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Schott, Jr.

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[54] **MACHINE FOR PERFORATING AND HEAT SEALING A WEB INCLUDING AN ELONGATED ELEMENT WITH A MULTIPLICITY OF DRIVERS**

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[52] U.S. Cl. **156/510,** 83/627, 156/583

[51] Int. Cl. **B32b 31/00,** B26d 5/08

[58] Field of Search 156/583, 510; 83/627, 590

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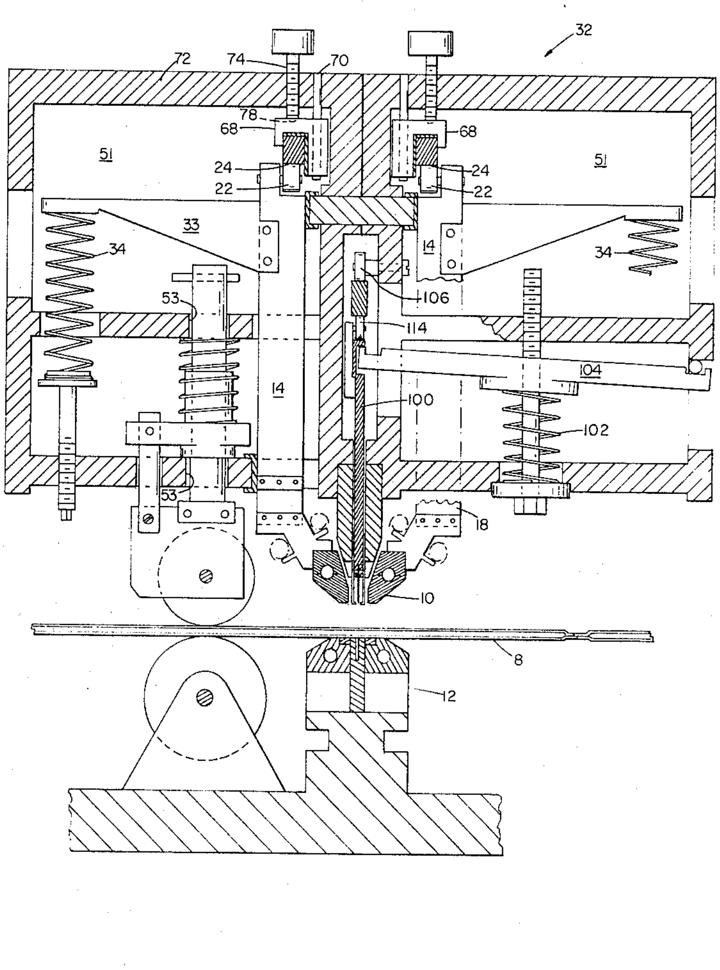
Primary Examiner—Douglas J. Drummond
Attorney—John Noel Williams

[57] **ABSTRACT**

Machines with elongated elements operable on an advancing web; elements such as heat seal bar, perforator blade and clamp for plastic film. Non-self supported elements are positioned and driven by drivers at middle and at ends, positioned by referencing stationary structure. Cam drivers, linear actuation, biased element positioning, angled push rod actuation and other features are shown. Slackness in web during heat sealing or supplemental indexing is produced by rotation of the normally stationary portion of a single direction clutch whose movable part is engaged with a shuttle belt. Compensation for slip and slackening also are achievable employing a differential drive between input and output nip roll pairs, with selected driving of the third shaft of the differential. Prolonged driving of the same differential can establish a desired speed ratio between the two nip pairs to compensate for slip, and change of the rotational input in response to a position sensor serves as a registry control.

16 Claims, 11 Drawing Figures



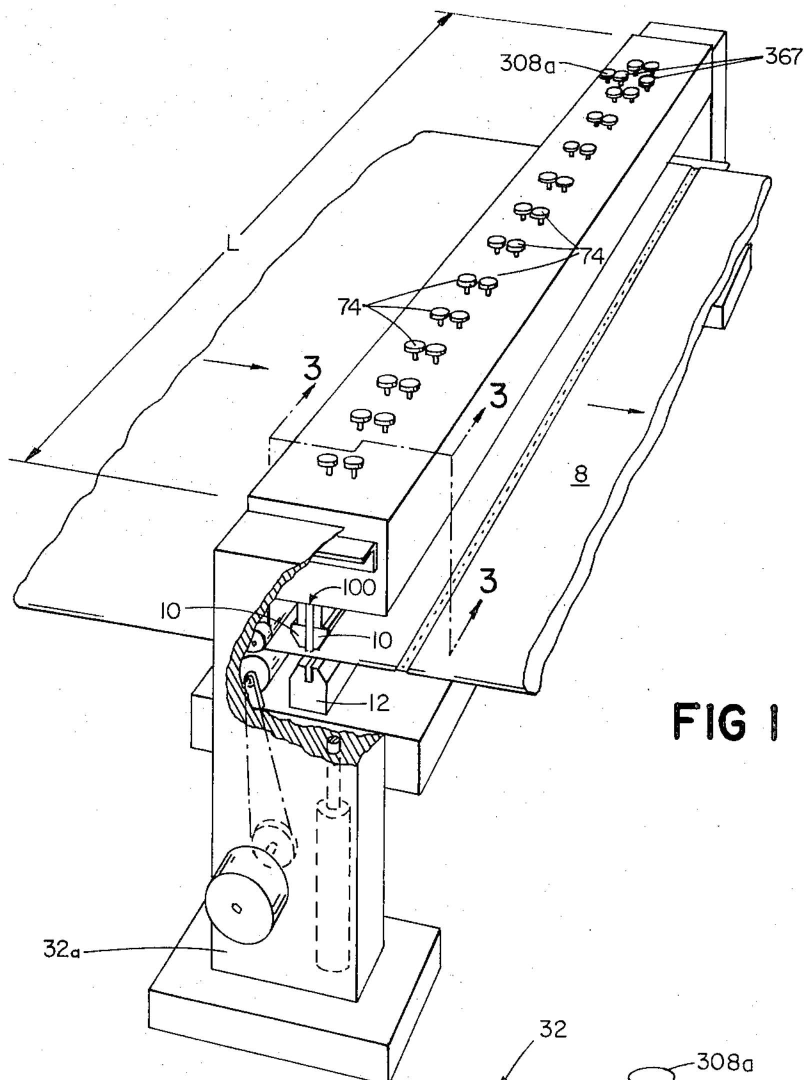

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FIG 1

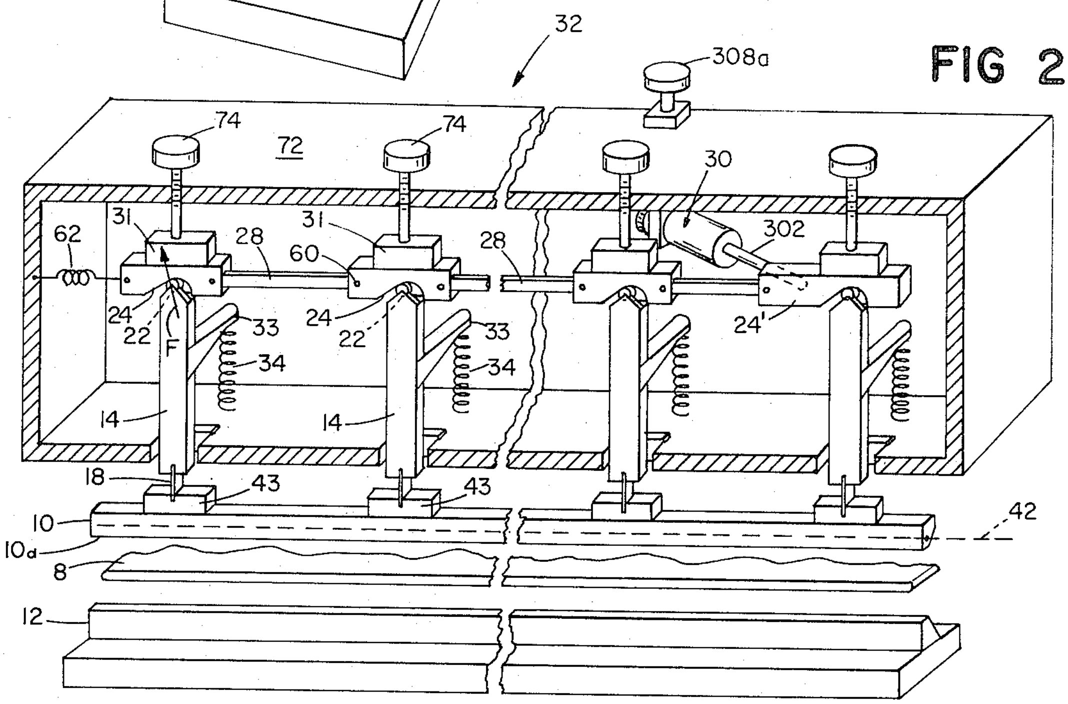
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FIG 2

