METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER

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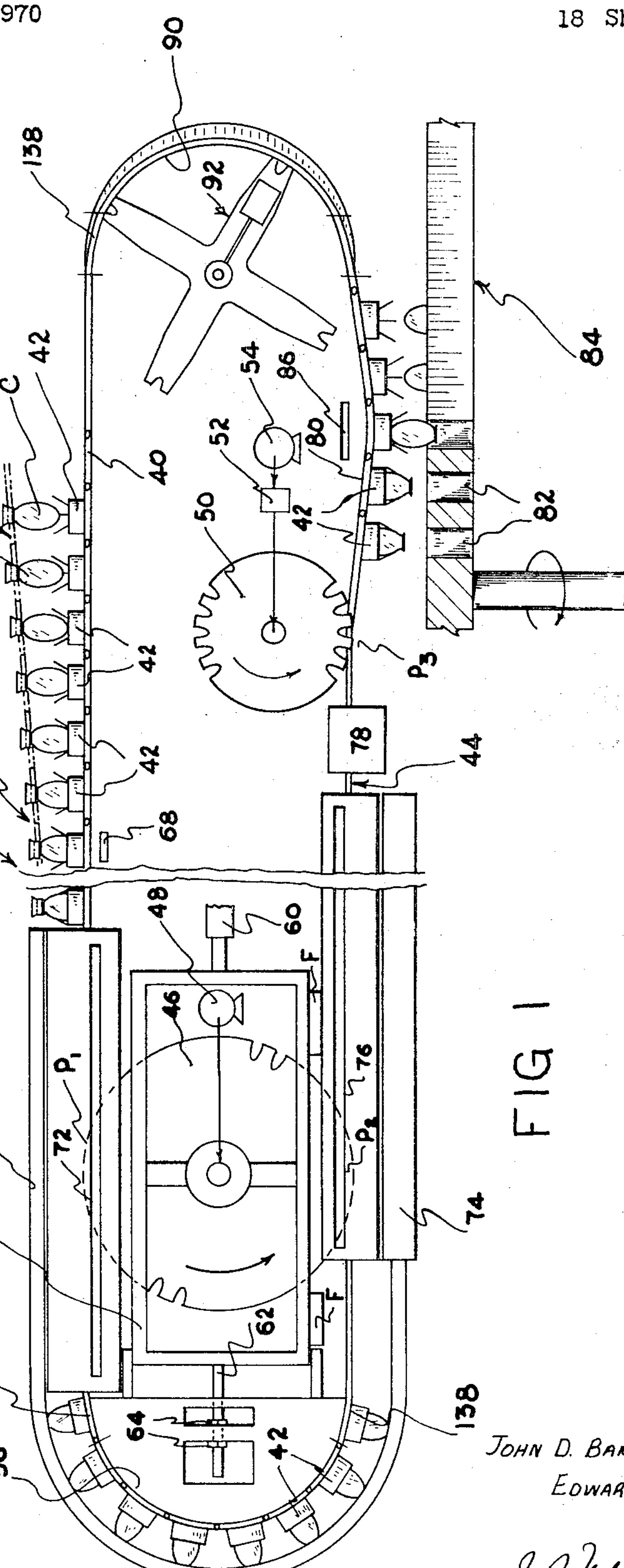


FIG I

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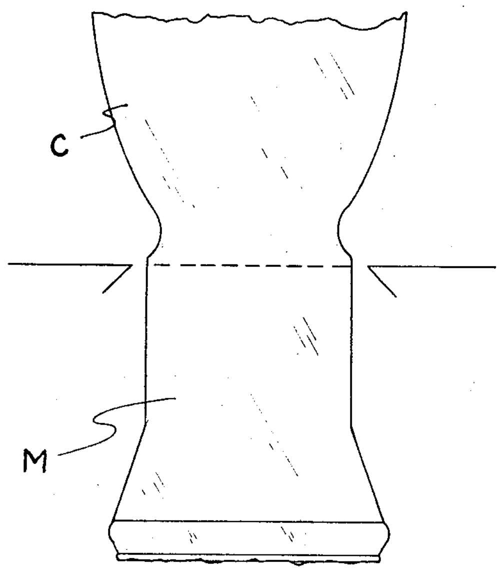


FIG 2

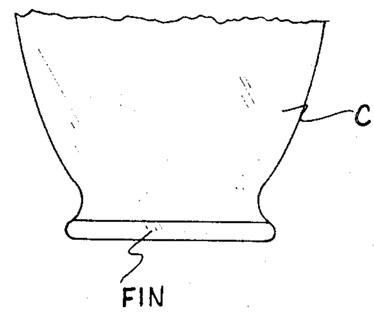


FIG 3

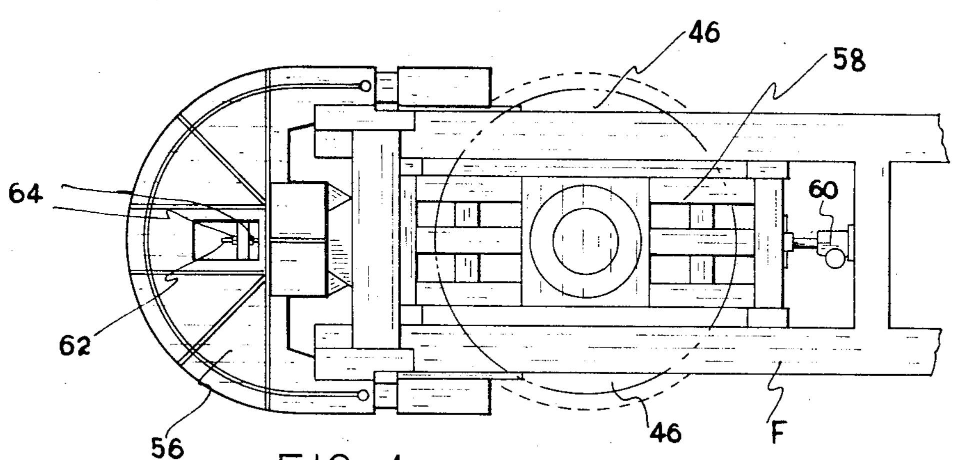


FIG 4

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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER

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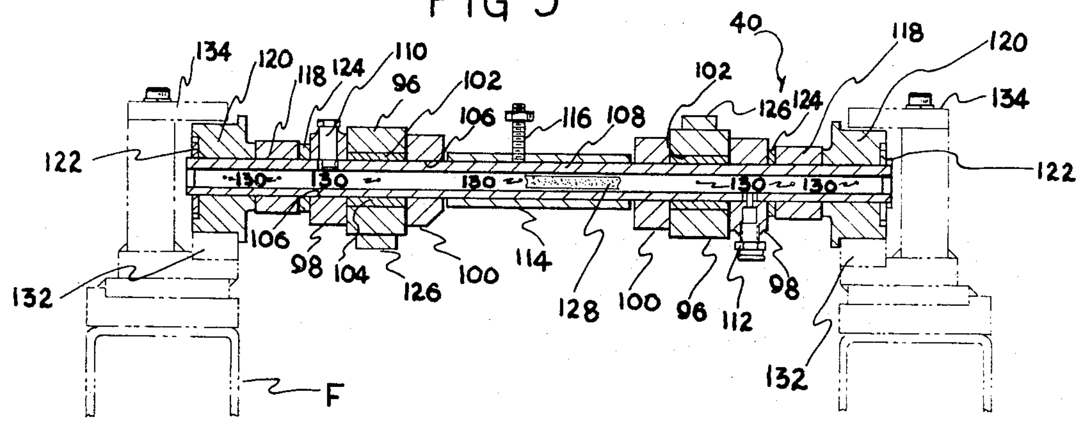
FIG 5



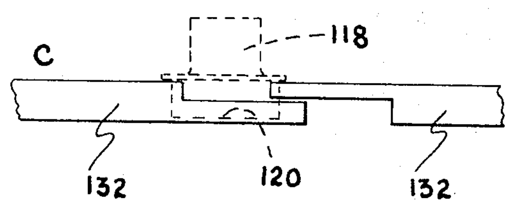




FIG 7

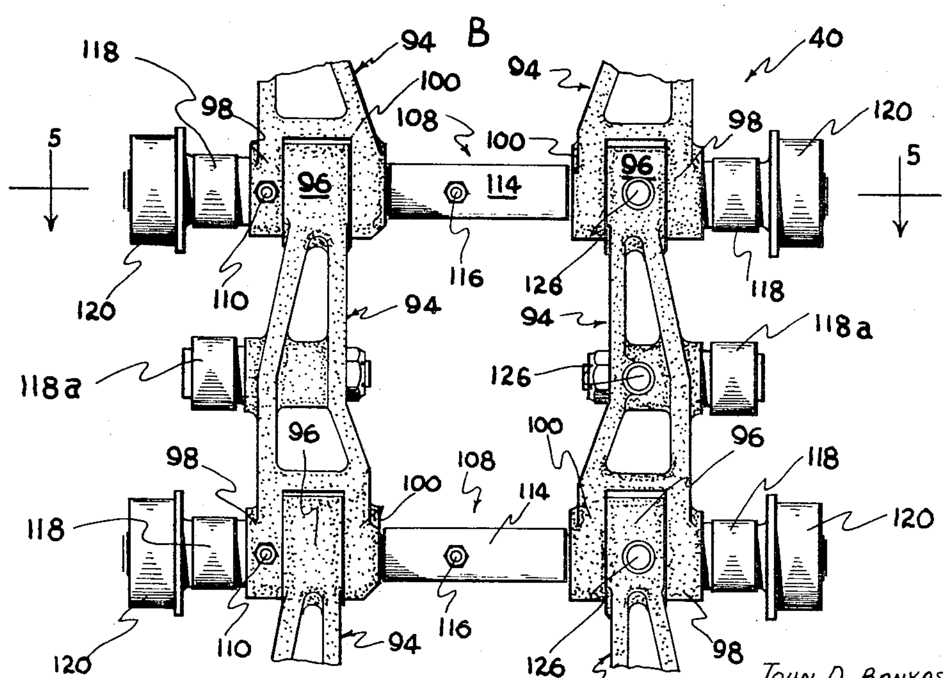



FIG 6

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April 10, 1973 J. D. BANYAS ET AL 3,726,659

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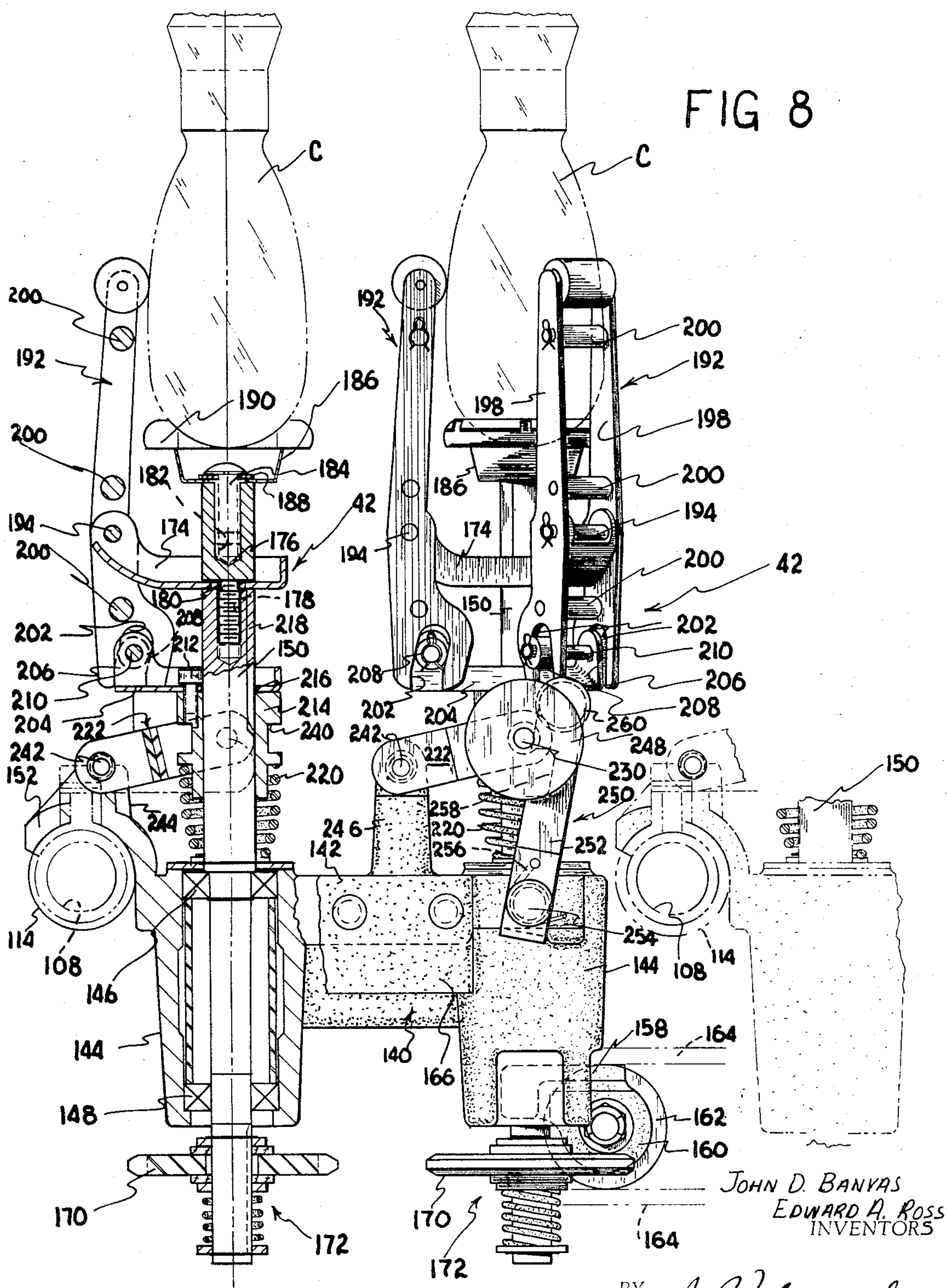
FIG 8



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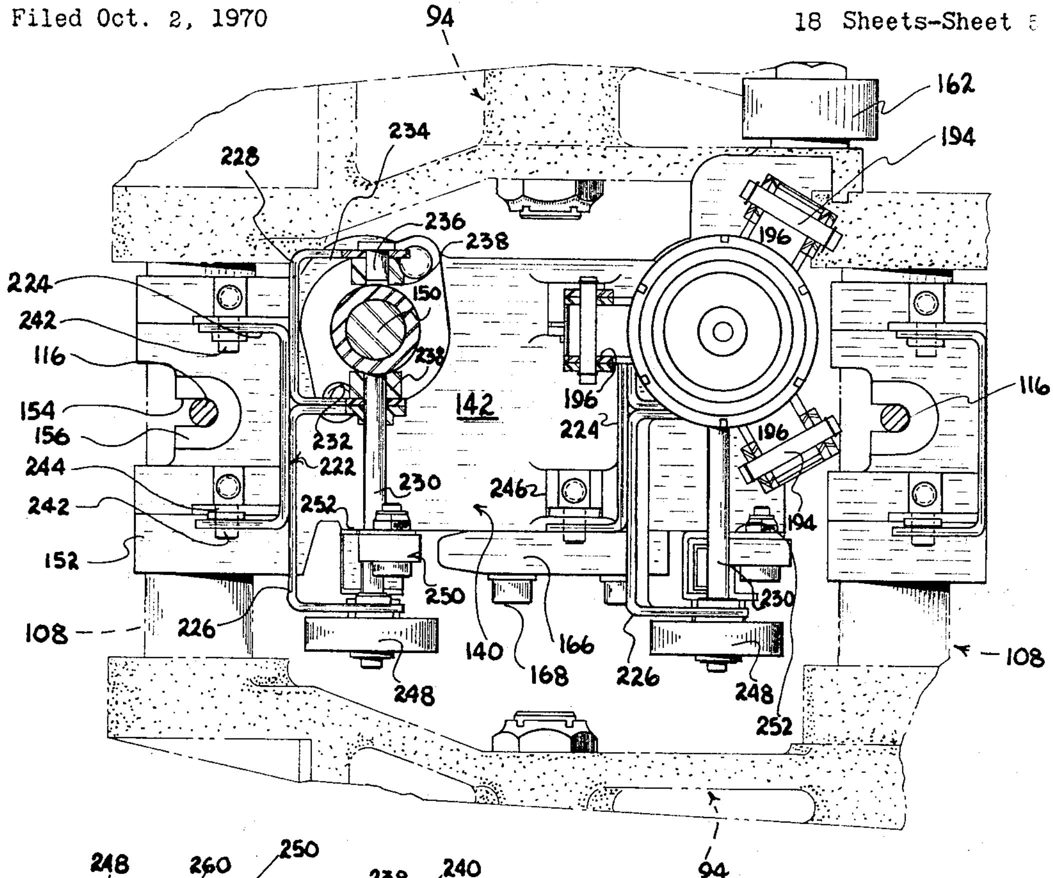


