from ring 100 to a selected contact depending on the degree of rotation of shaft 85 which is in turn proportional to motion of plunger 54.

FIGURE 7 shows a wiring diagram of a relay system operable with the sensing unit of FIG. 4. A relay series 111 to 114 inclusive is connectable by the sensing unit to individually connect the coils 115 to 120 of the respective rotary solenoids on the individual hopper gates previously discussed. A valve 105 may optionally be fixed in chute 68 and arranged to open whenever coil 121 is energized simultaneously with the opening of a hopper gate. This action admits air from a source of compressed air to admit a driving pulse behind a rivet. It will be understood that this valve arrangement is optional and the air may be continuously admitted to the chute for constant flow. The arm 98 moves around the circle within the several contacts in accordance with motion of a plunger 54 and terminates at a contact or contact pair which, in accordance with the relay schedule appearing below, energizes a predetermined gate and admits a rivet of the proper size to the chute 68 for transport to the work. For example: if the arm 98 stops in the position there shown wherein it engages contacts 109 and 110 then energy from the lower D.C. source energizes coils of relay 111 and 112 bringing the multi-position contacts down, and tracing the energy path from the upper D.C. source it will be seen that the coil of gate 116 is energized. The same procedure is true for all positions of the arm 98. The several relays connected to the sensing unit are of the relatively slow acting type so that the arm 98 may pass over a series of the contacts without necessarily actuating the relay armatures in seriatum. It will be understood that as many hoppers and gates may be provided as there are contacts on the sensing unit, and obviously, any number of sensing unit contacts may be provided at the discretion of the user.

Schedule

Contact Engaged	Relay Energized	Gate Coil Energized
110.....	111	115
110.....	112	116
109.....	111	117
109.....	112	118
109.....	113	119
108.....	112	120
108.....	113	
108.....	114	
104.....	113	

If for example rivets varying, inter se, in lengths of $\frac{1}{16}$ inch are placed in the six hoppers then a range of rivet lengths from $\frac{3}{8}$ inch to $\frac{11}{16}$ inch is available for automatic selection and delivery to the workpiece.

Summing up the operation of the sensing system to this point, vertical motion of bridge 40 in FIG. 2 causes head 56 to engage against plunger 54 thereby moving arm 98 to engage against a selected contact and energize a relay to release a selected rivet to the chute for transport to the work.

Refer now to the FIG. 6 wherein the details of the system for transporting the rivet to the workpiece after

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the selection is made is revealed. As there shown drilling head 125 depends from upper leg 12 to guide the drill which, as is usual, is movable toward and away from the work. A rotatable arm 127 having at the distal end thereof plate 128 and carrying a spring gripper 129 to receive rivets 75 is shown. Support 130 is secured to upper leg 12 and carries hydraulic cylinder 132 having a piston rod 133 terminating in a web 134 slidable in receiver 135 which is disposed at the end 136 of chute 68. Plate 128 carries a shield 137 which surrounds the end of the drill as is best seen in FIG. 2 during the rivet delivery and heading cycle. After the selection action has taken place and the rivet has been urged to the end 136 of chute 68 it is deposited in an elongated groove in receiver 135. Thereafter actuation of cylinder 132 moves piston rod 133 forward and web 134 forces the rivet between the springs of clip 129. Upon receipt of the rivet into the spring clip member 127 rotates through a horizontal plane to the position shown in dotted lines in FIG. 6 and in full outline in FIG. 2 wherein a cutout portion 140 embraces the drill and shield 137 covers the end thereof. In this position the rivet 75 is aligned with the aperture formed in the workpiece W. From this position the plate 128 is urged downwardly by a member within head 125 to deposit the rivet in the aperture. It will be understood that the shoe 20 has a hole formed therein to permit passing of the rivet therethrough.

The complete operation of the hereinbefore described structure will now be explained. When a workpiece W is inserted into the throat of the machine it is brought up against the underside of clamping shoe 20 and bridge 40 rises to urge the stripper assembly against the underside thereof. This squeezes the workpiece between the two members as seen in FIG. 6 and terminates the vertical motion of bridge 40 which has urged pin 46 against plunger 54 to rotate arm 98 an amount proportional to the workpiece thickness. While the drilling operation takes place by methods well known in the art the proper sized rivet is delivered to chute 68 and forced by air pressure into receiver 135 whereupon arm 134 forces it into the spring clip 129. Rotation of member 127 aligns the rivet with the aperture formed in the workpiece and motion downward of plate 128 places the rivet into the aperture and further motion of shield 137 forces the rivet out through the spring clip and into position for the heading operation. It is held in this position by shield 137 until anvil 44 comes up to upset the rivet and thereby join the workpieces together.

FIG. 8 illustrates a species of the preferred embodiment wherein a series of switches 13 having actuators 31 are disposed in the path of motion of the head 56 of pin 46 instead of the sensing unit 48 previously described. Here the several switches are actuated by vertical motion of the bridge-pin assembly and are connected directly to a relay system such as 111-114 shown in FIG. 7. The relay actuated, again, is a measure of the vertical excursion of the bridge 40 which is proportional to material thickness.

From the before described invention it will be seen that an organization is herein provided for sensing a thickness characteristic of materials handled by an automatic machine, and during the initial part of the cycle the thickness is automatically sensed and a proper fastening device is delivered to working position when the aperture therefor is being formed. These automatic features cooperate to produce a rapid and versatile machine and eliminate the necessity for having a plurality of machines each carrying a different rivet size.