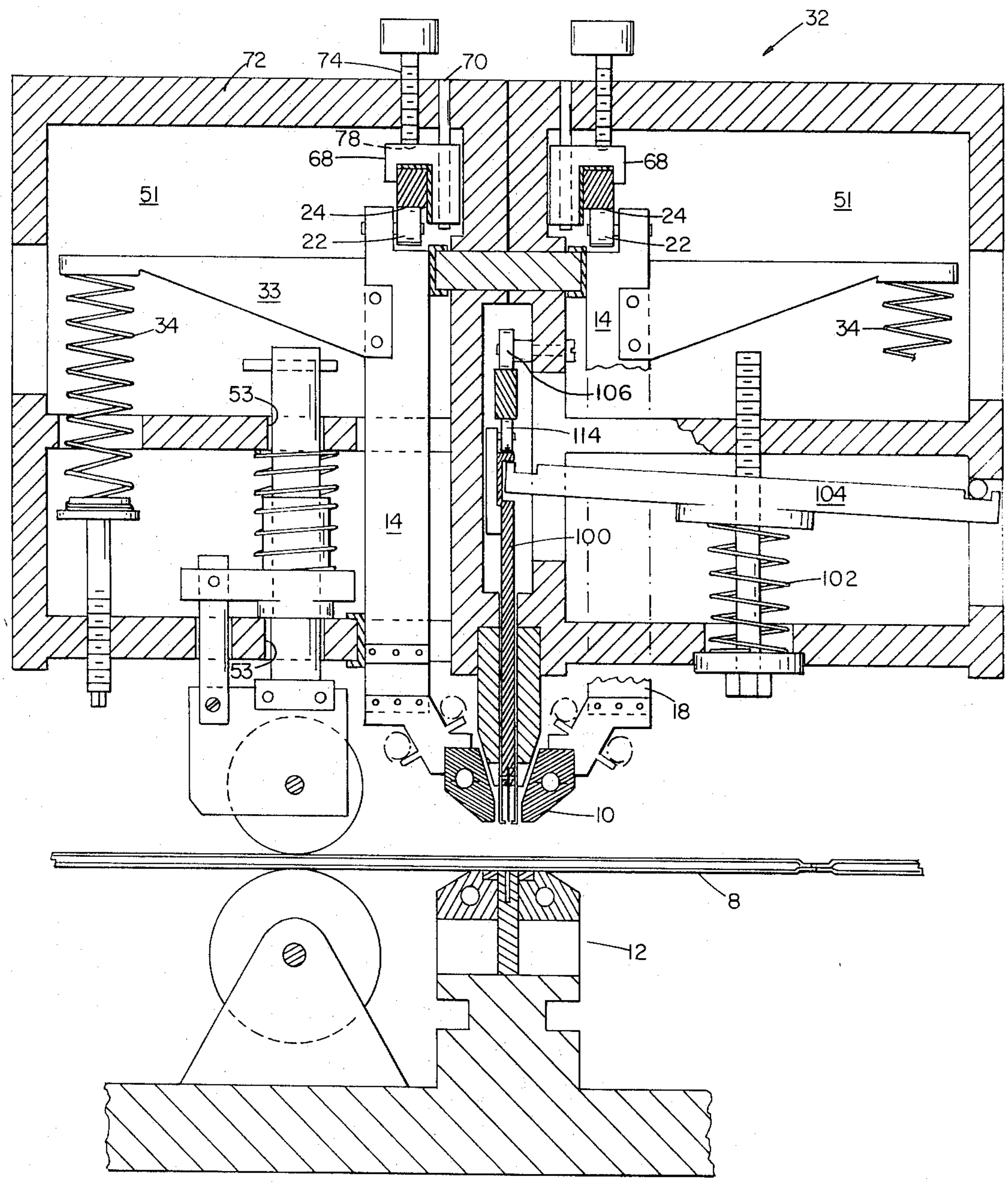
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FIG 3

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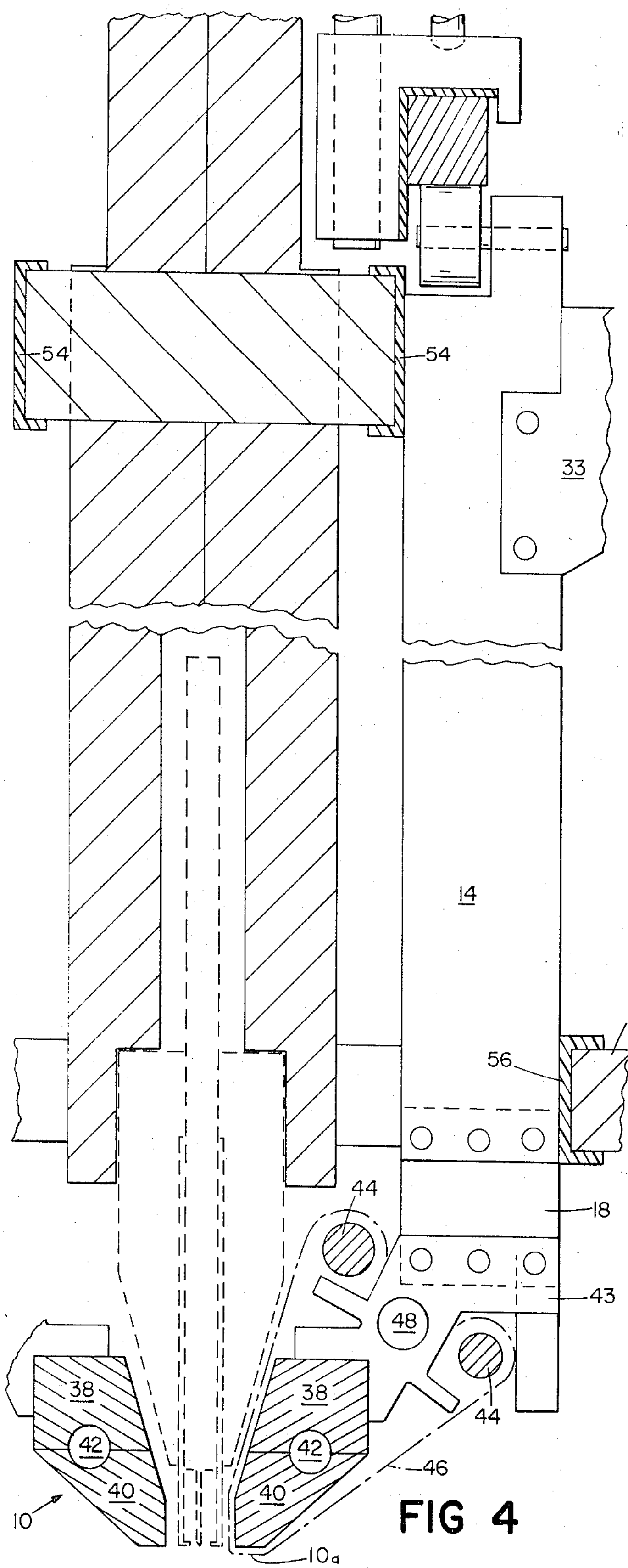