FIG 9

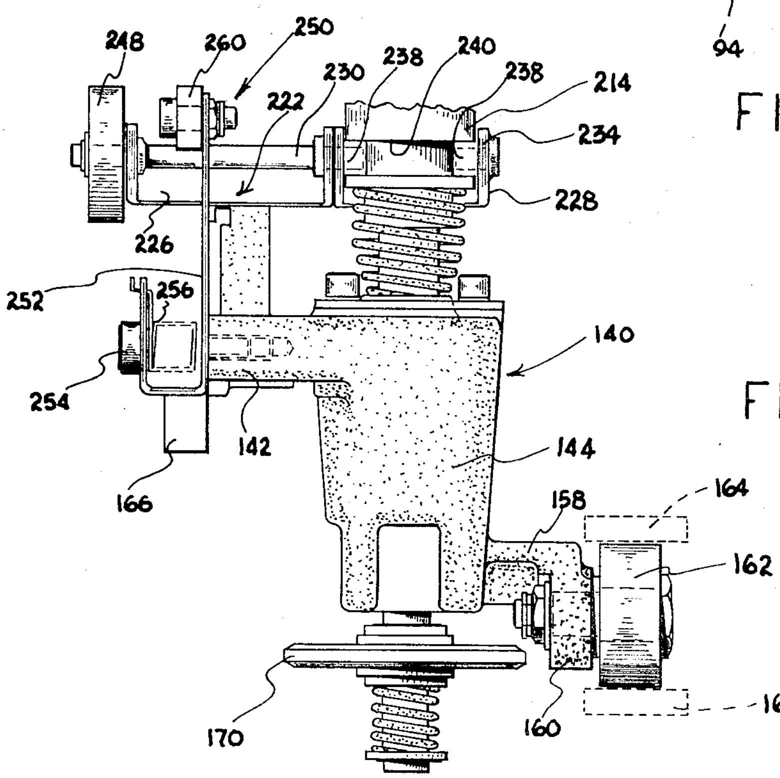


FIG 10

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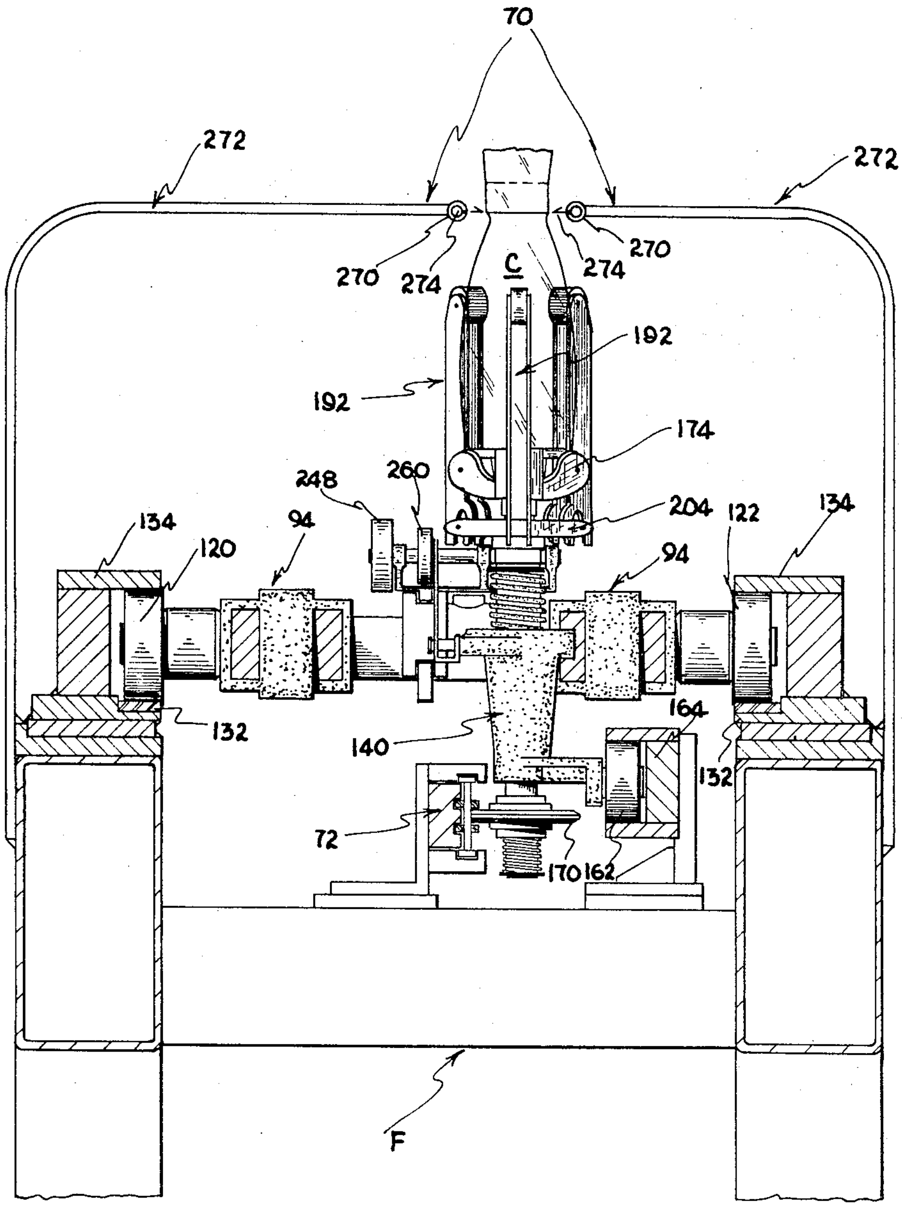


FIG 11

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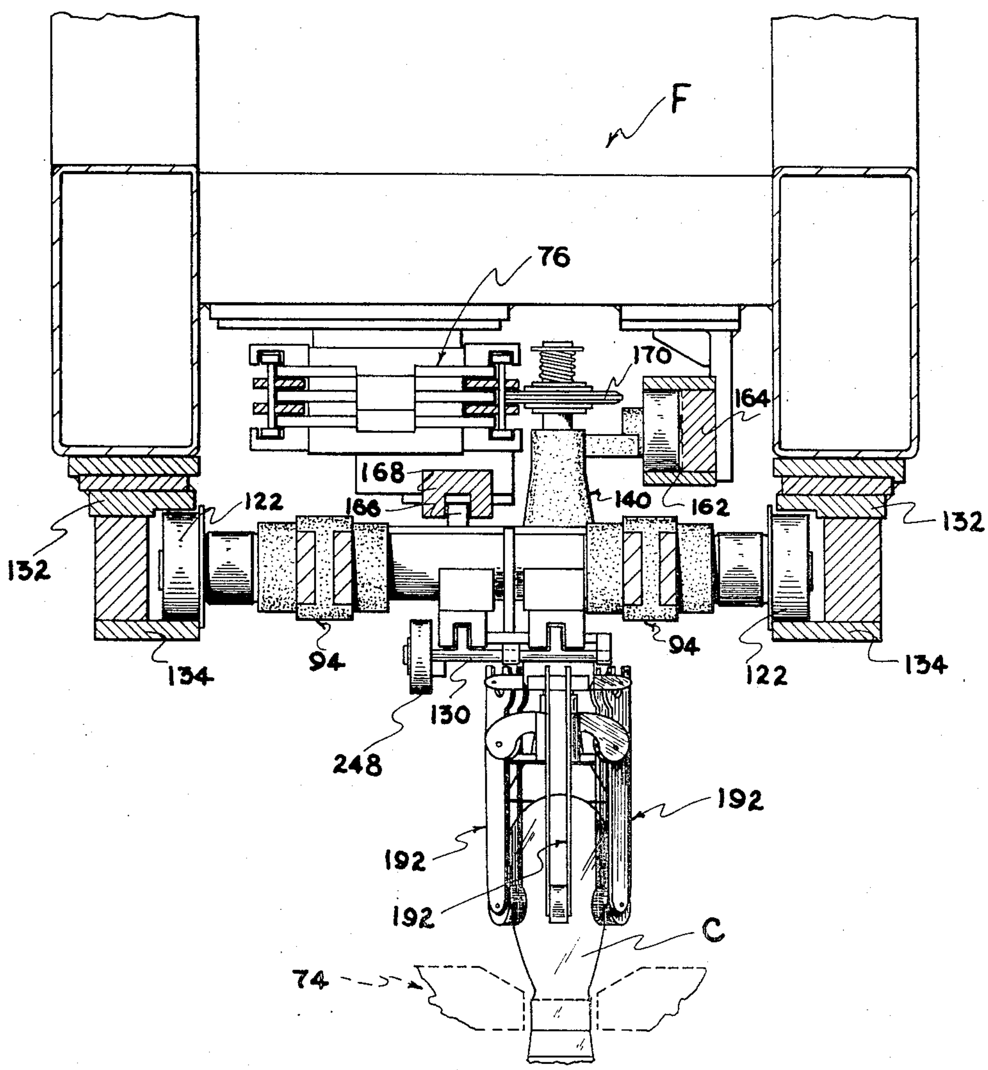


FIG 12

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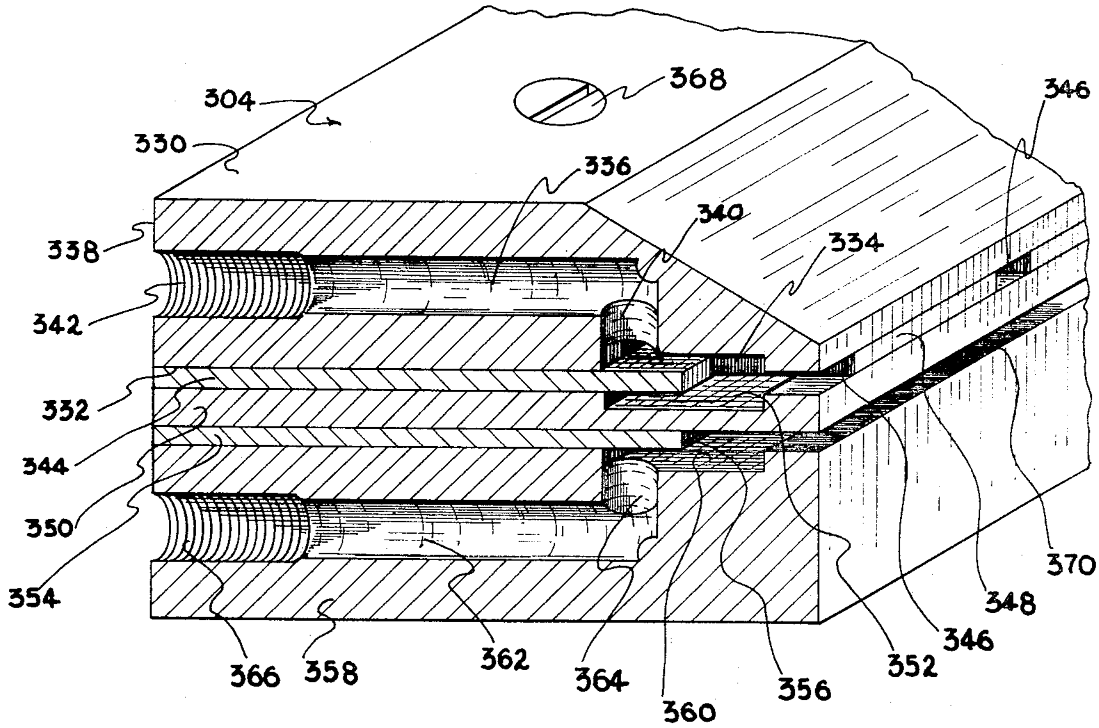


FIG 13

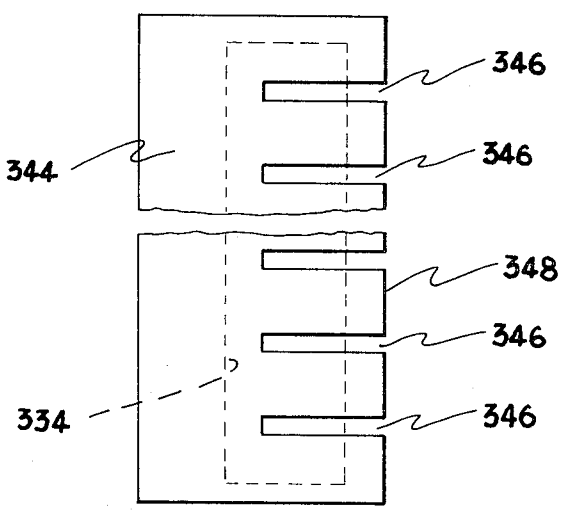


FIG 14

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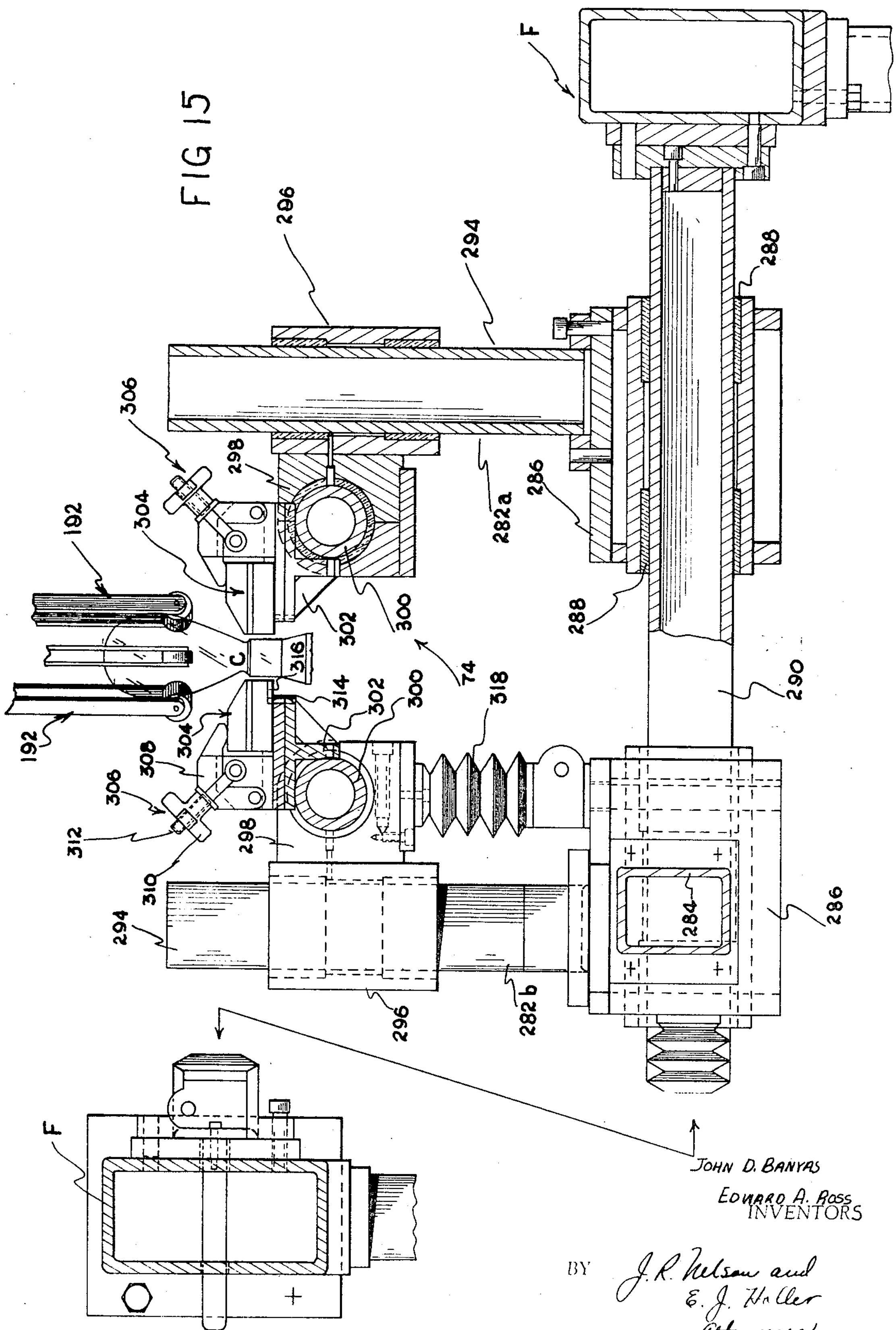


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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER



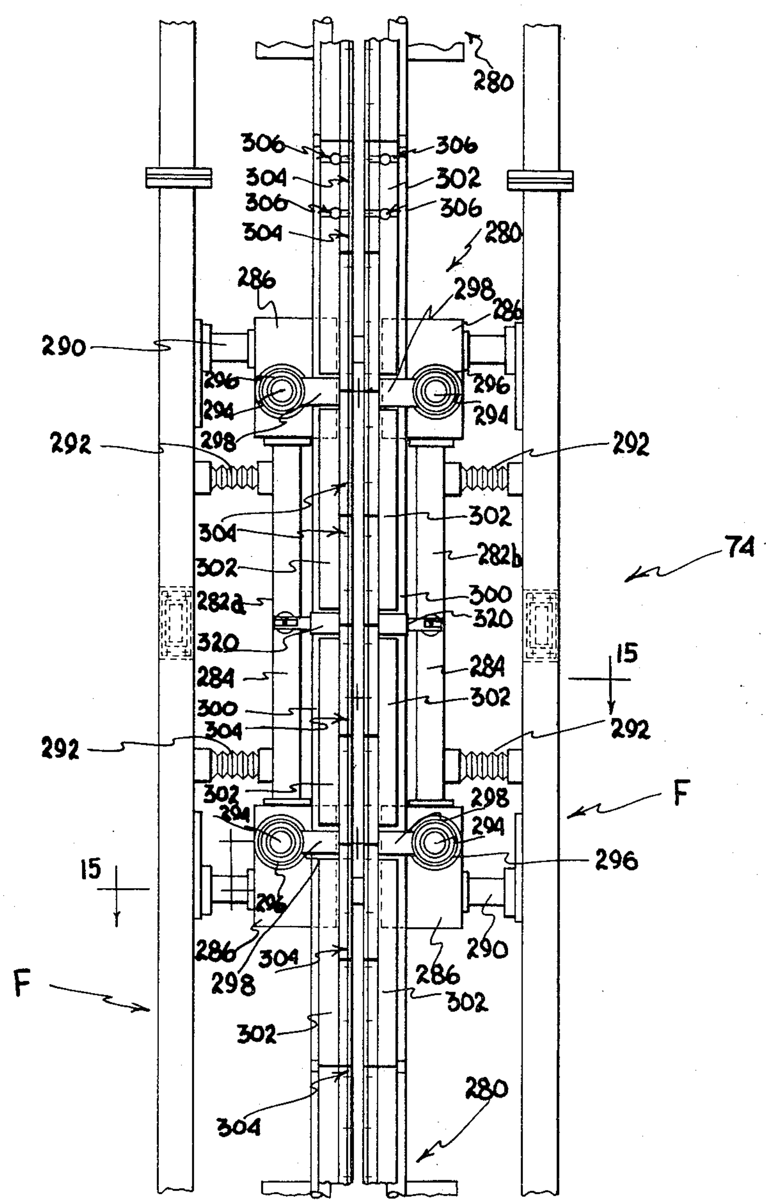


FIG 16

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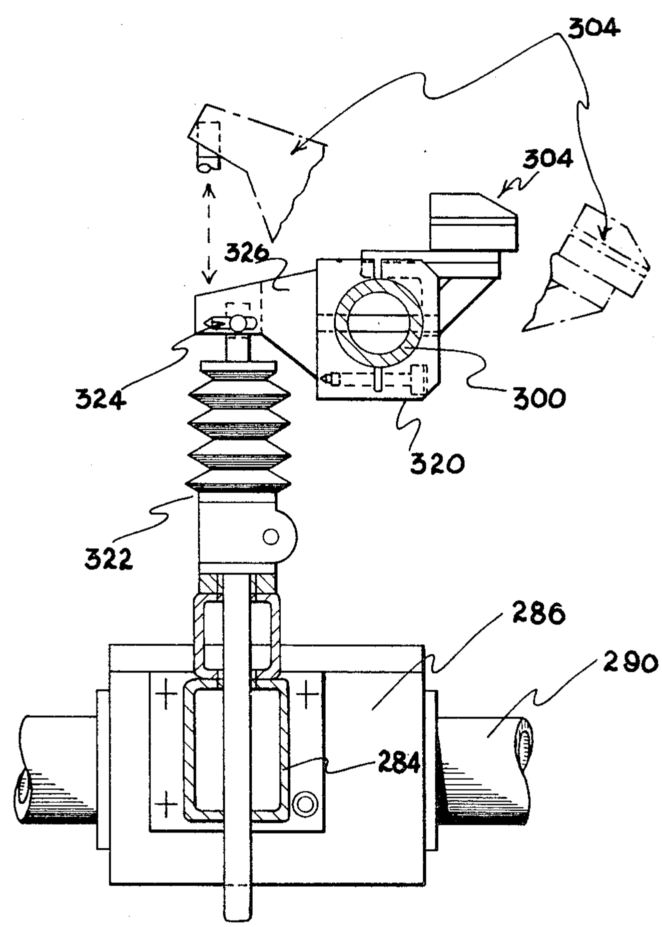


FIG 17

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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER

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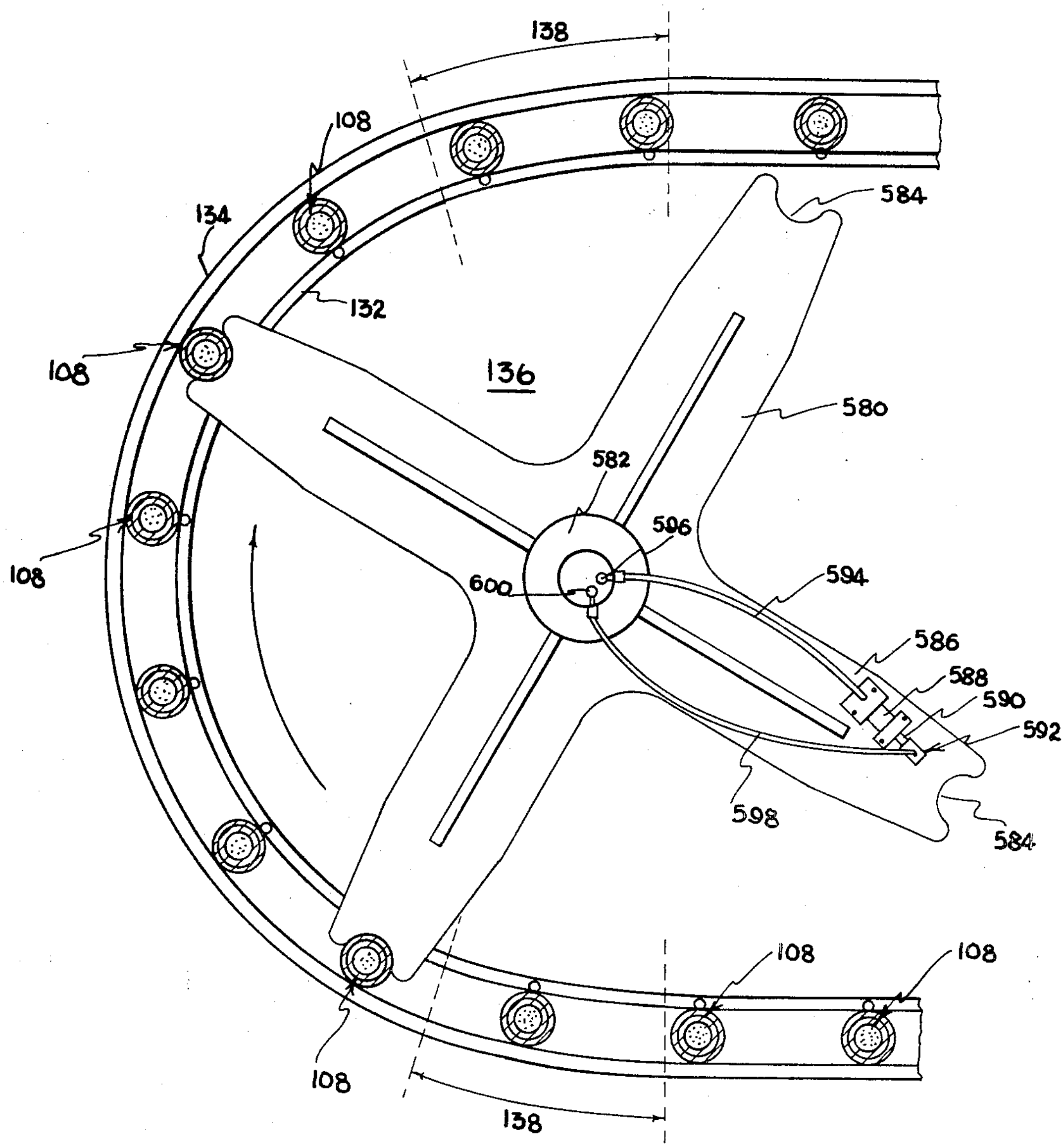


FIG 18

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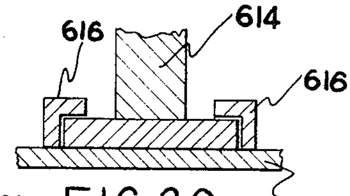


FIG 20

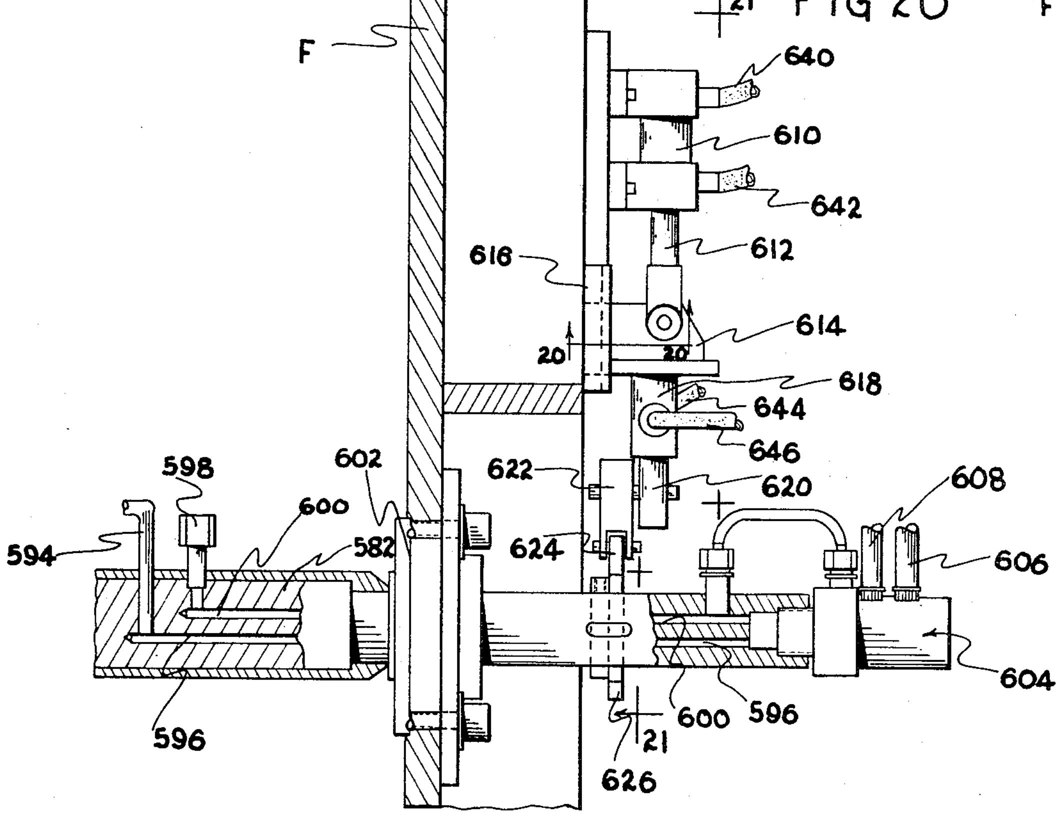


FIG 19

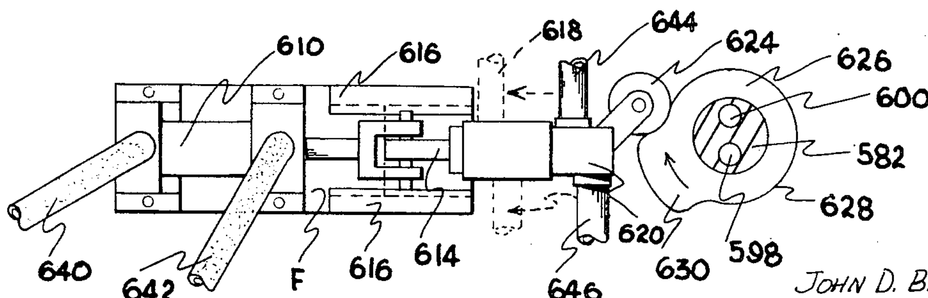


FIG 21

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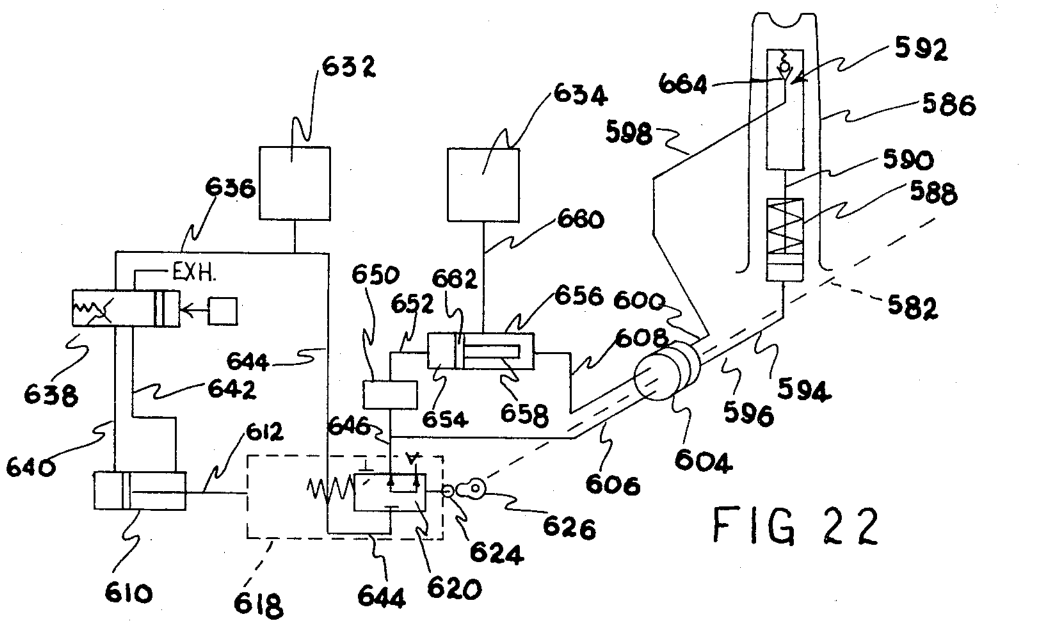


FIG 22

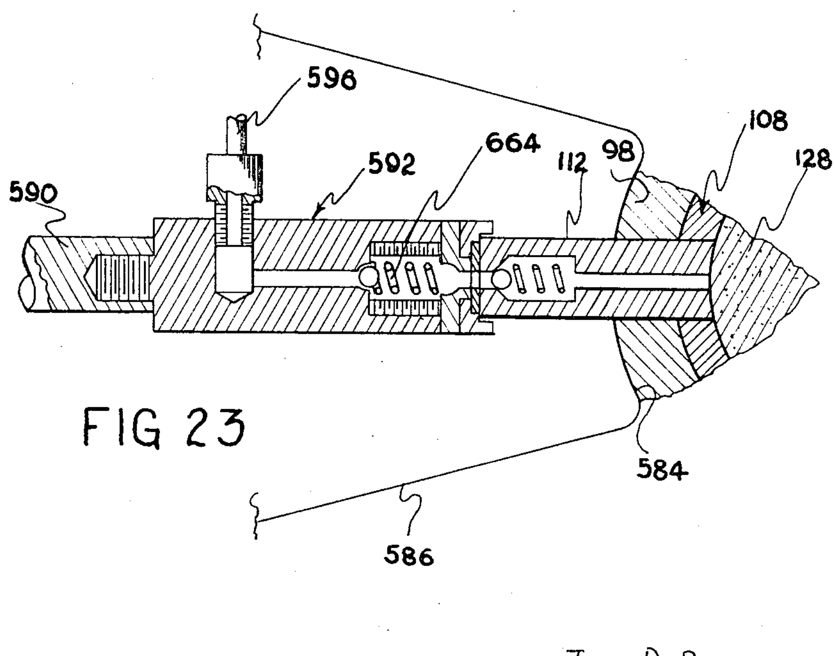


FIG 23

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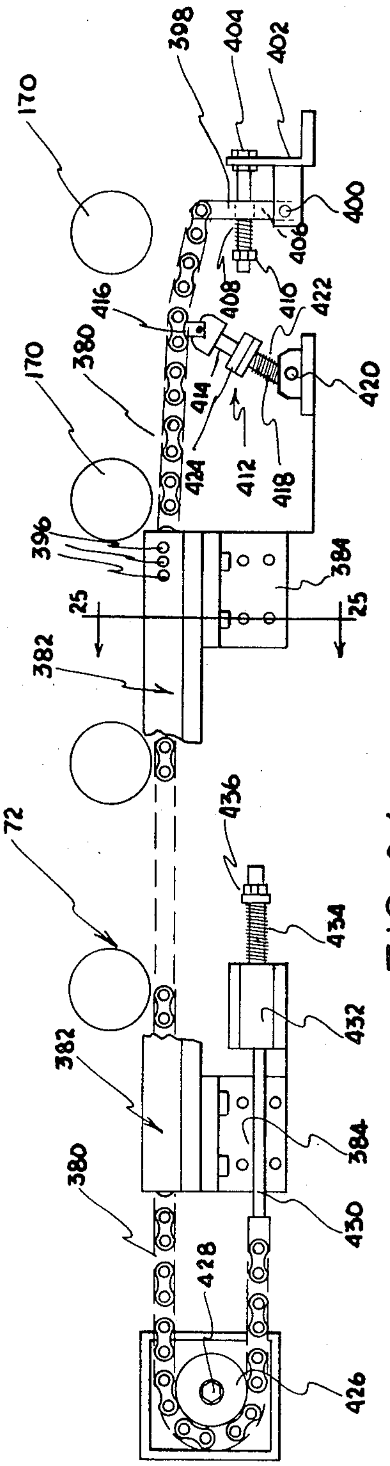


FIG 24

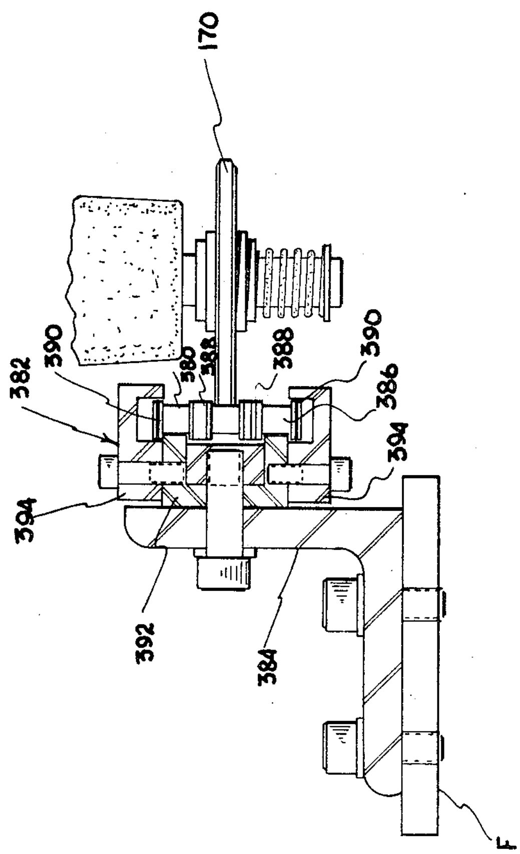


FIG 25

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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER



FIG 26

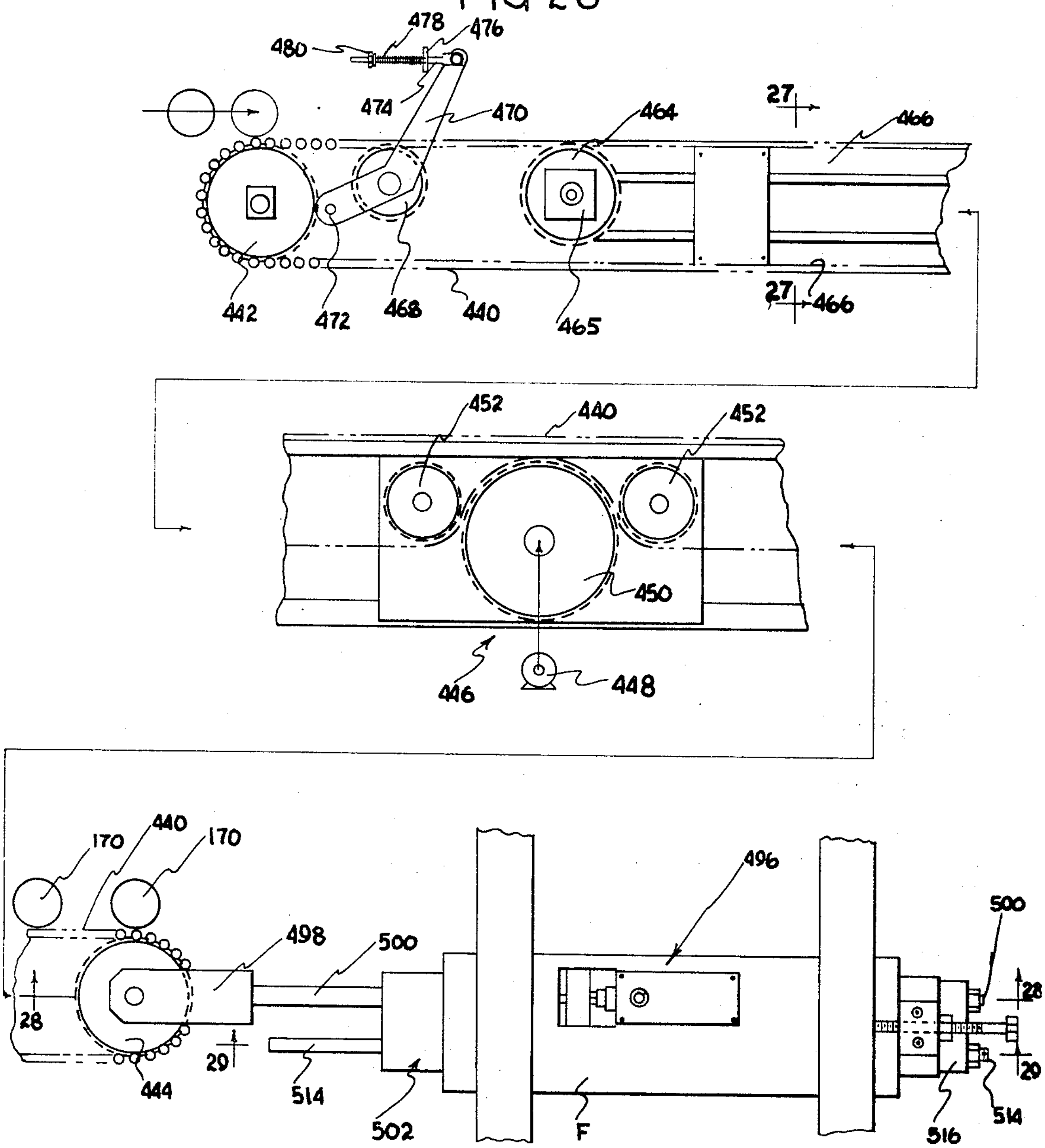
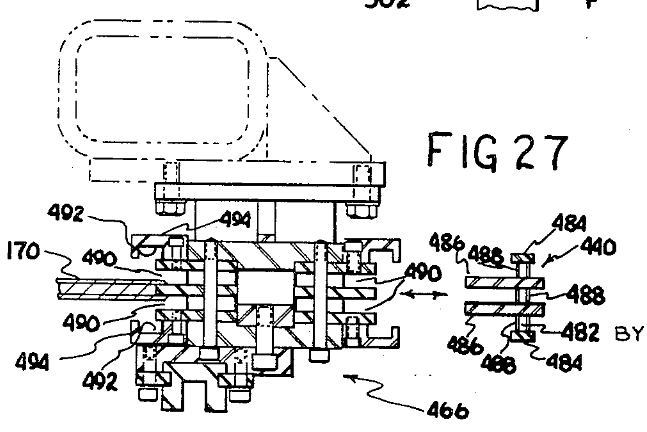



FIG 27

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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER

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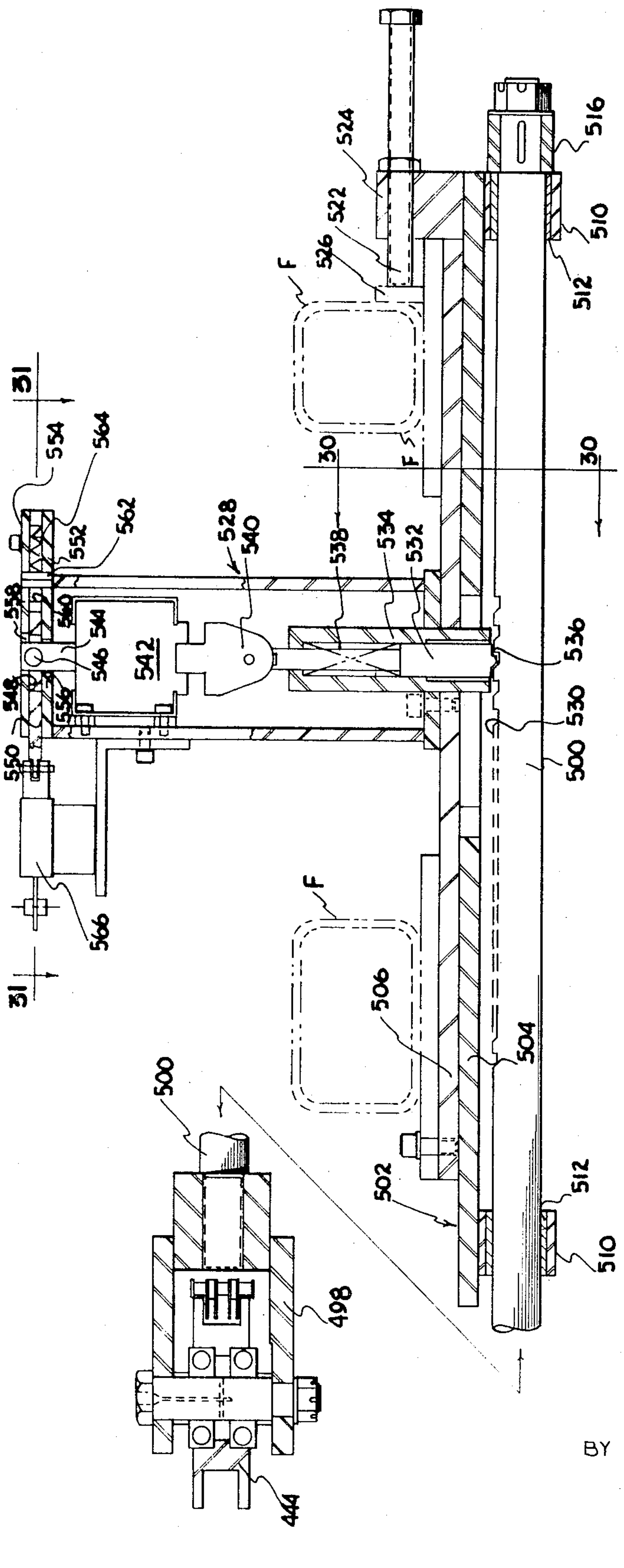


FIG 28

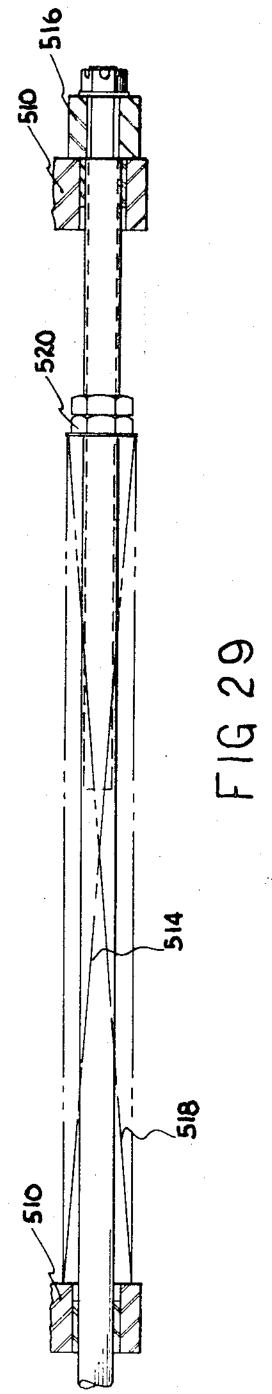


FIG 29

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METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER



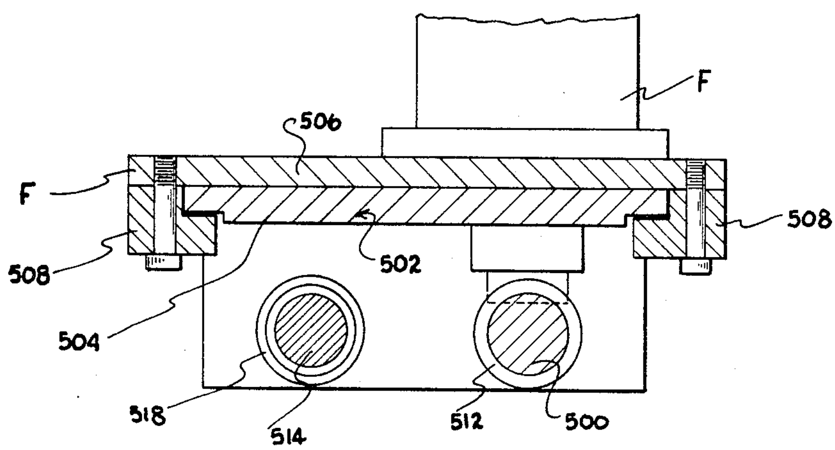


FIG 30

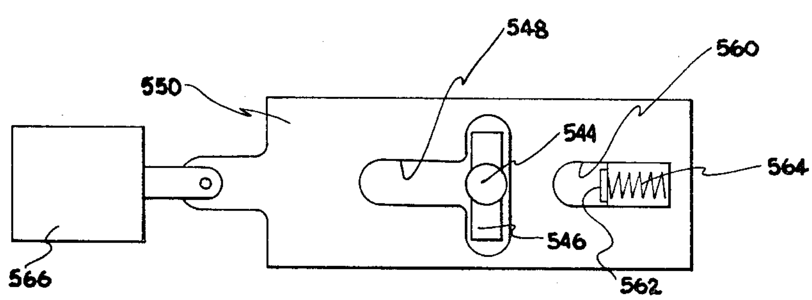


FIG 31

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United States Patent Office 3,726,659 Patented Apr. 10, 1973



3,726,659

# METHOD AND APPARATUS FOR FORMING A FINISH ON A GLASS CONTAINER

John D. Banyas and Edward A. Ross, Toledo, Ohio, assignors to Owens-Illinois, Inc.

Filed Oct. 2, 1970, Ser. No. 77,425
Int. Cl. C03b 9/12
U.S. Cl. 65—70 21 Claims


## ABSTRACT OF THE DISCLOSURE

Method and apparatus for forming a finish on a glass container on a production line. Glass containers having an integrally formed moil portion on the upper end of the container body portion are loaded in sequence in an upright position into uniformly spaced chucks on a continuously moving endless conveyor. The containers are carried through a first heating zone while being driven in rotation to achieve even thermal exposure of the containers. During transit of the first heating zone, the containers are passed around a vertical end turn to orient the containers in an inverted position, with the moil portion lowermost, as they pass along a horizontal lower run of the endless conveyor. During their transit of the lower run, the containers pass between a linear row of opposed burners which direct a high intensity row of flame jets against a narrow portion of the container body to first thermally sever the moil portion from the body and to subsequently form a beaded finish on the container. The containers are rotated during their passage through this set of burners at a controlled rate to achieve the desired finish formation. The finish is subsequently inspected and containers with malformed finishes are promptly ejected at the inspection station. Containers not ejected at the inspection station are subsequently lowered partially into the pockets of a synchronized pocket conveyor, the container chucks being opened when the container is partially inserted into the pocket to drop the container the remaining distance into the pocket.


## RELATED PATENTS AND APPLICATIONS

The machine disclosed in this application forms a portion of the overall container production line disclosed and claimed in the commonly owned copending application of Richard A. Heaton et al., Ser. No. 24,721, filed Apr. 1, 1970. Containers are loaded into the machine of the present invention by a transfer machine which forms the subject matter of another commonly owned copending application of John D. Banyas, Ser. No. 825,850, filed May 19, 1969, now Pat. No. 3,590,982. The container which is handled by the machine of the present invention forms the glass portion of the composite container disclosed and claimed in Heaton's U.S. Pat. No. 3,372,826.

## BACKGROUND OF THE INVENTION

As explained in detail in the aforementioned copending Heaton et al. application Ser. No. 24,721 the glass container of Heaton Pat. No. 3,372,826 is initially formed in a ribbon-type forming machine with a moil or waste portion formed integrally with the container body and projecting upwardly from the container body. The purpose of the integrally formed moil is to enable the freshly formed container to be handled immediately upon its removal from the forming machine, at a time when the temperature of the freshly-formed container is so high that mechanical handling elements may mar or deform those portions of the container with which they come in contact. The transfer machine of the aforementioned Banyas Pat. No. 3,590,982 is designed to take the freshly formed containers from the ribbon machine by grasping the moil



portion of the freshly formed containers, thus avoiding contact with that portion of the article which will form the ultimate finished container.

The function of the present machine and method is to receive the containers with the intergrally formed moil from the transfer machine of Banyas Pat. No. 3,590,982, to sever the moil portion and to form the container finish after the moil has been severed.

## SUMMARY OF THE INVENTION

The machine of the present invention takes the form of an endless chain conveyor driven in continuous movement along an endless path and carrying a series of uniformly-spaced container chuck assemblies. The endless path includes vertically aligned horizontal upper and lower runs interconnected by end turn sections, with the chuck assemblies being adapted to support the containers in an upright position on the upper run and in an inverted position on the lower run. The conveyor chain is formed with uniformly-spaced transverse link pins, with the chuck assemblies being coupled at their forward end to each link pin. Each chuck assembly includes two similar chucks, one behind the other and in order to minimize the change in acceleration as the elongate chuck assemblies move between linear portions of their path and the curved end turn sections, parabolic merging sections are employed at the inlet and outlet ends of each end turn section.

The chain is guided throughout its endless path by fixed guide tracks. A main drive sprocket meshes with both the upper and lower runs of the chain adjacent to, but spaced from one of the end turn sections. The main drive sprocket is driven by a motor which is synchronized with the drives of other machines of the production line, such as the transfer machine which loads containers onto the machine of the present invention and the pocket conveyor which receives containers from the present machine.

In addition to the main drive sprocket, a second or slave drive sprocket is meshed with the lower run of the chain near the opposite end of the lower run. The slave drive sprocket is driven by a constant speed motor through an eddy current or slip clutch at a speed which tends to drive the chain faster than it is driven by the main drive sprocket, the excess power being absorbed in the slip clutch to apply a predetermined degree of tension to the lower run of the chain between the two sprockets. The main drive sprocket and its adjacent end turn are mounted for horizontal adjustment to further adjust chain tension and the end turn section adjacent the main drive sprocket is further mounted for horizontal adjustment relative to the main drive sprocket to regulate tension of the chain passing around this end turn.

Containers with integrally formed moil portions are loaded onto the individual chucks in an upright position at a loading point on the horizontal upper run of the endless conveyor. The chuck assemblies include a seat engageable with the bottom of the container and three symmetrically disposed releasable gripping fingers which engage the body portion of the container to grip and center the container with its axis coincident with an axis of rotation established for the chuck upon its chain carried chuck assembly. The coincident axes extend in a true vertical direction on both the horizontal upper and lower runs. Each chuck includes a sprocket which is engageable with various chains mounted along selected portions of the chuck path to drive the chuck in rotation as it passes along the chain. After the containers are loaded onto the chucks, they pass along the upper run of the conveyor between a pair of opposed "pre-heat" burners which extend along opposite sides of the path of movement of the containers. The "pre-heat" burners extend along the upper run of the conveyor and around the first end turn section and function to maintain the temperature of the container within a predetermined range during its passage of this portion of their path. A stationary chain engages the chuck sprockets on the upper run to drive the chucks and supported containers in continued rotation to achieve an even exposure of the containers to the "pre-heat" burners.

After the containers pass around the end turn section, they are inverted and move into a main burner section which includes opposed burners of novel construction extending along the lower run of the conveyor at apposite sides of the path of movement of the containers. The main burners produce a linear row of narrow flame jets which are directed accurately to a narrow band on the containers at the juncture of the moil portion and container body portion. During their passage through the main burners, the chuck sprockets are engaged by one run of an endless chain which is driven by a reversible variable speed drive in a direction and speed such that a selected rate of rotation of the containers is maintained during their passage through the main burners. During their transit through the first section of the main burners, the moil portion is thermally severed by the action of the flame jets and drops freely from the container body. A beaded finish is formed on the severed edge as the containers pass through the remaining section of the burners. The burners are constructed from individual burner sections, so that different fuels, fuel pressures, flame widths, etc. may be employed at different sections of the burner. The burner sections are mounted for adjustment vertically relative to the container path, horizontally toward and away from the container path and also pivotally about a horizontal axis parallel to the container path so that the angle of impingement of the flame jets on the containers can be regulated.

After leaving the main burners, the containers pass through a finish inspection station, where they are rotated by a second stationary chain. Malformed containers are ejected from the line at this point by manipulating the chuck release mechanism to open the fingers, thus allowing the inverted container to drop freely from the chuck. After passing beyond the inspection-rejection station, the chain moves onto a downwardly inclined section of its path to lower the containers partially into pockets on a pocket conveyor driven in synchronium and alignment with the containers at this section of their path. As stated above, the forward end of each chuck assembly is supported upon a transverse link pin of the conveyor chain, and is supported so that it can be pivoted about the horizontal axis of the pin. A guide roller on the chuck assembly is engaged with a stationary track on the conveyor frame to control pivotal movement of the clutch assembly on the pin, and during their transit of the downwardly inclined portion of the chain path, the chuck assembly is pivoted to maintain the containers supported on the assembly in a true vertical position so that the containers are accurately partially inserted into the aligned pockets of the pocket conveyor. At the lower end of the downwardly inclined section of their path, a chuck release mechanism actuates the chucks to open the gripping fingers to drop the containers freely the remaining distance into the aligned pockets.

The chuck mechanism includes a latch automatically operable to retain the fingers in their open position, thus allowing a momentary actuation of the release mechanism at the normal release point or at the rejection station.

As the chucks pass around the second end turn, the link pins of the chain are engaged by a lubrication system which may be selectively operated to lubricate the chain pins. The opened chucks pass around the second end turn onto the upper run of the conveyor and again reach the loading point. The chucks remain latched in their open position until after a container has been lowered between the open gripping fingers. At the outlet end of the loading station, an actuator on the conveyor frame unlatches the chucks, allowing the gripping fingers to move to their closed position.



Although the machine and method are specifically described in terms of handling a specific glass container, the invention is equally capable of handling other types of glass containers or hollow glass articles initially formed as a blank with an intergarl moil, such as electric light bulb envelopes or glass tumblers, for example.

Other objects, features and advantages of the invention will become apparent in the following specification and in the drawings.

In the drawings:

FIG. 1 is a very schematic side elevational diagram of a burn-off machine embodying the present invention;

FIG. 2 is a partial side view of the finish end portion of a container blank as received by the burn-off machine;

FIG. 3 is a detail side elevational view of the finish portion of the container after the finish has been formed by the burn-off machine;

FIG. 4 is a side elevational view, with certain parts broken away or omitted, showing details of conveyor chain tension adjustments;

FIG. 5 is a detail cross-sectional view, taken on line **5—5** of FIG. 6, showing details of the link pin construction;

FIG. 6 is a detail plan view of a portion of the main conveyor chain of the burn-off machine;

FIG. 7 is a partial plan view showing an expansion joint employed in the chain supporting track;

FIG. 8 is a detail side elevational view, partially in section, of the chuck assembly;

FIG. 9 is a detail plan view, partialy in section, of the chuck assembly;

FIG. 10 is a rear view of a portion of the chuck assembly;

FIG. 11 is a detail cross-sectional view, taken on a vertical plane, showing a chuck assembly in the preheat burner along the upper run of the main conveyor;

FIG. 12 is a detail cross-sectional view, taken in a vertical plane, on the lower run of the main conveyor, showing a chuck assembly passing along the lower spin cycle portion of its path;

FIG. 13 is a perspective view of a portion of a main burner module, partially in cross-section;

FIG. 14 is a detail plan view showing a portion of a burner shim;

FIG. 15 is a detail cross-sectional view, taken in a vertical plane, through the main burner;

FIG. 16 is a top plan view of a portion of the main burner assembly;

FIG. 17 is a detail cross-sectional view of the burner assembly showing the mechanism for pivotally adjusting the burners;

FIG. 18 is a side elevational view, partially in cross-section, of a portion of the chain lubricating mechanism;

FIG. 19 is a detail cross-sectional view, taken on a plane passing through the main shaft axis, showing further details of the lubricating mechanism;

FIG. 20 is a detail cross-sectional view taken on line **20—20** of FIG. 19;

FIG. 21 is a detail cross-sectional view taken on line **21—21** of FIG. 19;

FIG. 22 is a schematic diagram of the lubricant mechanism control system;

FIG. 23 is a detail cross-sectional view of the lubricant discharge fitting;

FIG. 24 is a plan view, with certain parts broken away or omitted, of a stationary spin cycle chain;

FIG. 25 is a detailed cross-sectional view taken on line **25—25** of FIG. 24;

FIG. 26 is a plan view, with certain parts broken away or omitted, of the variable speed spin cycle mechanism;

FIG. 27 is a cross-sectional view taken on line **27—27** of FIG. 26;

FIG. 28 is a cross-sectional view taken on line **28—28** of FIG. 26;

FIG. 29 is a cross-sectional view taken on line **29—29** of FIG. 26;

FIG. 30 is a cross-sectional view taken on line **30—30** of FIG. 28; and

FIG. 31 is a cross-sectional view taken on line **31—31** of FIG. 28.

GENERAL DESCRIPTION

The function of the burn-off machine of the present invention is to receive containers C (FIGS. 2 and 3) having an integral moil or waste portion M projecting upwardly from the container finish, to burn off the moil M and form a beaded finish FIN (FIG. 3) on the container, and to subsequently deposit the container into a pocket conveyor.

The burn-off machine forms a part of the overall container production line which is the subject matter of a commonly-owned copending application of Richard A. Heaton et al., Ser. No. 24,721, filed Apr. 1, 1970. In this particular production line, the bulb-shaped containers are formed on a ribbon machine with an integral moil portion projecting upwardly from the container mouth or finish. The containers are severed from the ribbon on the ribbon machine at the top of this moil portion and the moil portion is simultaneously grasped by a finger assembly on a transfer machine which forms the subject matter of Pat. No. 3,590,982. The finger assembly of the transfer machine is adapted to grasp the freshly formed container by the moil portion, because at the time the container is engaged by the transfer machine, it is still at a relatively high temperature from the forming operation and susceptible to being marred or deformed by the finger assemblies of the transfer machine. To complete the container, it is necessary that the moil portion be subsequently severed from the container and that a beaded finish be formed at the point of severance.

In FIG. 1, an extremely schematic diagram of the burn-off machine is presented for the purpose of affording an overall view of the machine and the relationship of the individual mechanisms and components to each other. The various components and mechanisms will be individually described in detail below, their relative sizes and locations being such that it is not possible to show details of all mechanisms in a single view.

Referring to FIG. 1, the burn-off machine takes the form of an endless chain conveyor, the chain of which is schematically illustrated at **40**. A series of uniformly spaced container chucks **42** are mounted upon and carried by the chain in continuous movement along an endless path having horizontally extending upper and lower runs **43** and **44** respectively. Chain **40** is supported and guided in movement along its endless path by chain tracks mounted upon the machine frame F, not shown in FIG. 1, but described in greater detail below. Chain **40** is driven along its endless path in a counterclockwise direction as viewed in FIG. 1 by a main drive sprocket **46** driven in turn by a main drive motor **48**, and also by a slave drive sprocket **50** which is drivingly coupled through a slip clutch **52** to a slave drive motor **54**.