While only the preferred embodiments of the invention have been described and illustrated it will be apparent to those skilled in the art that other embodiments and modifications may be made without departing from the spirit or scope of the invention for the limits of which reference must be had to the appended claims.

We claim:

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1. In an automatic machine the combination comprising a first element defining a working position, a second element aligned with said first element and movable with respect thereto to engage against a workpiece disposed between the two elements in the working position, a plurality of containers corresponding to different positions of one of said elements to hold joining objects of respectively different dimensions, a tube intercommunicating between the containers and the working position, and a selector unit responsive to motion of said one of said elements and connected to the said plurality of containers to feed from the container corresponding to the final position of said one element a joining object of proper dimension to the said tube for transport there-through to the workpiece.

2. In an automatic machine the combination comprising a first element movable to a reference position to define a work area, a second element movable with respect to said first element and aligned therewith to engage against a workpiece in the work area, a plurality of containers to hold joining objects of respectively different dimensions, tube means intercommunicating between the containers and the work area, and a thickness sensing unit located adjacent and responsive to motion of said second element and selector means connected between said thickness sensing unit and the said plurality of containers to feed a joining object of required dimension from a selected container to the tube means for passage therethrough to the workpiece.

3. In an automatic machine the combination comprising a first element vertically movable to define a working position and to receive thereunder a stack of workpieces to be fastened together, a second element vertically aligned with said first element and movable with respect thereto to press against the workpieces, a series of containers each holding a respective plurality of rivets of varying lengths, a track connected between the containers and the working position, and means responsive to motion of the said second element to select and release a rivet of such length as to properly pass through the workpiece stack to the track for transport to the working position, said means comprising a conductive member movable with the said second element to wipe against a contact series, a relay system connected to said contact series, and an electromagnetic gate at each container respectively connected into the relay system to dispense rivets, whereby motion of said conductive member connects a source of energy to an individual relay of the system to energize and actuate a corresponding container gate and release a rivet to the said track for transport to the working position.

4. The combination in a riveting machine having a member to determine a work reference position and an operating element aligned with said member and movable relative thereto to seize a workpiece, of a thickness sensing device on the machine comprising means responsive to motion of the operating element to move to a position proportional thereto, a series of containers for holding rivets of respectively different dimensions, an electromagnetic gate on each respective container, a source of energy, and means responsive to the position of the said last recited means to connect the source of energy to a respective gate to deliver a rivet of proper length from a container to the work reference position for securing into the material.

5. The invention as set forth in claim 4 including a tube to transport the respective rivets from the containers to the work reference position.

6. The invention as set forth in claim 5 wherein the last named means comprises a relay system.

7. The invention as set forth in claim 6 wherein the first recited means comprises a rotor arranged to be moved by the operating element, and an annular series of contactors surrounding said rotor and engageable in sequence by the said rotor and connected into the said relay system.

8. The invention as set forth in claim 7 wherein the

said first recited means comprises a shaft connected to said rotor, a helical thread formed on said shaft to co-operate with a longitudinally movable threaded member whereby longitudinal motion thereof imparts rotary motion to wipe the rotor over the said contacts.

9. In apparatus for securing two or more pieces of material of varying thicknesses together by riveting, a thickness sensing system comprising in combination a clamping means to receive the workpiece in abutting relation, a stripper movable in relation to the said clamping means to press the material against the clamping means, a multi-position rotary switch having a control rotor element connected to move circumferentially in accordance with motion of the stripper, a series of stator elements positioned radially from the rotor element to be engaged in seriatim by the rotor element, a control relay system, means connecting the stator elements to said control relay system, a rivet hopper for each respective size rivet to be used, a release gate fixed on each hopper, means connecting the relay system to the hopper gates for energizing a selected hopper gate in accordance with the rotor position, and a chute connecting the rivet gates to a working position whereby the aggregate thickness of the materials results in termination of rotor element motion in such position as to engage against a stator element and energize a selected hopper gate to release a properly dimensioned rivet to the chute.

10. In an automatic machine the combination comprising a first element movable to define a working position and to receive thereunder a stack of workpieces to be fastened together, a second element vertically aligned with said first element and movable with respect thereto to press against the workpieces, a series of containers each holding a respective plurality of rivets of varying lengths and having an electromagnetic gate, a conduit connected between the container gates and the working position to transport the rivets, a series of switches positioned adjacent the said second element and adapted to be actuated thereby in seriatim in accordance with motion of the said second element from a mean position to thereby energize a selected container gate and release a rivet of of predetermined length to the conduit.

11. The invention as set forth in claim 10 including means to introduce air at elevated pressure into the said conduit to hasten transport of the rivet to the working position.

12. In a machine the combination comprising a first element defining a point of reference, a second element movable with respect to said first element to press against a workpiece disposed between the elements, a plurality of containers holding joining objects of respectively different lengths, means extending between the said containers and the said elements to feed the joining objects in seriatim to the workpiece, and means connected to the said second element and responsive to motion thereof to release from a selected container corresponding to said motion a joining object of length adequate to penetrate the workpiece to said last recited means for transport to the workpiece.

13. Apparatus comprising a riveting machine including a member to determine a work reference position and an operating element aligned with said member and movable relative thereto to seize a workpiece, a thickness sensing device on the machine comprising means responsive to motion of the operating element to move to a position proportional thereto, a series of containers for holding rivets of respectively different dimensions, a gate on each respective container, and means responsive to the position of the said last recited means for actuating a respective gate to deliver a rivet of proper length from a container to the work reference position for securing into the material.

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