FIG 4

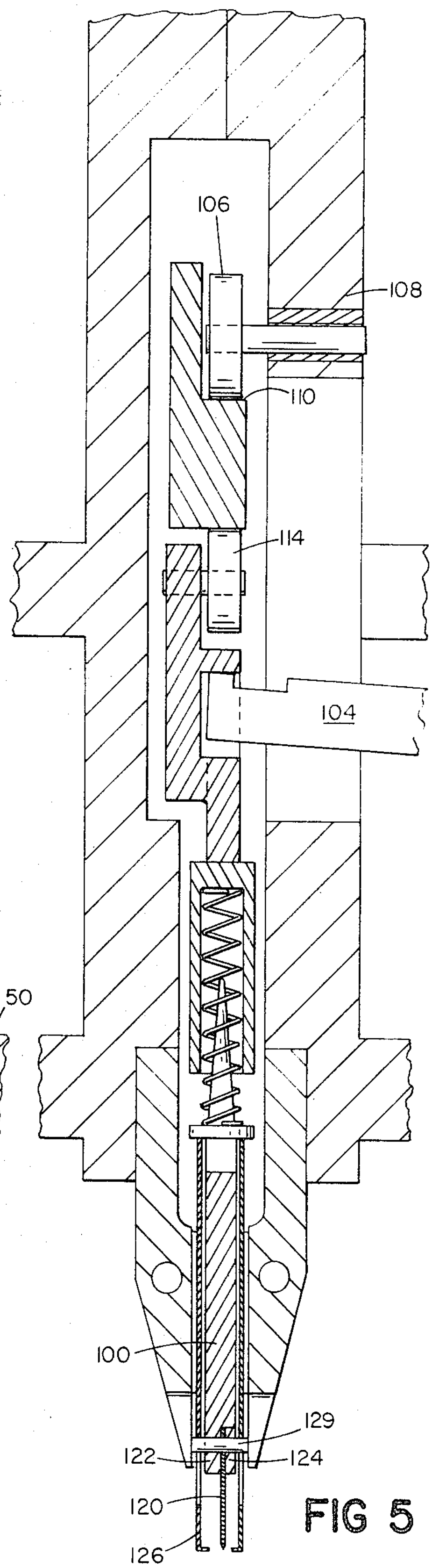

FIG 5

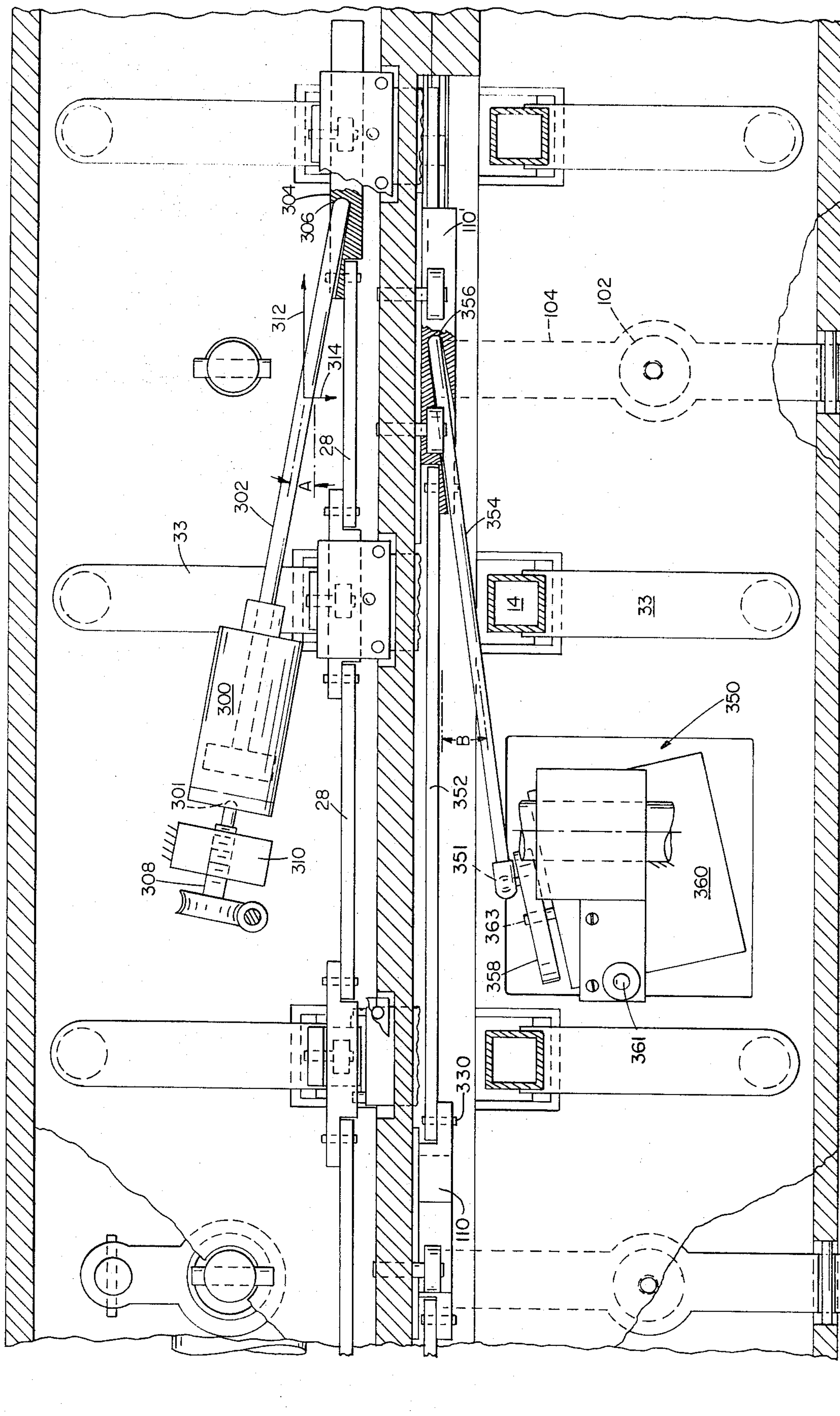
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FIG 6

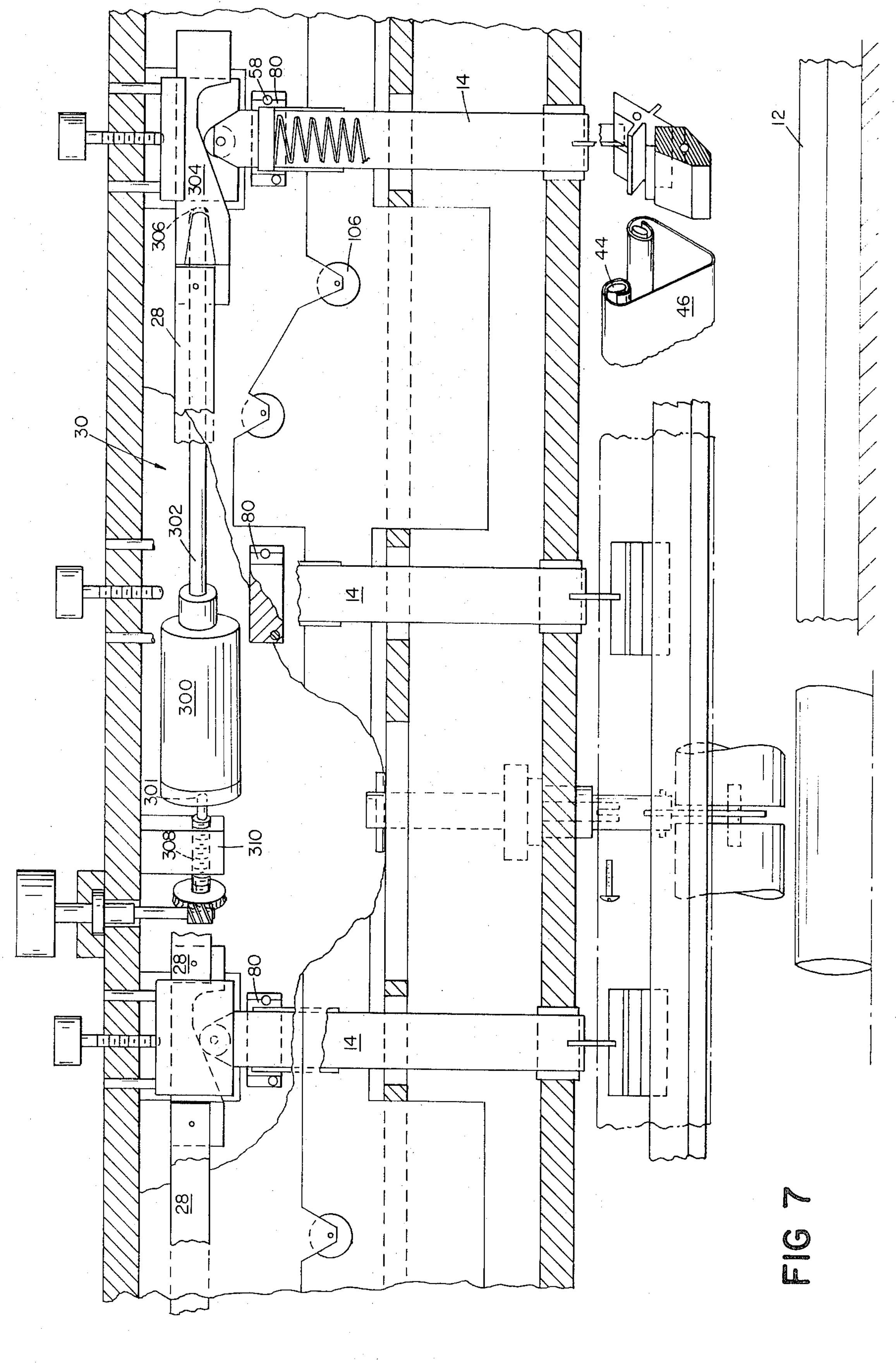
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FIG 7