Main drive sprocket **46** is meshed with both the upper and lower run of chain **40** at points P–1 and P–2 and supplies the major portion of the driving force for chain **40**. The remaining minor portion of the necessary driving force is supplied by slave drive sprocket **50** which is meshed with the lower run of chain **40** at point P–3 and driven by its drive motor **54** through slip clutch **52**. Motor **54** is driven at a rate such that slave drive sprocket **50** attempts to move chain **40** at a faster speed than chain **40** is driven by main drive sprocket **46**, part of the excess power being applied to tension chain **40** and the remainder absorbed in slip clutch **52**. The purpose of slave drive sprocket **50**, in addition to that of supplying a portion of the motive power to chain **40** is to maintain a constant tension in that portion of chain **40** on lower run **44** between points P–2 and P–3. By employing two drives, the magnitude of the chain tension is reduced—there are two drives each effectively pulling a short length of chain rather than a single drive pulling one long length of chain.

Overall tensioning of the chain is accomplished by mounting main drive sprocket **46** and that portion of the chain track defining the left-hand end turn **56** of the chain path upon a sub-frame **58** which is mounted for sliding movement from right to left and vice versa as viewed in FIGS. 1 and 4 upon the fixed frame, F, of the burn-off machine. Sub-frame **58** can be shifted horizontally as viewed in FIG. **1** relative to the fixed frame as by a screw jack mechanism schematically illustrated at **60** to establish overall chain tension. Adjustment of sub-frame **58** relative to the fixed frame by the jack mechanism **60** establishes the tension of the major portion of the horizontal upper and lower runs **43** and **44** of chain **40**—i.e. that portion of the chains to the right of the points P–**2** and P–**3** enmeshed with sprocket **46**. While it is desired to have an adequate amount of tension in the horizontal runs of the chain, it is desired to have the chain somewhat looser in its passage around end turn **56** and thus end turn **56** is in turn mounted upon sub-frame **58** for horizontal adjustment relative to sub-frame **58** by a threaded adjustment rod fixed to sub-frame **58** and coupled to end turn **56** by a pair of nuts **64**.

Containers C are loaded upon chucks **42** of the burn-off machine by the transfer machine of the aforementioned Banyas Pat. No. 3,590,982, partially indicated at **66** in FIG. 1. The containers C, supported from their moil portion M upon transfer machine **66** are lowered into chucks **42** as the transfer machine and chucks move in synchronism to the left along upper run **43** of the burn-off machine. Support of the containers is transferred from transfer machine **66** to the individual chucks **42** at the loading point designated L on FIG. **1**. As described in greater detail below the chucks **42** include three container gripping fingers which are maintained in an open position until the container C is deposited by transfer machine **66** onto chuck **42**, at which time the chuck fingers are closed by a closing mechanism schematically indicated at **68**.

As the chucks **42** with their supported containers move to the left along upper run **43** away from loading point L, the containers pass between a pair of opposed elongate burners **70** which apply heat to the container around the region at which the moil portion is integrally joined to the container. Burners **70** are sometimes referred to as "pre-heat" burners although their function might be more accurately described as that of maintaining a controlled rate of cooling of the finish region of the container during its transit between loading point L and the location at which the moil is burned off. The containers, at the time they are received by the burn-off machine at loading point L are at a temperature of between 900° and 1000° F. and at the commencement of the actual burning off of the moil it is desired to have the temperature of the container at between 800° and 900° F. Burners **70** can be regulated to achieve the desired temperature drop which would otherwise be dependent on such variable factors as ambient plant temperature, line speed, etc.

In order to achieve even exposure of the container around its entire circumference to the action of opposed burners **70**, the container chucks and their supported containers are driven in rotation by an upper spin cycle device schematically indicated at **72**. As indicated in FIG. **1**, burner **70** is continued around end turn **56** and terminates at the upstream end of the main burn-off and finish forming burners **74**. As the chucks enter the main burners **74**, they are operatively engaged and again driven in rotation by a second spin cycle mechanism schematically indicated at **76**.

As the chucks **42** with the supported containers pass around end turn **56**, the container is moved into an inverted position, with the moil portion which is to be burned off now being at the lower end of the container as supported on the chuck so that the moil portion can drop freely from the container upon severance. Main burner **74** is constructed with a first or burn-off section of opposed burners which extend along the line of travel of the finish portion the container and direct narrow high-intensity flame jets, in a manner to be described in more detail below, at the line of desired severance. During its passage between the main burners, the container is continuously driven in rotation at a controlled rate by spin cycle mechanism **76**. The heat applied by the burners is adjusted so that severance of the moil portion from the container will occur when the container is approximately one half of the way through main burners **74**. During the latter half of its passage through main burner **74**, the burners continue to apply heat to the severed edge of the container and this heating action, combined with the rotation of the container by spin cycle mechanism **76**, acts to form a beaded finish on the container.

After the containers pass beyond main burners **74**, they are conveyed through an inspection station **78** which inspects the newly formed finish and is operable, by manipulation of the chuck **42**, to cause ejection of a container having a malformed finish.

After passing to the right beyond inspection station **78**, chain **40** and the supported chucks pass along a downwardly inclined portion **80** of the chain path to lower the inverted containers partially into container receiving pockets **82** of a schematically illustrated pocket conveyor **84** driven in synchronism with chucks **42** of the burn-off machine. Chucks **42** are constructed, in a manner to be described in more detail below, so that during their passage along inclined section **80**, the containers are maintained in a vertical position for free entry into pockets **82**. A chuck opening mechanism schematically illustrated at **86** causes the chucks to open at the lower end of inclined path section **80** to release the container to permit it to freely drop the remaining distance into the aligned pocket **82** of conveyor **84**.

During its passage around the right-hand end turn **90** of its endless path, chain **40** passes into operative relationship with a chain lubricating mechanism designated generally **92** which is periodically actuated, in a manner to be described in greater detail below, to lubricate the chain.

## CHAIN AND TRACK CONSTRUCTION

The structure of endless chain **40** is best shown in FIGS. 5 and 6. Referring first to FIG. 6, chain **40** includes a plurality of pairs of transversely spaced rigid links designated generally **94**, each formed with an integral single hub **96** at one end and a pair of transversely spaced hubs **98, 100** at its opposite end, the spacing between hubs **98** and **100** being dimensioned to slidably receive a hub **96**. Links **94** on the right and left-hand sides of the chain as viewed in FIG. 6 are identical, the links **94** on the right-hand side of the chain being inverted with respect to the links on the opposite side of the chain. Thus, the hubs **100** are always disposed inwardly of the single hubs **96**, while the hubs **98** are always located outboard of the single hub **96**.

Referring now to FIG. 5, it is seen that hub **96** is bored as at **102** and a plain bearing **104** is mounted within this bore. Hubs **98** and **100** are coaxially bored as at **106**, the successive links being coupled to each other by a hollow link pin **108** which passes through bores **106** of the spaced hubs **98, 100** and through bushing **102** of the single hubs **96**. Link pin **108** is freely rotatable within the bushings **102**, however, to minimize wear on the pin, hubs **98** and **100** are locked to pin **108** by a plain set screw **110** at the lefthand side of the chain as viewed in FIGS. 5 and 6.

A tubular sleeve **114** is mounted for free rotation and a small degree of limited axial movement on pin **108** between the inner link hubs **100**. A threaded stud **116** is fixedly secured to and projects radially outwardly from sleeve **114**.

Link pin **108** projects axially outwardly beyond the outer hubs **98** of the links to rotatably support a pair of drive rollers **118** and a pair of support rollers **120** at locations outboard of links **94**.

Referring to FIG. 6, an intermediate drive roller **118*a*** is rotatably mounted on each link **94** midway between each pair of pin supported drive rollers **118**.

Synchronizing buttons **126** are integrally formed on each single link hub **96** and also upon the midpoint of each link. Buttons **126** are employed in a synchronizing system which synchronizes the speed of all of the various machines in the production line of Heaton et al. application Ser. No. 24,721.

A lubricant wick, partially indicated at **128**, is mounted in the hollow interior of link pin **108** to transfer lubricant supplied to fitting **112** in a manner to be described in detail below, over the entire interior of pin **108**. The lubricant is in turn transferred from wick **128** to the rotary bearing surfaces of the link pin via radial bores **130**.

The endless chain **40** is supported and guided in movement by its support rollers **120** which ride on track sections **132** mounted on the fixed frame F of the machine. Because of the extreme temperature differences between periods of operation and non-operation, the machine frame F and tracks **132** are constructed in a plurality of individual sections, with thermal expansion joints of the type illustrated in FIG. 7 between adjacent track sections.

The support track section including track **132** illustrated in FIG. 5 is a typical section, the particular portion shown being that at some point of one of the horizontal runs of the conveyor. The end turn sections of the track are functionally similar and constructed by fixedly mounting inner and outer track sections **132** and **134** onto a rigid plate such as **136** (see FIG. 18).

As will be described in greater detail below, the chuck assemblies of the machine are carried by chain **40** within the space between links **94** and adjacent link pins **108**. This requires link **94** to be of fairly substantial length, and the center-to-center distance between successive link pins **108** is approximately 10 inches. While the links **94** are traveling along the horizontal portions of their path, during normal operation of the machine the links move at constant velocity. During their transit around the curved end turns **56** and **90**, the links move along a curved path and hence are subjected during their passage around the end turns to a fairly substantial centripetal acceleration, the magnitude of which is dependent upon the chain velocity and the radius of curavture of the end section. This acceleration can be reduced by making the radius of curvature of the end turn larger, however from the standpoint of manufacturing economy there are practical limits to this approach.

In order to employ end turn sections of a relatively small radius, the chain tracks **132, 134** at the entry and exit of each end turn include a section **138** (FIGS. 1 and 18) which follows a parabolic path having a constantly changing radius of curvature at the juncture of section **138** with the adjacent straight track section to the radius of the constant radius of curvature section of the respective end turns. This gradual transition enables the centripetal acceleration imparted to the link as it enters the curved section to increase or decrease over a finite period of time rather than suddenly changing from a zero centripetal acceleration on the straight track section to a maximum centripetal acceleration as would be the case if the straight track section merged directly with a curved section of constant radius.

In a system where links of substantial length, such as the links **94** of the present machine, should the links pass directly from a straight track section to a curved section or relatively small radius, a whipping or chattering of the links will occur as they pass the transition point because one end of the link is suddenly subjected to a centripetal acceleration of substantial magnitude, while the trailing end of the link is still on a straight section of the path and not subjected to this acceleration. Particularly where the links, as will be described below, are carrying a chuck assembly of fairly substantial mass compared to that of the links, this sudden whipping or chattering is undesirable, because it is a periodic type of vibration which can approach resonance at certain critical chain speeds.

Parabolic track sections **138** minimize this problem by enabling the centripetal acceleration to be applied gradually, rather than suddenly.

## CHAIN DRIVE AND TENSIONING ADJUSTMENTS

As set forth above in the general description, the endless chain **40** is driven in movement along its endless path by two separate drives, one of which includes the main drive sprocket **46** and the other of which includes the slave drive sprocket **50**. Main drive sprocket **46** engages chain **40** at two vertically aligned points P–1 and P–2 respectively located on the upper and lower runs of the chain, while slave drive sprocket **50** engages the chain at a single point P–3 on the lower run of the chain.

Main drive sprocket **46** is driven by a main drive motor **48** whose speed is synchronized (by a control system including the buttons **126** on chain **40**) with the speed of other machines in the production line, specifically transfer machine **66** and pocket conveyor **84**. Slave drive sprocket **50** is driven by a constant speed motor **54** which is drivingly connected to sprocket **50** through an eddy current or slip clutch type coupling. The speed of motor **54** is such that it always tends to drive chain **40** at a speed faster than that at which the chain is driven by main drive sprocket **46**. A portion of the excess power exerted by motor **54** is employed to apply tension to that portion of the chain between points P–2 and P–3 of FIG. 1, while the remaining excess power supplied by motor **54** is absorbed in the eddy current coupling **52**. A constant tension is desired along that portion of the path between points P–2 and P–3, because it is along this portion of the path that the containers pass through the main burner **74** where the moil is severed and the container finish FIN is formed. The severing and finish forming operations call for a very precise positioning of the container relative to the burners, and it is thus necessary that the chain be firmly tensioned during these operations so that all possible lost motion in the chain is taken up.

During its passage around the curved end turns, on the other hand, the high tension applied to the chain during its passage through the main burners is undesirable, because it tends to interfere with the desired flexing of the chain. Referring to FIG. 1, it will be noted that the three points of engagement between chain **40** and sprockets **46** and **50**, namely points P–1 and P–2 and P–3 effectively provide points at which the chain tension can be changed.

The overall chain tension is adjusted by manipulation of jack **60** to shift sub-frame **58**, which carries main drive sprocket **46**, and end turn **56** from right to left or vice versa as viewed in FIGS. 1 and 4. End turn **90** at the opposite end of the machine is fixed, and thus adjustment of sub-frame **58** and sprocket **46** to the left as viewed in FIGS. 1 and 4 will increase the tension in chain **40** from point P–2 around end turn **90** to point P–1. The initial tension in the remaining portion of the chain—i.e. that from point P–1 around end turn **56** to point P–2 is independently adjusted by shifting end turn **56** from right to left or vice versa relative to sub-frame **58** by positioning nuts **64** on the threaded adjustment rod **62** mounted on sub-frame **58**. These adjustments are made during the initial startup of the machine to establish what might be termed the normal or reference chain tensions, the term tensions being employed in the plural to indicate the fact that the tension in chain **40** as it passes around end turn **56** may be different than the tension in the chain as it passes around end turn **90**.



Under normal operating conditions, the total driving force applied to the chain is distributed between sprockets **46** and **50** in a manner such that approximately 60% of the total driving force is supplied by sprocket **46**, while the remaining 40% is derived from sprocket **50**. The two points of engagement of sprocket **46** with chain **40** enable the application of a substantially reduced tension in chain **40** as it passes around end turn **56** between points P–1 and P–2, while the location of slave drive sprocket **50** just before end turn **90** enables the chain tension around end turn **90** to also be reduced.

## CHUCK ASSEMBLY

The structural details of the container chuck assemblies are best shown in FIGS. 8 through 10. As most clearly seen in FIG. 8, each chuck assembly includes a pair of chucks designated generally **42** which is mounted upon a common housing **140**. Housing **140** is preferably formed as a unitary casting having a generally horizontal platform portion **142** formed with a pair of vertically elongated sleeve sections **144** which support, as by upper and lower bearing assemblies **146**, **148** the central shafts **150** of the individual chucks.

At its forward end, housing **140** is formed with an integral semi-cylindrical mounting tongue **152** which is shaped and dimensioned to be seated upon the sleeve **114** of a chain link pin **108**. As best seen in FIG. 9, tongue **152** is formed with a recess **154** which receives the threaded stud **116** fixedly mounted on link pin sleeve **114**, while a flat bearing surface **156** around recess **154** provides a bearing surface against which a nut threadably received on stud **116** can clamp the mounting lug **152** to the chain pin sleeve.

Referring now to FIGS. 8 and 10, a projecting arm **158** is integrally formed on the outer side of the rearwardmost sleeve portion **144** and includes a hub **160** which rotatably supports a chuck support roller **162**. Roller **162** rides in a track **164** (see also FIGS. 11 and 12) mounted upon the machine frame to control pivotal movement of housing **140** about the axis of the link pin which supports its forward end.

A guide shoe **166** is fixedly secured to one side of housing platform **142**. Guide shoe **166** is employed in conjunction with guide tracks **168** (FIG. 12) mounted upon the machine frame and extending through the main burner section of the chain path to accurately locate the chucks transversely of the chain path during their passage through the main burners. The container has very little side-to-side clearance during its passage through main burners **74** and it is thus necessary to accurately position the containers midway between the burners in order that the burners may act evenly on the container. As explained above, sleeves **114** are mounted on link pins **108** with a slight degree of axial play which is prohibited by guide shoe **166** and its cooperating track **168** during the passage of the chuck through the main burner assembly.

The two chucks mounted upon the common housing **140** are identical and independently operable.

Each chuck includes a main shaft **150**, supported in a sleeve **144** of housing **140** for free rotation relative to the housing within bearings **146** and **148**. The axis of rotation thus established is mutually perpendicular to the path of movement of chain **4** and to the axes of link pins **108**. At various points along the path of movement of the chucks, the chucks are driven in rotation, by chains employed in spin cycle mechanisms **72** (FIG. 11) and **74** (FIG. 12), which engage a sprocket **170** coupled to shaft **150** by a conventional friction coupling designated generally **172**.

At the upper end of shaft **150**, a fulcrum plate **174** is fixedly clamped to the shaft by a threaded stud **176** which is received within a tapped bore **178** in shaft **150** and formed with a downwardly facing shoulder **180** which bears against the upper surface of plate **174**. Preferably, some means, such as a tab, is provided to rotatably lock plate 174 against rotation relative to shaft 150. Stud 176 is formed with a tapped bore 182 in its upper end which threadably receives a container seat retaining bolt 184. Bolt 184 clampingly secures a container seat 186 and washer 188 to the extension of shaft 150 formed by stud 176. Container seat 186 includes an annular seat element 190 which is coaxially aligned with the axis of shaft 150 and conformed to engage the bottom of a container C to support, in cooperation with a group of three container-gripping fingers desgnated generally 192, the container C in coaxial alignment with the shaft axis.

The purpose of mounting fulcrum plate 174 and container seat 186 by means of stud 176, bolt 184 and washer 188 is to enable the chucks to be rapidly converted to handle different sized containers. While the main burners 74 which sever the moil and form the container finish are capable, as will be described below, of limited vertical adjustment upon the machine frame, the range of burner adjustment is a limited one. The path of movement of chain 40, and hence of chuck housings 140, is fixedly established by the chain support tracks 132, 134, and thus if containers C longer than those shown in FIG. 8 are to be handled upon the machine, container seat 186 must be located at a lower elevation in order to locate the container finish line at the same elevation as that of the short containers C shown in FIG. 8. This adjustment can be easily made by replacing the stud 176 shown in FIG. 8 with a shorter stud so that container seat 186 is lowered or located closer to the upper end of shaft 150. This adjustment is readily made by merely removing bolt 184, replacing stud 176 with a shorter stud 176 and then replacing bolt 184 in the new stud.

In some instances, it may be desirable to also replace fulcrum plate 174, which pivotally supports gripping fingers 192 upon fulcrum pins 194, to relocate the fulcrum point of fingers 192. Fulcrum plates 174 can easily be replaced by removing stud 176 (without disassembling the container seat) to enable the original fulcrum plate 174 to be detached, inserting a new fulcrum plate 174 and threading stud 176 back into shaft 150.

Referring to FIG. 9, it is seen that fulcrum plate 174 is formed with three radially projecting arms 196 spaced 120° apart from each other about the chuck axis and that the fulcrum pins 194 are supported in the outer ends of arms 196. Gripping fingers 192 each conssit of a pair of side plates 198 secured in spaced relationship to each other as by a series of spacer pins 200. Arms 196 project between the spaced plates 198, and pins 194 project through the arms and adjacent plates 198 to support the finger for pivotal movement in a general plane which extends radially of the chuck axis.

At their lower ends, each of plates 198 is formed with a cam slot 202. An actuating plate 204 is formed with three radially projecting arms, each of which carries a pair of actuating rollers 208 which are received within the respective slots 202 on the lower end of the gripping fingers as best seen in FIG. 8. The overall configuration of actuating plate 204 is quite similar to that of fulcrum plate 174, although the actuating plate is somewhat smaller in its overall dimensions. As was the case with the fulcrum plate, the opposite side plates 198 of the gripping fingers pass on the outer sides of arms 206 of the actuating plate, and rollers 208 are mounted on the outer sides of arms 206 upon a common pin 210 rotatably supported in arm 206.