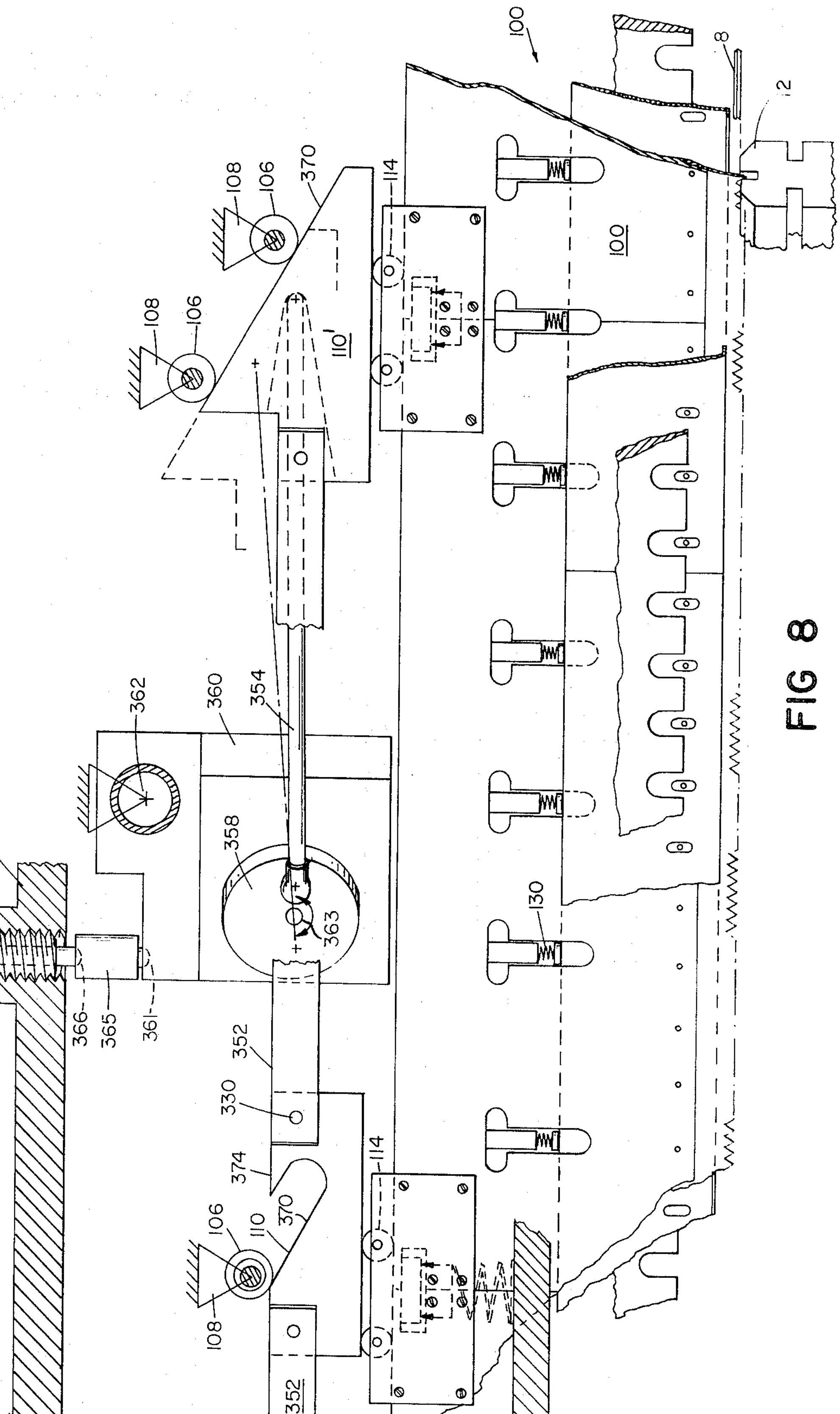
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FIG 8

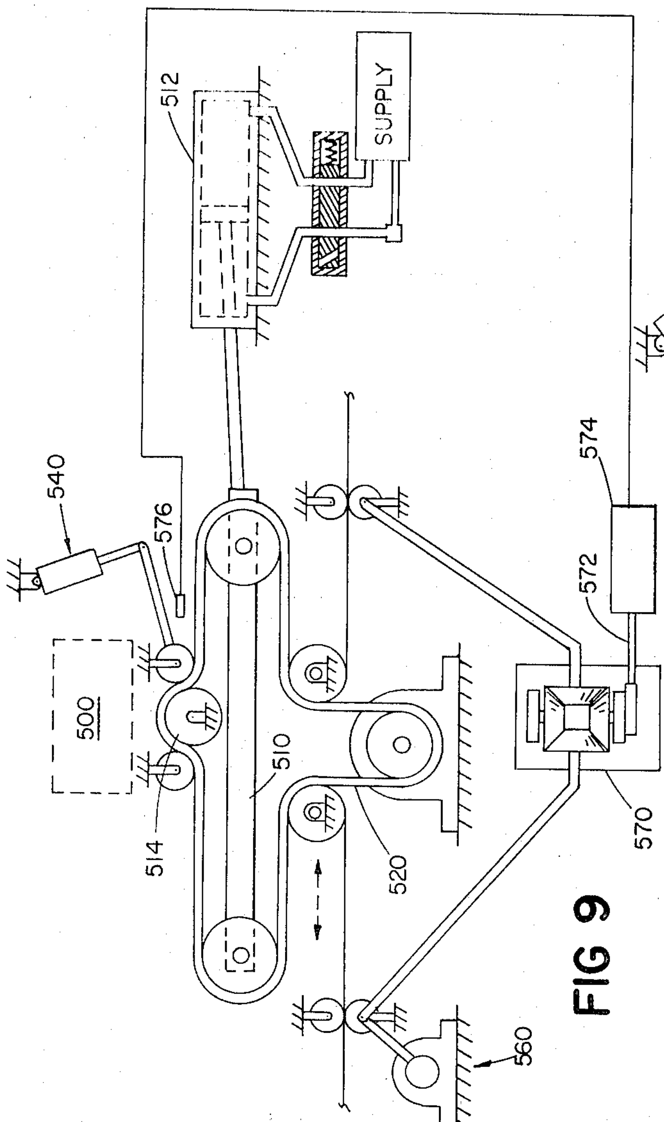

FIG 9

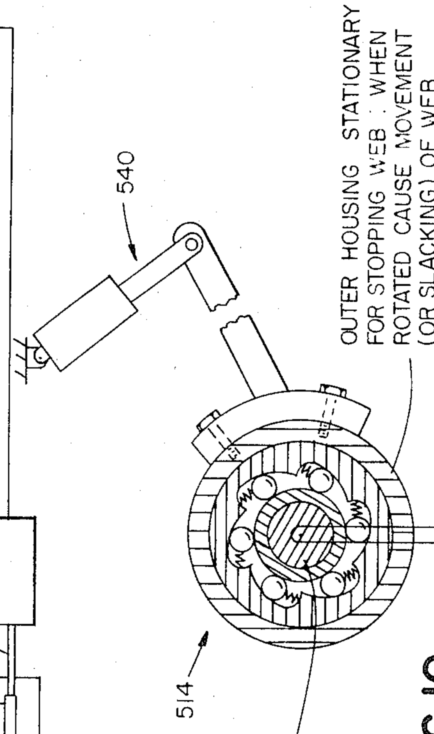

FIG 10

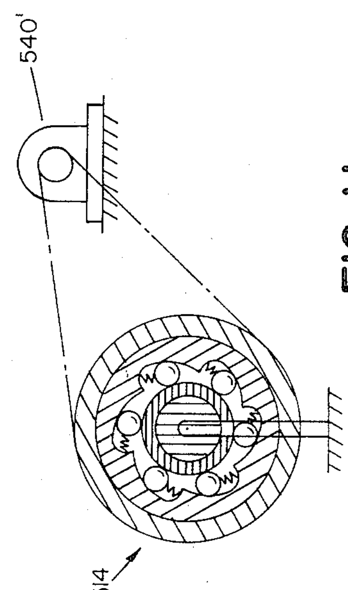

FIG 11

MACHINE FOR PERFORATING AND HEAT SEALING A WEB INCLUDING AN ELONGATED ELEMENT WITH A MULTIPLICITY OF DRIVERS

This invention relates to machines of the type having an elongated element which periodically acts upon a web. It is particularly relevant to the making of long formations or imprints in plastic film and sheet and to machines for making plastic bags.

Objects of the invention include providing such machines which are reliable and of high speed and in which the reciprocating member can be made of any length, e.g., longer than **10** feet, to span webs of similar width.

Particular objects are to provide such a machine which can act upon wide plastic webs with controllable accuracy over the entire extent of the active element.

The invention features an elongated element or forming surface and its associated reciprocating assembly which lacks self-support over its length sufficient to maintain the desired geometry of the element. Stationary structure which extends along the length of the element allows the desired back and forth motion of the element, and a multiplicity of drivers are spaced apart along the element, at its middle as well as at its ends. Each of these drivers includes a drive-force-receiving portion on the movable assembly and a drive force applying portion positioned by the stationary structure and mounted for movement relative to it. A main drive drives all of the force-applying portions in synchronism. This movement is effective to move the element in the predetermined direction and at the same time maintain the proper position and geometry of the element.

By use of this structure the movable element may be of low mass (permitting high speed), of simple construction and capable of simple adjustment, e.g., to contour the element as desired.

Preferred embodiments of the invention feature: a series of individual adjustment devices along the length of the active element; the stationary structure comprising an elongated beam extending across the width of the web and supported on end columns; associated drive means, for the drivers, extending along the elongated beam; active elements as forming dies, specifically exampled by a plastic heat-sealing bar, as plastic penetrating means exampled by a plastic perforator and as clamping surfaces exampled by the heat seal bar as well as strippers associated with the perforator. In the case of heat seal bars the invention features a protective curtain means associated with the bar, in which both bar and curtain means lack self-support and are positioned by the drivers through reference to the stationary structure.

The invention features the drivers as cam assemblies; the active element slidably guided by the stationary structure to reciprocate linearly; a series of support columns associated with the active element; and push rod actuation of a linkage for driving the drivers in synchronism; and both rotary and axially operable actuators provide means for driving the push rods and adjusting the stroke. In preferred embodiments positioning torque is applied to the active element preferably by the same series of springs that provide for return movement of the active element.

These and other objects and features of the invention will be more fully understood in the light of the following description of the preferred embodiments in connection with the drawings, wherein:

FIG. **1** is a perspective view, partially broken away, of a preferred embodiment of the invention useful for manufacturing plastic bags;

FIG. **2** is a diagrammatic, partially broken away perspective view of the machine of FIG. **1** viewing the side of the heat seal bar mechanism;

FIG. **3** is a cross-sectional view of the embodiment of FIG. **1** taken on line **3—3** thereof;

FIG. **4** is a cross-sectional view on a larger scale of portions of FIG. **3** showing the heat seal bar assembly details;

FIG. **5** is a view on scale similar to FIG. **4** showing perforator blade assembly details;

FIG. **6** is a partially diagrammatic plan view with portions broken away of the preferred embodiment;

FIG. **7** is a side view of one side of the machine showing in particular the actuating arrangement for the heat seal bar

FIG. **8** is a side view of the other side of the machine showing the actuating arrangement for the perforator blade and

FIG. **9** is a diagrammatic side view of a film drive according to the invention while FIGS. **10** and **11** are cross-sectional, partially diagrammatic views of preferred one way clutch assemblies for accomplishing web salackening and supplemental indexing.

Referring to the drawings, there is shown a preferred embodiment of the invention in which polyethylene film **8** is introduced between a horizontal heat sealing bar **10**, of length L, e.g., of 10 or 10 feet, and a lower platen **12.** The elongated reciprocating heat sealing bar **10** is connected to driven column members **14** through flexures **18**, all forming part of an elongated vertically reciprocating assembly. The reciprocating assembly is intentionally light-weight so that it may reciprocate quickly; however the assemblyy lacks sufficient self-support to maintain the proper geometry of the heat sealing surface **10***a* along its entire length. The column members **14** are driven at their upper ends in the vertical direction, transverse to the length of the heat sealing bar, by reciprocating cam assemblies which are spaced apart along the length of the heat sealing bar. Each of these comprises a first portion, cam followers **22**, and a second portion, cam surfaces **24.** The cam surfaces are reciprocated synchronously in the longitudinal, horizontal direction by a plurality of connecting rods **28** in a direction parallel to the heat sealing bar, these rods interconnecting the cam surfaces with a drive means **30**, for example, a hydraulic-actuated piston. The cam surfaces are slidably positioned for this motion by vertically adjustable extensions **31** FIG. **2** (see **68** FIG. **3**) of the stationary structure **32**, which comprises a rigid beam extending across the width of the web, supported by end pedestals **32***a*. The cam assembly is urged together by the action of arms **33**, connected to columns **14**, and springs **34**; the resultant force of the springs tending to urge the cam followers against the respective cam surfaces. The rigidity of the stationary structure is thus transferred to the reciprocating assembly through the adjustable extensions **31**, via the cam assemblies, and eventually to th heat sealing bar through the flexures **18** which are stiff in the vertical direction. The flexure connections are made periodically along the heat sealing bar, thus providing several points of transfer of the supporting forces.

As the second portions 24 of the driven assemblies, i.e., the cam surfaces, reciprocate in synchronism in the longitudinal direction, along the length of beam 32, the first portions 22 of the driven assemblies, i.e., the cam followers, reciprocate in the predetermined transverse direction, i.e., the vertical direction, thereby causing bodily reciprocation of the columns 14, fexures 18, and heat sealing bar 10. At the same time, forces transmitted by the cam surfaces serve to support and position adjacent portions of the bar vertically so as to preserve the desired geometry of the elongated forming surface. The forming surface thereby reciprocates between the inoperative position whereby the film can be advanced and the operative position whereby the plastic film is heat sealed.

Referring more specifically to FIGS. 2, 3 and 4, the elongated heat sealing bar 10 consists in part of an upper bar 38 and a lower bar 40 extending the length of the machine and welded as as to embrace an elongated resistive heater element 42 (e.g., of tubular type) also extending the length of the machine. The heater element provides heat necessary for the sealing process. Two small diameter bobbins 44, which extend the length of the machine and which support a non-stick, heat-resistant curtain 46 (preferably part Teflon), are also supported along the length of the heat sealing bar. This curtain is wound around one bobbin, fitted around the exterior of the lower bar 40, and is then wound around the second bobbin, and is indexed periodically, as the exposed portion of the curtain is used, in a known manner.

This assembly (i.e., the bars, bobbins and curtain) is supported at spaced apart points by individual brackets 43 connected to flexures 18. Openings 48 in these brackets provide isolation tending to prevent the structure above the openings from heating as the heat sealing bar becomes hot.

The brackets 43, typically ten inches apart, provide the means by which flexures 18 join the heat sealing bar to columns 14. The brackets are slotted, providing two parts, and the flexure is typically joined to these parts by screws. The flexure is a thin piece of metal, about 0.050 inch thick, the direction of thickness being arranged in the longitudinal direction of the bar and thus allows motion by the heat sealing bar in the longitudinal direction. The flexure however has much greater dimensions in the vertical direction and in the other horizontal direction, and is therefore rigid in those directions. Thus, the heat sealing bar will not distort as its temperature rises causing expansion, but rather will cause resilient deflection of the flexures in the longitudinal direction, while remaining straight in the vertical and other horizontal directions.