Actuating plate 204 is fixedly secured, as by bolts 212 to an actuating sleeve which is mounted upon shaft 150 for axial sliding movement relative to the shaft. A tab 216 on actuating plate 204 projects into a keyway 218 on shaft 150 to permit axial sliding movement of the assembled actuator plate 204 and sleeve 214 while locking these parts against rotation relative shaft 150. A compression spring 220 resiliently biases sleeve 214 upwardly as viewed in FIG. 8.

In FIG. 8, gripping fingers 192 are shown in their closed container gripping position. Opening of the fingers to accommodate loading or unloading of containers from the chucks is accomplished by axially shifting sleeve 214 downwardly from the FIG. 8 position against the action of spring 220. It will be noted that the configuration of the cam slots 202 in the lower end of the gripping fingers is such that their innermost sections are inclined upwardly and inwardly relative to the chuck axis. Axial movement of sleeve 214 and its attached actuating plate downwardly causes rollers 208 to engage the inclined inner sides of slots 202 to force the lower ends of gripping fingers 192 inwardly as the rollers 208 are moved downwardly. Inward movement of the lower ends of fingers 192 pivots the fingers about their respective pins 194 to move the upper ends of fingers 192 outwardly clear of the container C.

Downward axial movement of sleeve 214 is accomplished by an actuating lever assembly designated generally 222 most clearly shown in FIGS. 9 and 10. Each lever 222 is constructed from three U-shaped elements 224, 226 and 228 which are fixedly secured to each other, as by tack welding with a U-shaped element 224 opening forwardly and elements 226 and 228 opening rearwardly and secured in side-by-side relationship to the bight portion of element 224.

A shaft 230 is mounted in and projects through both legs of U-shaped member 226 and also through the legs 232 of U-shaped member 228 which is adjacent member 226. The opposite leg 234 of U-shaped member 228 carries a stub shaft 236 which is coaxially aligned with shaft 230. Stub shaft 236 and shaft 230 each support one of a pair of rollers 238 at the inner side of the opposed legs 234 and 232 of member 228, rollers 238 in turn being located within an annular groove 240 formed on sleeve 214. Levers 222 are pivotally supported on chuck housing 140 by a pair of spaced aligned pivot pins 242 mounted in front or rear projections 244 or 246 integrally formed on housing 242.

Because the biasing action of spring 220 normally maintains sleeve 214 in the position shown in FIG. 8, the interengagement between the walls of annular groove 240 and rollers 238 on lever 222 normally maintains lever 222 in the position shown in FIG. 8. Depression of the lever—i.e. in clockwise pivotal movement about its pivot 242 from the FIG. 8 position is accomplished by the engagement between an actuating roller 248 rotatably mounted on the outer end of shaft 230 with a cam located on the machine frame at an appropriate location along the path of movement of the chuck. When roller 248 engages such a cam, it is depressed to swing levers 222 in clockwise pivotal movement from the FIG. 8 position, this pivotal movement causing rollers 238 to engage the lower wall of groove 240 to drive sleeve 214 axially downwardly on shaft 150 against the action of spring 220. Downward movement of the sleeve, as described above, carries rollers 208 downwardly within cam slots 202 of the gripping fingers to swing the fingers concurrently to their open position.

Shifting of the gripping fingers 192 from their closed position shown in FIG. 8 to their open position is accomplished at either of two locations on the lower run of the machine while the chuck assemblies are in an inverted position. Referring briefly to FIG. 1, it will be recalled from the general description above that the containers are subjected to a finish inspection at inspection station 78 and that containers having an improperly formed finish are ejected from the machine at this point. The inspection-rejection device at station 78 forms no part of the present invention, and may take the form of any of several well-known devices operable for this purpose. In brief, the inspection device is operable to generate a reject signal upon the detection of a sub-standard container and the reject signal is employed to actuate an ejector which, in this particular case, will project a cam member into the path of the actuating roller **248** on the chuck carrying the flawed container.

As is apparent from FIGS. 8 and 9, rollers **248** on adjacent chucks are not spaced too far from each other (approximately 5 inches in practice) and thus the cam element of the reject device must be moved rapidly into and out of the path of movement of rollers **248** so that it strikes only the roller **248** on the chuck carrying the flawed container and is withdrawn clear of the path of movement of the rollers before the next subsequent roller reaches the reject station. This requirement in turn permits only a momentary depression of the lever **222** which may not hold gripping fingers **192** open long enough to permit the container to drop from the inverted chuck clear of the fingers.

To assure adequate time to allow ejected containers to drop clear of the chuck, and further for the practical reason that once the fingers are open there is no need to close them again until a new container has been inserted into the chuck at loading station L on the upper run of the conveyor, the chucks are constructed with a latching mechanism designated generally **250** which is automatically operable to releasably latch levers **222** in their lowermost or chuck open position. Mechanism **250** includes a lever **252** pivotally mounted on chuck housing **140** adjacent each chuck as by pivot pins **254**. A torsion spring **256** resiliently biases lever **252** in a counterclockwise direction as viewed in FIG. 8. When the associated actuating lever **222** is in its upper or chuck closed position, the upper end of lever **252** is resiliently biased against shaft **230** which is carried on lever **222**. When lever **222** is depressed to open the chuck, its shaft **230** is carried downwardly along the front edge of lever **252** into alignment with a latching notch **258** (FIG. 8) on the lever which engages shaft **230** to latch actuating lever **222** in its lower or chuck open position.

Reclosing of the gripping fingers at the container loading station L is accomplished by a stationary cam on the machine frame which releases the latch and engages roller **248** to achieve a cushioned closing of the fingers.

## PRE-HEAT AND MAIN BURNER ASSEMBLIES

Details of the pre-heat and main burner assemblies are best shown in FIGS. 11 through 17 inclusive.

A typical cross-section of pre-heat burner **70** is shown in FIG. 11. Burner **70** consists simply of a pair of spaced opposed pipes **270** which are supported by a suitable framework designated generally **272** to extend along opposite sides of the path of movement of that portion of containers C where the moil M is joined to the main body of the container. As indicated in FIG. 1, burners **70** extend along the upper run of the conveyor from a point slightly downstream of loading point L and pass around end turn **56** to terminate adjacent the entrance end of main burners **74**.

A plurality of bores **274** through the walls of pipes **270** establish nozzles from which a combustible gas is expelled under pressure from the interior of pipes **270** to maintain opposed rows of flame jets directed inwardly from bores **274** toward the containers.

A spin cycle chain **72**, to be described in greater detail below, engages the chuck sprockets **170** as they pass through the upper run portion of burners **70** to rotate the chucks and supported containers during their transit of this portion of the path.

The function of burners **70** is to establish a controlled temperature region through which the containers C pass as they move from loading point L to the entrance of main burners **74**. For optimum performance of the moil severing and finish forming functions of main burners **74**, it is desired that the temperature of the container, at least in the general region on which the finish is to be formed, be between 800° to 900° F. as the container moves into main burner **74**. The temperature of the containers as they are loaded onto the burn-off machine



at loading point L is approximately 900° to 1000° F., and hence the function of burners **70** is not to add heat to the container, but rather to establish a controlled rate of cooling of the container as it passes through burners **70**. In the absence of a controlled temperature zone, such as that established by burners **70**, the rate of cooling of the containers in transit between loading point L and the entrance to main burner **74** would be dependent on variable factors such as ambient plant temperature and the time required for a container to pass from loading point L to the main burners which would vary with line speed. Variations in line speed also influence the temperature of the container as it is loaded onto the burn-off machine, because this effects the time of transit of the container through the preceding transfer machine.

Burners **70** are normally mounted in a fixed position relative to the machine frame F, and their heating effect is varied simply by varying the rate of supply of combustion gas to the burners.

Main burner **74** is constructed from a series of like burner modules designated generally **280**. In the plan view of FIG. 16, one complete module is shown, with portions of two adjacent modules appearing at the top and bottom of this figure.

Each module **280** consists of two separate halves **282*a*** and **282*b*** respectively mounted on opposite sides of the path of movement of the containers C. The halves **282*a*** and **282*b*** are identical and are mounted for independent horizontal, vertical and pivotal adjustment relative to the machine frame F. A single set of reference numerals will be employed to identify the parts of the two halves **282*a*** and **282*b***.

Each module half includes a horizontally extending frame member **284** having a housing **286** fixedly secured to each end. As best seen in FIG. 15, each housing **286** carries a pair of coaxially aligned plain bearings **288** which are slidably supported upon a transversely extending tubular member **290** which is fixedly mounted upon the machine frame F. As best seen in FIG. 16, each module half is supported upon two tubular frame members **290** for horizontal adjustment of the respective module halves **282*a*** and **282*b*** toward and away from each other. Positioning of each module half along its tubular support members **290** is accomplished by a pair of jacks **292** engaged between machine frame F and module frame member **284**.

Returning to FIG. 15, each housing **286** supports a vertically extending post **294** fixedly secured to the housing. A sleeve assembly **296** is slidably received on each post **294** and carries a support bracket assembly **298**. An elongate pipe **300** is mounted in the two brackets **298** of each module half and extends the entire length of the module. Elongate mounting brackets of generally T-shaped cross-section **302** are fixedly secured, as by welding, to each pipe **300**. Each pipe **300** carries four individual brackets **302**, the brackets being spaced from each other to provide clearance at the points at which clamps **298** engage pipe **300** and also at a point approximately midway between clamps **298** for structure to be described below.

Brackets **302** provide a mounting platform for a series of elongate individual burner units designated generally **304**, there being eight burner units supported in end-to-end relationship on each module half **282*a*** and **282*b***. Referring to FIG. 15, the burner units **304** are releasably clamped upon bracket **302** by clamp assemblies designated generally **306**, each of which includes a pivoted clamping finger **308** which is locked in the clamping position shown in FIG. 15 by a knob **310** threadably received upon a clamping bolt **312**. Pin **314** mounted in bracket **302** is engaged within grooves **316** in the bottom of each burner unit **304** to cooperate with clamps **306** in locating the burner upon its bracket. Two pins **314** and two clamping units **306** are employed to mount each burner unit **304** upon the brackets, one clamping unit and pin being located adjacent each end of each burner unit. Due to the scale of FIG. 16, clamping units **306** have been indicated only on one set of burner units **304** at the upper end of the module **280** as viewed in FIG. 16.

Vertical positioning of the burner units is accomplished by means of a pair of jacks **318**, a jack **318** being mounted upon each of housings **286** and acting between the housing and the associated sleeve mounted support bracket **298**.

Pipe **300** is supported in brackets **298** for rotation about the pipe axis within brackets **298**. This enables an angular adjustment of burner units **304** about the pipe axis by rotating the pipe within clamp assemblies **298**. Referring to FIG. 17, a clamp **320** is fixedly secured to pipe **300** at a location approximately midway between clamps **298**. A jack **322** is mounted upon module frame member **284** and coupled by a pin and slot connection designated generally **324** to a crank arm **326** fixedly secured to clamp **320**. As indicated by broken line showing of FIG. 17, actuation of jack **322** causes rotation of pipe **300** about its axis, thus pivoting the burner about the pipe axis. Because the burners on the opposed module halves **282***a* and **282***b* are spaced from each other by a distance which provides only a small clearance for the passage of containers C through the burners (see FIG. 15), pivotal adjustment of the burners usually requires a coordinated horizontal and vertical adjustment of the burner location by appropriate manipulation of jacks **292** and **318**.

Burner units **304** are of a laminated or built-up layer type of construction, this construction being best shown in the cross-sectional view of FIG. 13. The individual layers of the burner unit are formed from appropriate lengths of bar or strip stock, each burner unit having a typical length of about one foot. The unit includes an upper housing member **330**, whose flat bottom surface **332** is formed with a longitudinally extending recess **334** which extends almost, but not quite, the entire length of housing **330**, recess **334** terminating just short of each end of member **330**. An inlet passage **336** extends from the rear wall **338** of housing **330** to communicate at its inner end with a vertical passage **340** which opens into recess **334**. The outer end of passage **336** is formed with an internal screw thread as at **342** to receive a supply conduit fitting.

A burner shim **344** is located in face-to-face engagement with the bottom surface of housing member **330**. Shim **344** is the same length and width as is housing **330** and is formed, as best seen in FIG. 14, with a plurality of uniformly spaced parallel slots **346** which extend rearwardly from the forward edge **348** of the shim. As indicated in broken line in FIG. 14, recess **334** overlies the inner ends of slots **346** so that the slots are in communication with recess **334** and thus, via passage **340**, with inlet passage **336**.

Shim **344**, in turn, lies upon the top of an intermediate plate **350** having a recess **352** formed in its top surface, recess **352** being of the same overall dimensions and vertically aligned with recess **334** of upper housing member **330**. The two recesses **334** and **352** cooperatively define a common chamber split by shim **344**, the chamber having an inlet constituted by inlet passage **336** and passage **340** and having a plurality of outlets constituted by slots **346**.

A second shim plate **354** underlies intermediate plate **350**, shim **354** being of the same length as the other components of burner **70**, but being of a reduced width so that its forward edge **356** is spaced inwardly from the forward edge of the burner unit in approximate vertical alignment with the inner ends of slots **346** of the burner shim.

Shim **354** is located on the top surface of a lower housing member **358** which, like upper housing member **330**, is constructed with an elongate recess **360** of a configuration similar to that of recess **334**. An inlet passage **362** extends forwardly from the rear wall of lower housing member **358** to communicate with a vertical passage **364**. An internal thread section **366** at the rear end of passage **362** is provided for the connection of a supply fitting.

The various elements described above are clamped into assembled relationship with each other as by a plurality of machine screws **368** which pass through bores in upper housing member **330**, shim **334**, plate **350**, shim **354** and are threaded into tapped bores in lower housing member **358**.

In operation, a combustible gas under pressure is supplied to inlet passage **336**, and passes through passage **340** into the chamber cooperatively defined by recesses **334** and **352**. The gas passes outwardly through slots **346** in the burner shim to establish a linear row of flame jets along the front edge of the burner unit, slots **346** constituting flame ports or nozzles.

In the moil severing operation, it is desired to concentrate the applied heat from the flame jets of burner units **304** to an extremely narrow band-like region of the container so that the line of severance is maintained within close tolerances. Burner unit **304**, by employing shim **344** to establish the vertical dimension of the flame ports, enables the achievement of a linear row of accurately aligned, vertically narrow flame jets. Because shims **344** can be readily replaced, they also provide for great flexibility in modifying the operating characteristics of the burners by the employment of shims of different thicknesses, slot dimensions and/or slot spacings.

For example, while the application of a very narrow band of heat to the container during the moil severing operation for precisely locating the line of severance on the container may be desirable; during the subsequent finish forming operation, it may be desirable to apply heat over a somewhat wider band, in which case a thicker shim **344** would be employed. Further, the working temperatures of the glass container during the finish forming operation may not need to be as high as the desired flame temperature during severing, in which case different fuels might be employed as between the severing and finish forming operations, together with different flame port configurations which can easily be established by varying the thickness of the shims employed in the respective operations as to thickness, the slot dimensions and slot spacing.

During operation of the burner unit, air under pressure is supplied to passage **362** and discharged from the burner unit through the continuous slot **370** established between intermediate plate **350** and lower housing **358** by shim **354**. The air employed for this purpose is normally at ambient temperature and establishes a sharp thermal gradient in the glass during the severing operation, as well as exerting a cooling effect on the burner unit.

## SPIN CYCLE MECHANISM

Two types of spin cycle mechanisms are employed to drive the chucks in rotation during their passage through pre-heat burner **70** and main burners **74**. Spin cycle mechanism **72**, which extends along the upper run portion of pre-heat burner **70** takes the form of a stationary chain mounted alongside the path of movement of chuck sprockets **170** to engage the sprockets as their chucks traverse this portion of the path. The rate of rotation of the chuck and its supported container, by spin cycle mechanism **72**, is thus directly dependent upon the line speed of the chuck. The rate of rotation of the container during its passage through the pre-heat burner **70** is not overly critical, because the sole requirement is that the container be more or less uniformly exposed around its circumference to burners **70**.

The rate of rotation of the containers as they pass through main burner **74**, where the moil severing and finish forming operations are performed, is more critical, and spin cycle mechanism **76** takes the form of an endless chuck sprocket engaging chain which is driven by a reversible variable speed drive motor so that the rate of rotation of the containers may be varied in accordance with the algebraic difference of the chuck and chain speeds.

Spin cycle mechanism **72** is shown in FIGS. 24 and 25. It includes a length of sprocket chain **380** which is supported over most of its length within a chain track or support designated generally **382** which in turn is supported upon the fixed frame F of the machine by suitably spaced mounting brackets **384**. Chain track **382** extends alongside the path of movement of chuck sprockets **170** to maintain chains **380** in engagement with chuck sprockets **170**, the forward motion of the sprockets causing the stationary chain to drive the sprockets in rotation as they move from right to left as viewed in FIG. 24.

Referring to the cross-sectional view of FIG. 25, it is seen that chain **380** includes a plurality of pins such as **386**, which interconnect an inner pair of spaced links **388** and a pair of outer links **390**. The chain is supporetd in track **382** with its pins in a vertical position by a central track member **392** of generally E-shaped cross-section which is secured to and supported upon mounting brackets **384** and upper and lower retainer strips **394** of channel-shaped cross-section which are fixedly secured, as by bolts, not shown, to track member **392**. At the upstream end (right-hand end as viewed in FIG. 24) of chain track **382**, three adjacent chain pins **386** are replaced by pins of extended construction **396**, the pins **396** extending through all of the chain links and being received within aligned bores which pass vertically through the retainer members **394** to fixedly anchor the chain to track **382** at this point. Otherwise, the chain merely rests within track **394** in the manner shown in the cross-sectional view of FIG. 25.

The purpose of anchoring chain **380** by means of pins **396** is twofold. It enables different degrees of tension to be applied to those sections of chain **380** to the left and to the right of pins **396** and also serves as a fixed anchoring point to isolate the tension of the chain at one side of pins **396** from the tension of the chain on the opposite side of pins **396**. These two features are both related to achieving a satisfactory initial engagement between the moving chuck sprockets **170** and the chain.

The upstream end of chain **380**—i.e. that portion to the right of pins **396** as viewed in FIG. 24—has its free end anchored upon a lever **398** pivotally supported as at **400** on a mounting bracket **402** which is in turn fixed to the machine frame F. A bolt **404** is fixedly mounted upon bracket **402** and passes freely through an opening **406** in lever **398**. A compression spring **408** is seated between lever **398** and an adjustment nut **410** threadably received on the end of bolt **404**. It is believed apparent that by suitable adjustment of nut **410**, an adjusted resiliently maintained tension can be applied to that portion of chain **380** to the right of pins **396** as viewed in FIG. 24.

At a location intermediate pins **396** and lever **398**, chain **380** is engaged by a resilient strut assembly designated generally **412**. Strut assembly **412** includes a hollow tubular sleeve **414** which is pivotally coupled at one end to chain **380** as at **416**. Sleeve **414** slidably receives one end of a pin **418** which is pivotally supported at its opposite end upon machine frame F as at **420**. A compression spring **422** is engaged between a shoulder on pin **418** and an adjustment nut **424** threadably received on the outer side of sleeve **414**. Spring **422** thus tends to extend the length of strut **412** with a resiliently applied force.

It will be observed from FIG. 24 that that section of chain **380** between pins **396** and **398** is not parallel to the path of movement of chuck sprockets **170**, but converges toward the sprocket path in its extent from lever **398** towards pins **396**.