The stationary structure, which supplies rigidity to the system, is composed of wall members welded together to provide an elongated horizontal tubular structure 51 extending the length of the reciprocating assembly. The column members 14 pass through periodically spaced openings 53, one in each of two horizontal members, and upwardly to support cam followers 22. The column members are typically one inch cross section tubular structures and the cam followers 22 are joined to the top ends of the column members. Torque arm brackets 33 are joined to the column members within the tube 51 and extend horizontally. A series of compression springs 34 are grounded on the stationary tube wall and act upon respective torque arms 33 to supply an upward force urging the cam followers upwardly against the cam surfaces 24. The sum of all forces on the periodically spaced columns is sufficient to raise the weight of the reciprocating assembly and thus provide positive contact of all of the cam followers against the respective cam surfaces, and automatic return of the bars to the inoperative position upon deactivating movement of the cams.

In addition to the vertical force on column members 14, there is also a torque tending to rotate the reciprocating assembly about its longitudinal axis due to the offset of the line of action of the springs 34 on arms 33. This resiliently applied torque is effective to force the column members against the bearing surfaces, upper bearing surfaces 54 on one side, and lower bearing surfaces 56 on the other side of each column, thus to accurately position the assembly in the sidewise direction. The bearing surfaces typically of anti-friction material, thus slidably position the reciprocating column members for movement in the reciprocating direction. The lower bearings are typically free floating bearings fitting around the lower wall member 50 for the length of the opening cut therein. The upper bearings are positioned by dowels not shown.

The cam structure includes a plurality of machined, cam surfaces 24 linked together by connecting rods 28 to form a chain-like series wherein slight, self-adjusting rotation is allowed at joints 60. Each cam surface 24 is slidably positioned against an adjustable L-shaped block 68, FIG. 3. The L-shaped blocks slide in the vertical direction on rod 70 which are secured to upper stationary structure 72. The spacing between the upper stationary structure and the upper surface of the L-shaped blocks is individually adjusted by the screws 74 which are secured in the tapped upper structure 72 and seat in the recesses 78 of the L-shaped blocks.

The action of the cam surfaces 24 against the cam followers 22 can produce significant longitudinal forces on the reciprocating assembly. The force vector F resulting from the contact of the cam surfaces against the cam followers is essentially normal to the cam surfaces and therefore has both a vertical and a horizontal component. The vertical component overcomes the spring forces and produces the downward motion. The horizontal component is a longitudinal thrust force. To oppose these longitudinal forces, dowels 58 also secure third bearing members 80 (FIG. 7) which prevent longitudinal movement of columns 14 as a result of the longitudinal thrust force.

The drive means 30, which produces the reciprocating cam motion, is preferably a hydraulic piston arrangement positioned as shown in FIG. 7. The linear piston arrangement advantageously allows control of the driving force necessary for proper operative positioning of the sealing process when the machine is not run in a fixed gap condition. The cylinder-piston rod arrangement preferably lies in a horizontal plane and engages the driven cam 304 at a vertical height substantially equal to the height at which the connecting rods engage the cam surfaces. In this manner, vertical moments resulting from the driving force are substantially eliminated. Being at substantially the same vertical height as the connecting rods, the driving means must be angled away from the direction of motion of the cam rod chain, at an angle A, FIG. 6, the angle changing slightly as the hydraulic cylinder reciprocates.

In the preferred embodiment, the piston arrangement is horizontally arranged and consists of a hydraulic actuated cylinder 300 pivotally mounted at point 301 with drive rod 302 engaging driven cam 304 at a rotatable joint 306, preferably a bearing surface of anti-friction material, to permit rotation during lengthening of the cylinder and resulting relative movement of the cam surface. The bearing surface engaging drive rod 302 at 306 provides the reaction force to oppose the driving force and reduces forces normal to the driving force to a minimum.

By positioning the drive rod at an angle A to the direction of cam movement, the driving force at joint 306 has a driving component 312 in the direction of cam movement and a smaller component 314 normal to force 312 which force 314 being opposed by reaction forces from suitable bearing surfaces.

The throw of the linear piston driving means is fixed, however the position of the drive can be varied by adjusting screw 308 supported by stationary structure 310. Screw 308 allows the position of pivot point 301 to be changed, changing the bottom position of the reciprocating member, allowing easy adjustment for varying thicknesses of web. Pivot point 302 is defined by the recess of cylinder 300 which is engaged by the rounded end of screw 308 and remains fixed during a series of sealing operations.

Drive rod 302 is always under compression to engage cam surface 304 and to ensure that the cylinder continues to engage adjusting screw 308 at a pivot point 301. The forces tending to urge the surface of cam 304 against piston rod 302 are the upward spring force supplied by springs 34, combined with the horizontal urging force supplied by spring 62.

The adjusting screws 74 and vertically adjustable L-shaped blocks 68 allow fine vertical adjustment of an individual cam surface to allow for local distortions or otherwise to contour the heat seal bar as desired. While the throw of the sealing bar is fixed by the reciprocating cam assemblies and the drive means, typically three-eighths inch, the extremes of the throw are locally translated. The sealing bar may be shaped by these periodically spaced adjustments to match any distortions in the lower platen 12.

The upper stationary structure 72 is part of the tubular structure 51, this weldment providing sufficient rigidity for the accurate positioning and adjustment of the heat sealing bar reciprocating motion.

Referring in particular to FIGS. 3 and 5, adjacent the heat sealing bar is the reciprocating perforating blade carried on plate 100. The perforating blade assembly unlike the heat sealing bar, need not dwell at the film and therefore may be heavier than the heat sealing bar because more time (hence slower permissible speed) is available to move the blade. It reciprocates as a result of reciprocating cam action in a similar manner as the heat sealing bar; however, periodically spaced adjustment is not necessary, an error of 0.045 inch along the length of the plate not being critical.

Plate 100 is biased against cam assemblies by the action of springs 102 against levers 104 (FIGS. 3, 5, 6) which are distributed periodically along the length of the plate 100. Cam followers 106 are attached to a rigid support 108, and the cam surfaces 110 are urged against the cam followers by the action of the spring and lever. In order to prevent the longitudinal thrust forces resulting from the sloping cam surfaces from affecting the perforating plate, contact is made by a nearly frictionless, rolling or sliding contact, thereby minimizing the transfer of horizontally directed forces against the perforating plate and eliminating the need for end bearings on the plate. The preferred method (FIG. 8) consists of rollers 114 attached to plate 100, these rollers having a very low coefficient of friction with the cam. Thus, the longitudinal thrust load is absorbed by the rigid support 108, and the horizontal component of force on plate 100 as a result of contact with rollers 114 is insignificant.

It is therefore not necessary to oppose longitudinal forces on the heavier perforating plate in the manner in which bearing surfaces 58 opposed longitudinal forces acting on the reciprocating heat sealing assembly.

In the preferred embodiment, the cam surface driven by driving means 350 (FIG. 6) is designated the master cam 110′ and is different in construction than the other reciprocating cams surfaces, the slave cams 110. The master and slave cams are connected together and substantially aligned in one direction in a chain-like series by connecting rods 352 at joints 330 which allow limited rotation. As the driving means 350 forces the master cam to the right, FIG. 8, the resulting forces from drive cam followers 106 transmitted to the perforating plate 100 through roller 114, force the perforating plate downward, overcoming the spring force urging the perforating plate upward.

The driving means 350 is a hydraulic rotary actuator which advantageously has controlled acceleration. The actuator has directional valves which provide self-cushioning; the cushioning occurs at the two dead center positions, which are 180° apart and correspond to the extremes of travel of the perforating plate, and results from a small amount of hydraulic fluid, preferably oil, which remains in the actuator chamber unable to instantly escape from the chamber at the extreme of plate travel, thereby cushioning the extremes of travel of the drive means. It is the cushioning action which makes the rotary actuator not preferred for the reciprocating heat sealing bar because the forces at the extremes are difficult to control.

The range of travel of the perforating plate is established by the point 352 (FIG. 6) at which the drive rod 354, which engages the master cam at bearing surfaces 356, engages the oscillatory rotating drive wheel 358. The rotation-allowing joint at point 352 is preferably a self-aligning spherical roller bearing which allows rotation as the drive wheel circularly oscillates driving the master cam in linear reciprocation. The drive wheel, shown in FIGS. 6 and 8 near, but below the right dead center position, where the perforating plate is in the downward vertical position rotates downward, through has rotated less than 180°, from below the left dead center position. The direction of rotation then reverses. Because of the cushioning effect, the exact point of reversal is not precisely controllable; however, since this occurs at that portion of the circular cycle which has an almost insignificant component in the direction of cam reciprocation, the effect is negligible.