Because the rotative orientation of chuck sprockets **170** as they approach chain **380** is completely random, the initial engagement between a tooth on the chuck sprocket and a chain pin on chain **380** will not always be at a mechanically desirable relationship. Further, the chuck sprocket is moving at a constant velocity, while the chain pin is stationary, thus resulting in a fairly substantial impact at the initial moment of full contact. This impact is to some extent cushioned by the resilient, relatively light tensioning bias applied to this section of the chain by lever **398**, while strut **412** resiliently resists lateral whipping of this rather loosely tensioned section of the chain under the impacting caused by the initial chain-chuck sprocket engagement. The convergent relationship of this section of the chain to the sprocket path also permits the sprocket to initially contact any one of several different chain pins, depending upon the rotative position of the sprocket, thus distributing the wear due to impacting over several chain pins.

That portion of chain **380** to the left of pins **396** as viewed in FIG. 24 is somewhat more tightly tensioned by passing the free end of the chain around a sprocket **426** rotatably mounted on the machine frame at **428**.

This free end of the chain is coupled to a rod **430** slidably received within and projecting through a mounting block **432** fixedly mounted on the machine frame. A compression spring **434** is engaged between block **432** and an adjustment nut **436** threadably mounted on the end of rod **430** is employed to establish the desired tension adjustment and take care of chain stretch.

A generally similar stationary chain-type spin cycle mechanism (not shown) is also employed at inspection station **78** to rotate the chuck as they pass through the inspection station.

Details of the variable speed spin cycle assembly **76** employed to rotate the chucks during their passage through main burners **74** are best shown in FIGS. 26 through 31 inclusive.

Referring first to FIG. 26, spin cycle mechanism **76** includes an endless chain **440** which is operatively trained around an upstream end sprocket **442** and a downstream end sprocket **444**, the terms upstream and downstream referring to the direction of movement of chuck sprockets **170**. Chain **440** is driven in movement along its endless path by a reversible variable speed drive mechanism designated generally **446** which includes a reversible variable speed drive motor **448** which is drivingly coupled to a drive sprocket **450** mounted for rotation in the machine frame. A pair of idler sprockets **452** mounted in the machine frame for free rotation adjacent sprocket **450** confine the path of chain **440** to one which extends around a substantial portion of the periphery of main drive sprocket **450** in a more or less conventional arrangement.

As was the case with the stationary chain spin cycle mechanism previously described, the path of chain **440** converges from upstream end sprocket **442** toward the path of chuck sprockets **170**. Chain **440**, in passing from end sprocket **442** toward the path of chuck sprockets **170** is trained around a guide sprocket **464** mounted in the machine frame for free rotation about a stationary axis as at **465**. Immediately to the right of sprocket **464**, as viewed in FIG. 26, the chain is engaged within a chain track **466** which supports and guides chain **440** in movement.

Between sprockets **442** and **464**, that run of chain **440** adjacent the chuck sprocket path is engaged by a sprocket **468** mounted for free rotation upon a bell crank **470**. Bell crank **470** is mounted at one end for pivotal movement upon the machine frame as by a fixed pivot **472**. The opposite end of bell crank **470** is pivotally coupled to a rod **474** slidably mounted in a bracket **476** fixedly mounted upon the machine frame. A compression spring **478** engaged between bracket **476** and an adjustment nut **480** threadably received on rod **474** resiliently biases bell crank **470** in a counterclockwise direction about pivot **472** as viewed in FIG. 26, thus urging sprocket **468** against chain **440** to bow the chain outwardly toward the path of chuck sprockets **170**. Bell crank **470** and its sprocket **468** perform the same function as did adjustable strut assembly **414** of spin cycle mechanism **72**.

Referring now to FIG. 27, there is shown in this figure a typical cross-section of chain track **466**. Preferably, the track assembly is built-up, as indicated, from individual layers of strip stock to form opposed guide channels complementary in shape to the chain cross-section. Chain **440** is formed with chain pins **482** which carry rollers **484** at each end. A pair of links **486** are carried on the pin between rollers **484**, the links being maintained in spaced relationship to each other and to rollers **484** by tubular spacers **488** loosely received upon chain pin **482** and mounted between the rollers and links. In their transverse extent, the links **486** are not symmetrically disposed with respect to the chain pin, but are extended on the inner side of the chain to slidably project into complementary recesses **490** formed in the chain track **466**. Rollers **484** of the chain are received within grooves **492** formed in channel-shaped retainer members **494** of the chain track assembly. As indicated in FIG. 27, chuck sprockets **170** engage the chain between links **486**, all of the various sprockets engaging the chain at the outer sides of links **486**.

Downstream end sprocket **444** is mounted upon and supported by a chain tensioning mechanism designated generally **496** which acts to apply operative tension to the chain. End sprocket **444** is rotatably mounted in a yoke **498** which is secured to one end of a ratchet rod **500** which is slidably mounted in the frame **502** of mechanism **496**, frame **502** in turn being slidably mounted on the frame F of the machine. Referring particularly to FIGS. 28 and 31, tension mechanism frame **502** includes a main frame plate **504** which is slidably supported on the underside of a plate **506** forming a portion of the main machine frame F, plate **504** being supported as by gibs **508** (FIG. 30). A pair of slide brackets **510** are fixedly secured to the lower side of frame plate **504** and formed with aligned bushed bores **512** which slidably support ratchet rod **500**, as best seen in FIG. 28. As best seen in FIG. 29, brackets **510** also slidably support a push rod **514** in parallel spaced side-by-side relationship to ratchet rod **500**. At their right-hand end, as viewed in FIGS. 26, 28 and 29, rods **500** and **514** are fixedly secured to a tie bar **516** which rigidly and fixedly connects the respective rods to each other. Referring now to FIG. 29, a compression spring **518** is engaged between the left-hand slide bracket **510** and an adjustment nut **520** threadably received on rod **514**. Compression spring **518** exerts a resiliently adjusted force, depending upon the position of nut **520**, urging rod **514** to the right, as viewed in FIG. 29. This force is directly transmitted by tie bar **516** to ratchet rod **500**, thereby urging ratchet rod **500** and its coupled end turn sprocket **444** to the right as viewed in FIGS. 26 and 28 to tension chain **440**.

To establish a minimum permissible chain tension, frame plate **504**, as mentioned above, is adjustably supported for movement relative to the machine frame from right to left or vice versa as viewed in FIG. 28. The adjusted position of frame plate **504** in turn establishes the position at which tie bar **516** is engaged with the right-hand slide bracket **510**, thus establishing the maximum possible limit to leftward movement of end sprocket **444** as viewed in FIGS. 26 and 28. Positioning of frame plate **504** is accomplished by means of an adjustment screw **552** threadably received within a mounting block **524** which is fixedly secured, as by welding, to frame plate **504**. Bolt **522** bears against a pad **526** mounted upon the machine frame F. When threaded into block **524** from the position shown in FIG. 28, bolt **522** will drive frame plate **504** to the right from the illustrated position.

That section of chain **440** between sprocket **464** and sprocket **444**—i.e. the chuck sprocket engaging run of of chain **400**—is subjected to a cyclically varying loading during operation of the machine, the load being reduced as a chuck sprocket **170** leaves the chain at sprocket **444** and being increased as a chuck sprocket **170** passes to the right of sprocket **464**. Even when the arrival of a new chuck at one end of this chain section is precisely synchronized with the departure of an old chuck from the downstream end, the point of application and release of the load are different, and hence a periodic or cyclic loading variation is encountered by the chain. Variations in line speed of the chucks, the speed and direction in which chain **440** is being driven, and many other variable factors present a possibility that under certain conditions this variable loading may start to approach a resonant condition, particularly where the tension in the chain is applied by a spring.

To overcome this problem, a ratchet mechanism designated generally **528** is employed to lock ratchet rod **500**, and hence sprocket **444** in the maximum rightward position to which they have been biased by spring **518**.

As best seen in FIG. 28, ratchet rod **500** is formed with a series of ratchet teeth **530** on its upper side, the right-hand side of each tooth **530**, as viewed in FIG. 28, being inclined. A pawl **532** is supported for vertical sliding movement with a hollow sleeve **534** fixedly mounted upon the machine frame. The lower end of pawl **532** is formed with a latch tooth complementary in shape to the teeth **530** on rod **500**—i.e. the left-hand side of latch tooth **536** is inclined oppositely to the inclined right-hand edges of ratchet teeth **530**. The inclined surfaces on the respective teeth enable rod **500** to be pulled to the right as viewed in FIG. 28, the engaged inclined surfaces of the respective teeth sliding to enable pawl **532** to move upwardly as a ratchet tooth slides beneath it and to then drop downwardly in front of the ratchet tooth to prevent leftward movement of the rod. A compression spring **538** within sleeve **534** resiliently biases pawl **532** downwardly against ratchet rod **500**.

During normal operation of the machine, chain **440** tends to expand, due to its relatively close proximity to main burners **74**, and thus, as the chain expands, its tension decreases until the opposing force of spring **518** is able to shift ratchet rod **500** to the right. This expansion of the chain results in a continuing step-by-step adjustment of rod **500** to the right, pawl **532** dropping in front of successive ratchet teeth **530** as the adjustment proceeds step by step.

When it is desired to shut down the line, cooling of the chain will cause the chain to contract, thus increasing the chain tension by virtue of the fact that sprocket **444** cannot move to the left to relieve the tension because of the engagement between pawl **532** and the aligned ratchet tooth. In order to prevent this buildup in chain tension upon machine shutdown, a system for automatically releasing the ratchet mechanism upon shutdown is provided.

Pawl **532** is connected, at its upper end, to the armature **540** of a solenoid **542**. An extension **544** on the upper end of armature **540** projects upwardly beyond solenoid **542**, and a cross-pin **546** is fixedly mounted at the upper end of extension **544**. Referring to FIG. 31, it is seen that cross pin **546** is normally disposed within the arm section of a T-shaped slot **548** in a slide plate **550**. Plate **550** is mounted for sliding movement from left to right as viewed in FIGS. 28 and 31 between a pair of stationary plates **552** and **554** which are fixedly mounted upon the machine frame. As best seen in FIG. 28, the lower fixed plate **552** is bored as at **556** to provide free passage for extension **544**, while the upper fixed plate **554** is formed with a transversely extending slot **558** which provides clearance for free upward movement of extension **544** and cross-pin **546**.

Referring to FIG. 31, an elongate slot **560** formed in plate **550** provides clearance for a fixed post **562** secured to and extending between upper and lower fixed plates **554, 552**. A compression spring **564** is engaged between post **562** and the right-hand end of slot **560** to resiliently bias plate **550** to the right as viewed in FIGS. 31 and 28.

When solenoid **42** is in its normal, de-energized position, its armature **540** and extension **544** are in the position shown in FIG. 28, in which cross pin **546** is engaged in the arm section of T-shaped slot **548** to prevent slide plate **550** from moving to the right under the biasing action of spring **564**.

When the machine is shut down, solenoid **542** is energized and elevates its armature **540** and extension **544** upwardly to a position where cross pin **546** is located above slide plate **550**. With cross pin **546** disengaged from T-shaped slot **548**, slide plate **550** is free to move to the right from the FIG. 31 position, the leg portion of T-shaped slot **548** clearing the extension **544**, until the left-hand end of slot **548** engages the extension **544**. When solenoid **542** is subsequently de-energized, spring **538** attempts to pull the solenoid armature downwardly, however, cross pin **546** is no longer aligned with the arm portion of slot **548** and thus cannot move downwardly, thereby retaining pawl **532** in a position withdrawn clear above ratchet rod **500**.

When the machine is subsequently started up, a second solenoid **566** is momentarily energized to pull slide plate **550** to the left to return the arm portion of T-shaped slot **548** into vertical alignment with cross pin **546**. As soon as this occurs, spring **538** pulls extension **544** downwardly to again position cross pin **546** within the arm portion of slot **548**, and restoring pawl **532** into engagement with the ratch teeth **530** on rod **500**.

## CHAIN LUBRICATION SYSTEM

Details of chain lubrication system **92** are shown in FIGS. 18 through 23. Referring first to FIG. 18, lubrication mechanism **92** includes a rotary member in the form of a four-armed star wheel **580** mounted upon a shaft **582** rotatably supported in machine frame F. The axis of rotation of shaft **582** is coincident with the center of curvature of the constant radius section of end turn **90**, and as indicated in FIG. 18 the radial length of the arms of wheel **580** is such that the wheel is driven in rotation by the engagement of chain pins **108** in notches **584** formed in the distal end of the arms. One arm **586** of the wheel **580** carries the cylinder of a pneumatic motor **588** whose piston rod **590** carries a lubricant discharge fitting designated generally **592**. A conduit **594** connects the head end of the cylinder of motor **588** to an air passage **596** bored in shaft **582**, while a lubricant conducting conduit **598** is connected between lubricant discharge fitting **592** and a second passage **600** in shaft **582**.

Referring now to FIG. 19, it is seen that one end of shaft **582** is supported in a bearing assembly **602** in machine frame F and projects outwardly through bearing **602** to the exterior of the machine frame. At the outer end of shaft **582**, a rotary coupling union **604** connects passages **596** and **600** in shaft **582** to stationary conduits **606** and **608** respectively, conduit **606** conducting air under pressure to or from motor **588**, while conduit **608** is connected, in a manner to be described below, to supply lubricant to lubricant discharge fitting **592**.

A second pneumatic motor **610** has its cylinder fixedly mounted upon machine frame F. The piston rod **612** of motor **610** is connected to a slide bracket **614** which is mounted for sliding movement upon machine frame F guided by a gib assembly designated generally **616**. Bracket **614** carries a three-way valve **618** having a shiftable valve actuating member **620** which carries a cam follower member **622** which includes a follower roller **624**. Roller **624** can be positioned to ride on the periphery of an actuating cam **626** fixedly secured to and rotatable with shaft **582**. As best seen in FIG. 21, cam **626** is formed with a reduced diameter section **628** extending around the major portion of the cam periphery, and an enlarged section or lobe **630**.

The operation and interrelationship of the various components described thus far is best explained by reference to the schematic diagram of FIG. 22 which shows the air and lubricant supply systems. Referring to FIG. 22, a source of air under pressure is schematically illustrated at **632**, while a supply of lubricant is indicated at **634**. The system as shown in FIG. 22 is shown in its inoperative or non-lubricating condition.



Air under pressure from source **632** is conducted via conduit **636** to an inlet port of a solenoid actuated spring return four-way reversing valve schematically illustrated at **638**. Valve **638** controls the venting and supply of pressure to motor **610** via head end and rod end conduits **640** and **642** respectively. In the non-lubricating condition shown in the diagram of FIG. 22, the solenoid which controls valve **638** is de-energized, and the valve spring positions the valve to connect pressure conduit **636** to head end conduit **642** of motor **610**, while at the same time connecting rod end conduit **640** to the exhaust port of valve **638**. This set of connections establishes a condition which maintains the piston rod **612** of motor **610** in its fully retracted position which withdraws mounting bracket **614** and valve **618** to the left as viewed in FIG. 22 to a position such that cam follower roller **624** on valve actuator **620** is drawn clear of actuating cam on rotary shaft **582**.

A second pressure conduit **644** is connected between air pressure source **632** and the inlet port of three-way valve **618**. Actuator **620** is biased by a spring within valve **618** to its extreme right-hand limit of movement, at which the valve inlet port connected to conduit **644** is blocked. An outlet port of valve **618**, in this position of actuator **620** is connected within the valve to a vent port V.

Conduit **646** is connected directly to conduit **606** which, via rotary coupling union **604**, passage **596** and conduit **594** is connected to the head end of pneumatic motor **588**. As indicated in FIG. 22, motor **588** is of the spring return type, hence the connection shown in FIG. 22 which vents the head end of motor **588** via valve **618** enables its spring to bias piston rod **590** to its fully retracted position, thus locating discharge fitting **592** retracted clear of lubricant receiving fittings **112** on link pins **108**.

Conduit **646** is also connected via a sequence valve **650**, which functions as a flow restrictor, and a conduit **652** to the air chamber **654** of a lubricant pump **656**. Pump **656** also includes a lubricant chamber **658** which is connected to lubricant supply **634** via conduit **660** and also connected via conduit **608**, rotary union **604**, passage **600** and conduit **598** to lubricant discharge fitting **592**. In the absence of air under pressure in air chamber **654**, no pressure is applied to the piston interface **662** between air chamber **654** and lubricant chamber **658** of lubricant pump **656**. Discharge of lubricant from discharge fitting **592** in this condition is prevented by a spring-loaded check valve **664**, see also FIG. 23.

To shift the system of FIG. 22 to its lubricant supplying condition, the solenoid of valve **638** is energized to reverse the connections of valve **638** from those illustrated in FIG. 22—that is to connect pressure conduit **636** to head end conduit **640** while at the same time connecting rod end conduit **642** to vent. This set of connections causes piston rod **612** of motor **610** to be driven to the right from the FIG. 22 position to shift valve **618** bodily to the right as viewed in FIG. 22, thus moving actuating roller **624** of valve actuator **620** into engagement with the periphery of cam **626**. This position of the valve, actuator and cam is that shown in FIGS. 19 and 20. Referring briefly to FIG. 21, when motor **610** has been actuated to position follower roller **624** in engagement with the periphery of cam **626**, the small diameter section **628** of the cam will merely rest against roller **624** while valve actuator **620** stays in the extended position illustrated in FIG. 22. However, when cam **626** is rotated to a position where its large diameter lobe **630** is engaged with roller **624**, valve actuator **620** is shifted to the left from the position illustrated in FIG. 22, which action seals vent port V and connects conduit **644** to conduit **646**.

Referring to FIG. 18, the angular position of lobe **630** upon shaft **582** is fixed with respect to that arm **586** which carries pneumatic motor **588**. The orientation of roller **624** is such that it is engaged and depressed by lobe **630** only when arm **586** has a link pin **108** in seated engagement with its notch **584**. The angular extent of lobe **630** about the axis of shaft **582** is such that valve actuator **620** will be depressed while arm **586** is moving with an aligned link pin **108** from approximately the 7 o'clock position of FIG. 18 to the 11 o'clock position.

As stated above, depression of valve actuator **620** by lobe **630** of the operating cam directly connects pressure conduit **644** to conduit **646**, and air under pressure promptly flows from conduit **646** through conduit **606**, rotary union **604**, passage **596** and conduit **594** to the head end of motor **588**. The supply of pressure to motor **588** causes its piston rod **590** to stroke outwardly, thereby driving the attached lubricant discharge fitting **592** into seated engagement with the lubricant receiving fitting **112** on that chain pin **108** which, at this time, is operatively engaged by arm **586**.

Air under pressure also flows from conduit **646** through sequence valve **650** and conduit **652** into air chamber **654** of the lubricant pump **656**. The pressurizing of air chamber **654** is delayed by sequence valve **650** so that no effective pressure is supplied to lubricant pump **656** until after discharge fitting **592** has been seated upon lubricant receiving fitting **112**.

Upon the supply of pressure to air chamber **654**, interface piston **662** is driven to the right a preselected distance to discharge a charge or pulse of lubricant under pressure into conduit **608**, this pressure pulse of lubricant passing through rotary union **604**, passage **600** and conduit **598** into discharge fitting **592**. The pressure of lubricant thus supplied to fitting **592** is sufficient to unseat ball check valve **664** and the lubricant flows from discharge fitting **592** into the receiving fitting **112** on link hub **98**. As explained above, lubricant is distributed axially within link pin **108** by the wick **128** carried in the interior of the pin.

At a point in time before arm **586** is disengaged from the chain pin, lobe **630** of the cam **626** rotates past actuating roller **624** which then drops onto the small diameter section **628** of the cam, thereby permitting valve actuator **620** to return to the position illustrated in FIG. 22. This action connects conduit **646** to vent port V, thereby venting motor **588** and air chamber **654**, the venting of motor **588** retracting lubricant discharge fitting **592** clear of the fitting **112** on the chain pin. With air chamber **654** of the lubricant pump vented, the pressure on the lubricant side of interface piston **662** is insufficient to unseat ball check valve **664**.

Returning to FIG. 18, it is seen that the adjacent arms of wheel **580** engage every fourth chain pin **108**, and because lubricant fitting **592** is mounted on only one of the four arms, this means that in the disclosed embodiment while the lubrication system is in operation, it lubricates every sixteenth link pin. Where this relationship is employed, chain **40** is formed with a number of link pins which exceeds an even multiple of sixteen by one. In the machine shown in this application, one hundred and seventy-seven link pins **108** are employed, and thus the lubrication system when operating will lubricate every pin in the chain once before lubricating any one pin twice.

Normally, the lubrication system is operated only periodically during operation of the machine, preferably under the control of an automatic timer.

## OPERATION

In order to prepare the machine for operation, chucks **42** and main burner **74** are first set up for the particular size of container which is to be handled. Chucks **42** are set up by mounting upon the chucks the particular spacer **188** and fulcrum plate **174** which correspond to the dimensions of the container to be handled. As explained above, the spacers **188** and fulcrum plate **174** are detachably assembled upon the end of the main chuck shaft **150** so that this initial portion of the setup can be conveniently performed without requiring any major disassembly of the chucks.

Transverse spacing of the main burners is accomplished



by appropriate adjustment of jacks **292**, which locate the burners horizontally to establish the spacing between the burners and the path of travel of the containers. Jacks **318** position the burners vertically relative to the containers to establish a fine adjustment of the location of the line on which the containers are burned off. Pivotal adjustment of the burners to establish a desired inclination of the direction of the flame jets to the horizontal is accomplished by jacks **322**.

During their passage through the burners, particularly during the moil severing step, the containers are passed directly through the flame jet in order that the container may contact the high temperature portion—i.e. the tip of the blue "inner cone"—of the flame. The presence of the container within the flame jet disturbs its configuration, much in the same manner as when a stream of water from a hose strikes a wall. By inclining the direction of the flame jet to the horizontal, by adjustment of jacks **322**, it is possible in some instances to control the temperature distribution on the container more precisely in the axial direction, thus achieving a more precise severing action.

With the foregoing adjustments made, the entire line is started up, with main drive motor **48** driving main drive sprocket **46** at a speed such that movement of chucks **42** along their endless path is synchronized accurately with the container handling elements of transfer machine **66** and take-out pocket conveyor **84**. This synchronism is accomplished by buttons **126** on chain **40** which, at some point along their path, pass beneath a proximity sensor, not shown, which is connected into the control system of motor **48**. Similar buttons and proximity sensors are employed on transfer machine **66** and take-out conveyor **84** and fed into a computer which automatically regulates the speed of motor **48** and of the drives of transfer machine **66** and take-out conveyor **84**.

Because of the relatively high temperatures of the containers as they are handled on the burn-off machine, as well as the temperatures generated by pre-heat burner **70** and main burner **74**, a certain period of operation is required before steady state temperature conditions are achieved in all parts of the machine. During this initial start-up period, thermal expansion of both chain **40** and the machine frame will be encountered, thus requiring changes in the chain tensioning adjustment until steady state temperature conditions are achieved. Normally, this will require some manipulation of jack **60**, which shifts main drive sprocket **46** to increase or decrease the chain tension.

After steady state operation of the machine has been achieved, some further final adjustments of the burner elements **304** of main burner **74** may be required.

With all initial adjustments made and steady state operation achieved, chucks **42** approach loading point L with their gripping fingers **192** latched in their open position. At this time, the chuck actuating levers **222** are in their lowermost position and releasably latched in this position by the engagement of their shaft **230** within latching notch **258** on latch lever **252**. As each chuck approaches loading point L, it is moved into underlying registry with a container suspended in an upright position on transfer machine **66**. As the aligned container and open chuck **42** move along in vertical registry, the container is lowered by transfer machine **66** until the container bottom engages container seat **186**. The transfer machine support fingers continue to lower, as described in detail in the aforementioned Banyas application Ser. No. 825,850, thereby transferring support of the container to the chuck, and at this time latch roller **260** on the chuck latch assembly **250** is engaged by a stationary cam **68** on the machine frame which acts to release the latch, thereby permitting gripping fingers **192** on the chuck to close on the container under the action of chuck spring **220** which is cushioned by a second cam section which engages roller **240** to prevent the fingers from snapping shut. The fingers close uniformly to grippingly support the container on the chuck seat with the vertical axis of symmetry of the container coaxially aligned with the axis of chuck shaft **150**.

The chuck then advances the container along the upper run, through pre-heat burners **70**, the stationary chain of spin cycle mechanism **72** engaging the chuck sprockets **170** to rotate the chuck and supported containers.

The chucks then pass around end turn **56**, inverting themselves and the container as they pass onto the lower run of the machine and into the entrance of main burner **74**.

As the chucks enter main burner **74**, their sprockets **170** are engaged by the endless chain **440** of spin cycle mechanism **76**. The rate of rotation of the chucks by spin cycle mechanism **76** is determined by the algebraic difference between the speed of movement of the chucks and the speed and direction in which chain **440** of spin cycle mechanism **76** is driven.

The rate of rotation of the container during its passage through burners **74** is of concern primarily in the finish forming step performed by burners **74**, where a certain amount of centrifugal force is necessary to achieve the desired bead formation on the outside of the finish. Some compromise is necessary here, because a high rate of rotation during the moil severing operation is not desirable due to the fact that the moil may not be truly symmetrical. As explained in more detail in the aforementioned Heaton et al. application Ser. No. 24,721, the container and moil are initially formed integrally with a glass ribbon and are separated from the ribbon by a cracking off operation which results in a jagged fracture type edge on the moil which may be unsymmetrical to a point creating an unbalanced condition. For optimum severing, it is desired that the moil separate from the container body portion simultaneousy around the entire circumference. When the moil is unbalanced, a high rate of rotation of the chuck will tend to cause the unbalanced moil to hinge, thus resulting in a distorted finish.

The initial adjustment of the burners is thus set up to apply a high intensity heating action to the containers during the initial or upstream portion of their passage through burners **74** to sever the moil as rapidly as possible, thus minimizing problems created by unbalanced moils. To this end, the burners at the upstream end of main burner **74** may be supplied with a fuel, such as a gas-oxygen mixture, which produces an extremely high-temperature flame, and the flame ports of the burners at the upstream end of burner **74** may also employ a narrower burner shim **344** to achieve a narrower and thus more highly concentrated flame. Preferably the burners are so regulated as to assure severance of the moil before the container has moved more than halfway through burner **74**.

The remaining portion of burner **74** is set up to form the beaded finish on the container after the moil has been severed. As explained above, the rate of rotation of the container, combined with the heating action applied by the burners is adjusted to work the finish into the desired form. In forming the finish, it may be desirable to apply heat over a somewhat wider band on the container and to operate with somewhat lower flame temperatures than those employed in the severing operation. Thus, the burners at the downstream or finish forming section of burner **74** may employ a somewhat thicker shim **344** and may be supplied with a different fuel mixture—i.e. a gas-air mixture—to achieve a lower flame temperature.

After the finish has been formed, the containers leave main burner **74** and pass through a finish inspection station **78** which inspects the freshly formed finish for flaws. In the event a container with a flawed finish is detected at station **78**, the station actuates a reject mechanism which inserts a cam into the path of movement of the actuating roller **248** of the chuck carrying the flawed container. The cam causes depression of the actuating lever **222** carrying roller **248** to depress the lever to open the gripping fingers **192** of the chuck. The lever **222** is latched in its depressed or chuck open position by latch assembly



**250** to permit the container to drop freely from the inverted chuck. Gripping fingers of a chuck **42** actuated at inspection station **78** remain latched in their open position until they again reach the loading point L.

Chucks carrying containers having satisfactory finishes are not opened at inspection station **78**, but proceed to the right along the lower run of the conveyor as viewed in FIG. 1 and pass on to the downwardly inclined track section **80**, with the containers maintained in vertical alignment with a pocket **82** on the synchronized pocket conveyor **80**. During their passage down inclined track section **80**, the chuck and container axes are maintained in a vertical position by track **164** which guides rollers **162** on the chuck housing. The relationship of track **164** to inclined track section **80** is such that the chuck housing **140** is pivoted slightly about the axis of the link pin upon which it is supported to maintain the axes in true vertical position. The containers, as they pass down inclined section **80** are lowered partially into the pockets of conveyor **84**. At the lower end of inclined section **80**, a stationary cam **86** on the machine frame engages the chuck actuating rollers to open the chucks which are immediately latched in the open position by latches **250**. The container drops freely the remaining distance into the aligned pocket **82** of the pocket conveyor. The chucks latched in their open position until they again reach loading point L.

While we have described one embodiment of our invention it will be apparent to those skilled in the art that the disclosed embodiment may be modified. Therefore, the foregoing description is to be considered exemplary rather than limiting and the true scope of the invention is that defined in the following claims.

We claim:

**1.** in a method of making a hollow glass article having a beaded finish at one end wherein the article is initially formed as an article blank symmetrical about a vertical axis having a moil portion integral with the upper end of the body of the article, and the freshly formed article blank is grasped by the moil portion and transported in an upright portion along a first path until the body of the article blank has cooled to a temperature of between 900° and 1000° F. so that the body of the article blank may be handled without deformation; the improvement comprising the steps of lowering the article blank in an upright position with the moil uppermost while at a temperature of between 900° and 1000° F. into a moving chuck operable to grip the body of the article blank at a location remote from the moil, inverting the chuck and gripped article blank and conveying the article blank in an inverted position with moil portion lowermost along a horizontal path while rotating the article about its vertical axis, heating a narrow band of the inverted blank at the junction of the moil and body portion of the blank as the blank is conveyed along a first portion of said horizontal path to sever the moil from the body portion and cause the severed moil to drop freely from the blank, and heating the severed edge on the body portion while continuing to rotate the body portion to form a finish on the severed edge as the body portion traverses a second portion of said horizontal path.

**2.** The method of claim **1** further comprising the step of passing the article blank through a controlled temperature zone prior to conveying the article along said first portion of said path to establish the temperature of said blank in the region of said narrow band at a temperature of between 800° F. to 900° F. as said blank enters said first portion of said path.

**3.** Apparatus for forming a finish on a hollow glass article blank symmetrical about a central vertical axis and having a body portion integrally joined at its upper end to a moil portion comprising a plurality of article blank supporting chuck assemblies linked to each other in uniformly spaced succession in an endless chain, means for supporting and driving said endless chain of chuck assemblies in continuous movement along an endless path having vertically aligned horizontal upper and lower runs, each of said chuck assemblies being operable to releasably grip the body portion of an article blank to support the blank in an upright position with the moil portion uppermost on said upper run and in an inverted position with the moil portion lowermost on said lower run, loading means for loading article blanks in an upright position into said chuck assemblies as said chuck assemblies are driven past a loading station on said upper run, opposed horizontally elongate burner means extending along opposite sides of said path on said lower run, said burner means having a first upstream section for thermally severing the moil portions from article blanks passing therethrough and a second downstream section for forming a finish on the thermally severed edge of the body portion of the blank, means for driving the supported article blanks in rotation about the blank axes at a preselected rate during their transit past said burner means, and release means adjacent said lower run of said endless path at a location downstream of said path from said burner means for causing the chuck assemblies to drop the articles.

**4.** Apparatus as defined in claim **3** wherein said loading means support said blanks from their respective moil portions while said blanks are at a temperature of approximately 900° to 1000° F., and heating means extending along the path of movement of said blanks from said loading station to said burner means to establish said blanks at a temperature of approximately 800° to 900° F. as the blanks enter said burner means.

**5.** Apparatus as defined in claim **3** wherein each of said chuck assemblies comprises a pair of chucks mounted on a common housing one behind the other, the spacing between adjacent chucks on adjacent assemblies being equal to the spacing between the two chucks on one assembly.

**6.** Apparatus as defined in claim **3** wherein each chuck on each assembly is operable independently of the other.

**7.** Apparatus as defined in claim **3** wherein said means for driving the supported article blanks in rotation during their transit past said burner means comprises means for varying the rate of rotation of said article blanks independently of the speed of movement of said blanks along their path of movement.

**8.** Container handling apparatus comprising a conveyor frame, spaced opposed channel shaped track means mounted on said frame to define an endless path having vertically aligned horizontal upper and lower runs joined at their opposite ends by curved end turns, an endless chain comprising a plurality of pairs of transversely spaced elongate rigid links, transversely extending link pins in said chain pivotally interconnecting the pairs of links to each other in head-to-tail relationship with said pins projecting outwardly beyond said links, support roller means rotatably mounted on the outer ends of each link pin and respectively received in said opposed track means to support and guide said chain in movement along the endless path defined by said track means, a sleeve rotatably mounted on each link pin between each pair of links, a plurality of container supporting chuck assemblies each comprising a chuck frame releasably clamped at its forward end to one of said sleeves, guide roller means on the rearward end of said chuck frame, guide track means on said conveyor frame engaged with said guide roller for supporting and guiding said chuck frame during movement around said endless path, means on said chuck assemblies for supporting a container in an upright position on said upper run and in an inverted position on said lower run, opposed elongate burner means extending along said lower run on opposite sides of the path of movement of a container for thermally working the container, first drive roll means on each of said link pin means between each support roller means and the adjacent link, second drive roll means on each link midway between the adjacent link pins, and drive means on said conveyor frame



engageable with said first and second drive roll means for driving said chain along said endless path.

**9.** Apparatus as defined in claim **8** wherein said sleeve is supported for limited axial movement on said link pin, a guide shoe on said chuck frame, and guide means on said conveyor frame slidably engageable with said shoe for shifting said chuck frame and said sleeve axially of said link pin to precisely locate the chuck assembly transversely of the chain during transit of said burner means.

**10.** Apparatus as defined in claim **8** further comprising means in said drive means for adjustably regulating the tension in said chain over that portion of its path extending through said burners independently of the tension in said chain on other portions of its path.

**11.** A burnoff machine for severing a moil portion from the body portion of a hollow glass article blank comprising endless conveying means for conveying article blanks in succession along an endless path having vertically spaced horizontal upper and lower runs, chuck means on said conveying means for supporting article blanks with their moil portions uppermost during transit of said upper run and supporting the blanks in an inverted position with the moil portion lowermost during transit of said lower run, burner means for severing the moil from the body of the blank and forming a container finish on the severed edge of the body comprising a pair of horizontally elongate burner elements mounted in parallel opposed relationship along opposite sides of said fixed path, each of said burner elements having means for directing a linear row of vertically narrow flame jets toward article blanks passing along said fixed path between said elements, first support means mounting said burner elements for independent adjustment horizontally toward and away from said fixed path, second support means mounting said burner elements for independent vertical adjustment, and third means for pivotally adjusting each burner element about a horizontal axis parallel to said fixed path.

**12.** The invention defined in claim **11** wherein said first support means comprises a fixed frame assembly having a pair of spaced parallel fixed frame members extending horizontally below said fixed path in perpendicular relationship thereto, a pair of horizontal movable frame members extending between and slidably supported upon said fixed frame members in parallel relationship to said fixed path, and adjustment means for independently slidably positioning said movable frame members upon said fixed frame members.

**13.** The invention defined in claim **11** wherein said second support means comprises a pair of elongate shafts extending parallel to said fixed path, one of said burner elements being detachably mounted on each of said shafts, a pair of support brackets mounting each of said shafts upon said first support means, and means for raising and lowering said shaft and support brackets upon said first support means.

**14.** The invention defined in claim **13** wherein said third means comprises means for rotatably adjusting said shaft within said pair of support brackets.

**15.** The invention defined in claim **11** wherein each of said burner elements comprises a plurality of elongate burner units, and coupling means detachably securing the units of each burner element in aligned end-to-end relationship.

**16.** The invention defined in claim **11** wherein said burner means comprises a plurality of pairs of burner elements extending in series along said fixed path, said conveying means being operable to convey said blanks successively between a first group of said pairs of elements and then past a second group of said pairs of elements, said means for directing flame jets from said first group of elements being operable to sever the moil from the body of the blank, and means for regulating the flame jets of the burner elements of the second group to form a finish on the severed edge during passage of the article through the second group of burner elements.

17. Apparatus for forming a finished edge on a hollow glass article blank symmetrical about a central vertical axis and having a body portion integrally joined at its upper end to a moil portion comprising endless article blank conveying means for conveying blanks along an endless path having vertically spaced horizontal upper and lower runs with the blank supported in an upright position with the moil portion uppermost while traversing the upper run and supported in an inverted position with the moil portion lowermost while traversing the lower run, loading means for suspending article blanks from their moil portions and loading the blanks in said upright position onto said conveying means at a loading station on said upper run, moil severing means extending along a first section of said lower run for severing the moil from inverted article blanks passing along said first section of said lower run, opposed horizontally elongate burner means extending along opposite sides of a second section of said lower run downstream from said first section for heating the severed edge of article blanks passing between said burner means, and spin cycle means for driving said blanks in rotation about their central axes as said blanks traverse said second section of said lower run to form said severed edge into a finished edge having an outwardly projecting annular bead.

18. Apparatus as claimed in claim 17 wherein said conveying means comprises an endless chain having a plurality of uniformly spaced link pins extending transversely of said endless path, chuck assemblies mounted upon said link pins for pivotal movement about the pin axis and for limited movement axially of the pin, and cooperating guide means on said frame and said chuck assemblies for positioning said chuck assemblies axially of said link pins during transit of said first and said second sections to accurately position said blanks transversely of said path of movement during their passage by said severing means and said burner means.

19. Apparatus as defined in claim 18 further comprising means for tensioning that portion of said endless chain extending along said first and said second sections independently of the tensioning of the remainder of said chain.

20. Apparatus as claimed in claim 17 wherein said severing means and said burner means each comprise a plurality of horizontally elongate burner units each having a horizontally aligned row of flame ports extending along one longitudinal side of said unit, support means mounting said burner unit in a horizontal position parallel to the path of movement of said blanks along said first and said second sections with said one side of said unit facing said path of movement, first and second positioning means on said support means for respectively positioning said burner unit horizontally and vertically relative to said path of movement, and third positioning means on said port means for pivotally positioning said burner unit about a horizontal axis parallel to said path of movement.

21. Apparatus as defined in claim 17 wherein said conveying means comprises a plurality of chuck frames linked together in an endless chain, article blank gripping chuck means mounted on each of said chuck frames for free rotation about an axis normal to the path of movement of said chuck means, said chuck means being adapted to support an article blank with the central axis of the article blank coaxial with the axis of rotation of said chuck means, a sprocket mounted on each chuck means, said spin cycle means comprising an endless sprocket chain having a first run extending along said first and second sections of said path for tangential meshing engagement with the sprockets of said chuck means passing along said first and second sections of said path, and reversible variable speed drive means for driving said endless sprocket chain to thereby drive said chuck means in rotation at a rate dependent upon the algebraic difference between the speed of said sprocket chain and the speed of said endless chain of chuck frames.

**References Cited**

UNITED STATES PATENTS


| | | | |
|---|---|---|---|
| 3,510,287 | 5/1970 | Panczner | 65—70 X |
| 1,857,492 | 5/1932 | Beatty | 65—113 |

FOREIGN PATENTS

| | | | |
|---|---|---|---|
| 66,654 | 11/1950 | Netherlands | 65—113 |


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