The bottom position of the perforating plate can be adjusted by pivoting the rotary actuator supporting structure 360 about supporting pivot point 362. Thumbscrew adjustment 364 threaded through rigid support 108 engages the supporting structure 360 at recess 361 through compression line 365. Thumbscrew

364 engages compression link 365 at recess 366. Compression link 365 allows for horizontal movement of supporting structure 360 as it pivots about pivot point 362 thereby adjusting the bottoming position of the perforating plate. Adjusting screw 364 is arranged with a shear pin to provide overload protection against the perforating plate bottoming out. If the perforating plate should bottom out, thereby able to cause destructive forces to be generated by the drive means 350, the shear pin will release, allowing supporting structure 360 to pivot clockwise about pivot point 362 relieving and reducing the built-up forces from the rotary actuator drive.

As with the reciprocating cam surfaces for the heat sealing structure, drive rod 354 engages the master cam at substantially the same height as the connecting rods 352; and therefore to avoid interference with those rods, the drive means is placed at an angle B to the plane of plate reciprocation. The center of rotation 363 of the driver wheel is positioned at all times so that the driving force on the master cam always has an upward vertical component urging the master cam against the guides, cam followers 106.

Also similar to the cam-drive assembly for the reciprocating heat sealing assembly, a force normal to the plane of the perforating plate is generated because of the required angle B between the direction of drive and the direction of the cam reciprocation. This force is opposed by supported sliding bearing surfaces, preferably anti-friction sliding bearing pads.

The master cam and slave cams are preferably placed approximately every twenty inches along the perforating plate. The connecting rods are always in tension, tension being supplied by the pulling master cam as the perforating plate moves downward and are held in tension by the upward urging tendency of the perforating plate against the slave cams as the plate moves upward.

Each slave cam 110 moves to the right and downward, as the master cam 110′ moves to the right and downward in response to the drive force, and following the action of the cam surface 370 against fixed guide cam follower 106. As the perforating plate reverses its direction the upward urging of the plate causes the slave cams to move upward and to the left in conjunction with the action of the master cam, the connecting rods always being kept in tension. Uppper guide surface 374 ensures the path which the slave cams traverse.

The perforating blade 120 is mounted in the bottom of the perforating plate 100. Referring to FIG. 5, a notch 122 is machined in the plate 100, in which the blade is positioned. A resilient holding strip 124 is then placed in the notch to cover and hold the blade, and strippers 126 are held in place while the gib, securing the whole assembly, is fastened to the plate with fastener 129. The strippers and web grippers 126 are slotted so that they may reciprocate vertically and are spring loaded 130 (FIG. 8) so that in moving vertically upward the spring force must be overcome. Therefore, as the plate 100 lowers, the strippers first contact the web. The plate continues to lower as the strippers remain stationary and the blade emerges from between the strippers to perforate the web. The motion of the plate is then reversed and as the plate moves upwards, the blade retreats between the strippers and any web still attached to the blade is stripped from the blade by strippers 126.

The web is advantageously driven periodically past the machine by a shuttle arrangement such as is shown in applicant's prior U.S. Pats., No. 3,322,604, 3,361,614 and 3,526,563, to which reference is made.

Referring to FIG. 9 improvements are introduced to the machine shown enabling relaxation or supplementary indexing of the web.

The forming head 500 corresponds to the heat seal and perforator machine discussed so far. The shuttle 510 driven by cylinder 512 takes up and pays out the web and the single direction clutch 514, with its outer race normally stationary and its inner race engaged with timing belt 520, all as explained in U.S. Pat. No. 3,526,563.

According to the present invention instead of permanently mounting the outer race of the single direction clutch, it is mounted to rotate, and a periodically operating drive, here cylinder 540 is adapted to be actuated immediately after the heat seal bar raises. The result of this movement is that the plastic film moves slightly, proportional to the rotation of the outer race, and is thus removed from the hot jaws of the heat seal bar where it is cooled. Upon reversal of the movement of the shuttle the cylinder may be returned to its original position, thus assuring registry.

In FIG. 10 an alternate device is shown consisting of a chain drive which can selectively drive the outer race. A longer range of travel can be obtained, thus to achieve a supplementary indexing effect. For instance the plastic heat seal can be advanced to a pair of cooling jaws.

Referring to FIG. 8 there is also provided a drive 560 for one pair of nip rolls the second pair being driven through a differential 570. A third input shaft 572 to the differential selectively driven by the motor 574 provides a different speed. This motor can respond to tension sensor 576 to adjust rate of speed for slippage. By momentarily driving the shaft 572 at a different speed it is possible to slacken the film between the nip rolls, and reversal can remove the slack.

Another means of introducing slack is to translate a pair of nip rolls (or the idler as noted in dotted lines) slightly on a periodic basis as desired.

What is claimed is:

1. In a machine suitable for forming articles from plastic film including an elongated forming surface adapted to be heated to a temperature sufficient to weld plastic film and means to move the forming surface in a predetermined path transverse to its length to an operative position against the film, and back therefrom to an inoperative position to allow advance of the plastic film, the improvement wherein said elongated forming surface is defined by an elongated element flexible in the direction of said path, lacking self-support sufficient to maintain the proper geometry of said forming surface throughout its length, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element, positioned at the middle as well as the ends thereof, each driver comprising a cam and roller follower combination, one of said combination comprising a drive-force-receiving portion associated with said movable element and the other comprising a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon move-

ment of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said geometry of said forming surface during its movement, and individual adjustment devices associated with individual drivers, each adjustment device adapted to permit adjustment of the position of the corresponding portion of said elongated element in the direction of travel relative to other portions of said elongated element.

2. The machine of claim **1** wherein the drive-force-applying portion of said cam and roller-follower drivers are pivotally linked together in an elongated linkage extending parallel to said elongated forming surface, each said portion being free to be displaced relative to the others by the respective adjustment device, and a reciprocating drive moving said linkage axially to drive and allow return of said forming surface.

3. The machine of claim **1** wherein said elongated element comprises a heat seal bar, a series of support columns spaced apart along the length of said bar are joined thereto through sheet-form flexures flexible only in the direction of the length of said bar, each column carrying thereon said drive-force-receiving portion of a respective cam and roller-follower combination.

4. In a machine for perforating plastic film in which an elongated plastic perforator element having a desired geometry along its length periodically moves in a predetermined path transverse to said length, the element adapted to move against a web to act thereupon and away to allow web advance, said element associated with strippers movable relative thereto during perforating and withdrawal motions, the improvement wherein said elongated element is comprised of a series of segments joined together, end to end and is flexible lacking self-support sufficient to maintain said desired geometry, stationary structure extending along the length of said movable perforator element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element positioned at the middle as well as at the ends thereof, each driver comprising a cam and roller follower combination, one of said combination comprising a drive-force-receiving portion associated with said movable element and the other comprising a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said desired geometry of said elongated element during its movement.

5. In a machine suitable for forming articles from plastic film including an elongated forming surface adapted to be heated to a temperature sufficient to weld plastic film and means to move the forming surface in a predetermined path transverse to its length to an operative position against the film, and back therefrom to an inoperative position to allow advance of the plastic film, the improvement wherein said elongated forming surface is defined by an elongated element flexible in the direction of said path, lacking self-support sufficient to maintain the proper geometry of said forming surface throughout its length, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element, positioned at the middle as well as the ends thereof, each driver comprising a drive-force-receiving portion associated with said movable element and a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said geometry of said forming surface during its movement, and wherein said element comprises a heat seal bar and curtain means associated with said bar, adapted to interpose a protective curtain between said heat seal bar and said plastic, both said heat seal bar and said curtain means being flexible in the direction of said path and individual adjustment devices associated with individual drivers, each adjustment device adapted to permit adjustment of the position of the corresponding portion of said heat seal bar and curtain to the other portions of said heat seal bar and curtain.

6. The machine of claim **5** wherein the drive-force-applying portions of said drivers are pivotally linked together in an elongated linkage extending parallel to said elongated forming surface, each said portion being free to be displaced relative to the others by the respective adjustment device, and a reciprocating drive moving said linkage axially to drive and allow return of said forming surface.

7. The machine of claim **5** wherein a series of support columns spaced apart along the length of said elongated heat sealing bar and associated curtain means are joined thereto through flexures flexible only in the direction of the length of said heat seal bar, each column associated with a respective driver for transmitting drive and positioning forces to said heat seal bar and curtain means.

8. In a machine in which an elongated element having a desired geometry along its length periodically moves in a predetermined path transverse to said length, the element adapted to move against a web to act thereupon and away to allow web advance; the improvement wherein said elongated element is flexible in the direction of said path lacking self-support sufficient to maintain said desired geometry, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element positioned at the middle as well as at the ends thereof, each driver comprising a drive-force-receiving portion associated with said movable element and a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said desired geometry of said elongated element during its movement,

said machine adapted to operate across the width of an elongated traveling web, said stationary structure comprising an elongated beam structure, stationary during operation, supported on end columns and extending across the width of said web, and said

machine including the combination of at least two elongated elements of the character above described, one of said elements comprising a heat seal bar and the other comprising a perforator blade, each element having associated therewith an independent drive means, each of said elements positioned by its drivers relative to said elongated beam structure.

9. In a machine in which an elongated element having a desired geometry along its length periodically moves in a predetermined path transverse to said length, the element adapted to move against a web to act thereupon and away to allow web advance, the improvement wherein said elongated element is flexi ble in the direction of said path lacking self-support sufficient to maintain said desired geometry, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element positioned at the middle as well as at the ends thereof, each driver comprising a drive-force-receiving portion associated with said movable element and a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said desired geometry of said elongated element during its movement, and

wherein said drivers comprise cam assemblies one of said portions of each assembly comprising a cam follower and the other of said portions comprising a cam surface engaged with said follower, and

said cam assemblies are mutually driven by a linkage reciprocating in the direction parallel to the elongated element,

the machine including resilient biasing means for resiliently urging said cam followers and cam surfaces together, said biasing means applying a torque tending to rotate said elongated element about its longitudinal axis, and said stationary structure includes bearing surfaces opposing said tendency to rotate, thereby cooperating to position said element,

said biasing means comprising a series of springs, one end of each mounted to said stationary structure and the other end of each being positioned to apply a portion of said torque, there being

a series of slidable supports spaced apart along the length of and movable with said movable element, each extending from said element to a said driver, each support including a torque arm extending sideways and each said spring engaging a said torque arm.

10. The machine of claim **9** wherein said element includes a heat sealing bar.

11. The machine of claim **10** wherein said element includes two spaced apart bobbins, and a curtain of heat resistant, non-adherent material extends between said bobbins under said heat sealing bar.

12. A plastic film-working machine having a pair of elongated plastic-working elements disposed side by side in proximity, each of said elements having a desired geometry along its length and movable in a predetermined path transverse to said length, each element adapted to move against a web to act thereupon and away to allow web advance, each said elongated element is flexible in the direction of said path lacking self-support sufficient to maintain said desired geometry, stationary structure extending along the length of each said movable element and constructed and arranged to allow said motion, each of said elements having a multiplicity of drivers spaced apart along the length of the said movable element positioned at the middle as well as at the ends thereof, each driver comprising a cam and roller-follower combination having a drive-force-receiving portion assocated with the said movable element and a cooperating drive-force-applying portion positioned by stationary structure and movable realtive thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and each of said element having a separate drive means for driving all of said force-applying portions of the respective set of drivers in synchronism to cause bodily movement of the respective element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said desired geometry of the respective elongated element during it movement.

13. In a machine for forming bags from plastic film including an elongated forming surface adapted to be heated to a temperature sufficient to weld superposed plastic films together and means to move the forming surface in a predetermined path transverse to its length to an operative position against the film, and back therefrom to an inoperative position to allow advance of the plastic film, the improvement wherein said elongated forming surface is defined by an elongated element flexible in the direction of said path, lacking self-support sufficient to maintain the proper geometry of said forming surface throughout its length, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element, positioned at the middle as well as the ends thereof, each driver comprising a drive-force-receiving portion associated with said movable element and a cooperating drive-force-applying portion positioned by stationary structure and movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said geometry of said forming surfaces druing its movement,

said drivers comprising cam assemblies, one of said portions of each assembly comprising a cam follower and the other of said portions comprising a cam surface engaged with said follower, said cam assemblies are mutually driven by a linkage reciprocating in the direction parallel to the elongated element, said linkage including movable portions of said cam assemblies is biased to one position and a push rod and actuator assembly is mounted alongside said linkage at an acute angle thereto, said push rod engaged with said linkage and adapted upon activation of said actuator to push said linkage in the direction overcoming said biasing means,

said actuator being a fluid drive cylinder pivotally mounted at a pivot point fixed during operation, said rod engaging the linkage to permit rotation during lenghtening of the cylinder with the attendant change in angle between the push rod and the line of action of said linkage.

14. The machine of claim **13** wherein said pivot point is formed by an adjustable member engaging said cylinder, thereby to change the position of said pivot point and alter the bottom position of the movable element.

15. In a machine for forming bags from plastic film including an elongated forming surface adapted to be heated to a temperature sufficient to weld superposed palstic films together and means to move the forming surface in a predetermined path transverse to its length to an operative position against the film, and back therefrom to an inoperative position to allow advance of the plastic film, the improvement wherein said elongated forming surface is defined by an elongated element flexible in the direction of said path, lacking self-support sufficient to maintain the proper geometry of said forming surface throughout its length, stationary structure extending along the length of said movable element and constructed and arranged to allow said motion, a multiplicity of drivers spaced apart along the length of said movable element, positioned at the middle as well as the ends thereof, each driver comprising a drive-force-receiving portion associated with said movable element and a cooperating drive-force applying portion positioned by stationary structure nd movable relative thereto, each said driver adapted, upon movement of its force-applying portion, to position and drive the respective portion of said movable element in said predetermined path, and a drive means for driving all of said force-applying portions of said drivers in synchronism to cause bodily movement of said element, said force-applying portions and said stationary structure adapted to transmit positioning forces through said drivers sufficient to maintain said geometry of said forming surface druing its movement,

said drivers comprising cam assemblies, one of said portions of each assembly comprising a cam follower and the other of said portions comprising a cam surface engaged with said follower, said cam assemblies are mutually driven by a linkage follower, said cam assemblies are mutually driven by a linkage reciprocating in the direction parallel to the elongated element, said linkage including movable portions of said cam assemblies is biased to one position and a push rod and actuator assembly is mounted alongside said linkage at an acute angle thereto, said push rod engaged with said linkage and adapted upon activation of said actuator to push said linkage in the direction overcoming said biasing means,

said actuator being a fluid rotary actuator, said actuator mounted on supprting structure and said rod engaging said linkage and the rotary actuator through rotary joints to permit an attendant change in angle relative thereto during rotation of said actuator and reciprocation of said linkage.

16. The machine of claim **15** wherein said supporting structure is pivotally mounted to permit a change in the bottoming position of said element and said position is adjustable by rotating said structure in the direction of cam reciprocation by means of a supported adjustment member.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,775,225 Dated November 27, 1973

Inventor(s) Charles M. Schott, Jr.

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

Col. 2, line 32, "10" (second occurrence) should be --20--;

Col. 3, line 19, "as" (first occurrence) should be --so--;

Col. 6, line 45, "352" should be --351--;

Col. 6, line 48, "352" should be --351--;

Col. 6, lines 54 and 55, "through has rotated" should be --has rotated through--;

Col. 6, line 67, "line" should be --link--;

Col. 8, line 26, "Fig. 10" should be --Fig. 11--;

Col.11, line 43, after "drive", insert --means for driving all of said force-applying portions of said drivers--;

Col. 12, line 32, "relative" is misspelled;

Col. 12, line 35, delete "of";

Col. 13, line 6, "during" is misspelled;

Col. 13, line 24, "lengthening" is misspelled;
Col. 13, line 34, "plastic" is misspelled;
Col. 14, line 6, "nd" should be --and--;

Col. 14, line 16, "during" is misspelled;

Col. 14, lines 21-23, delete "follower, said cam assemblies are mutually driven by a linkage";
Col.14, line 33, "supporting" is misspelled.

Signed and sealed this 23rd day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents