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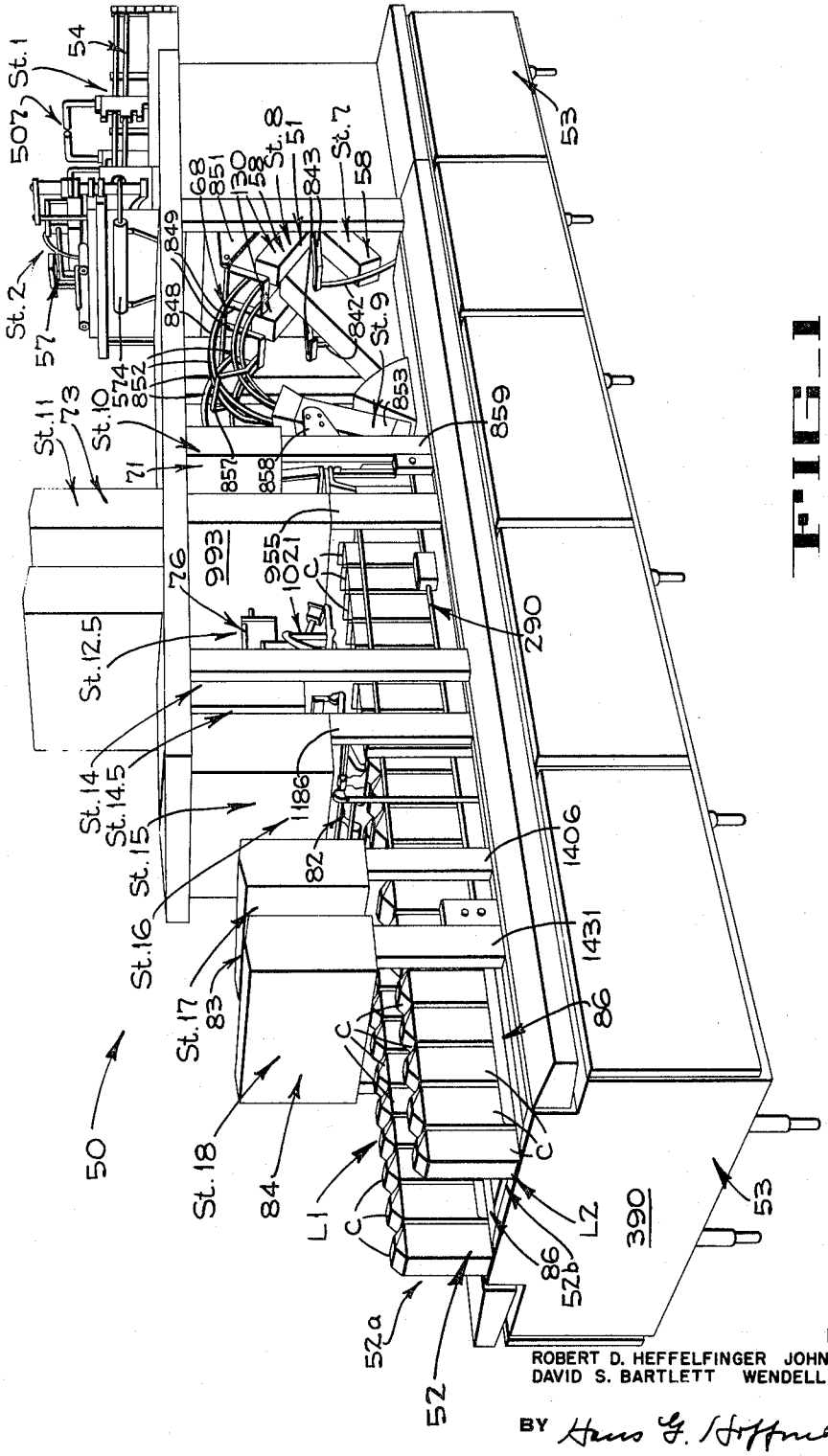


FIG. 1

INVENTORS
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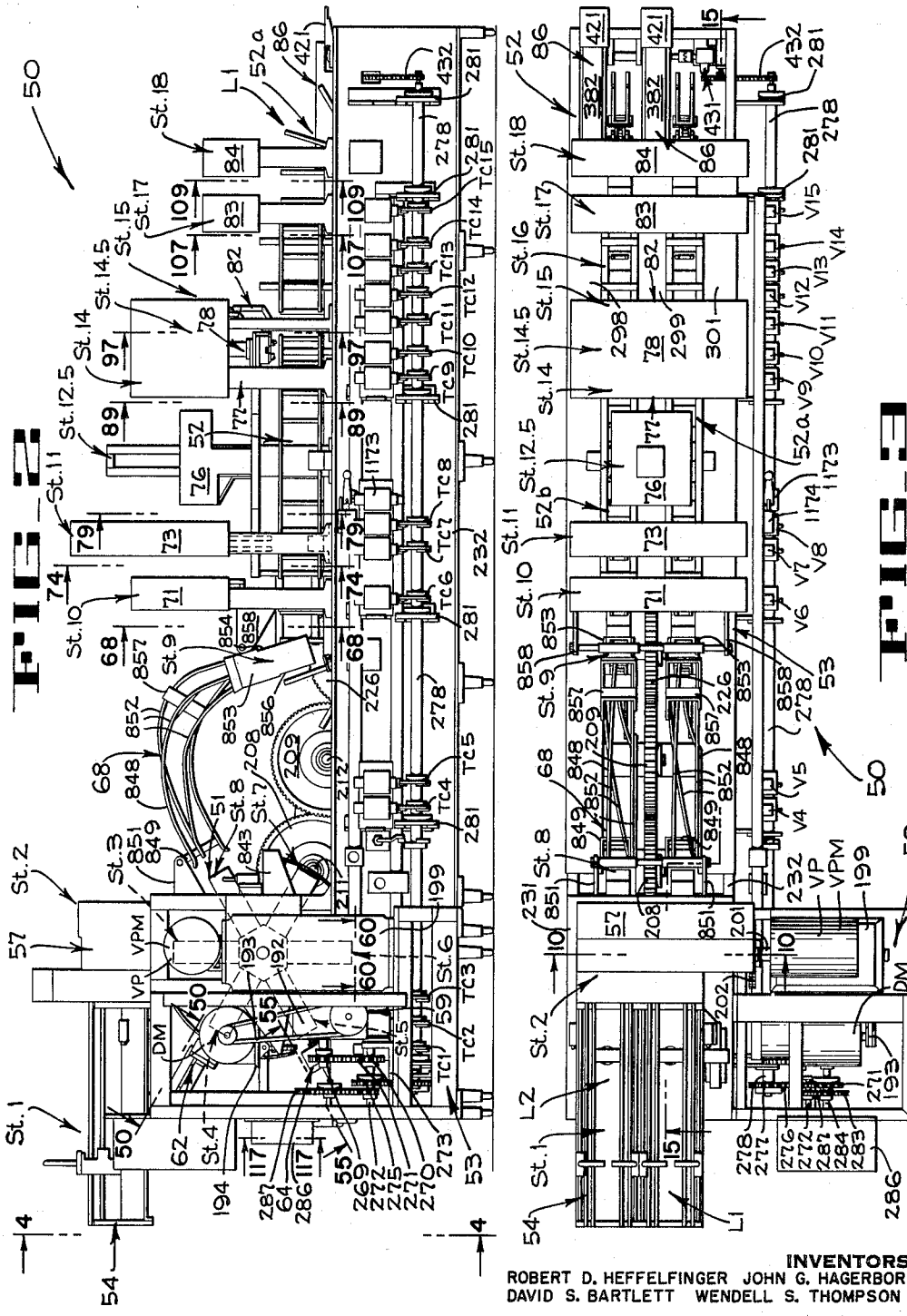


FIG. 2

FIG. 3

INVENTORS
ROBERT D. HEFFELFINGER JOHN G. HAGERBORG
DAVID S. BARTLETT WENDELL S. THOMPSON

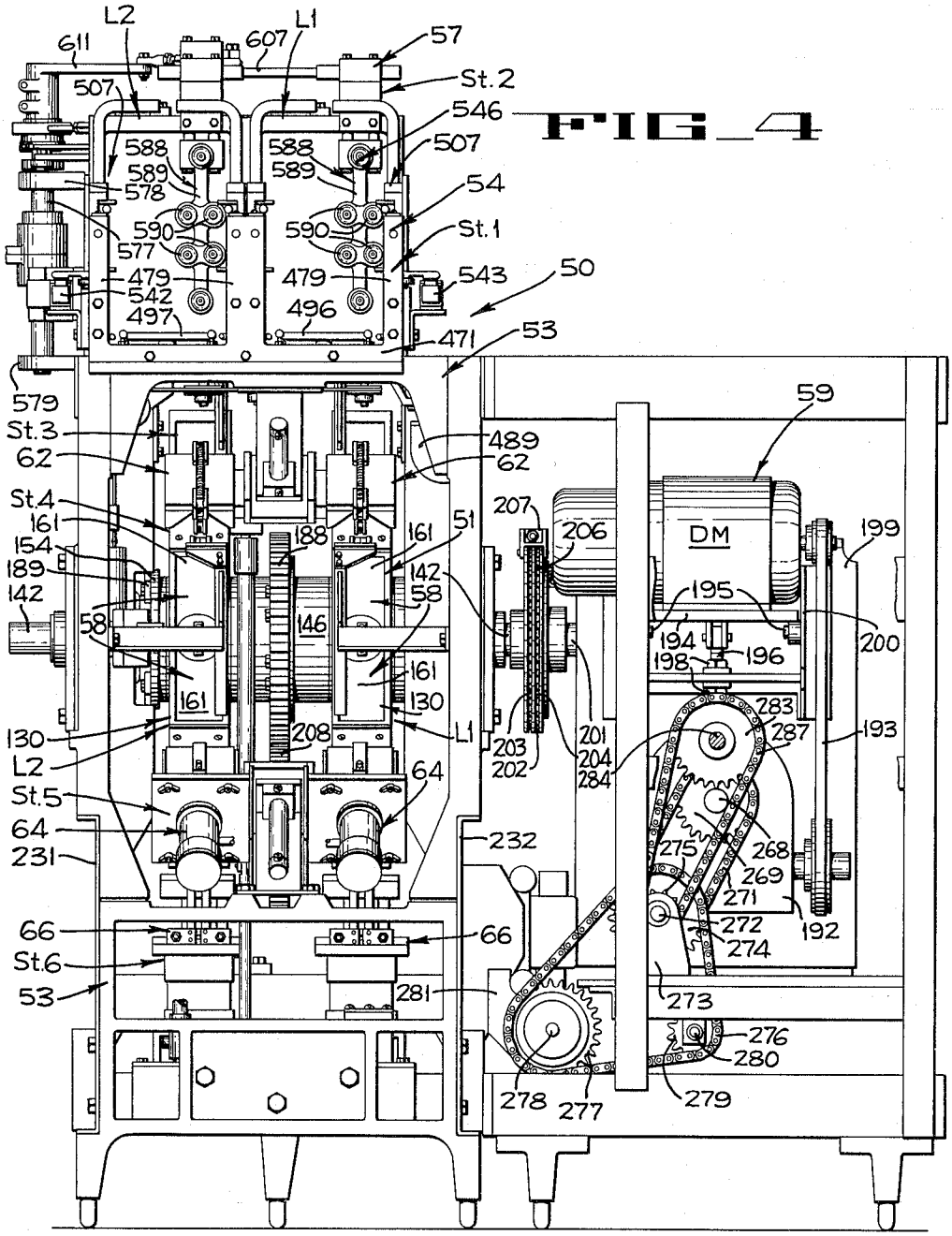
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FIG_4



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FIG_5

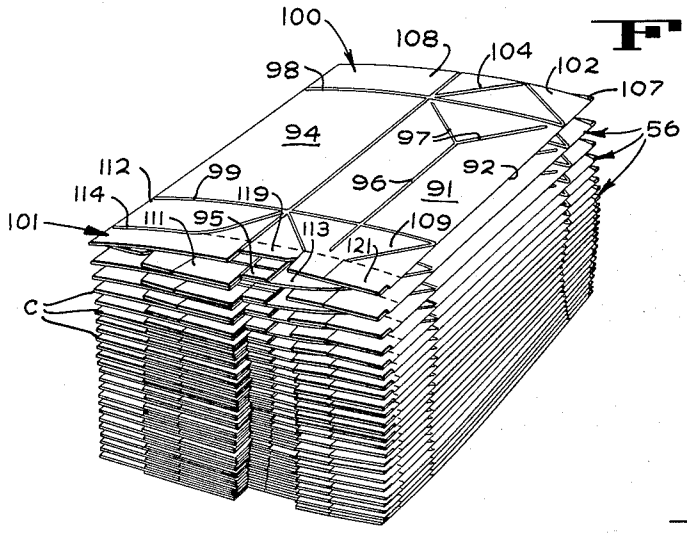
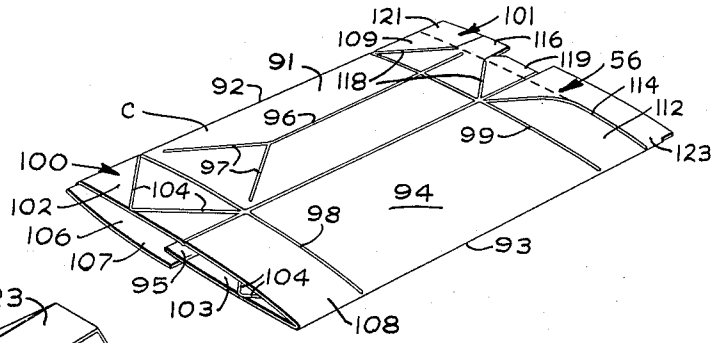


FIG_6



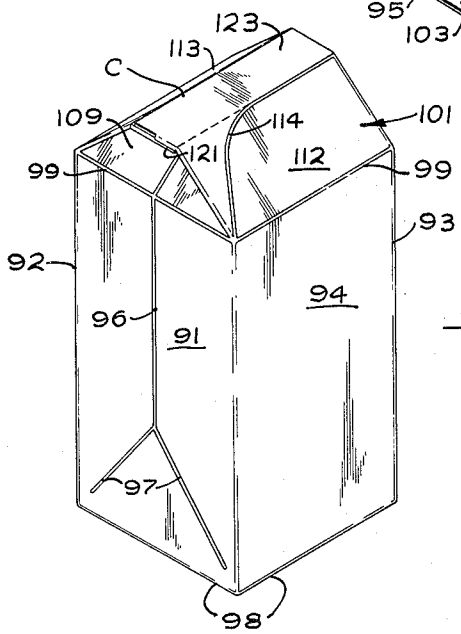


FIG_7

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FIG_8A

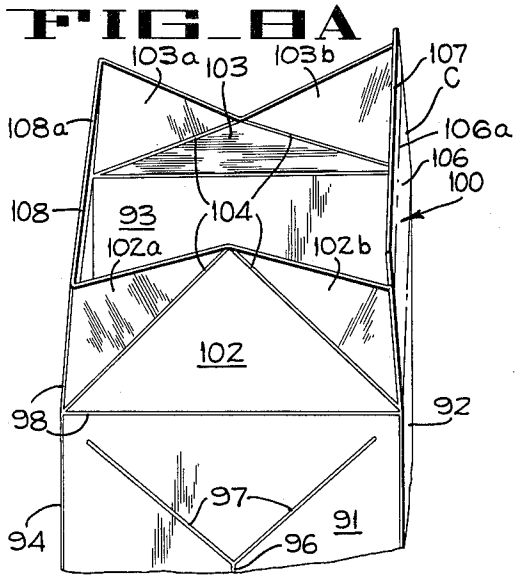


FIG_8B

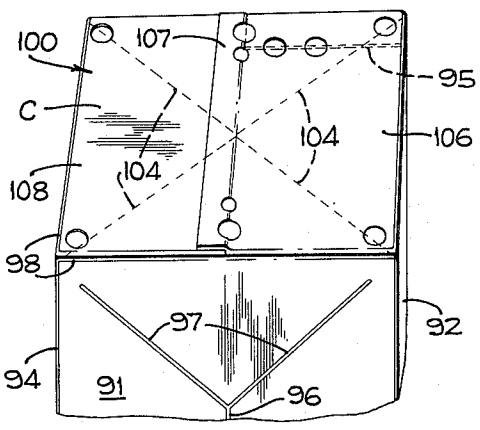


FIG_9A

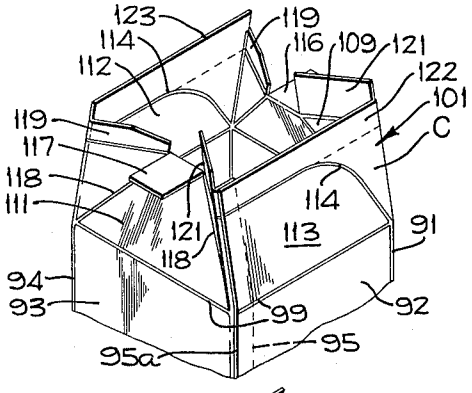
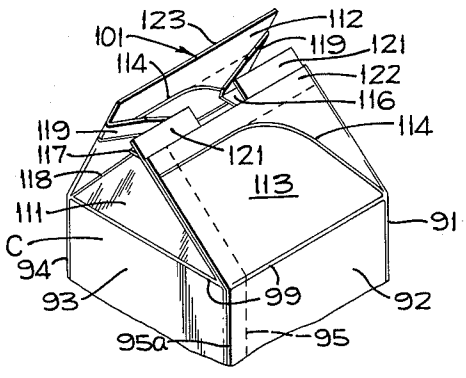


FIG_9B



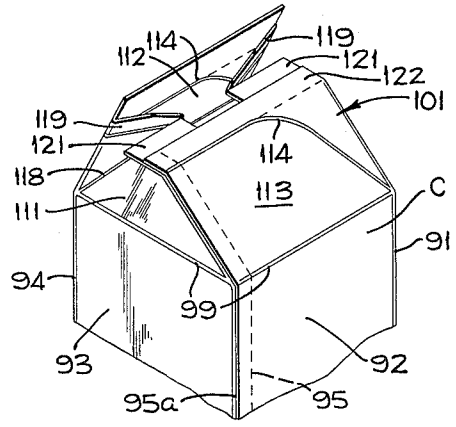
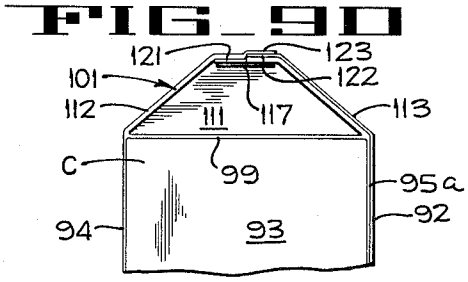


FIG_9C

FIG_9D



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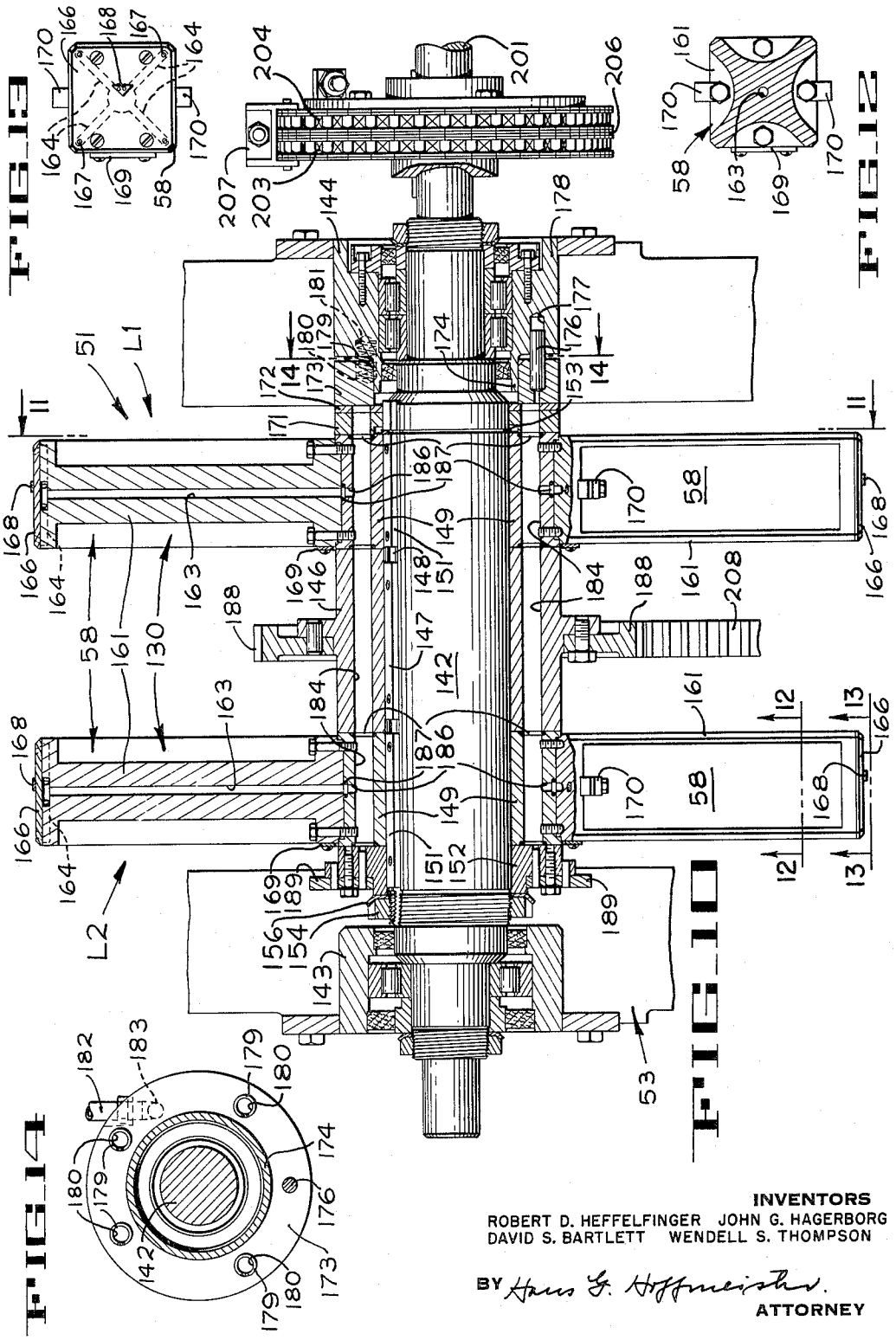


FIG. 13

FIG. 12

FIG. 10

FIG. 14

INVENTORS

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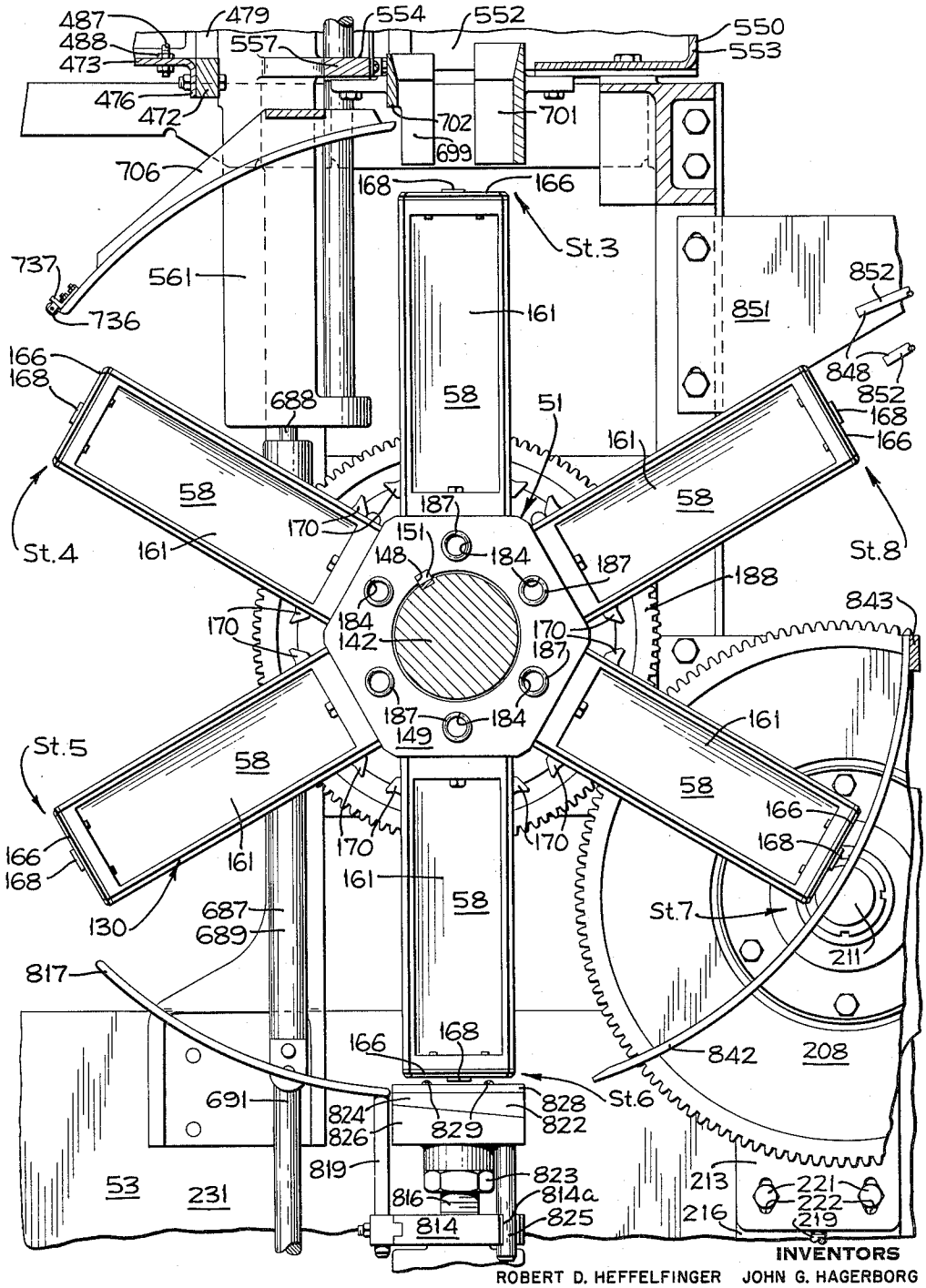


FIG_11

INVENTORS
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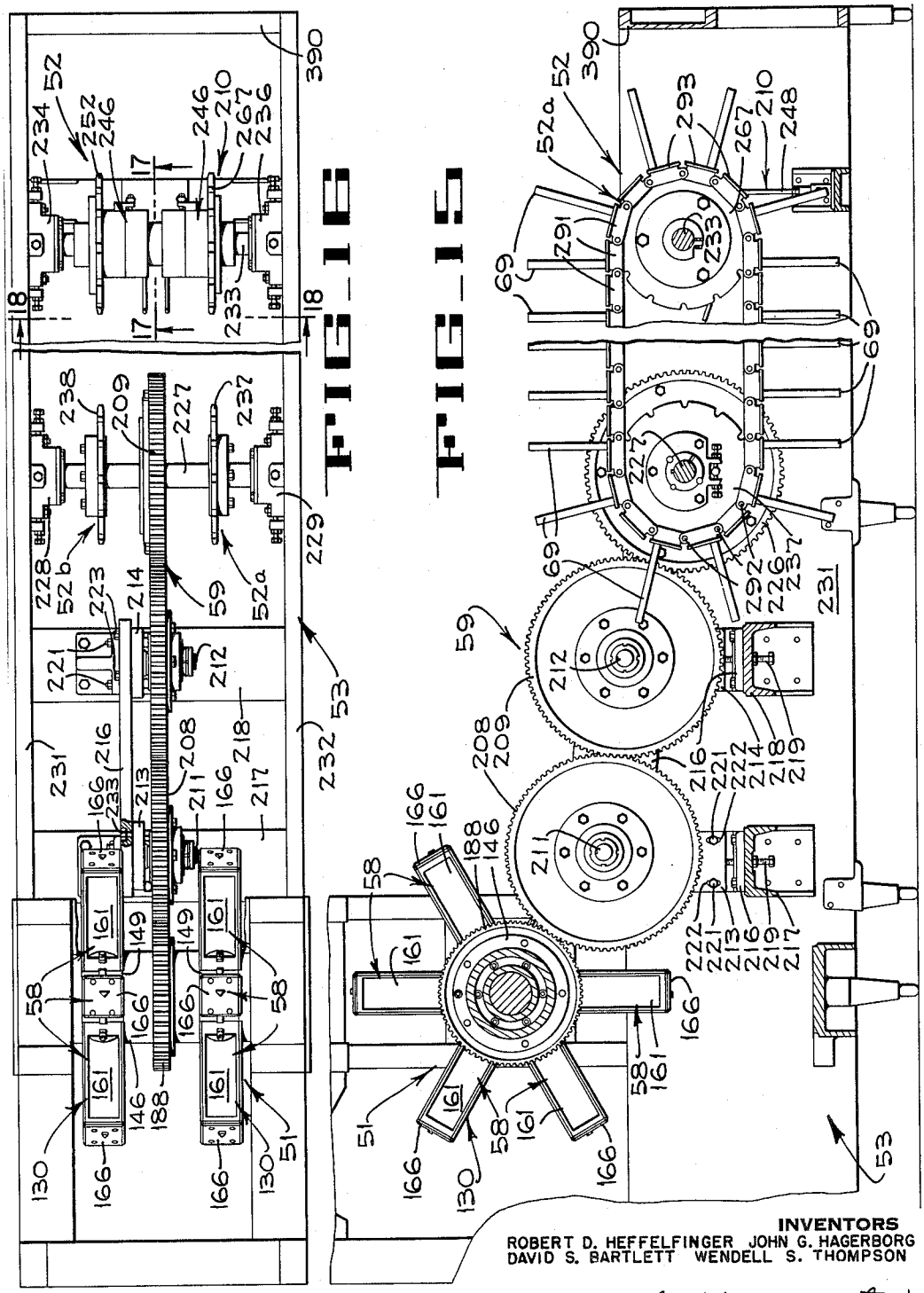
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FIG. 15



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FIG_17

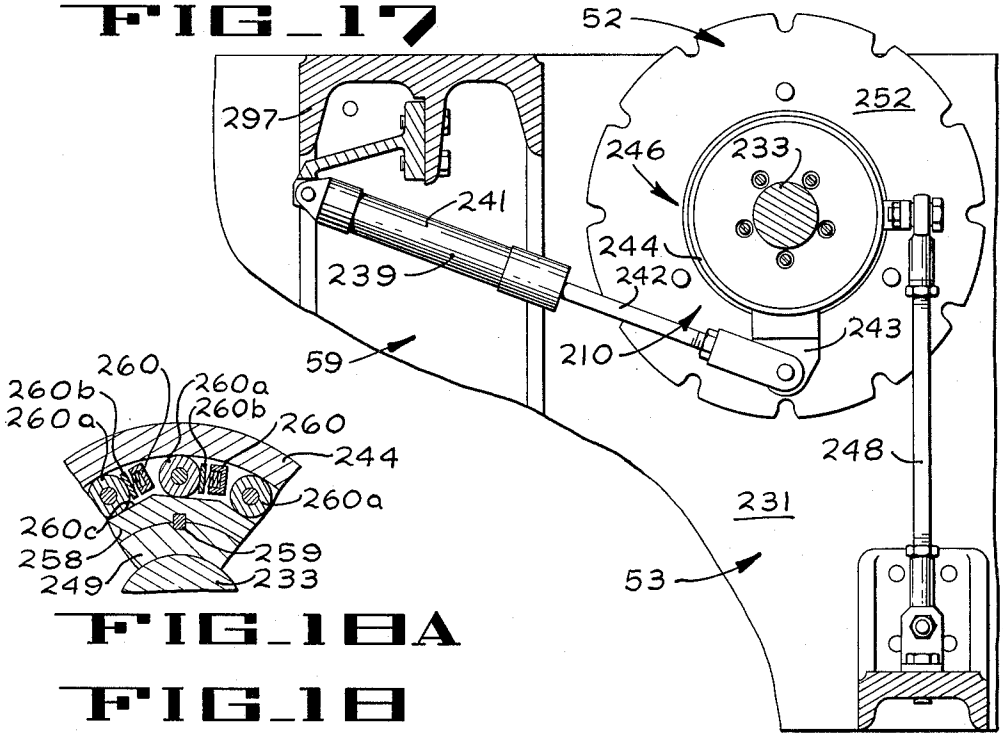
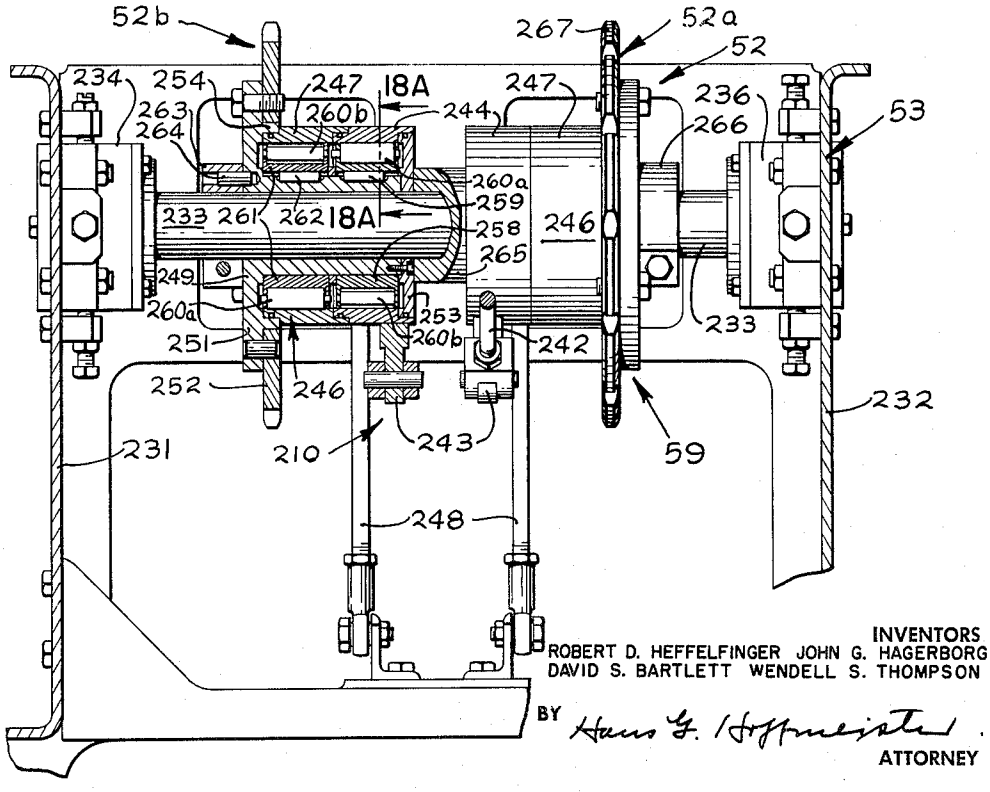


FIG_18A

FIG_18



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FIG_19

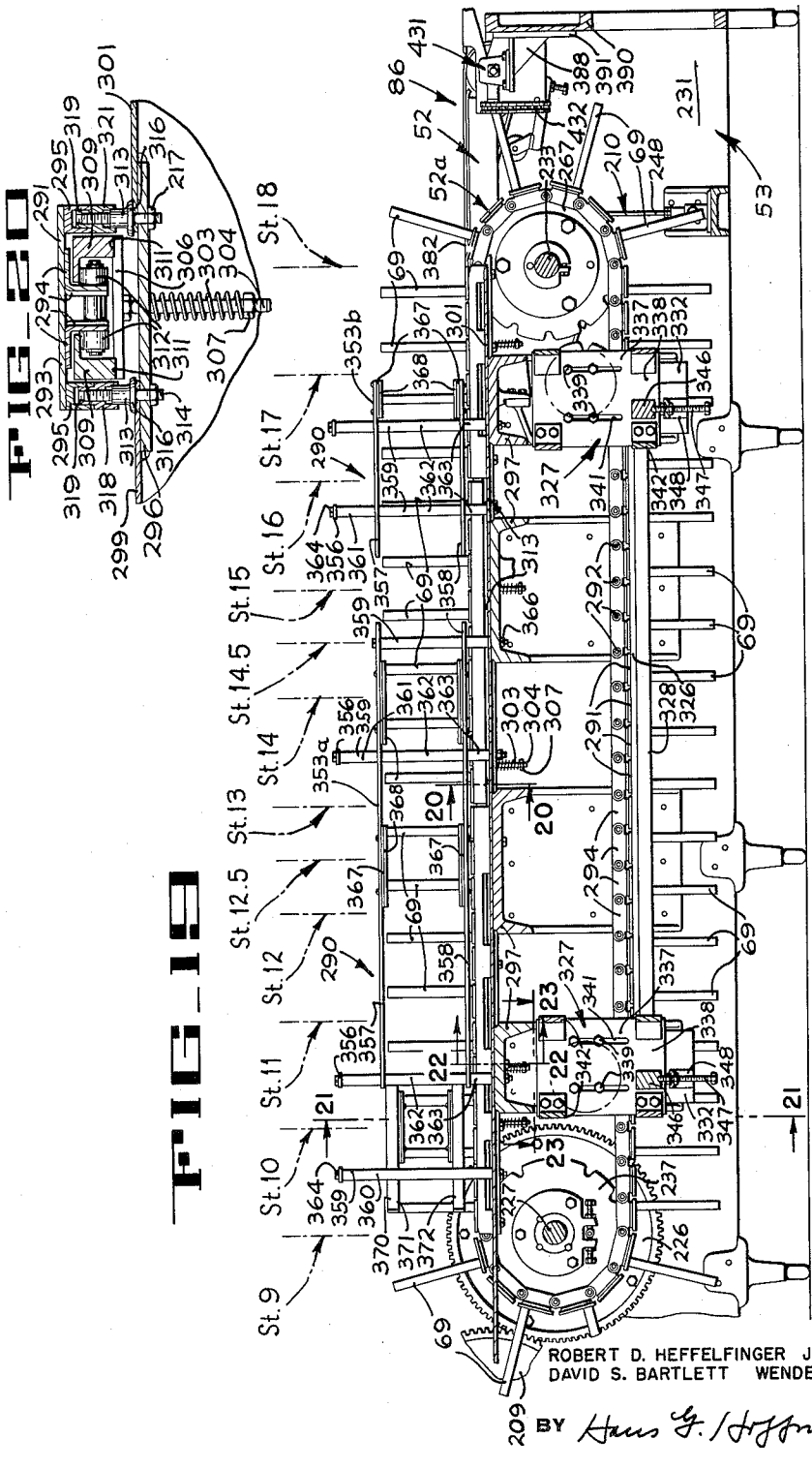


FIG_20

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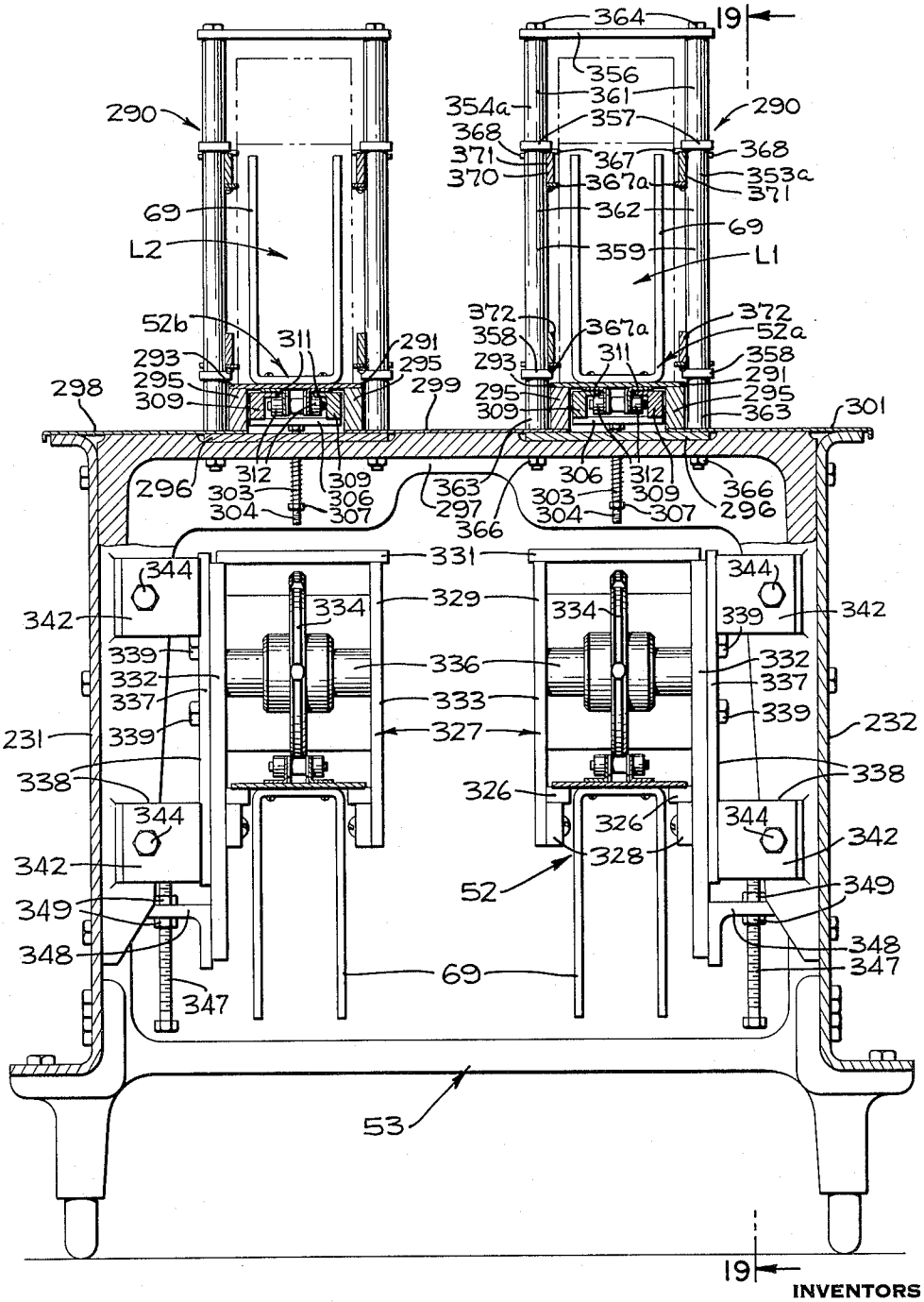


FIG_21

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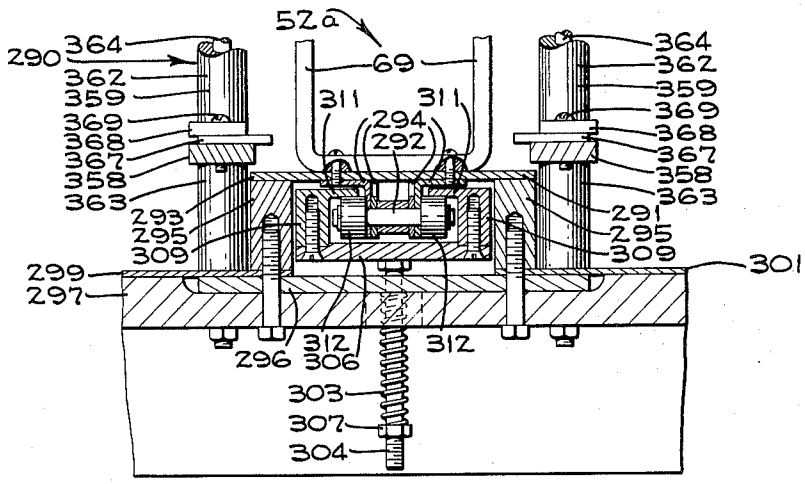
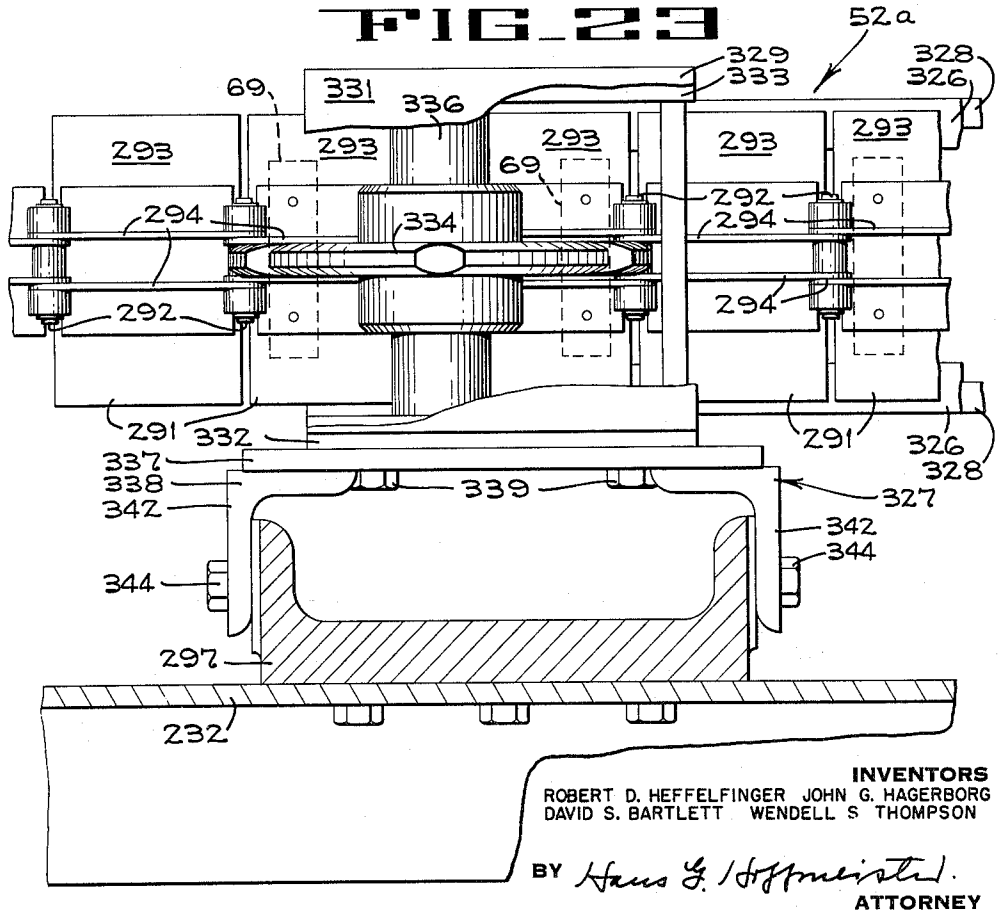


FIG_22

FIG_23



INVENTORS
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DAVID S. BARTLETT WENDELL S THOMPSON

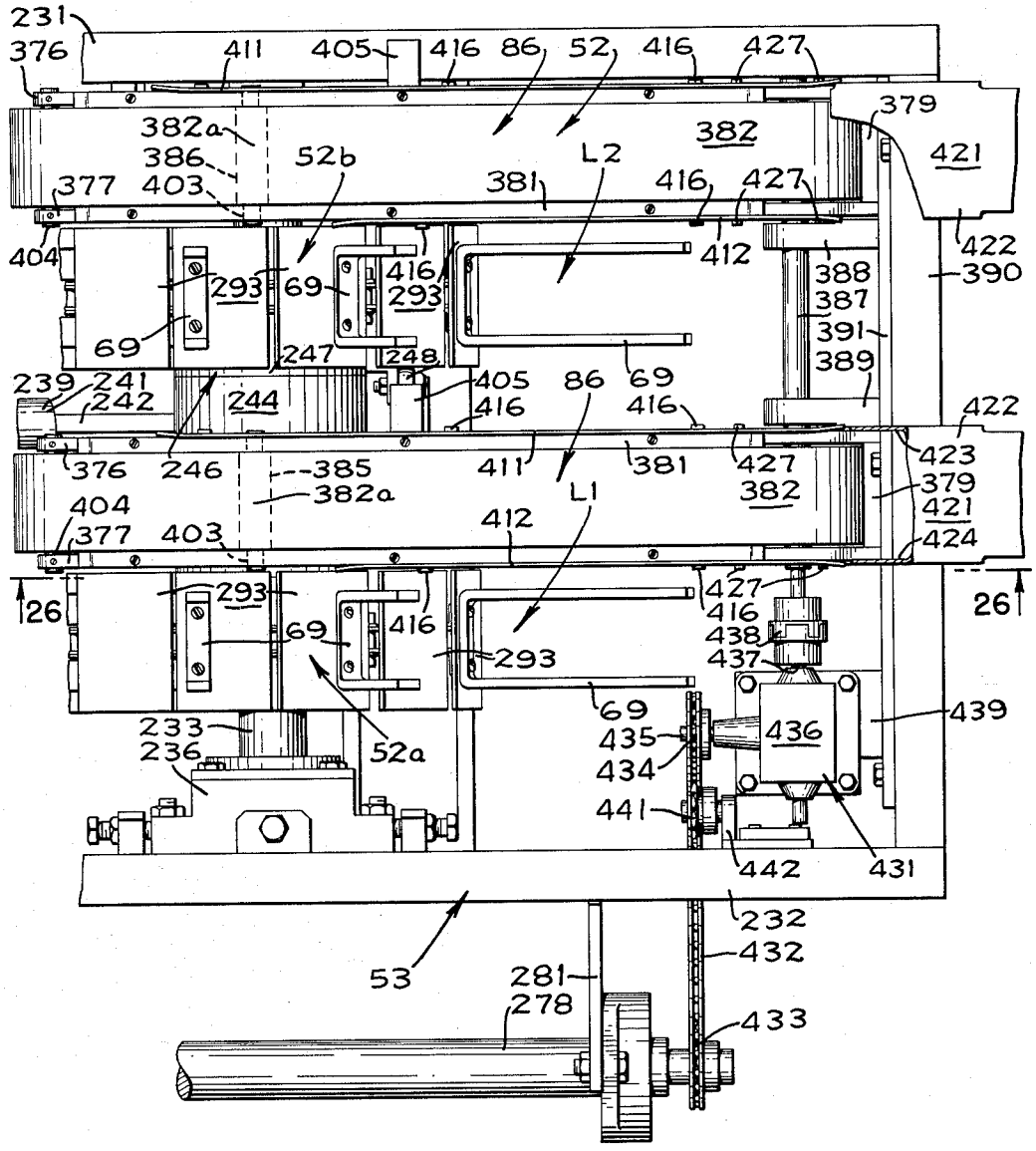
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FIG_24



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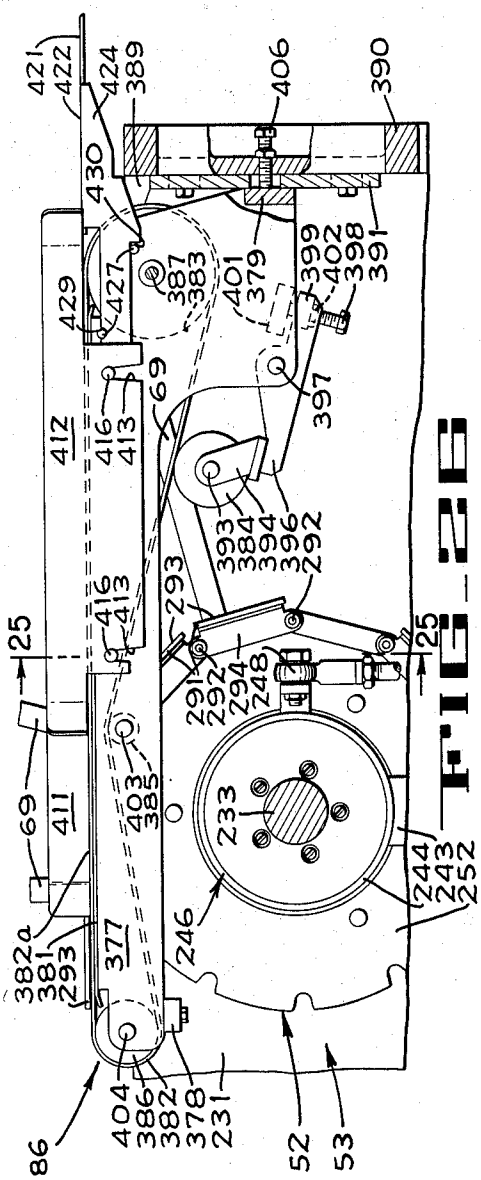


FIG. 26

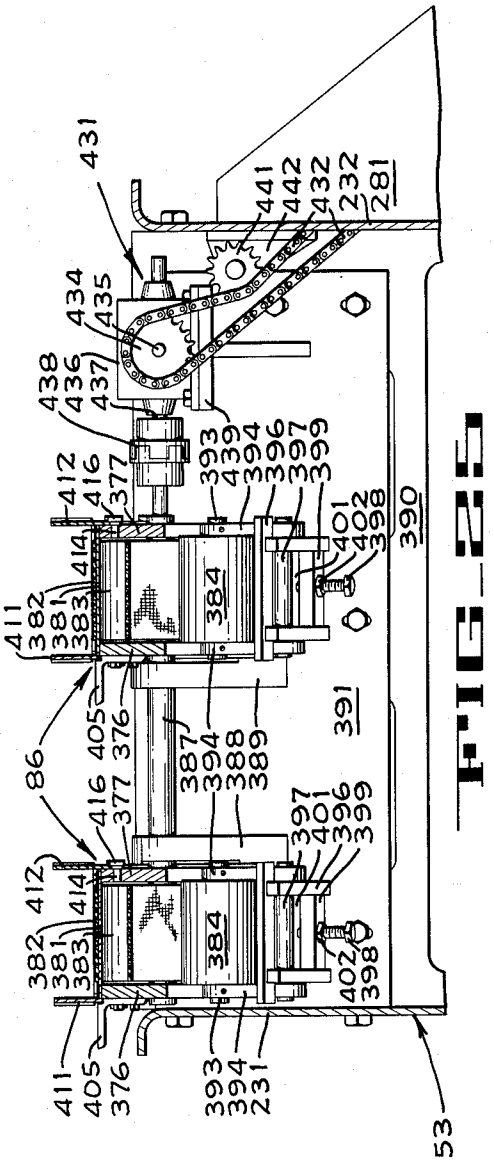


FIG. 25

INVENTORS
ROBERT D. HEFFELFINGER JOHN G. HAGERBORG
DAVID S. BARTLETT WENDELL S. THOMPSON

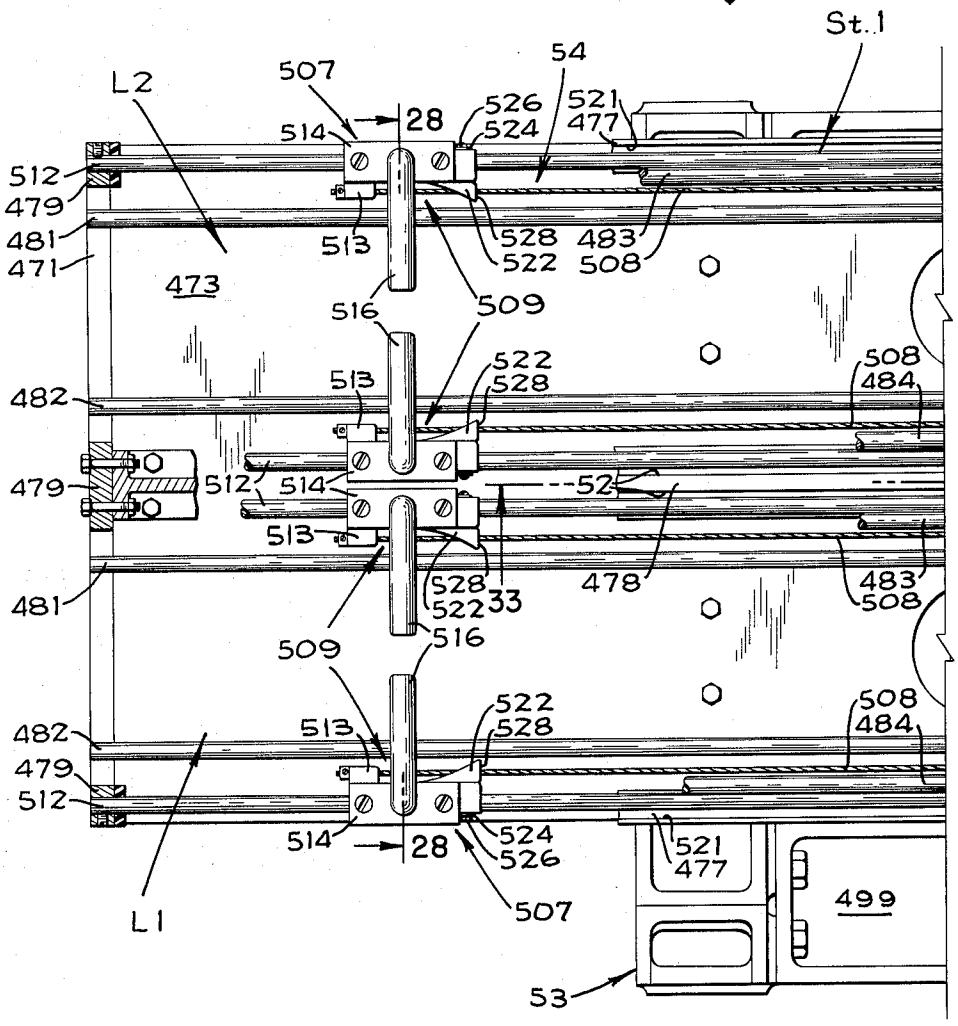
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FIG_27A



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FIG_27C

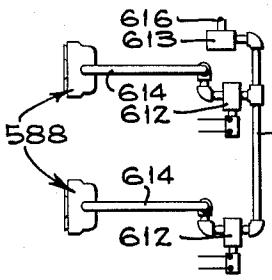
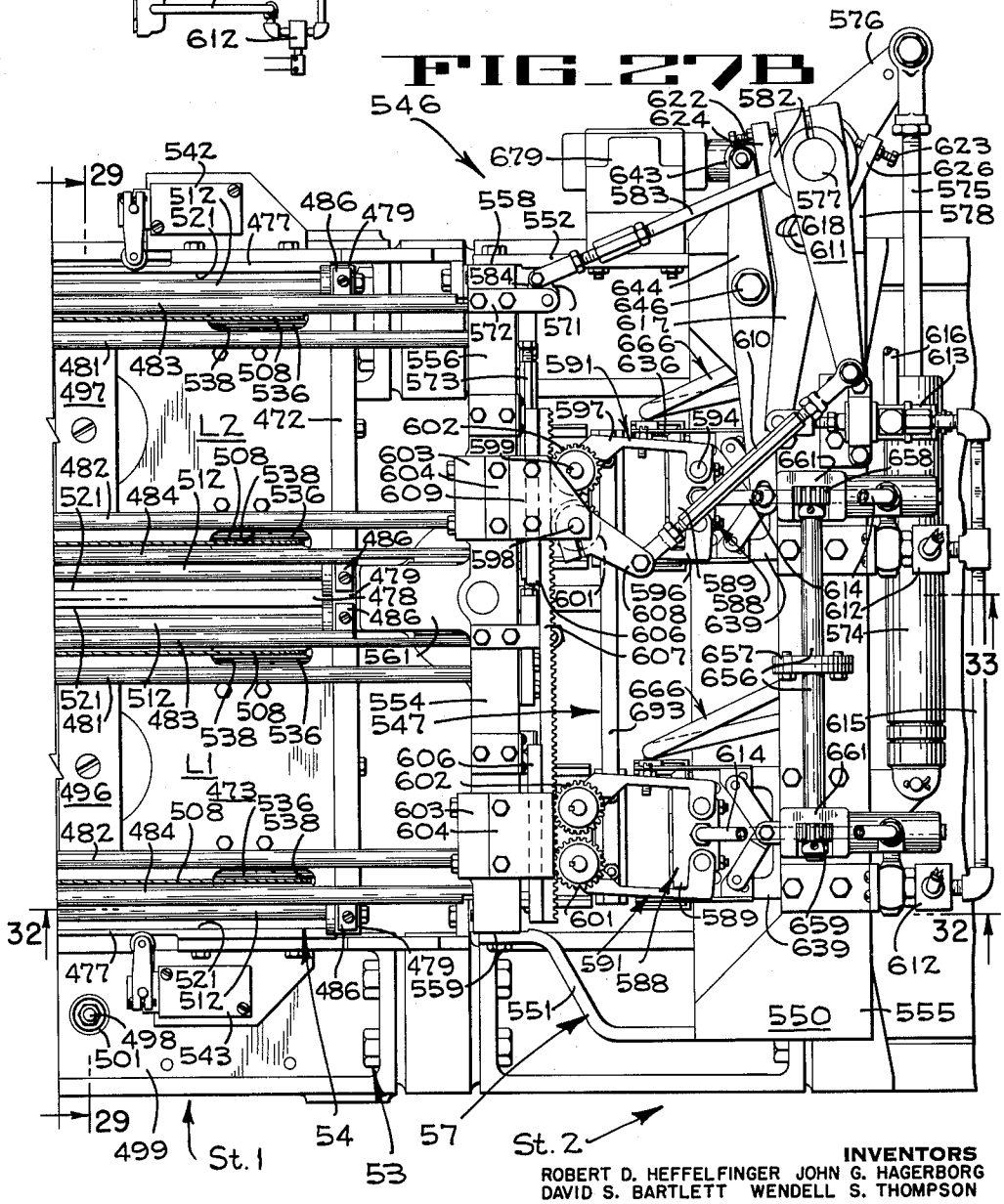


FIG_27B



INVENTORS
ROBERT D. HEFFELFINGER JOHN G. HAGERBORG
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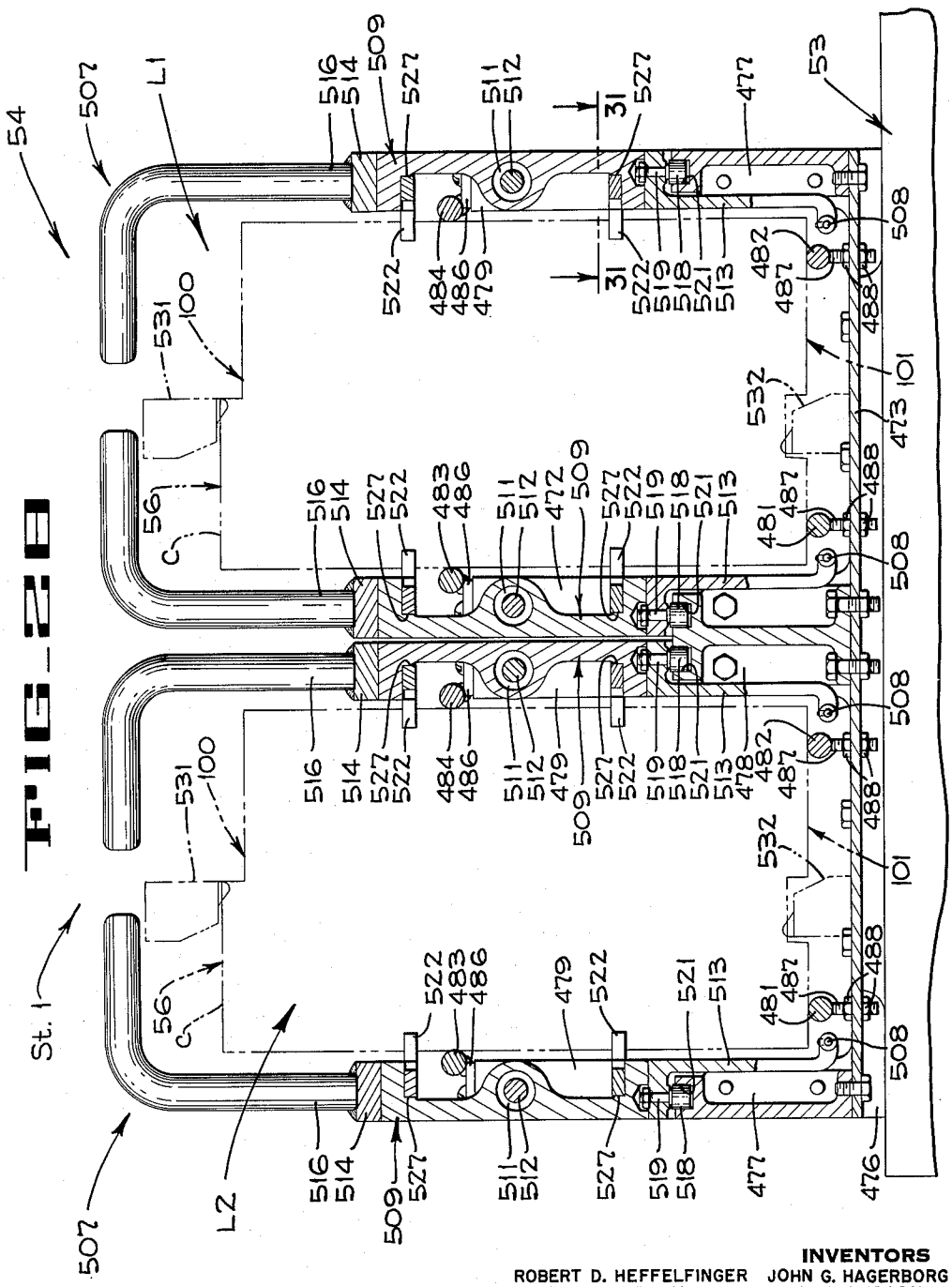
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FIG_28



INVENTORS

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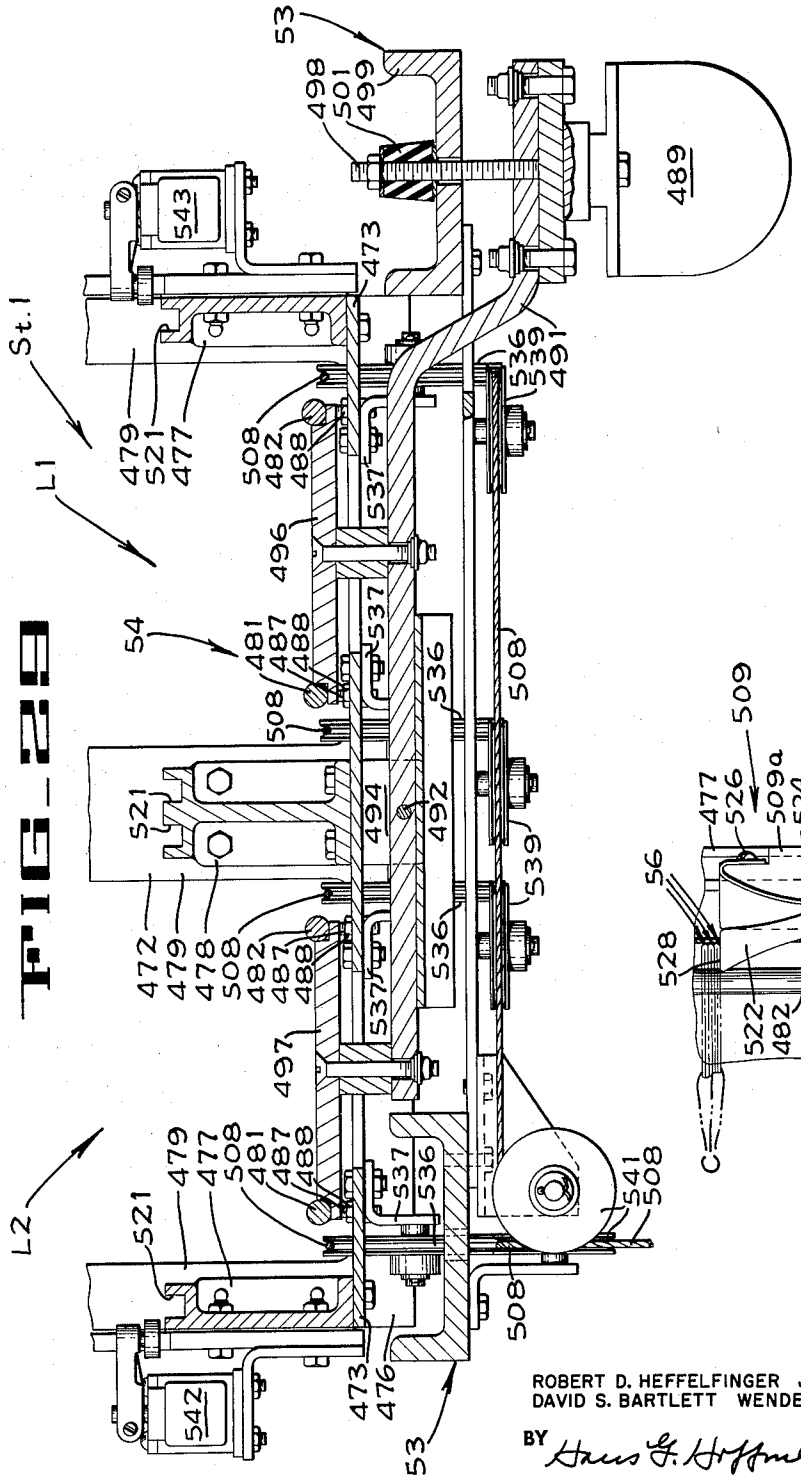
BY Hans G. Hoffmeister

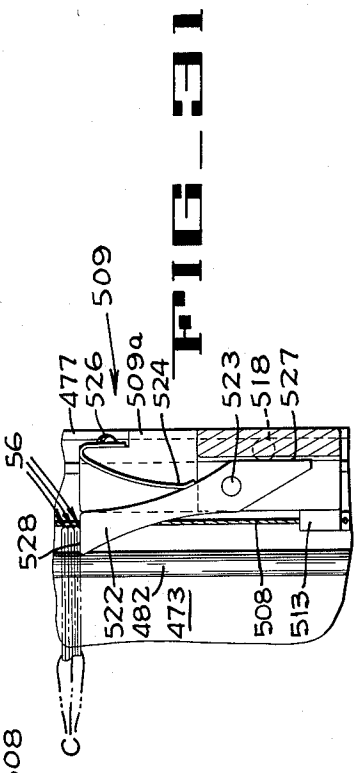
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INVENTORS
ROBERT D. HEFFELFINGER JOHN G. HAGERBORG
DAVID S. BARTLETT WENDELL S. THOMPSON

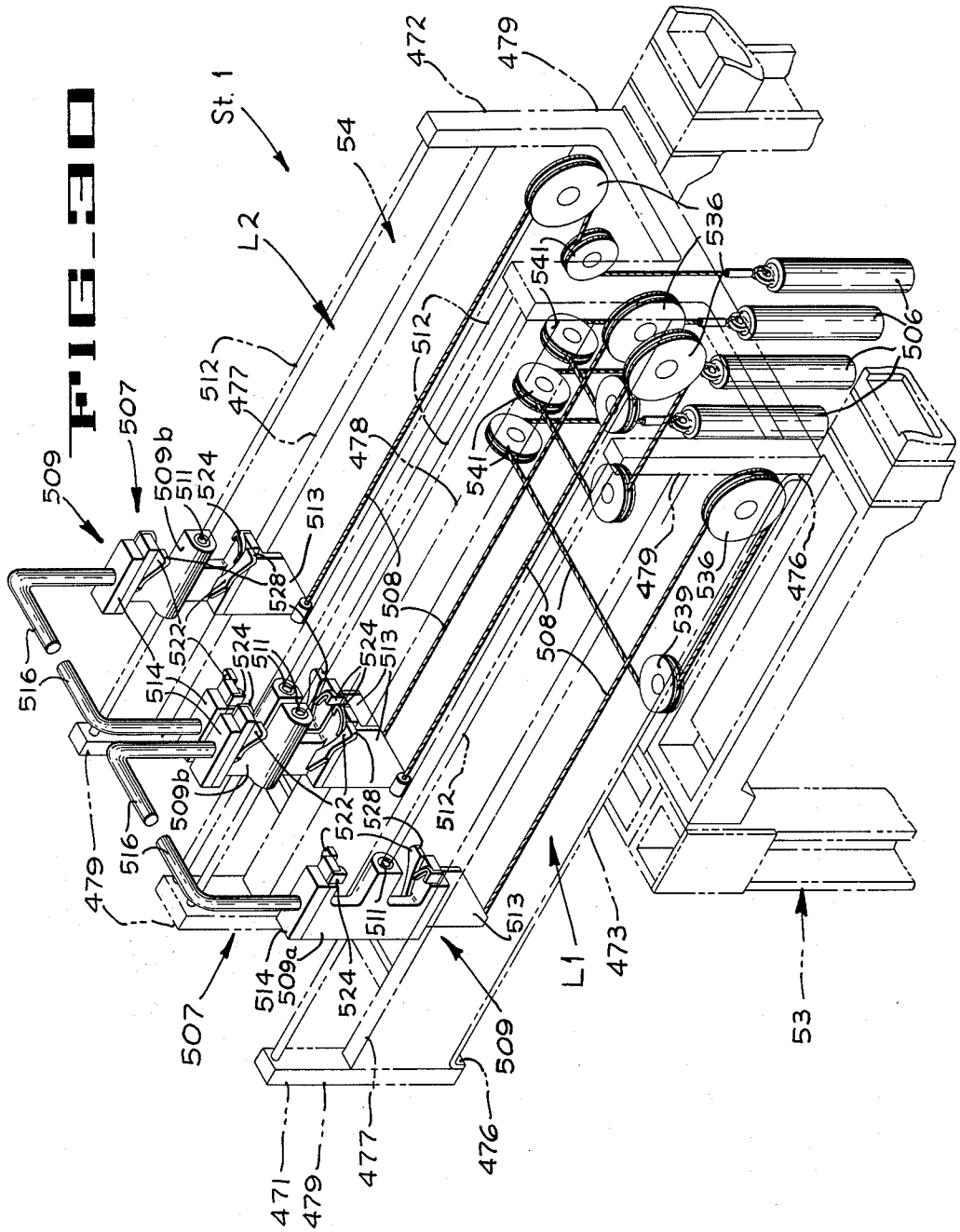
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FIG. 30



INVENTORS

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DAVID S. BARTLETT WENDELL S. THOMPSON

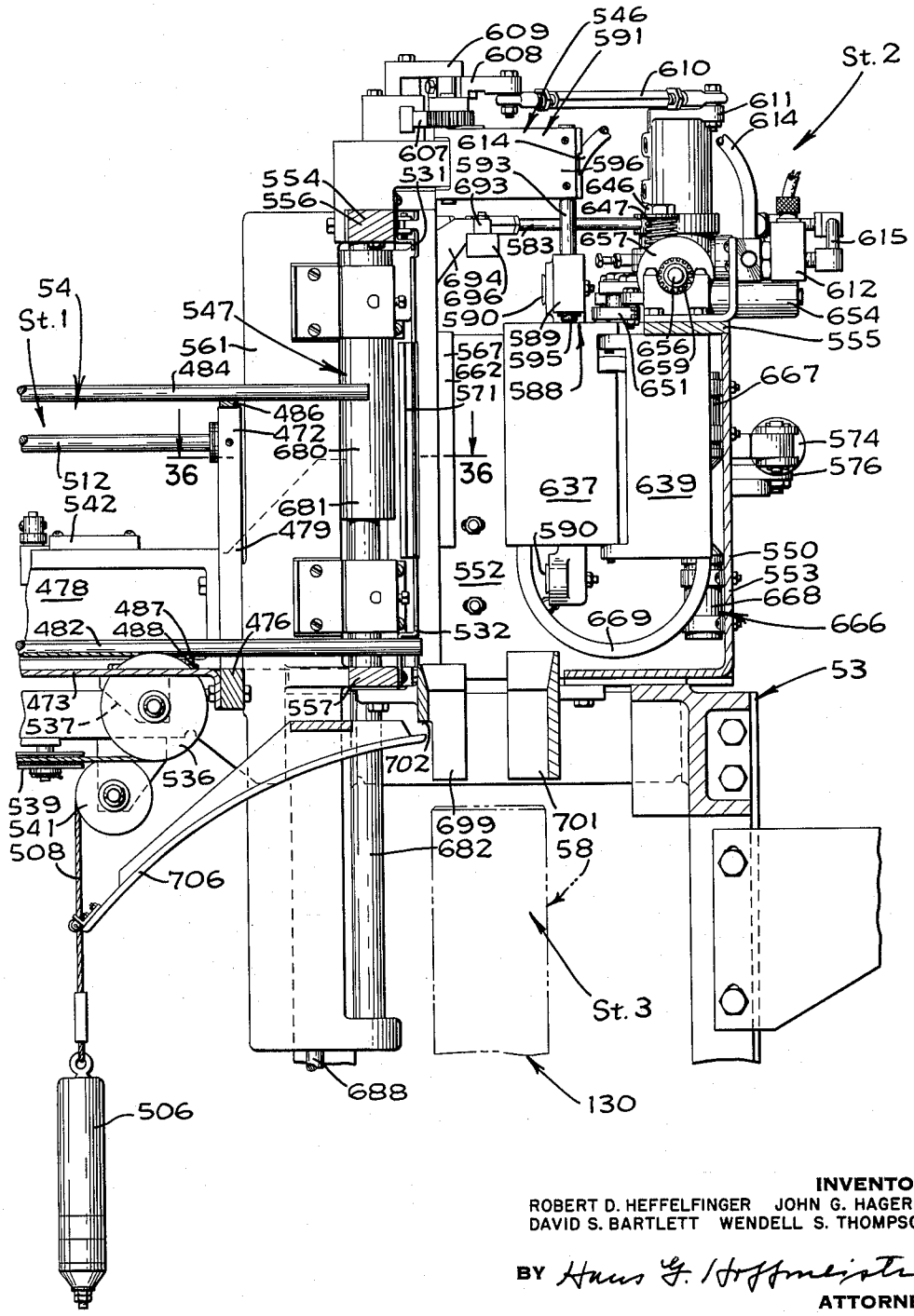
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FIG_32



INVENTORS
ROBERT D. HEFFELFINGER JOHN G. HAGERBORG
DAVID S. BARTLETT WENDELL S. THOMPSON

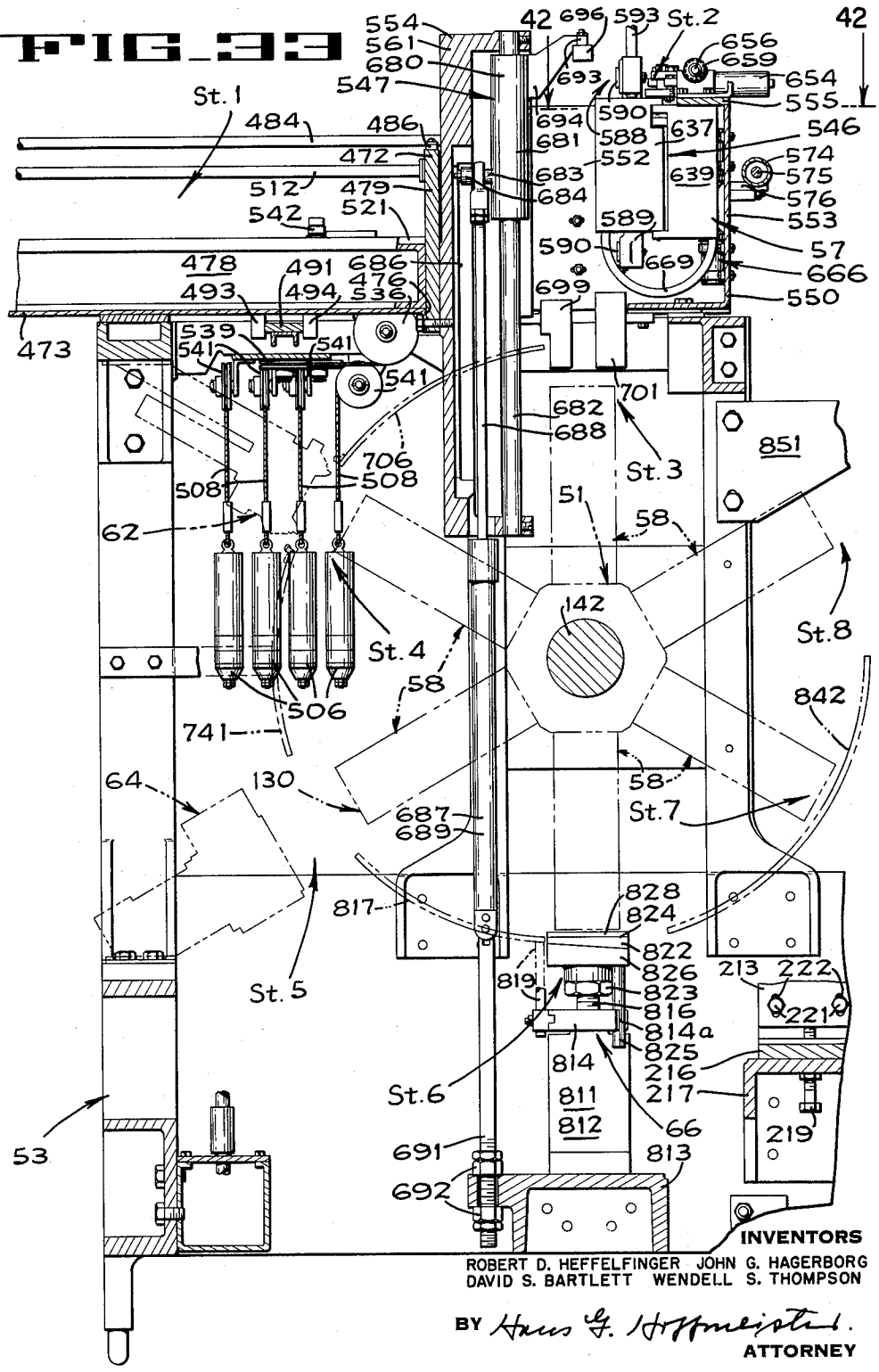
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FIG_33



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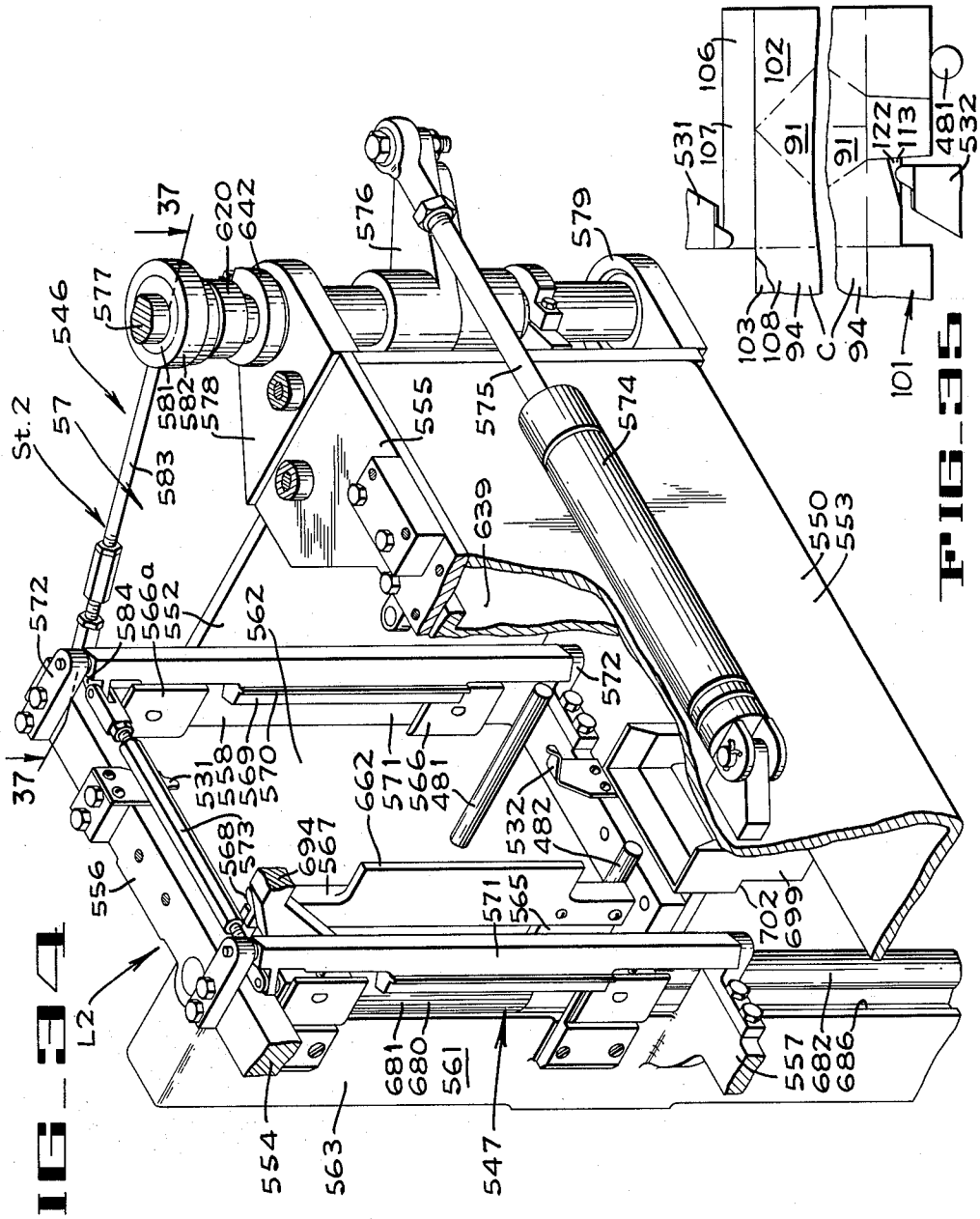


FIG-34

FIG-35

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FIG_36

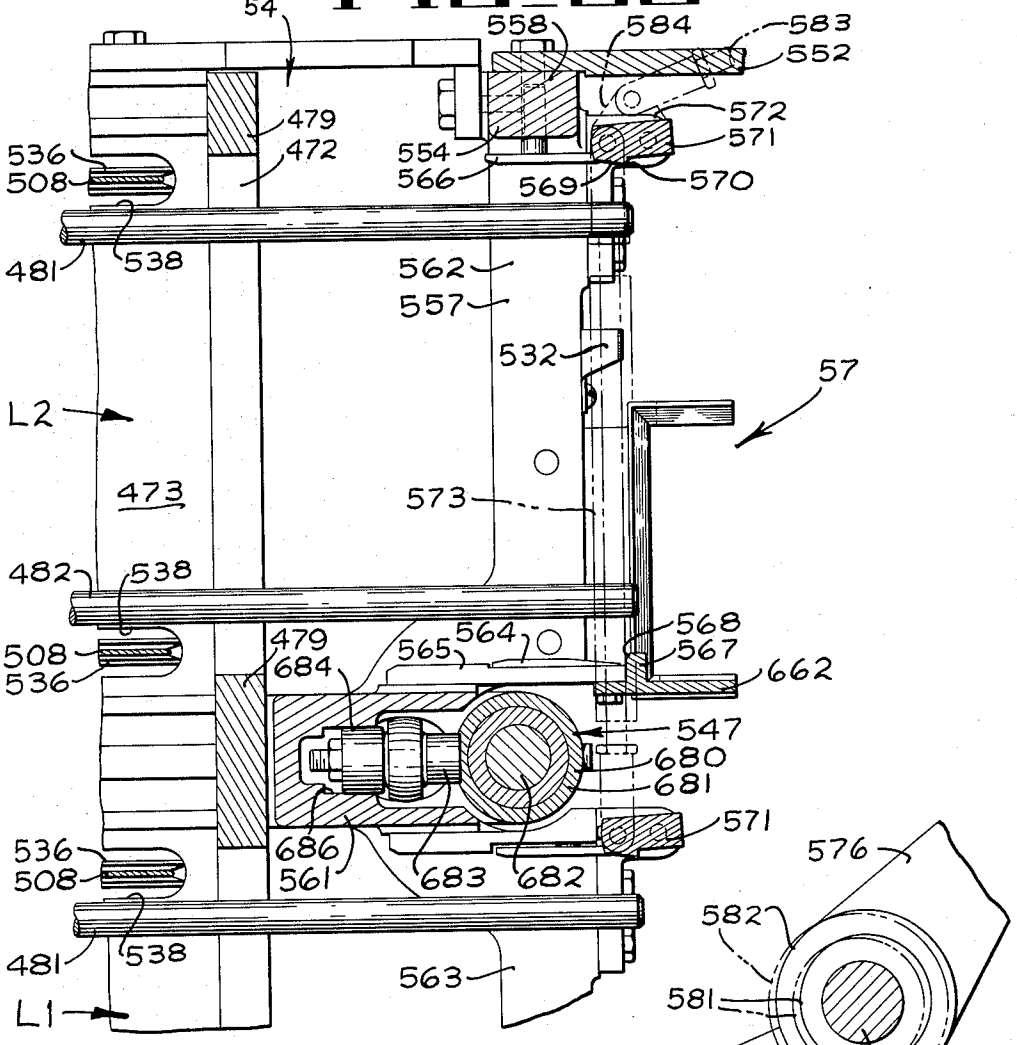
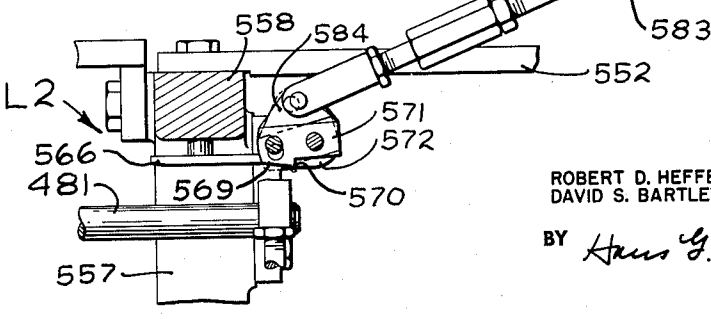


FIG_37



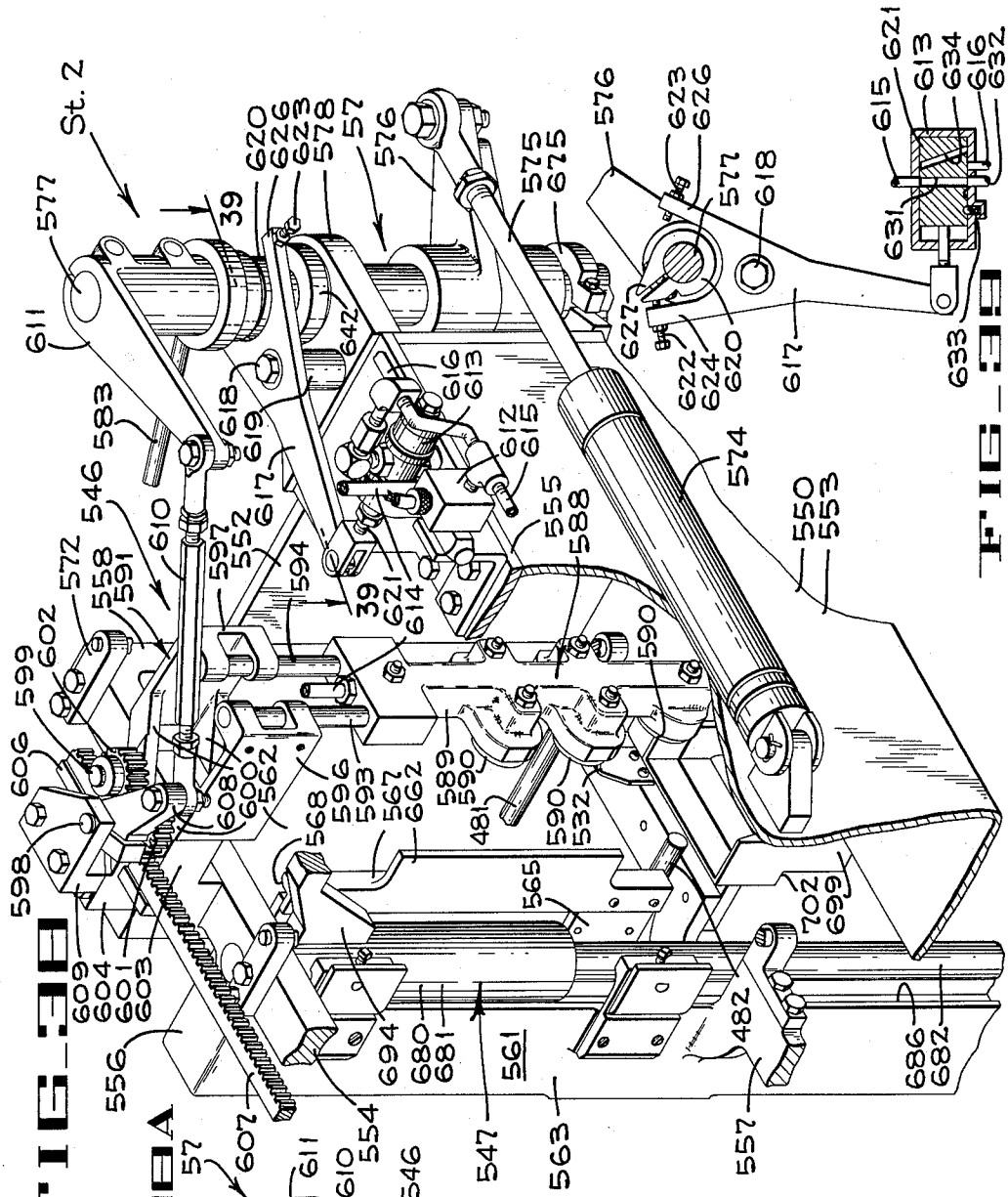
INVENTORS
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DAVID S. BARTLETT WENDELL S. THOMPSON

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FIG. 40

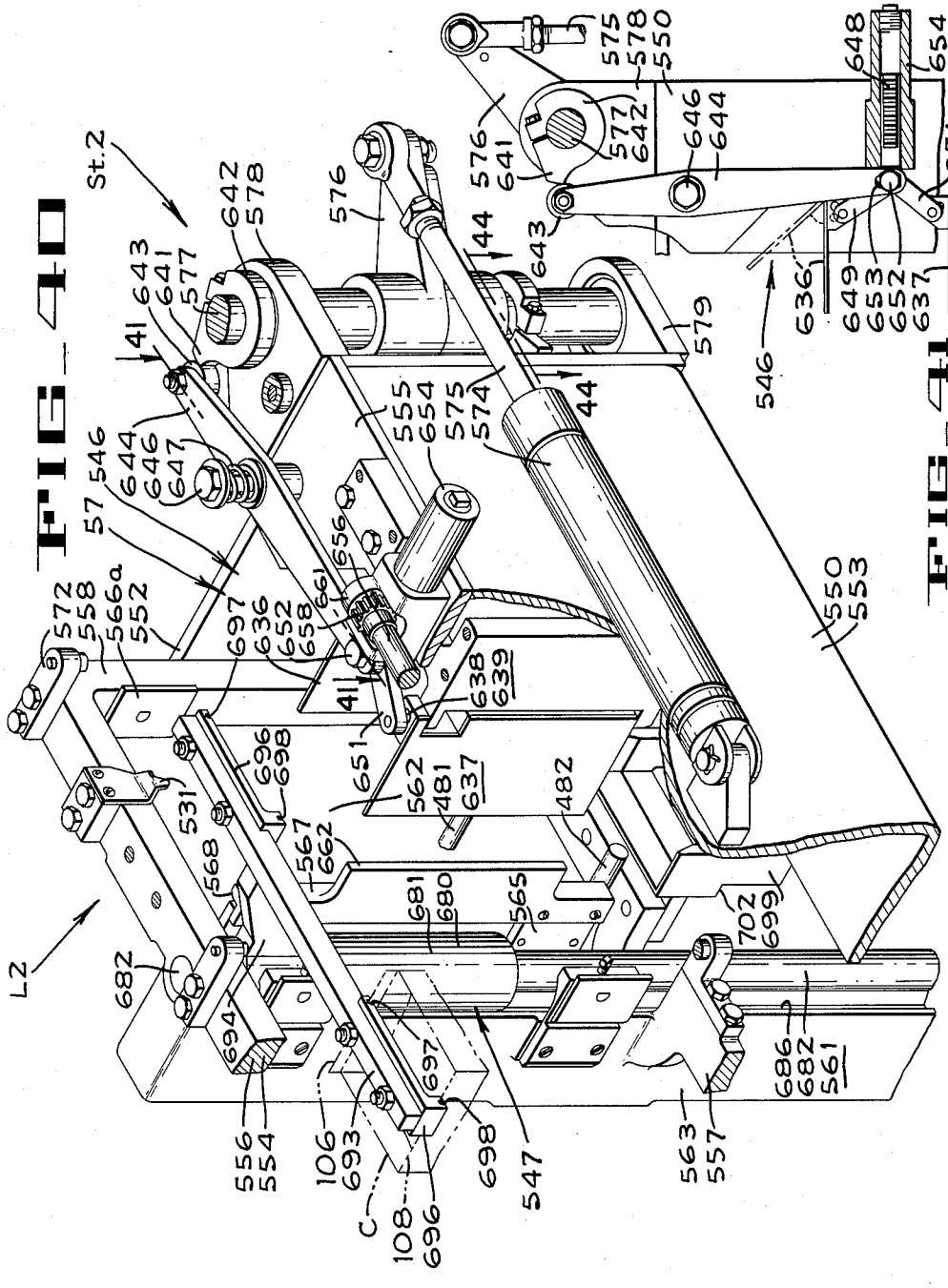


FIG. 41

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FIG_42

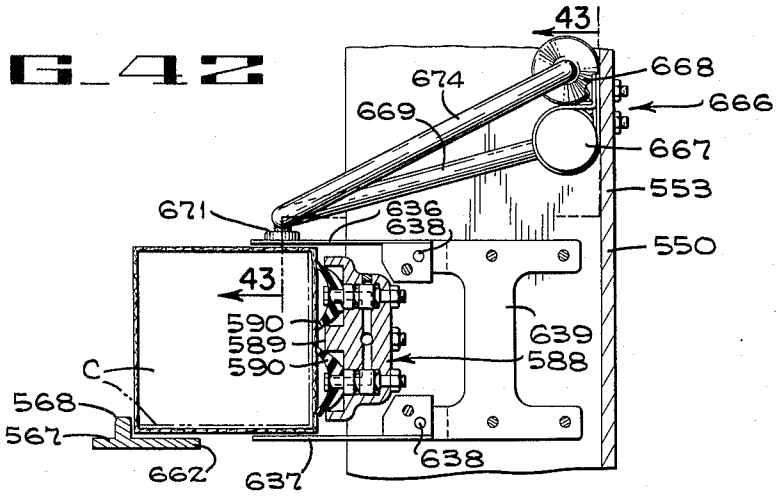


FIG_43

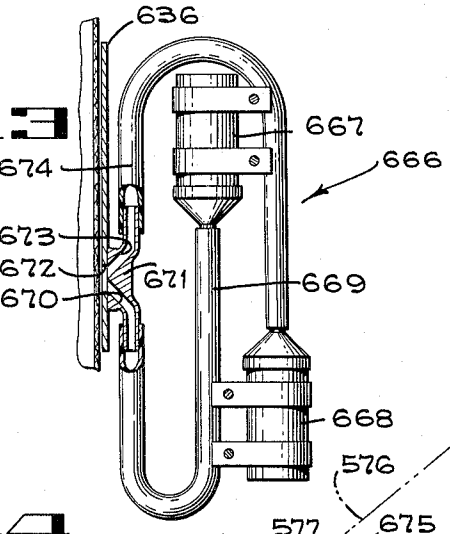
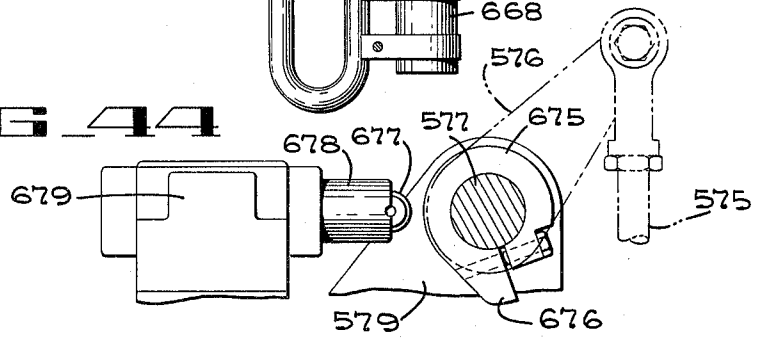


FIG_44



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FIG_45

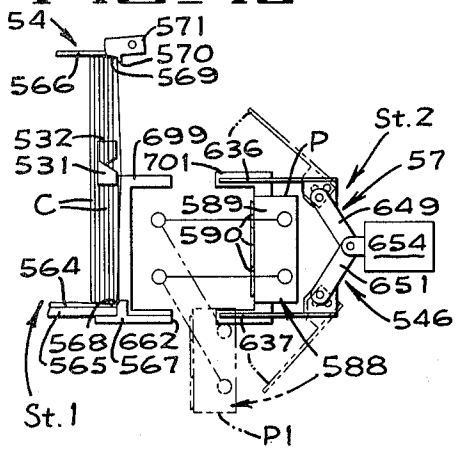


FIG_46

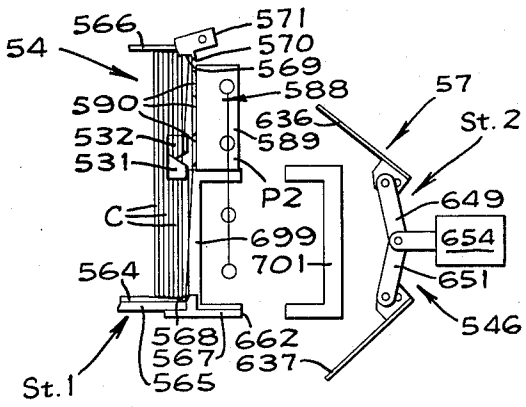


FIG_47

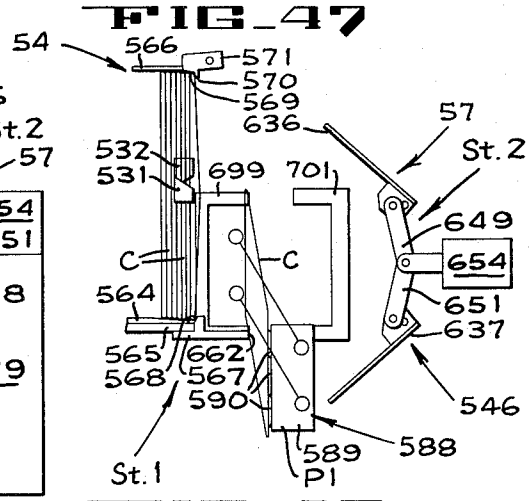


FIG_49

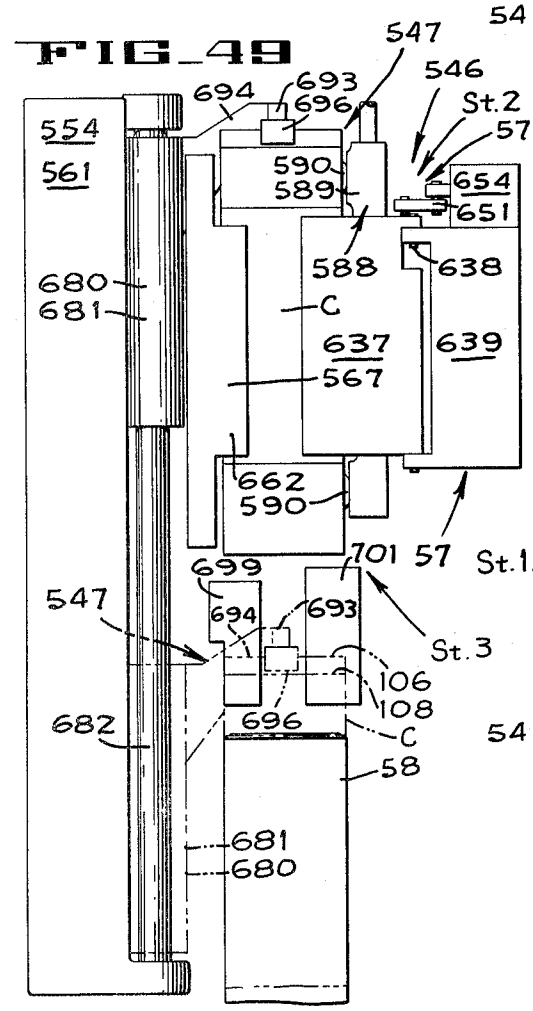
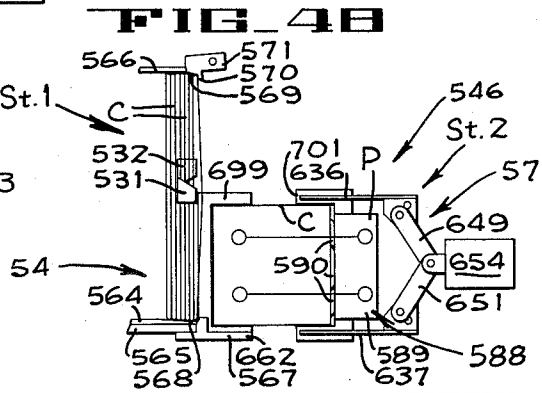


FIG_48



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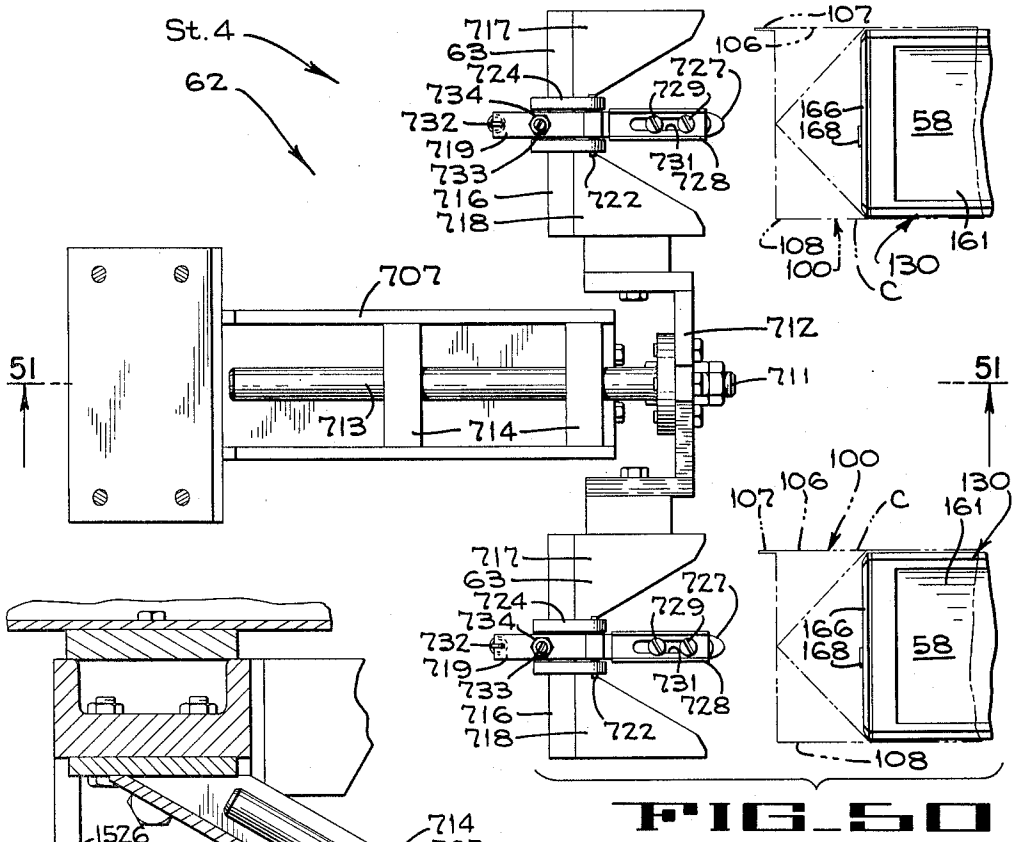


FIG_50

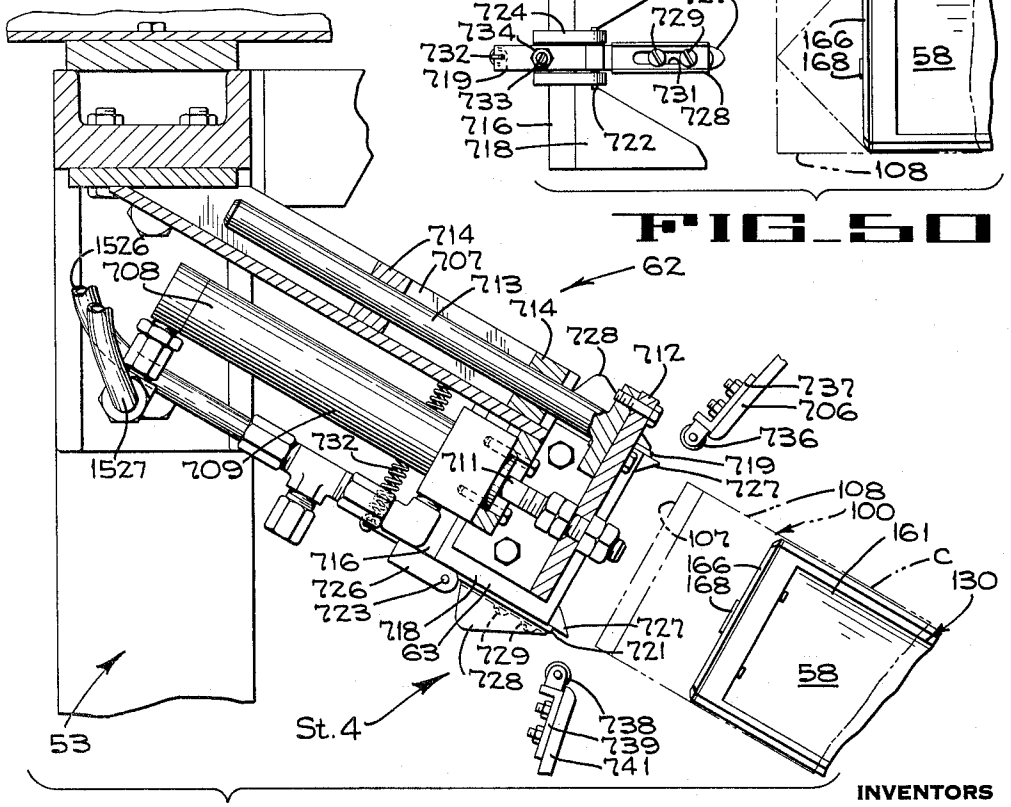


FIG_51

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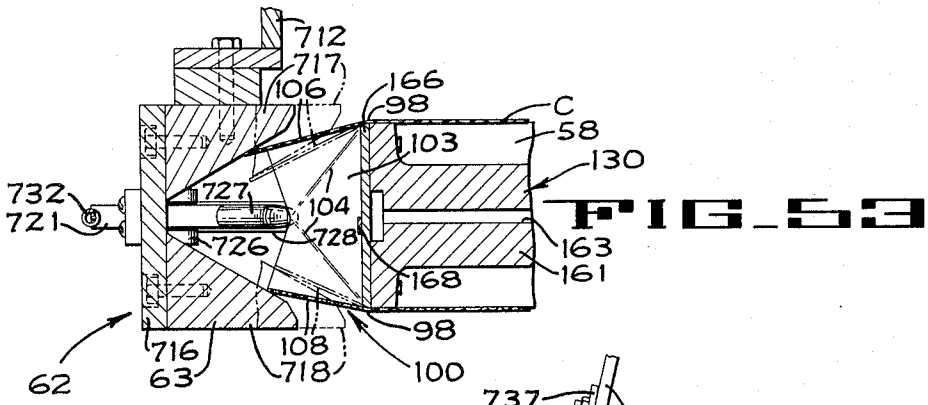


FIG_53

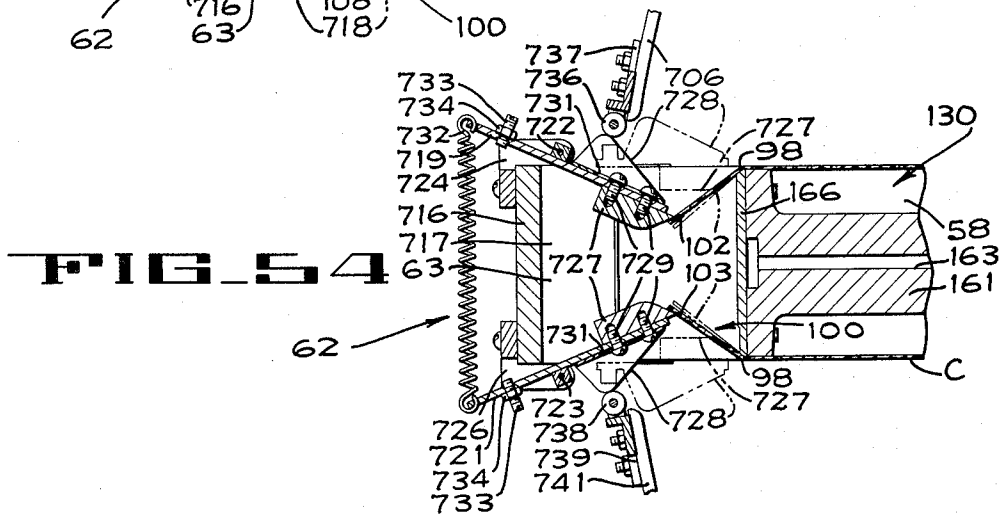


FIG_54

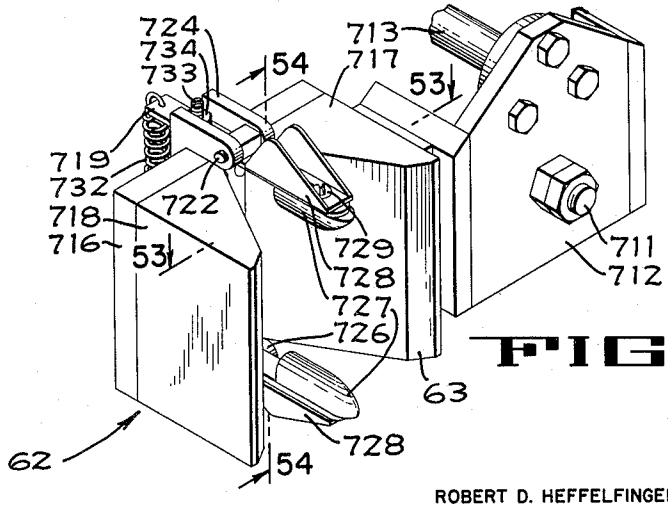


FIG_52

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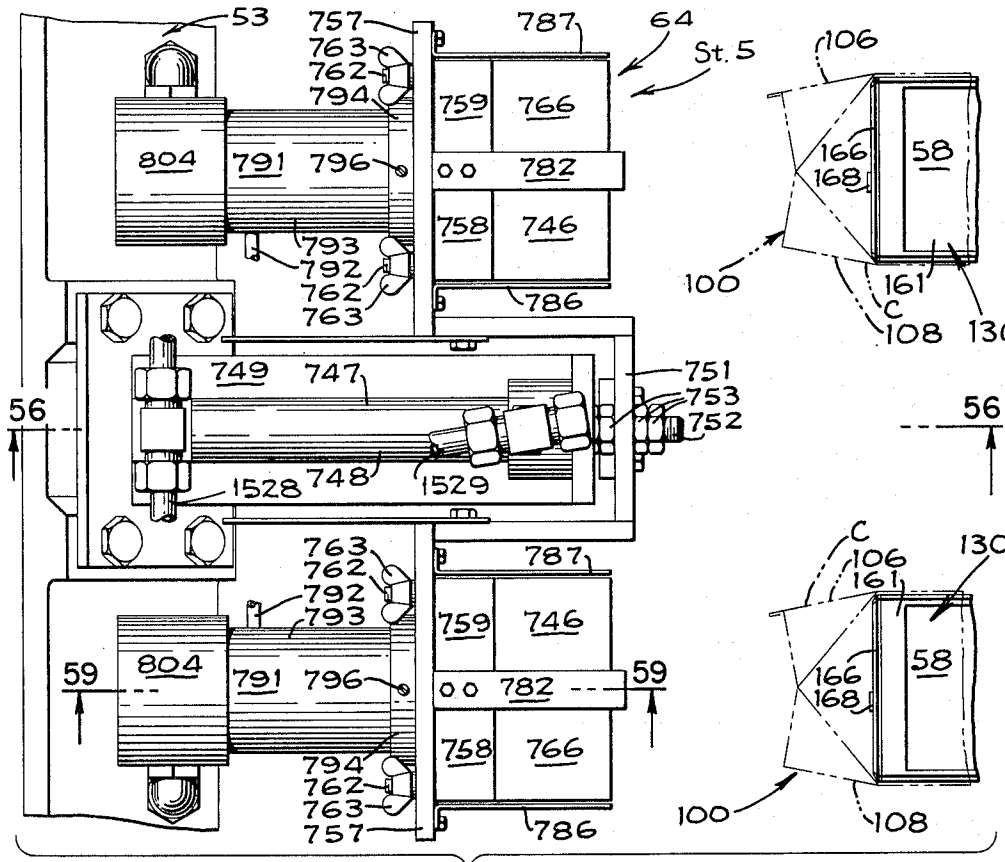


FIG_55

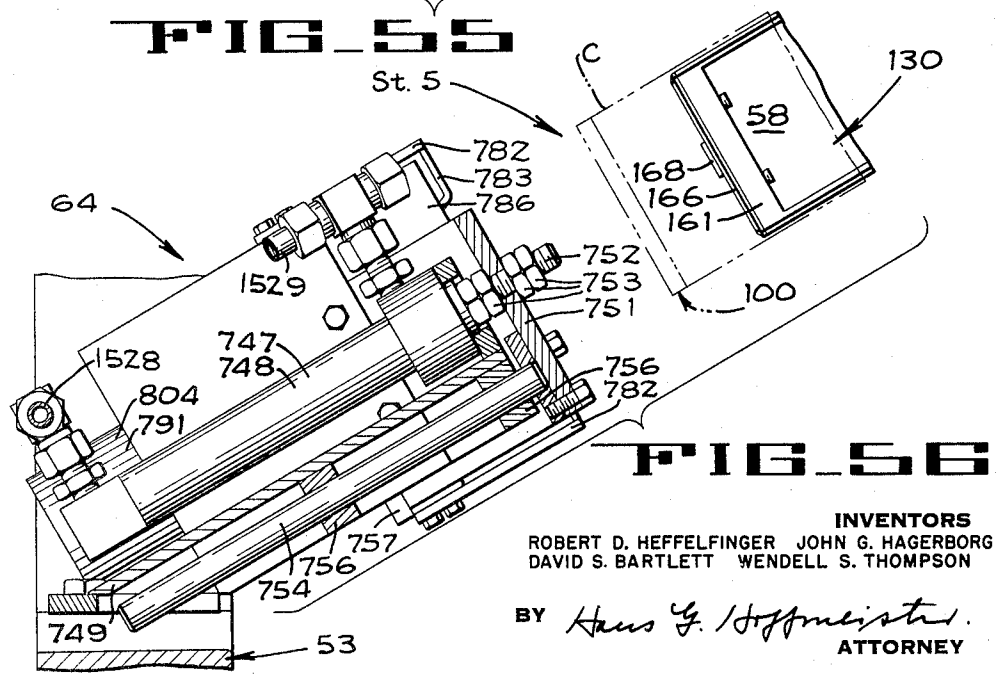


FIG_56

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FIG_57

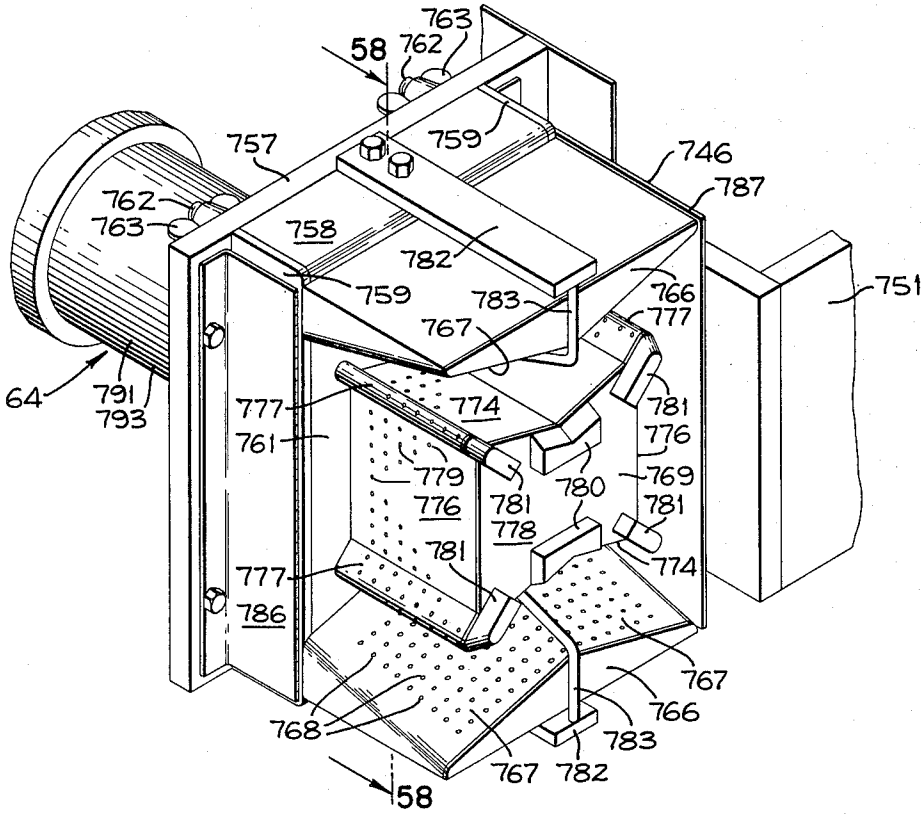


FIG_58

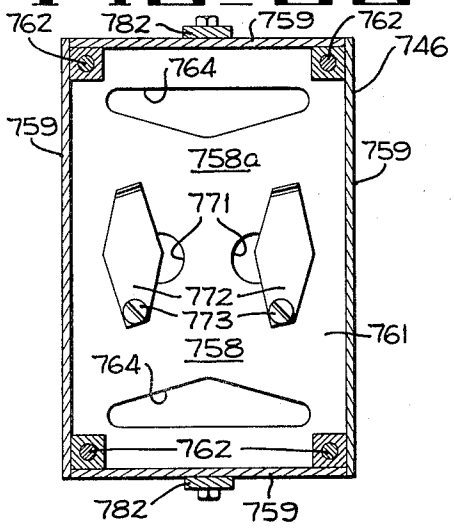
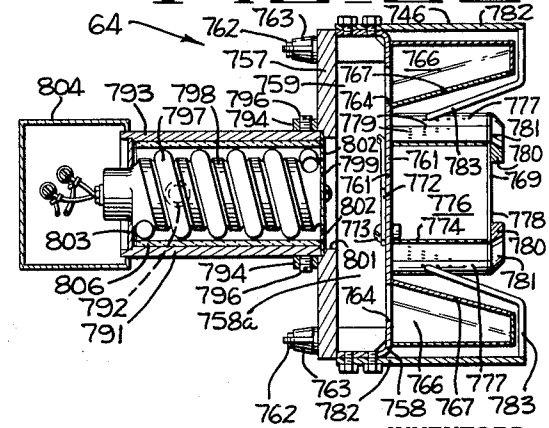


FIG_59



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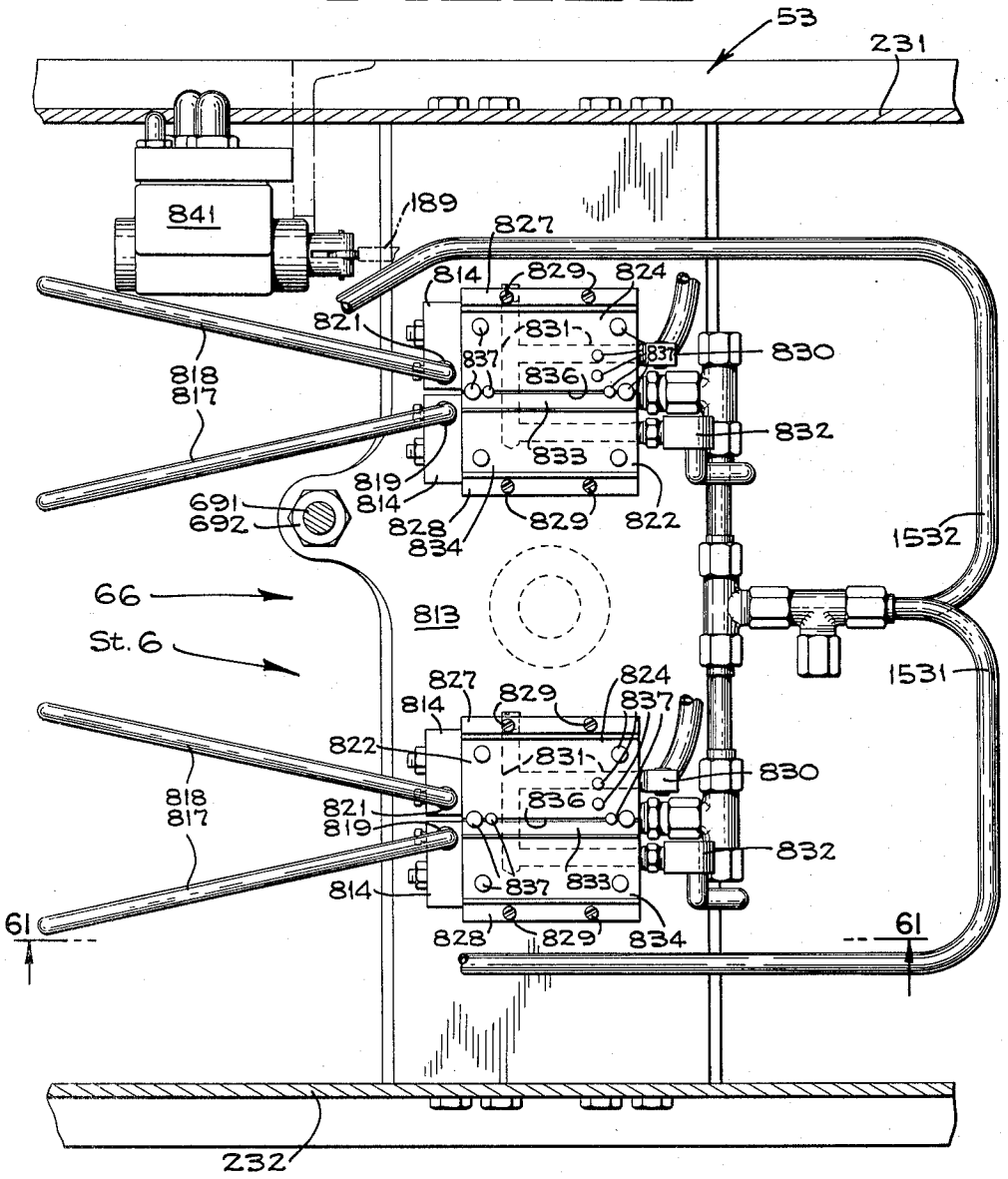
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FIG_60



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FIG_61

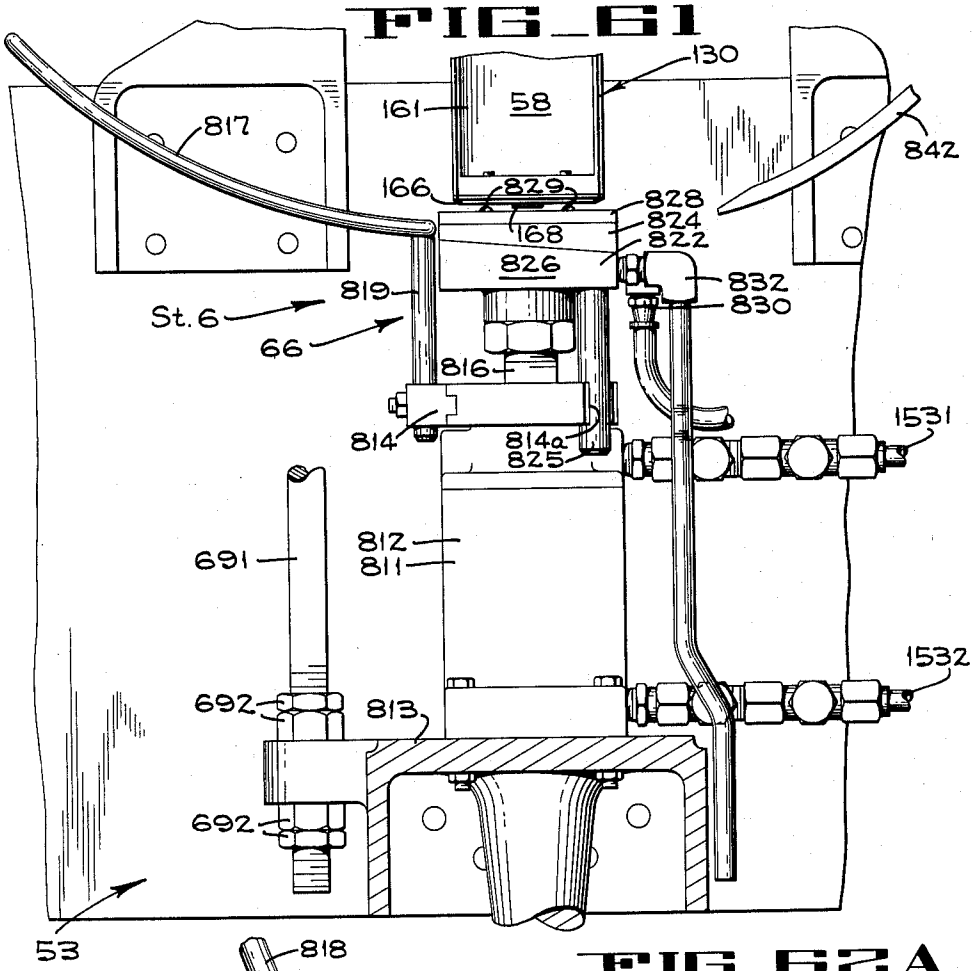
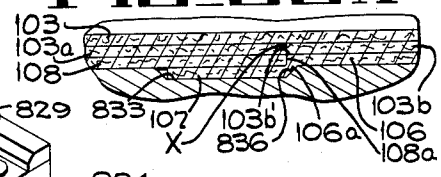


FIG_62A



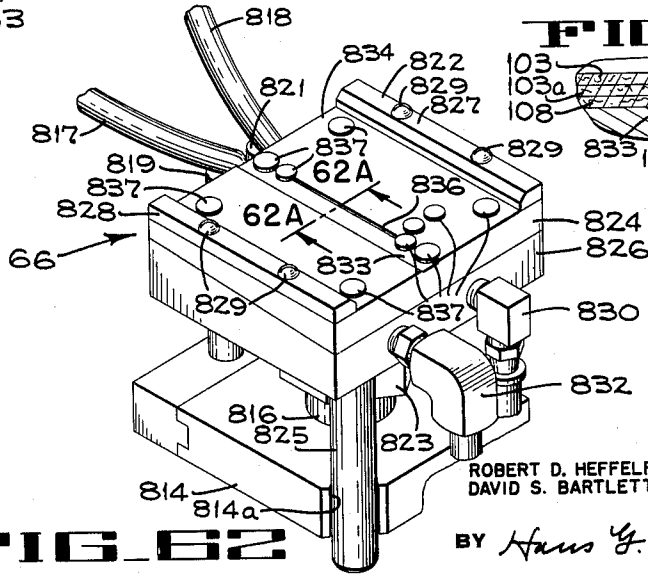


FIG_62

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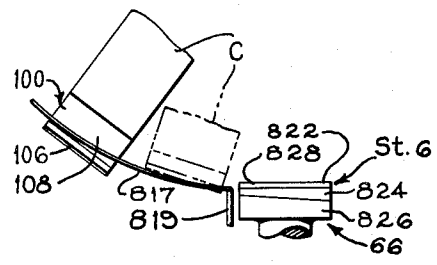


FIG_63

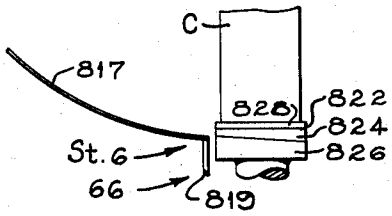
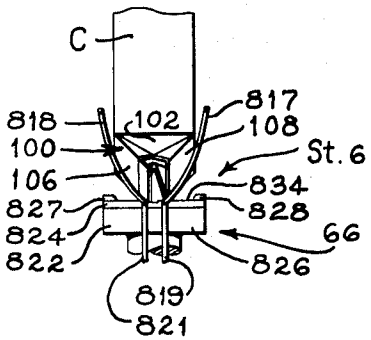


FIG_64

FIG_65



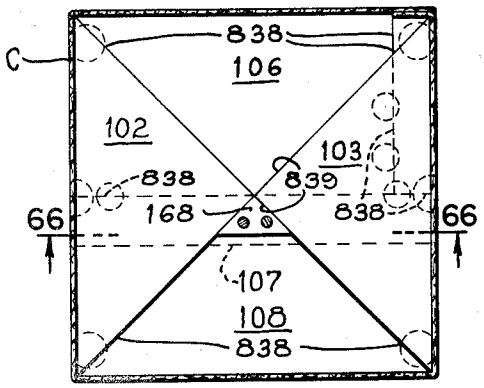
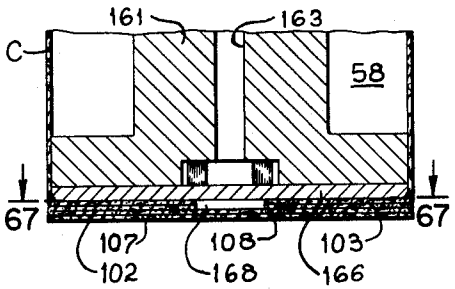


FIG_67

FIG_66



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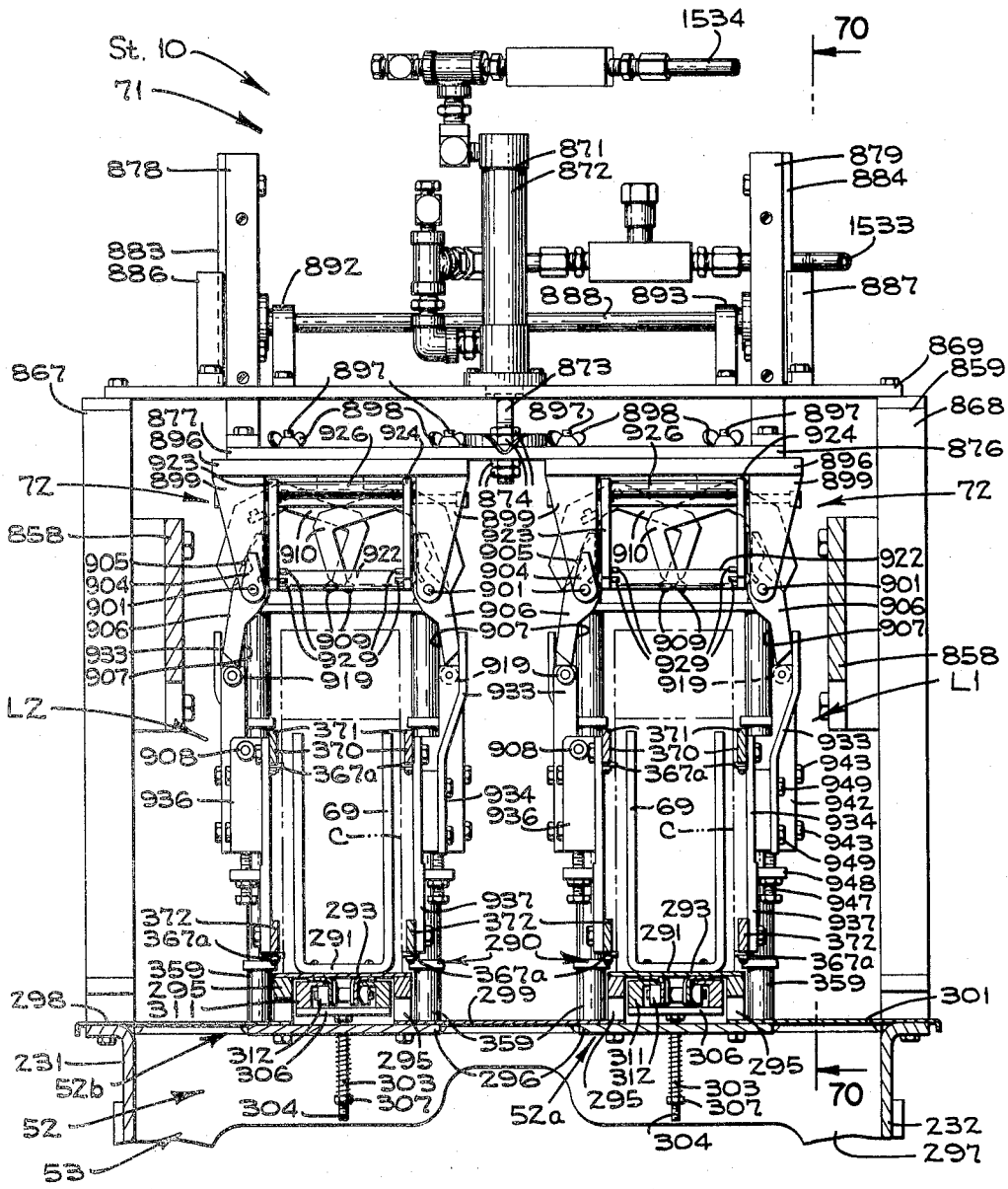
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FIG_68



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FIG_69

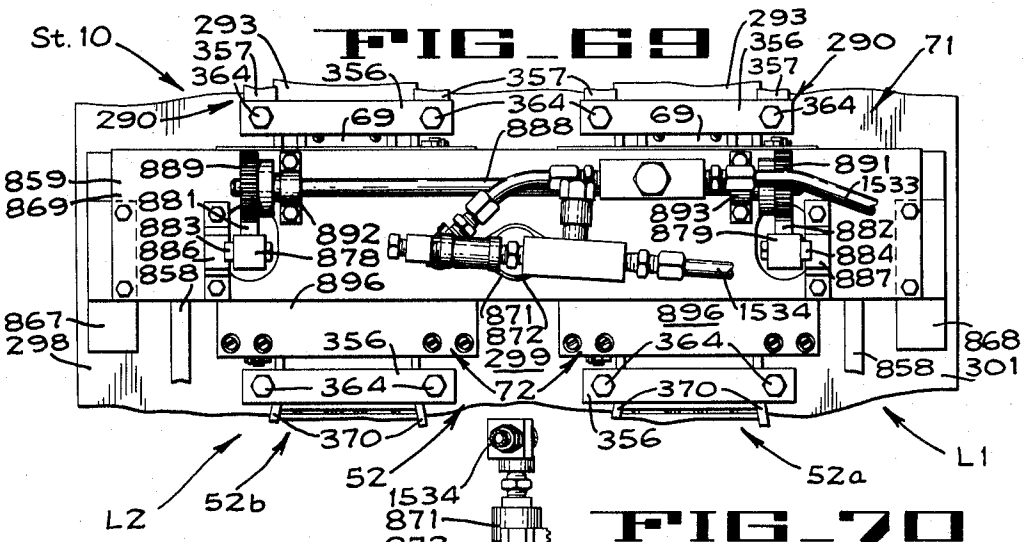
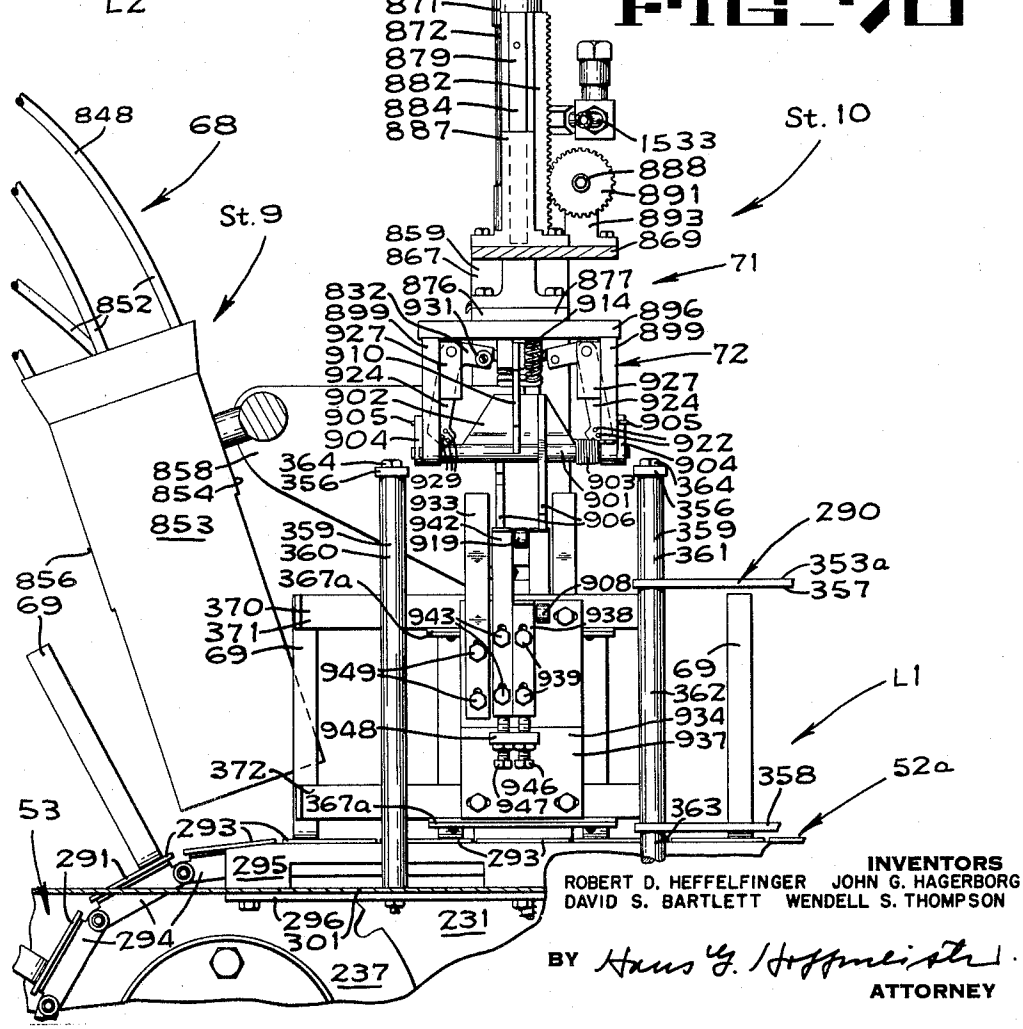


FIG_70



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FIG_72

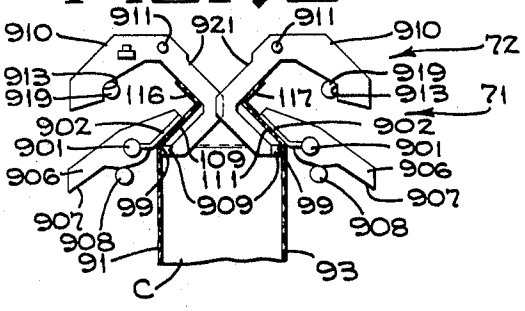
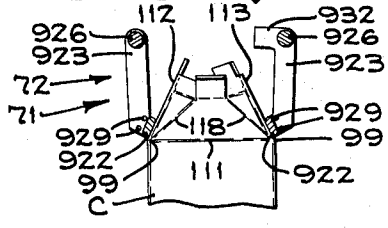


FIG_73



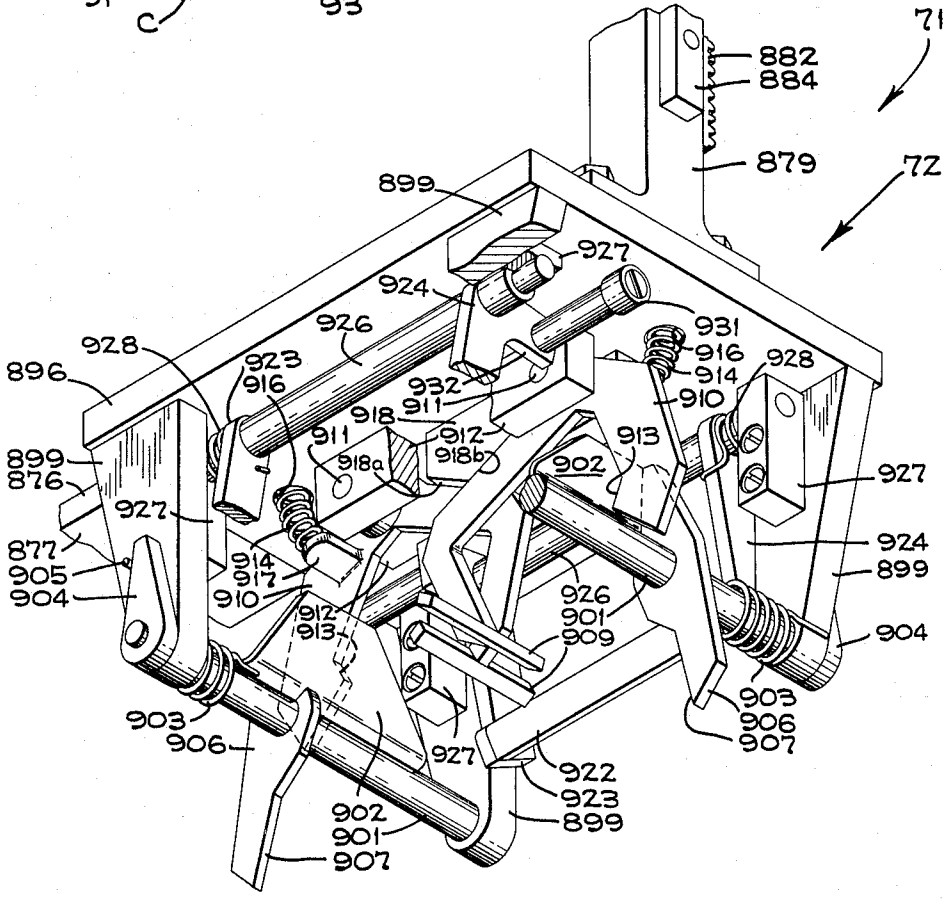


FIG_71

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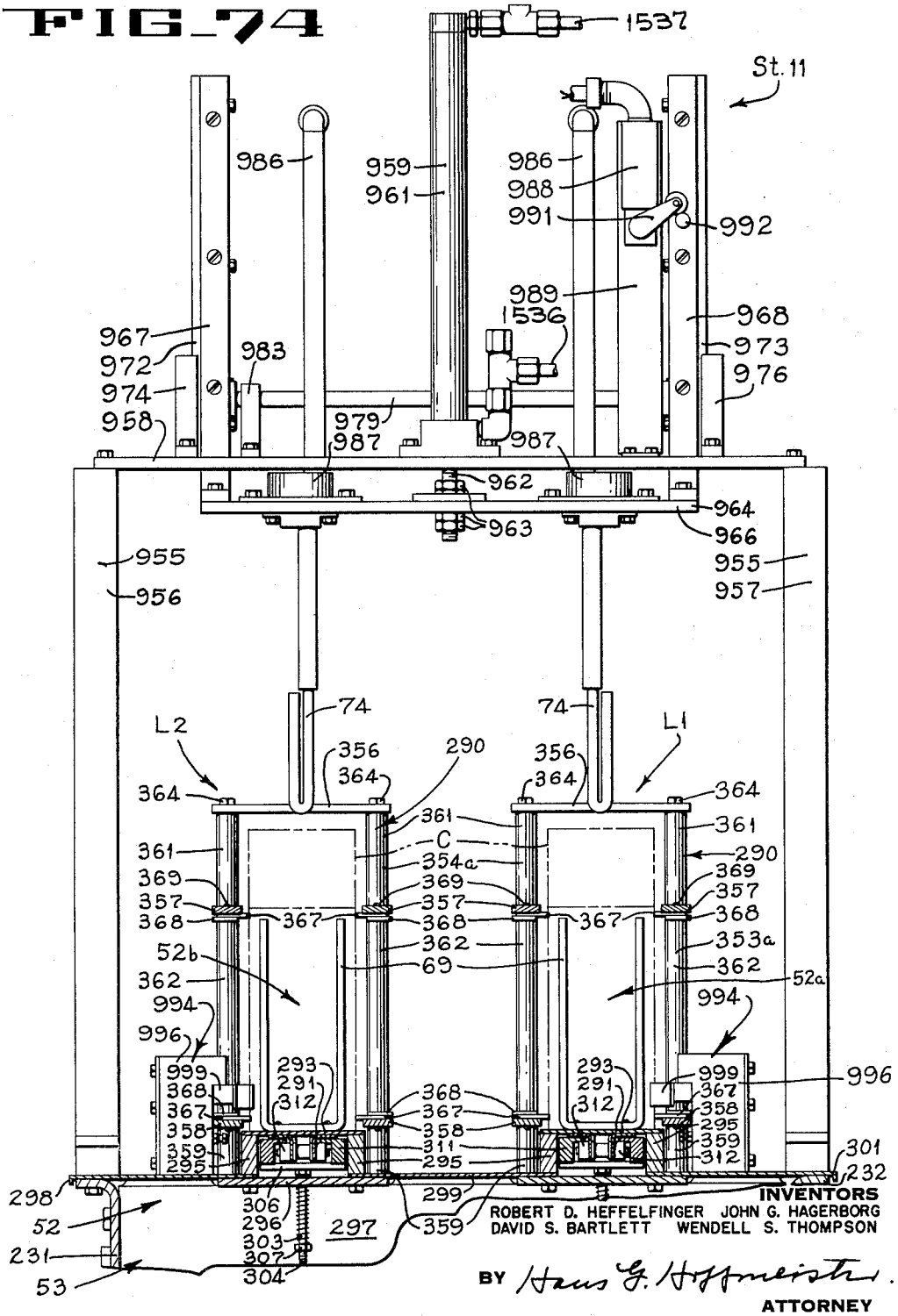
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FIG_74



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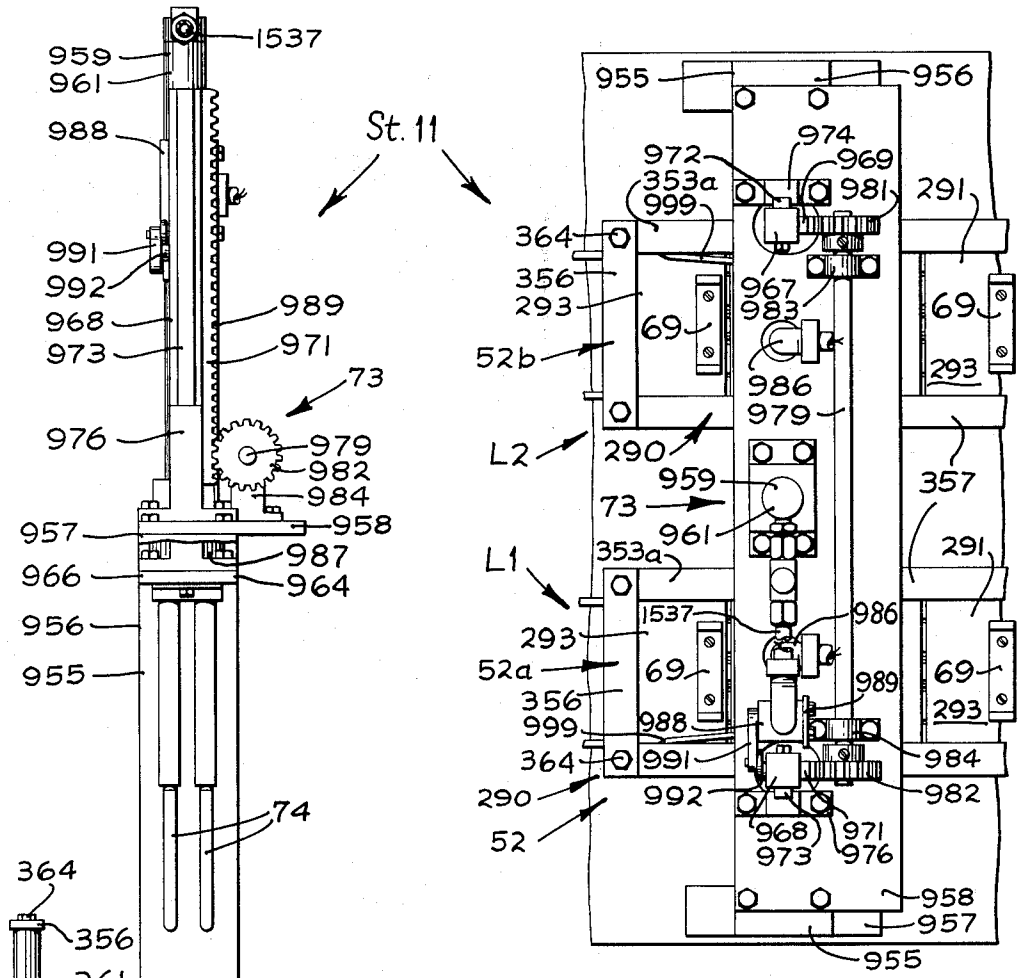


FIG_75

FIG_76

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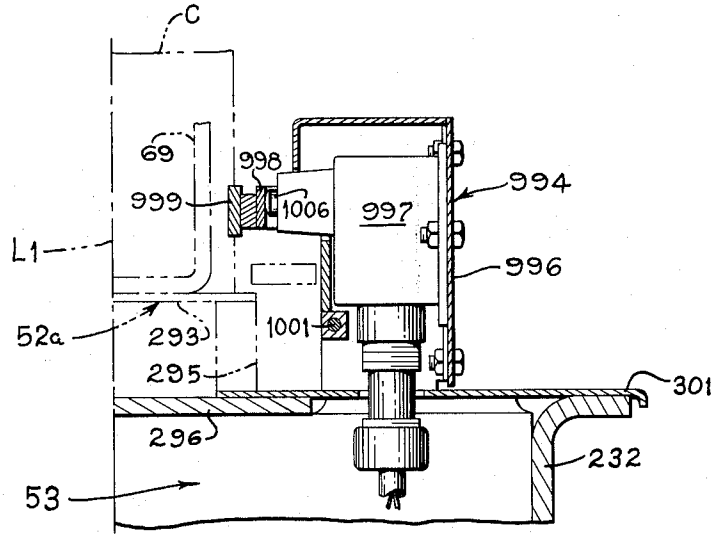
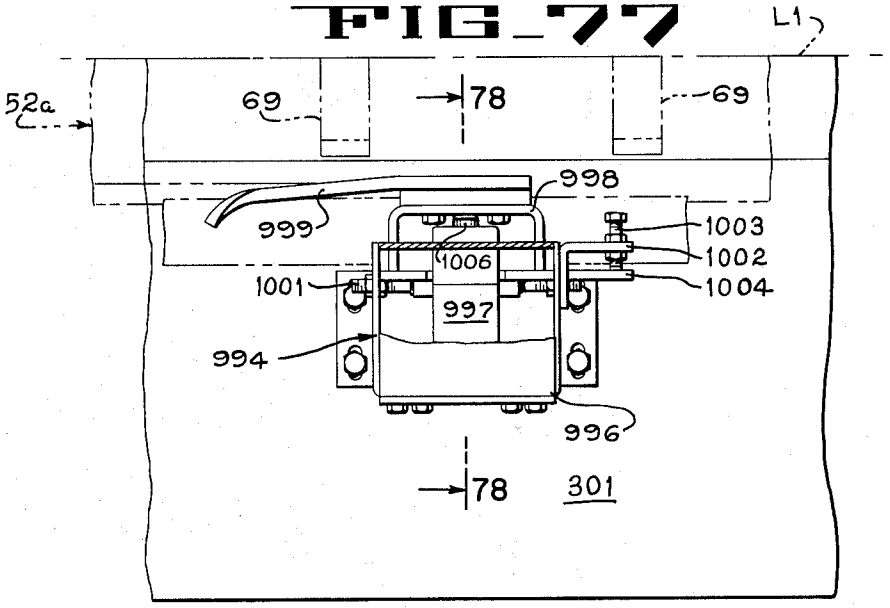


FIG_78

FIG_77



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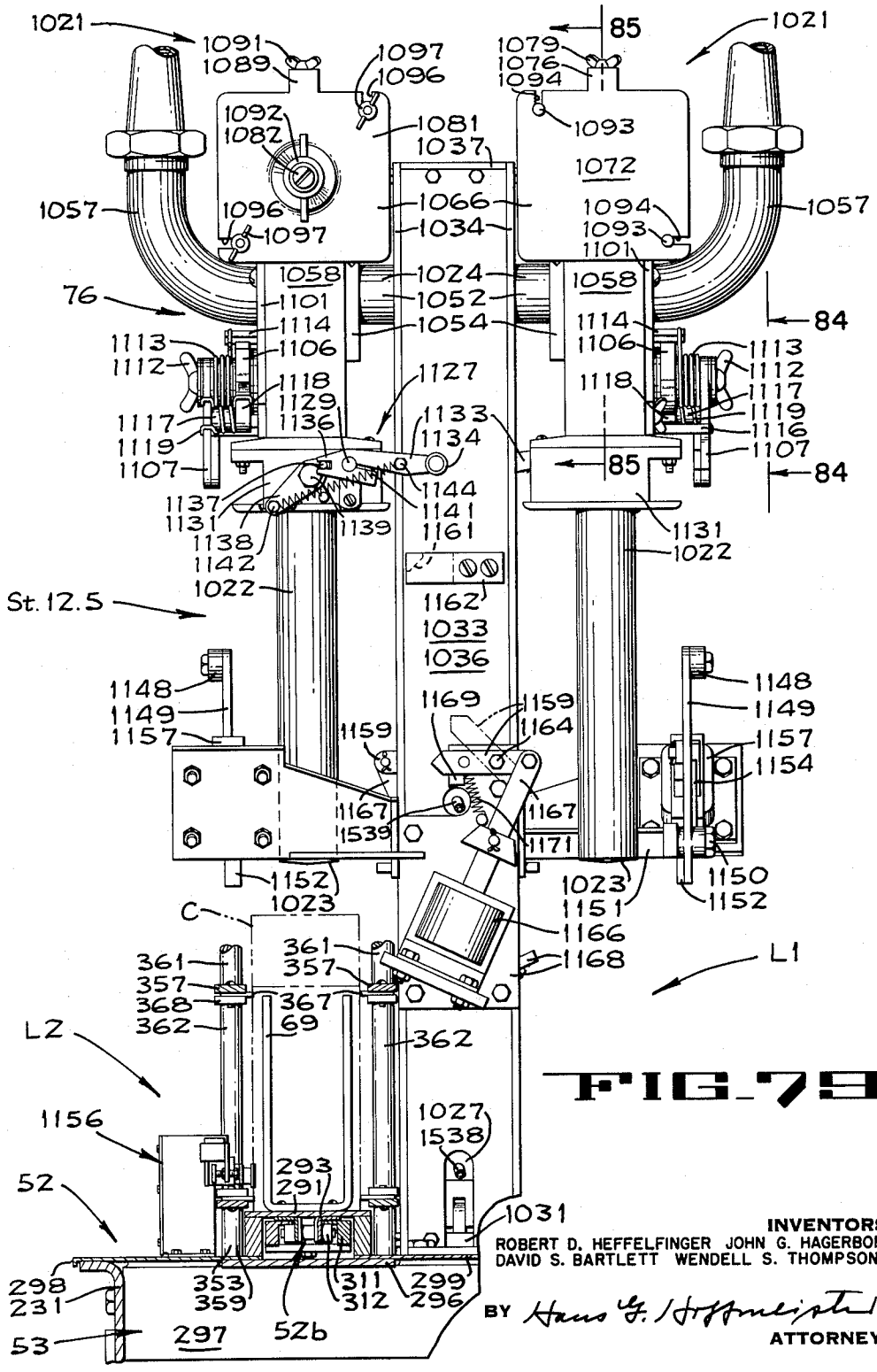


FIG_79

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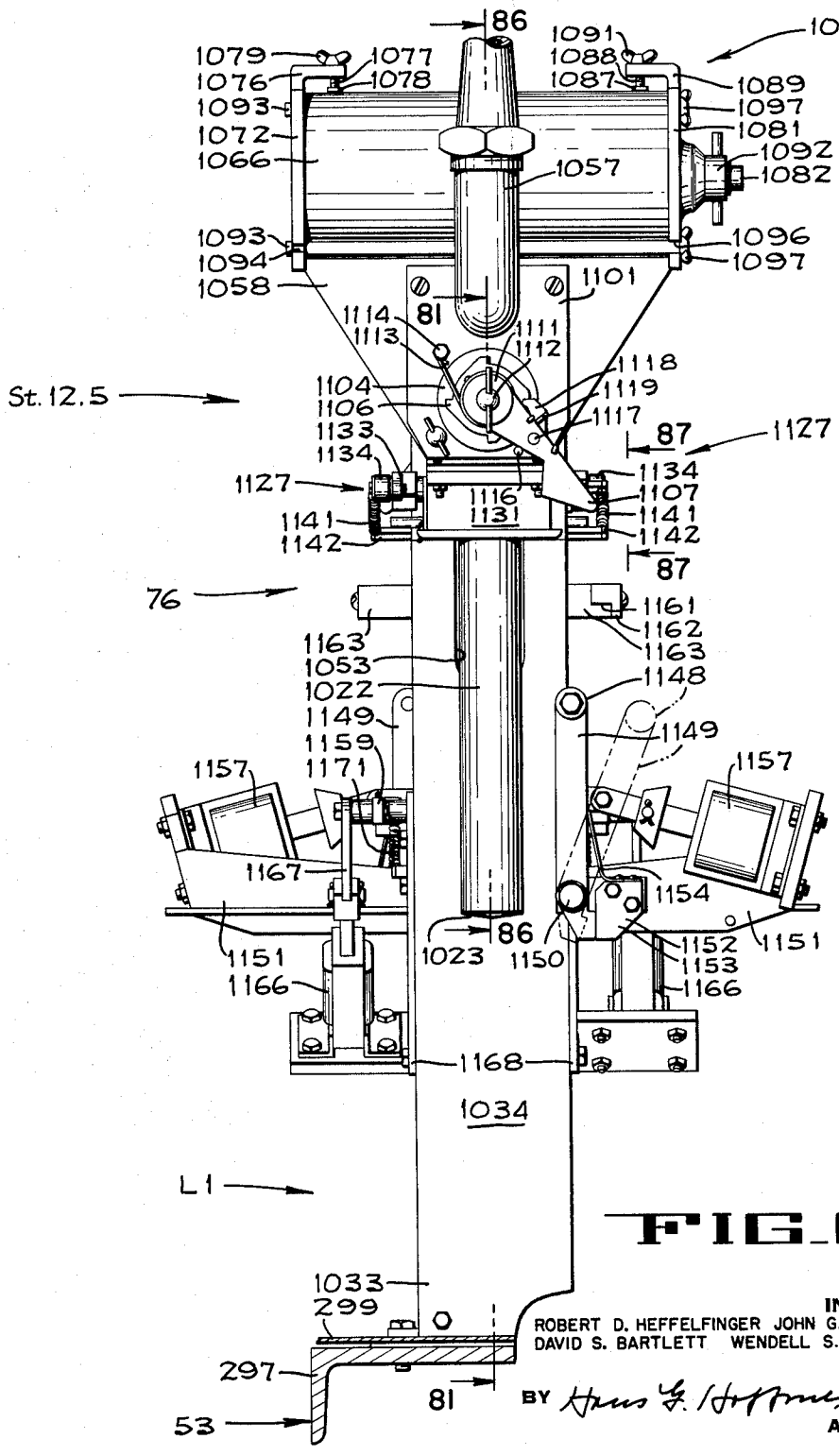


FIG_80

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FIG_81

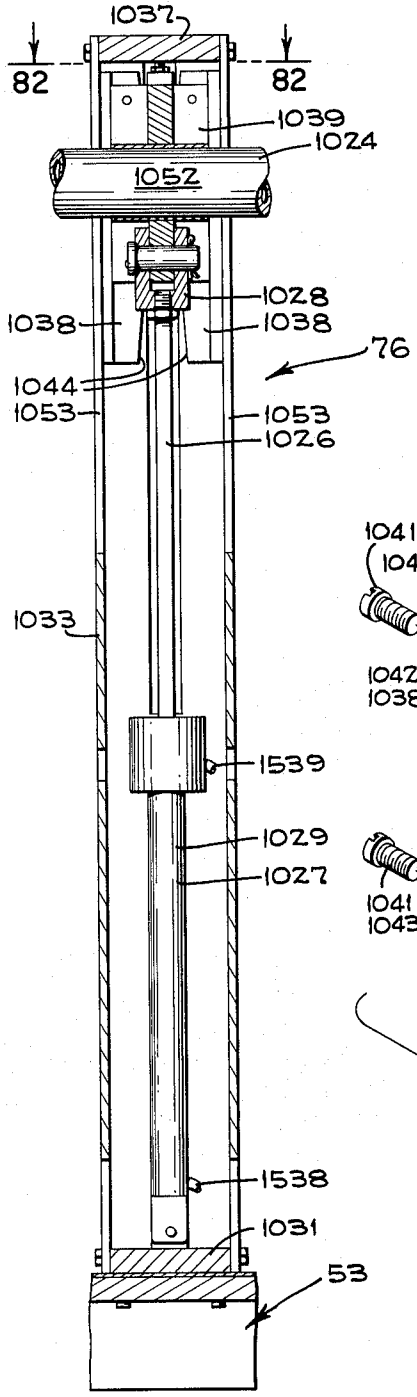
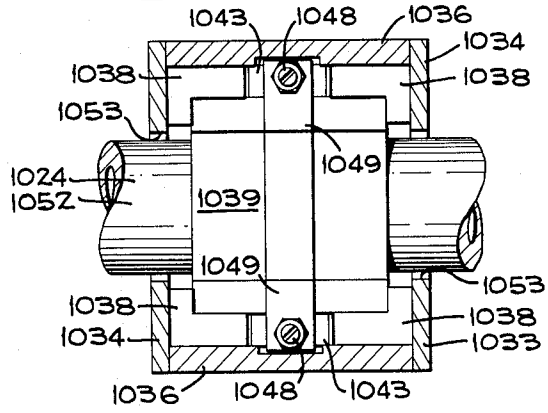


FIG_82



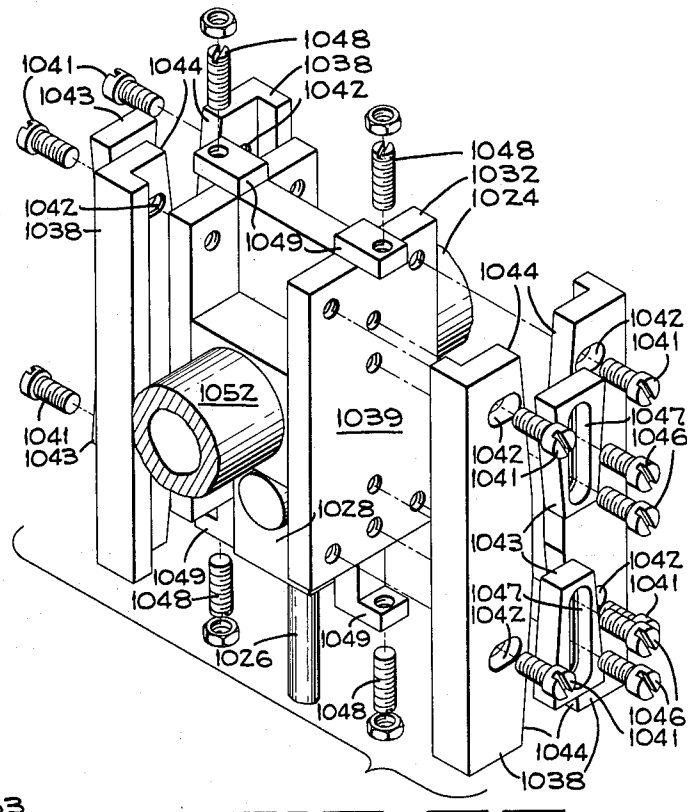


FIG_83

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FIG_84

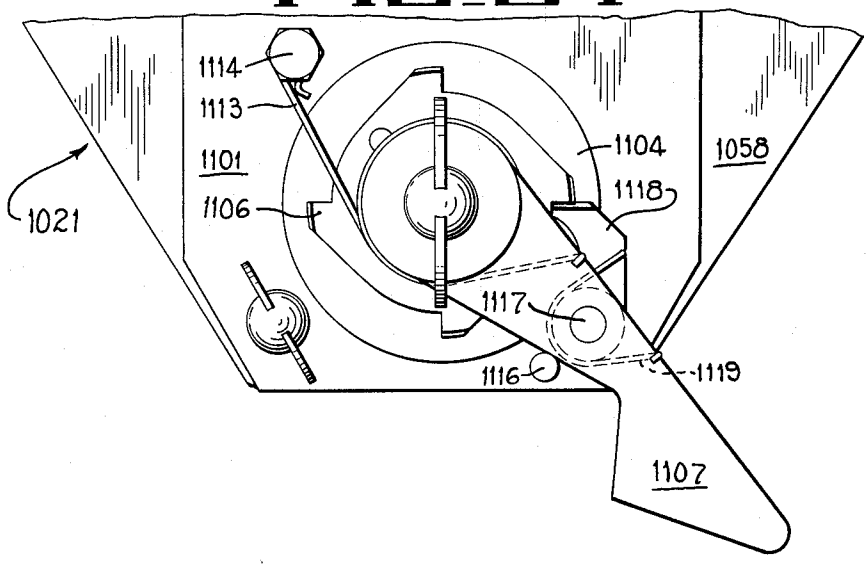
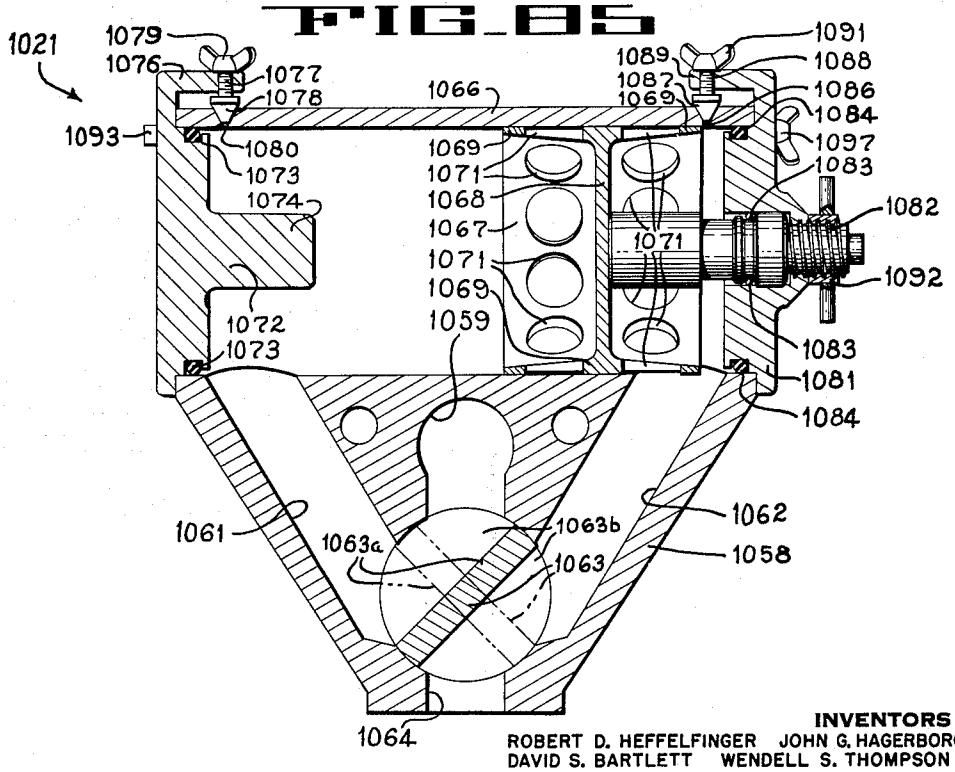


FIG_85



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FIG_86

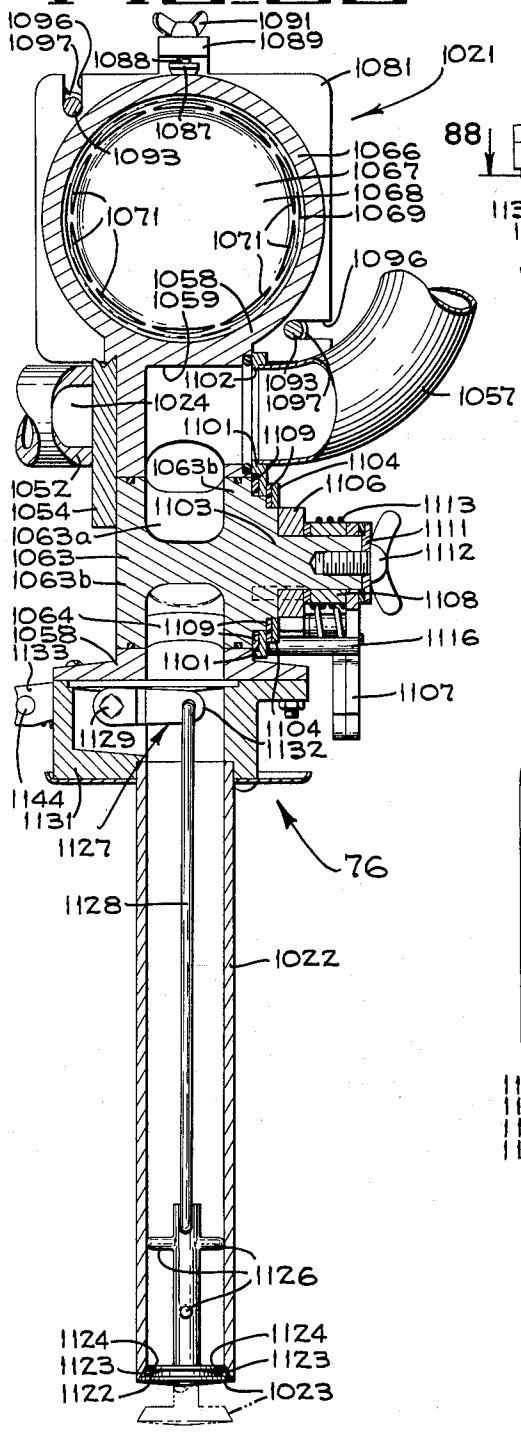


FIG_87

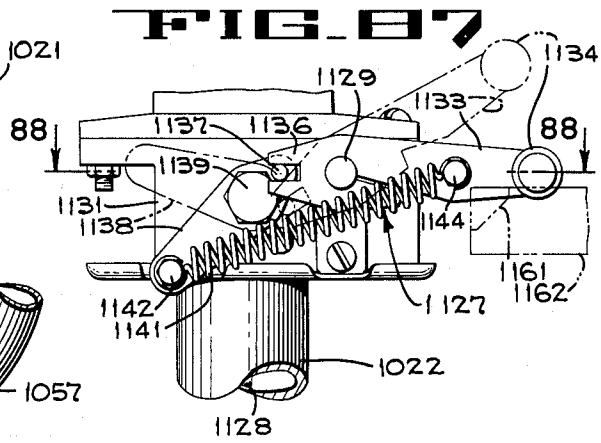
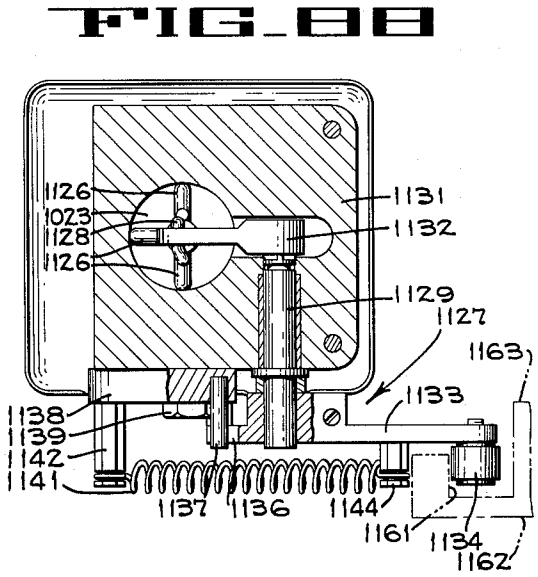


FIG_88



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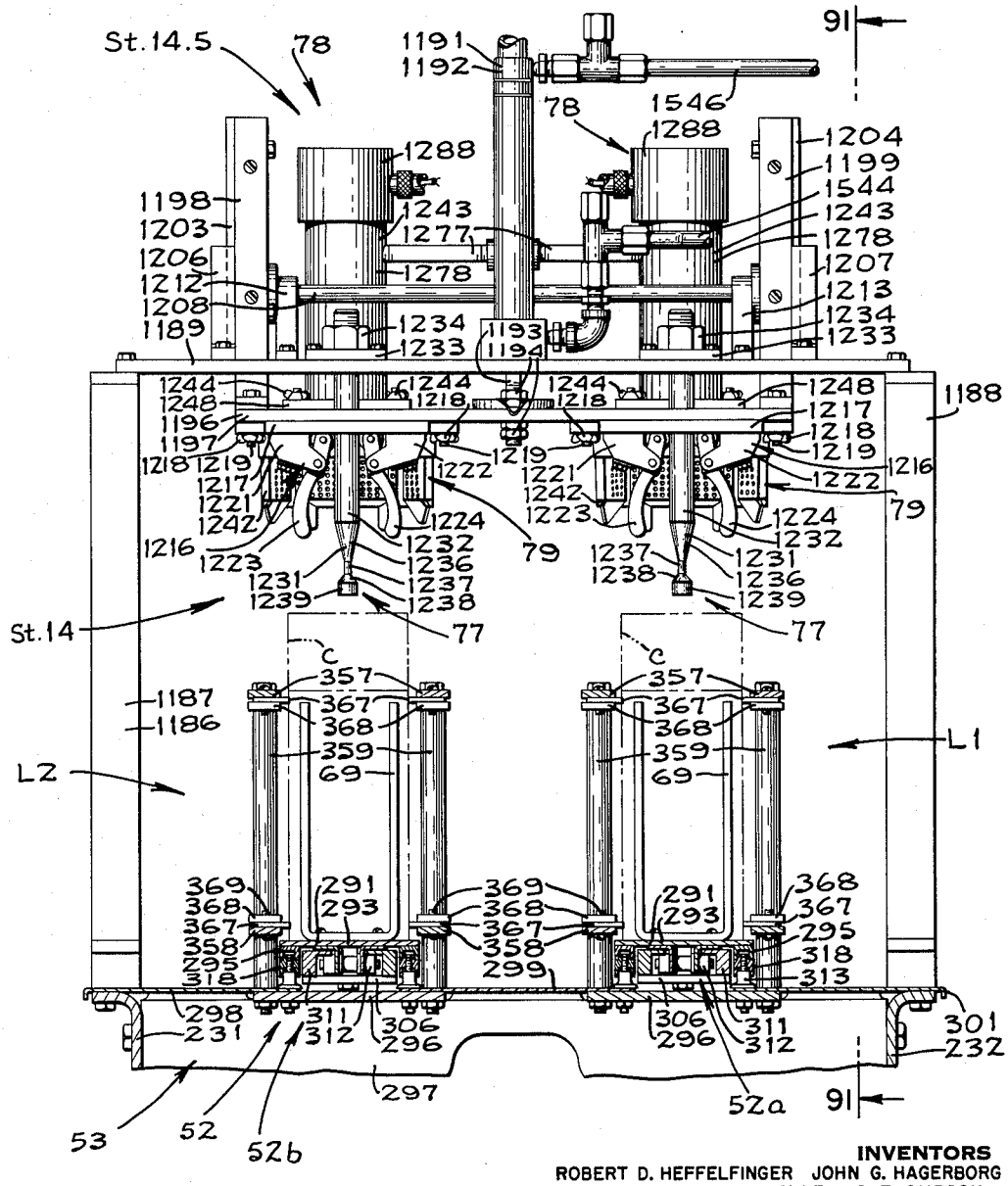
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FIG_89



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FIG_90

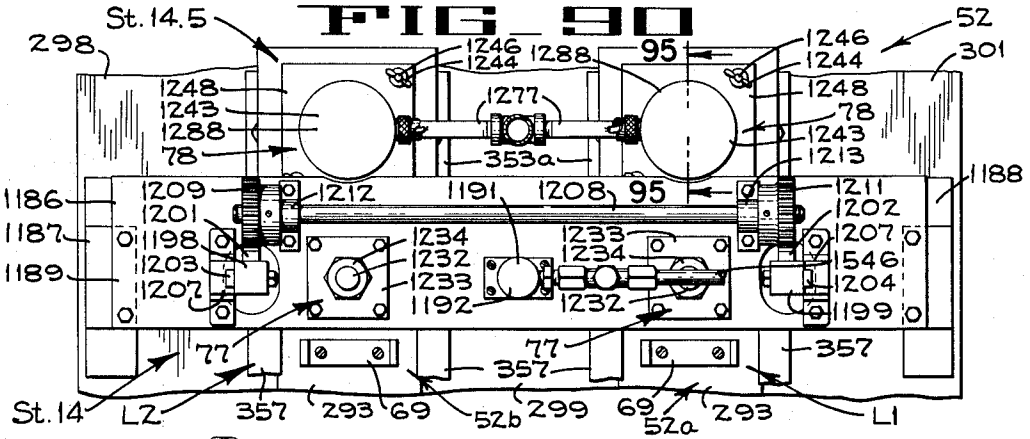


FIG_92

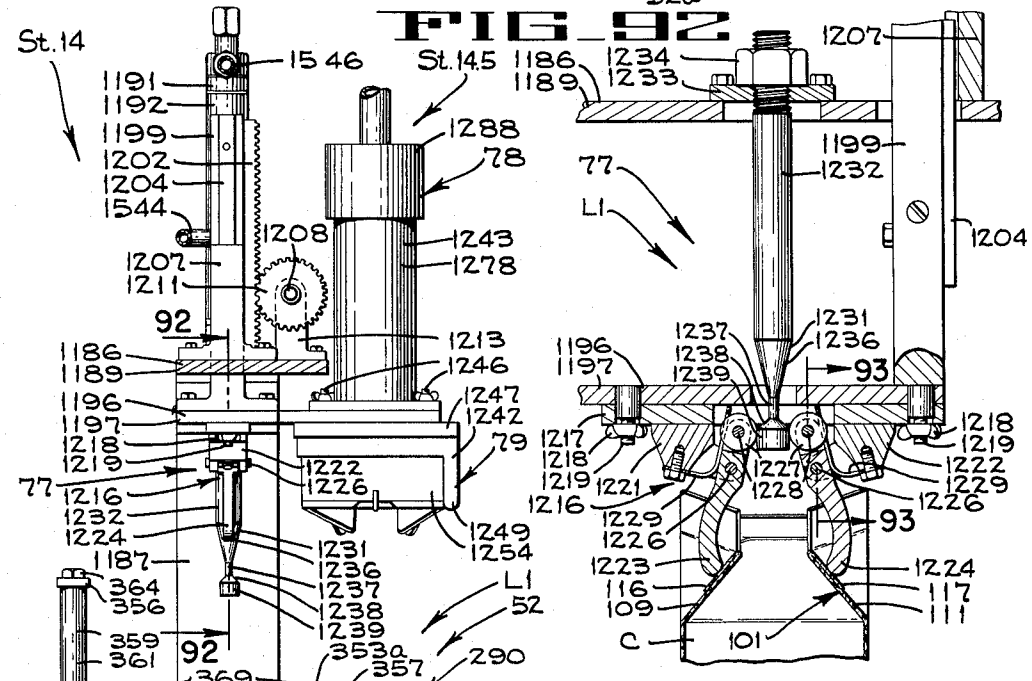
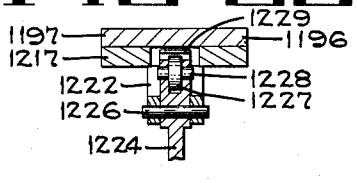


FIG_91

FIG 93



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FIG_94

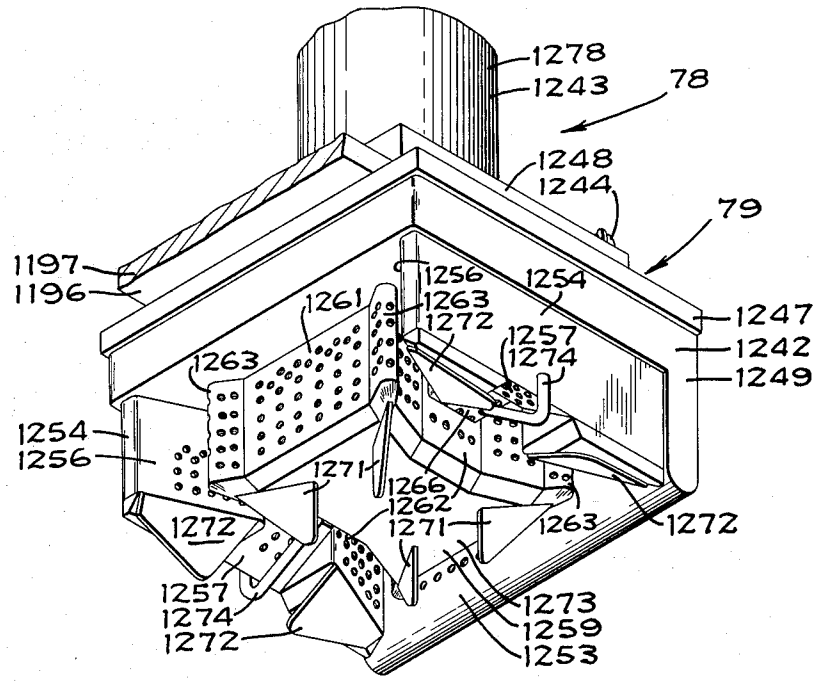


FIG_96

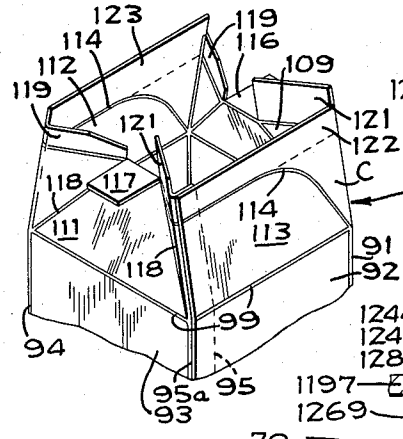
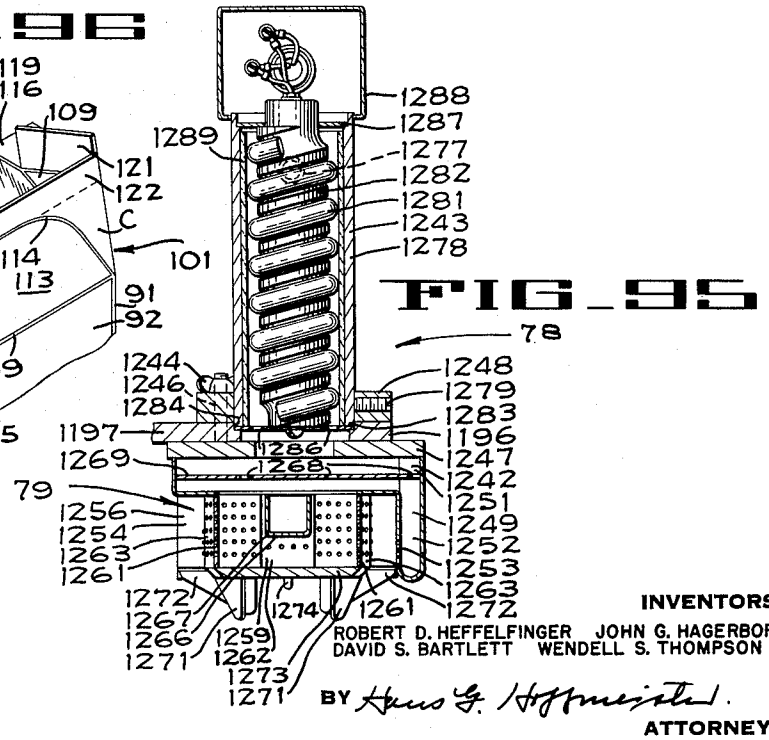


FIG_95



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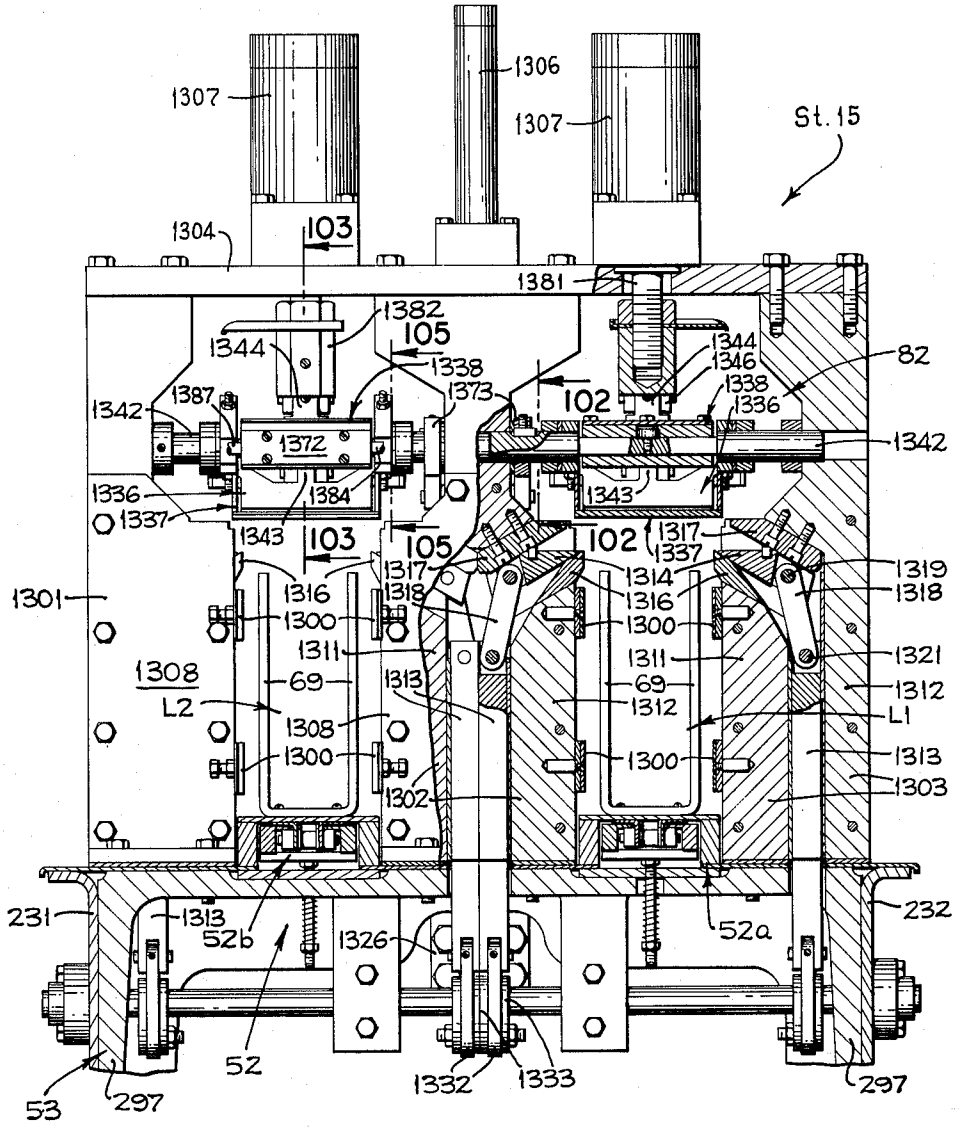
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FIG_97



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FIG_98

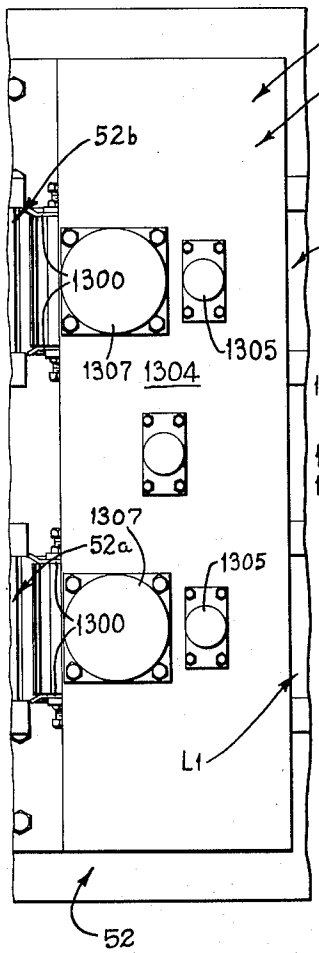
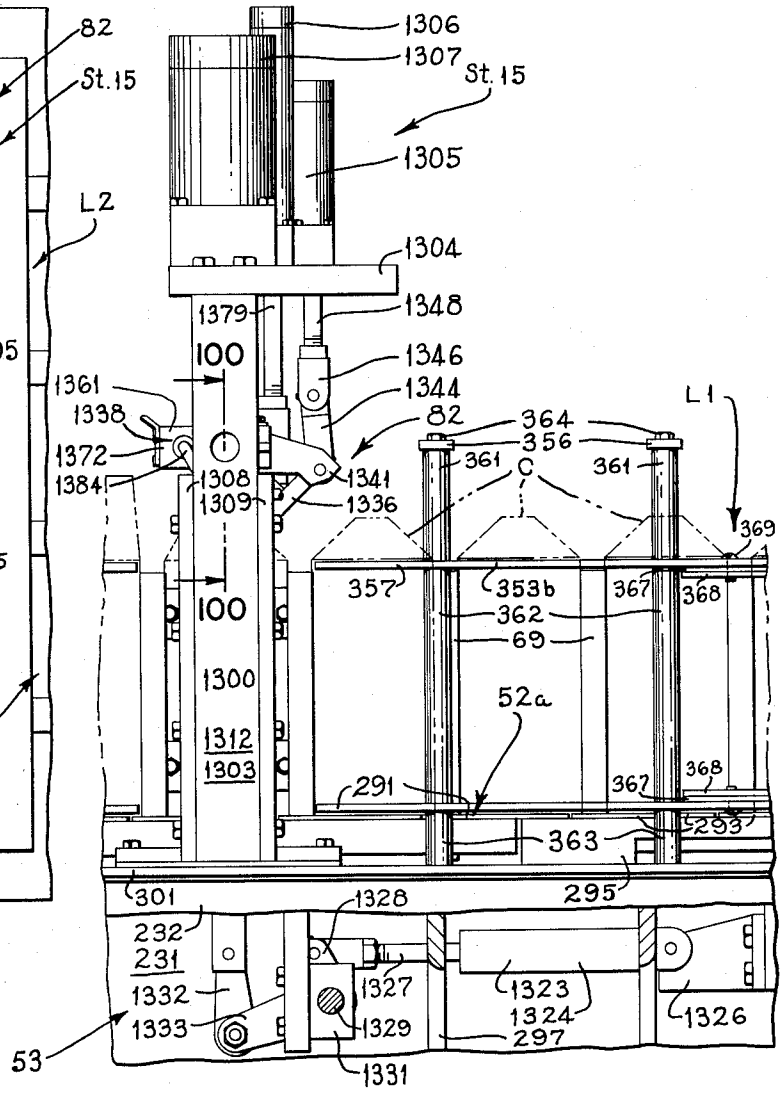


FIG_99



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FIG_101

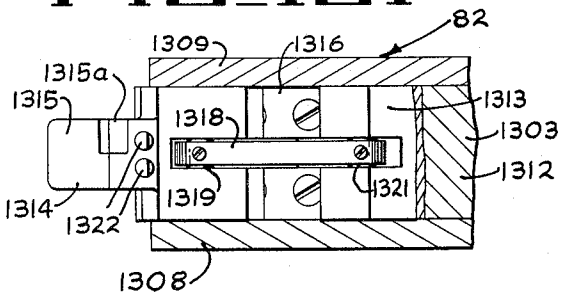


FIG_102

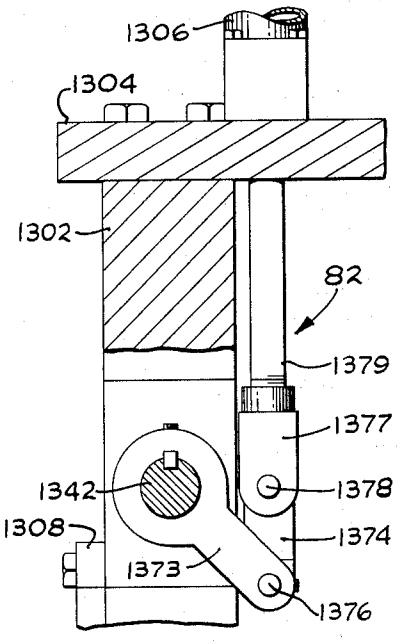
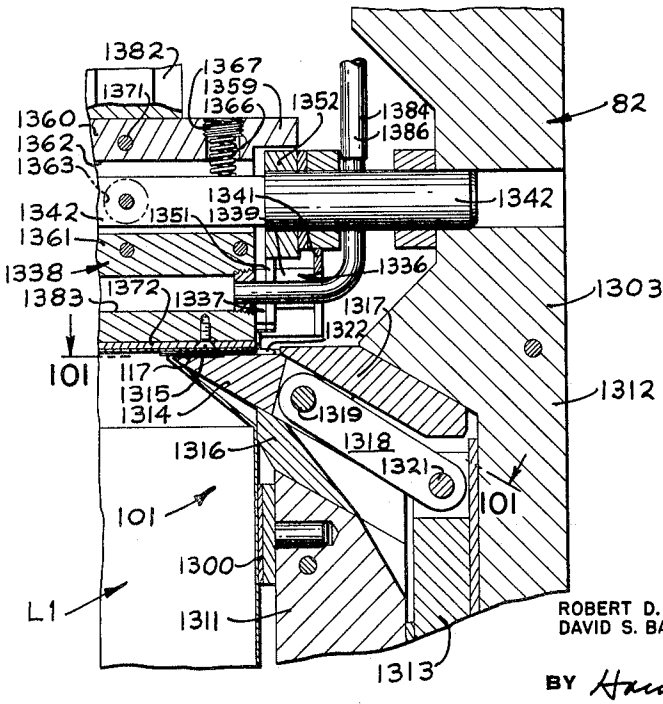


FIG_100



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FIG_103

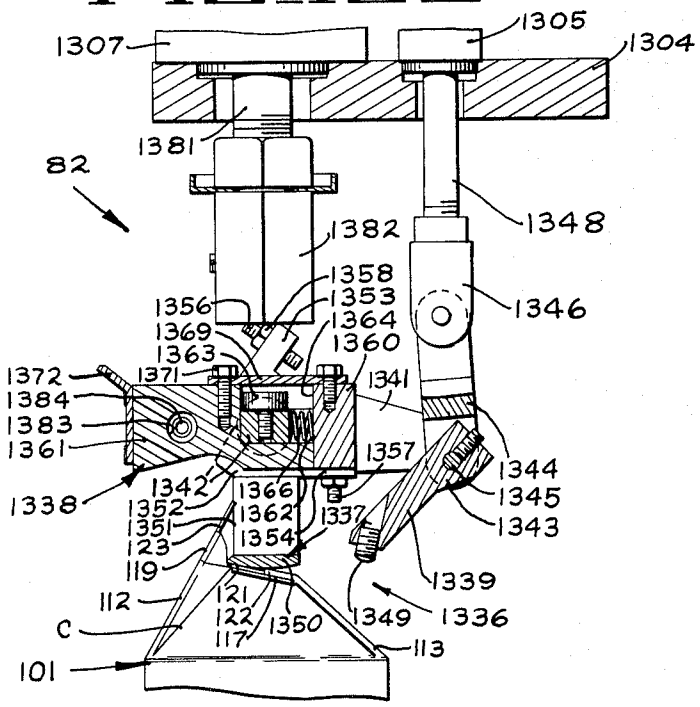
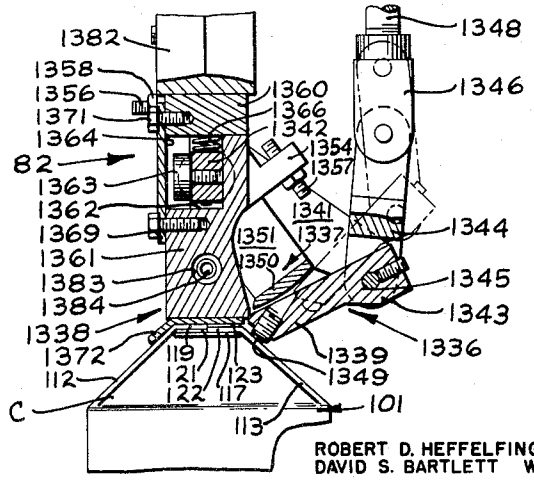


FIG_104



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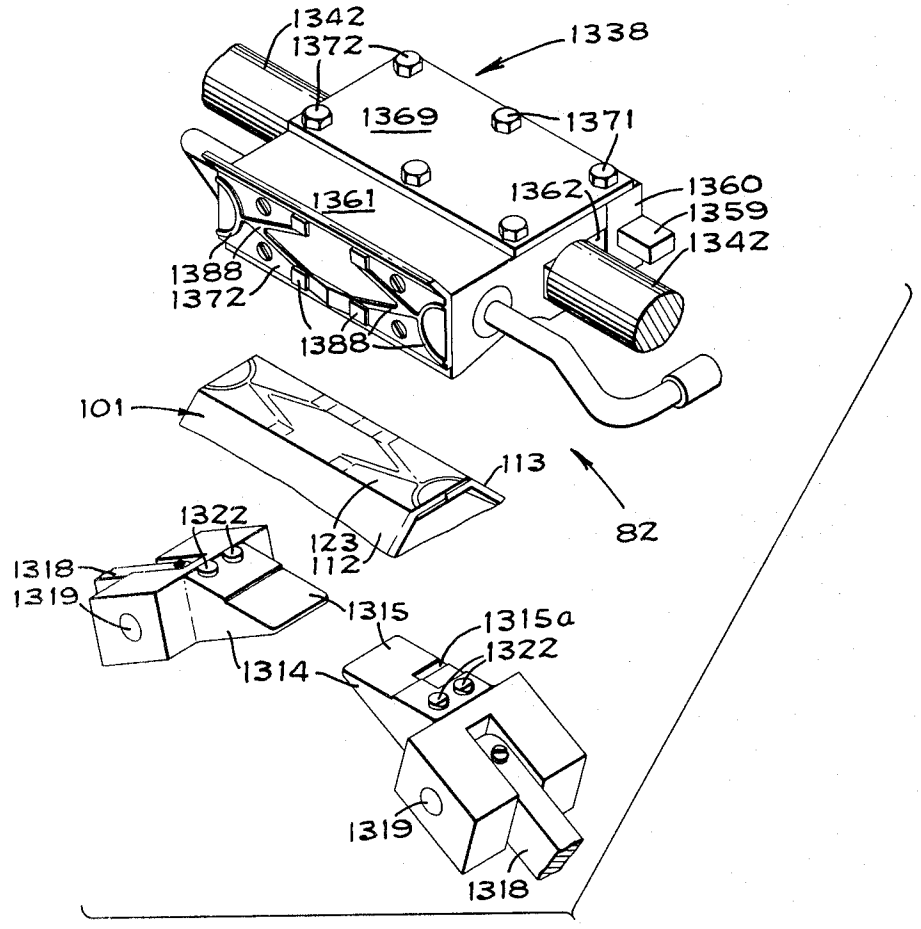


FIG_106

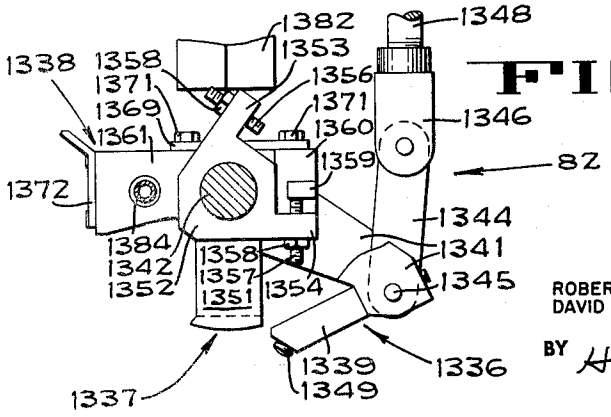


FIG_105

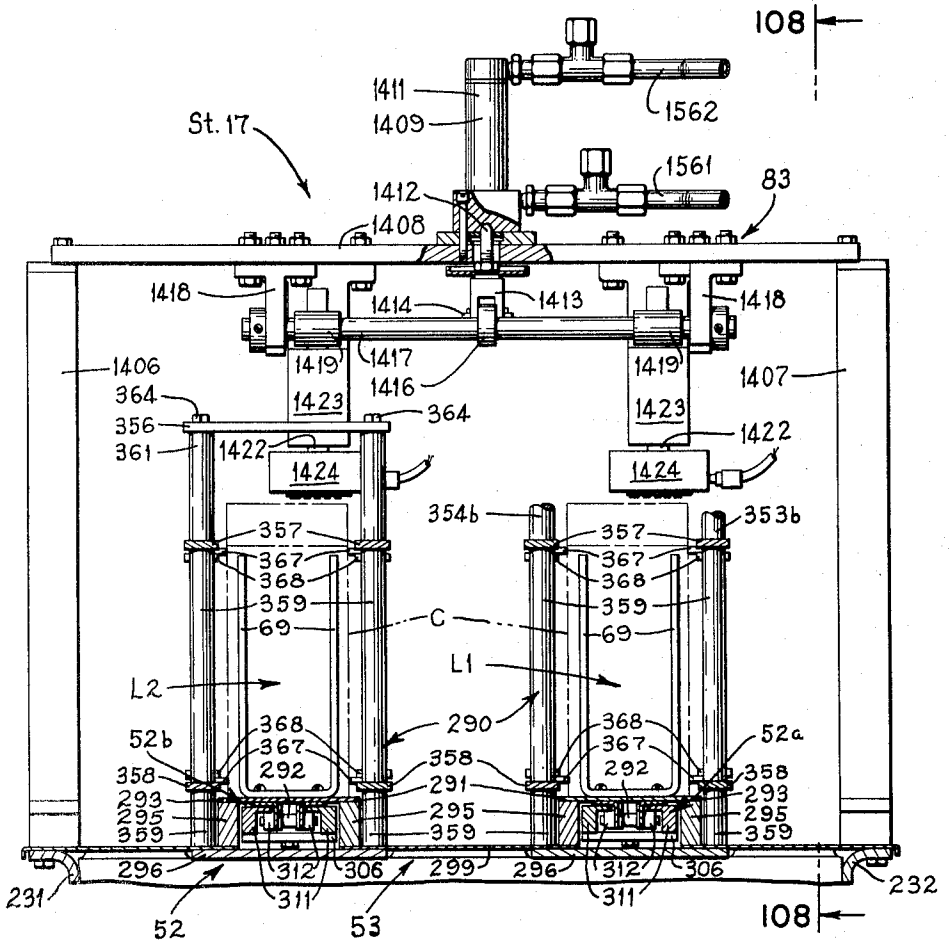
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FIG_107

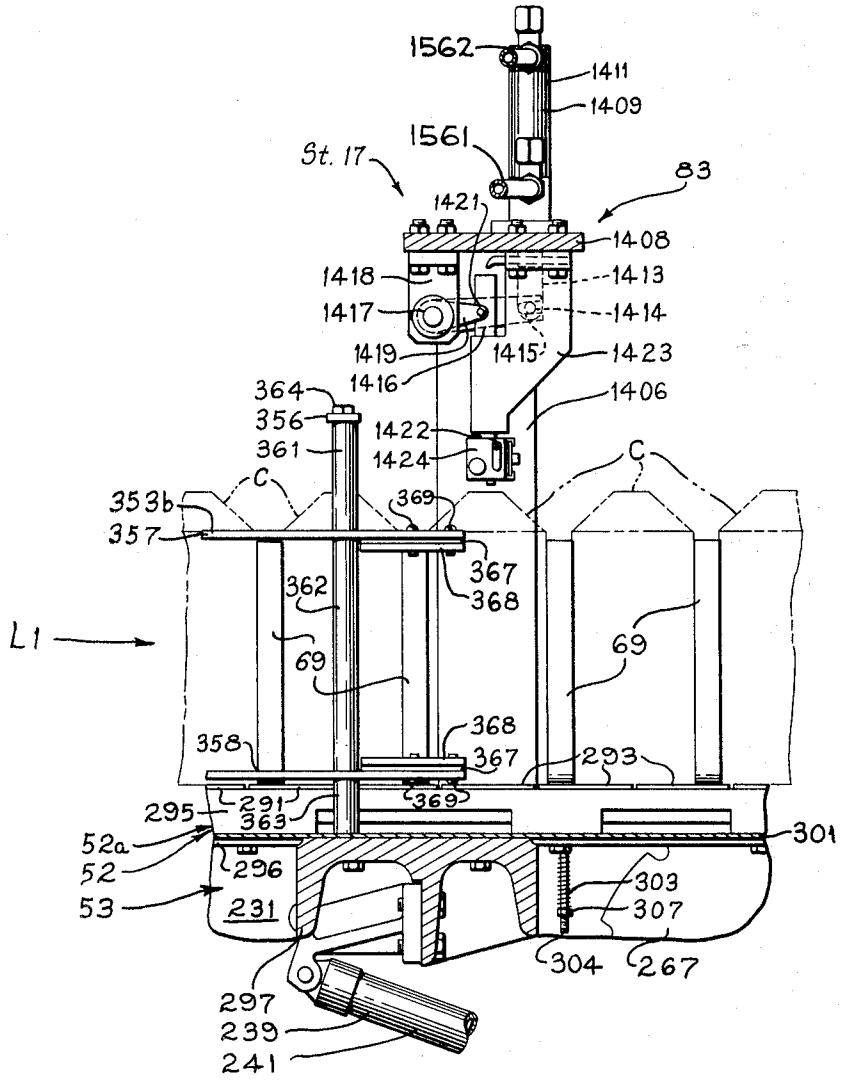


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FIG_108



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FIG_109

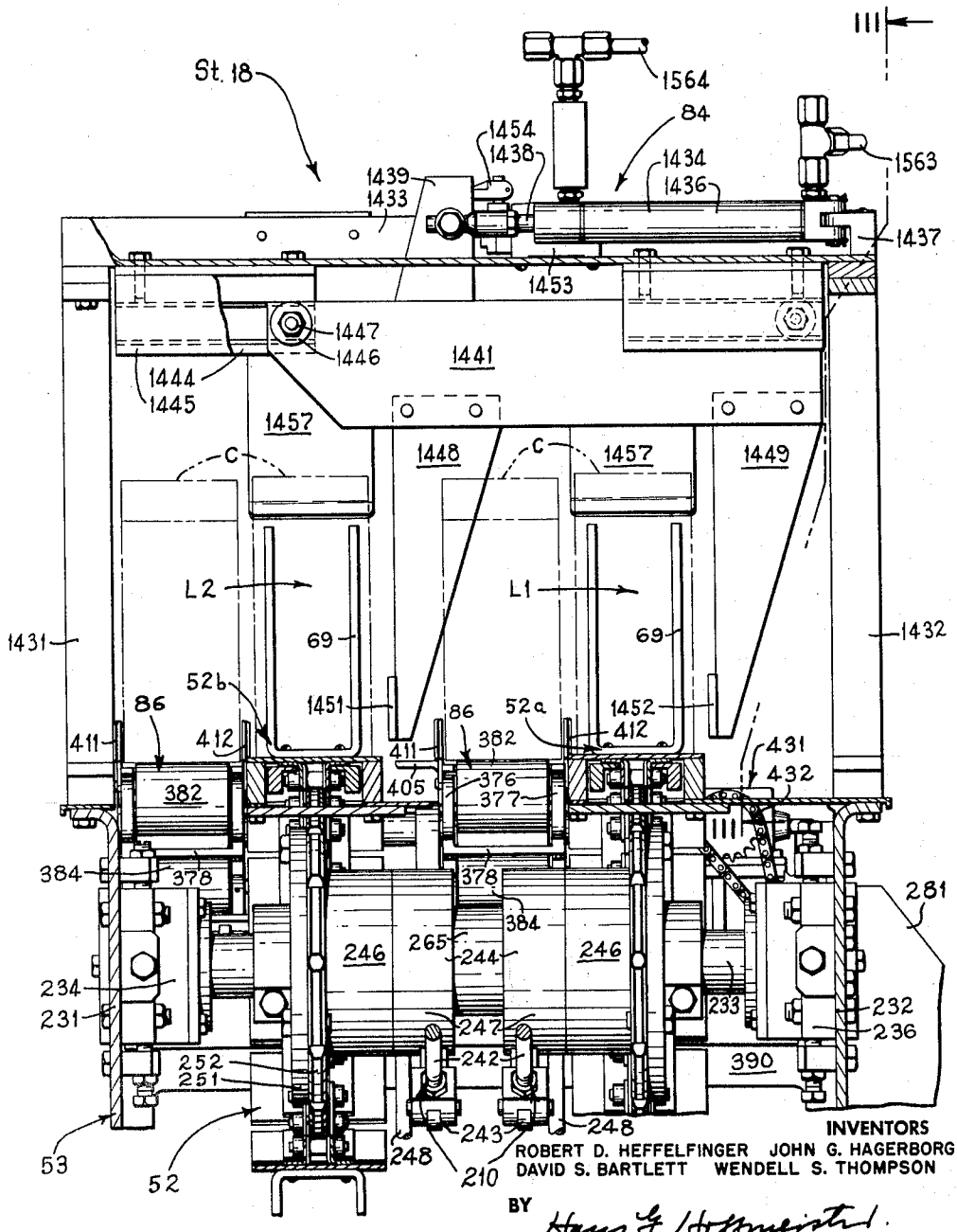


FIG_110

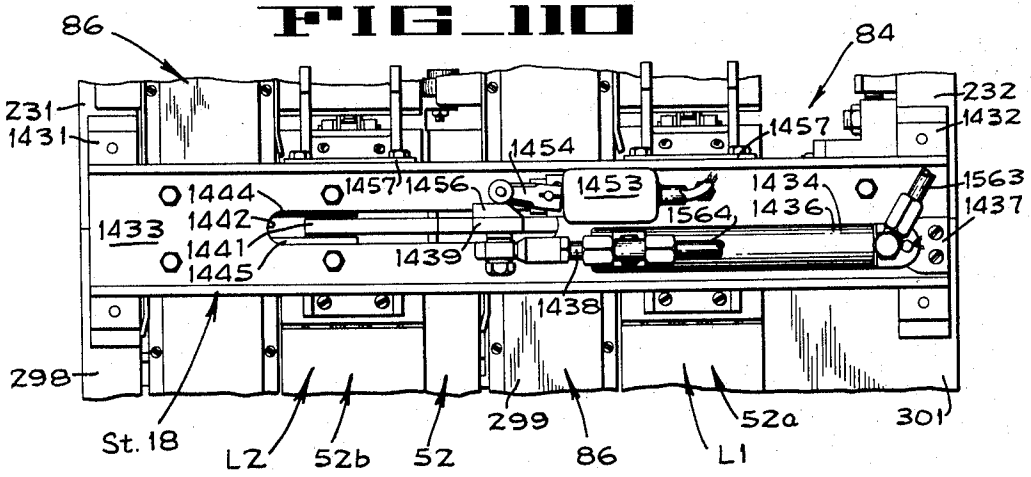
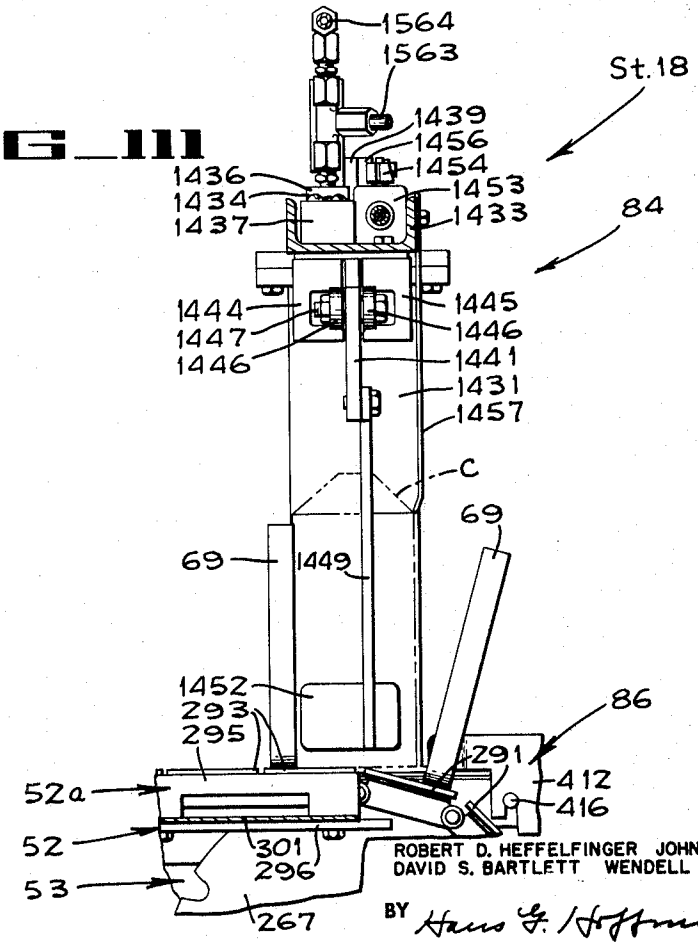


FIG_111



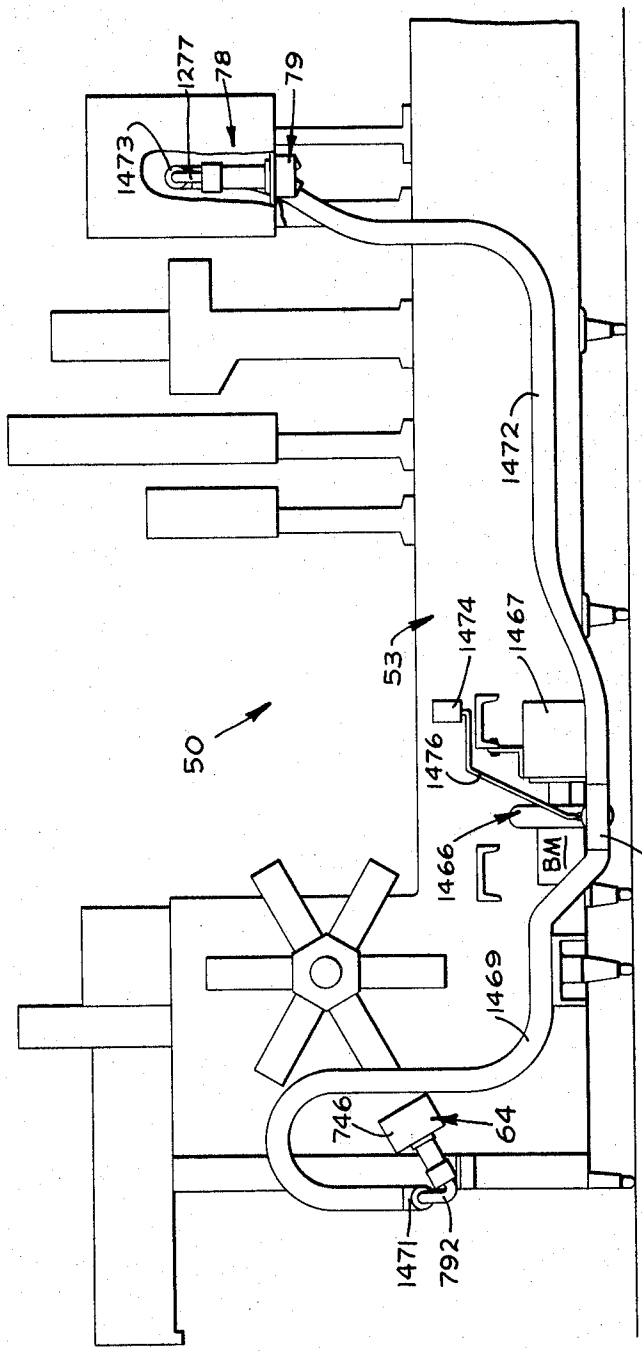
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FIG. 112



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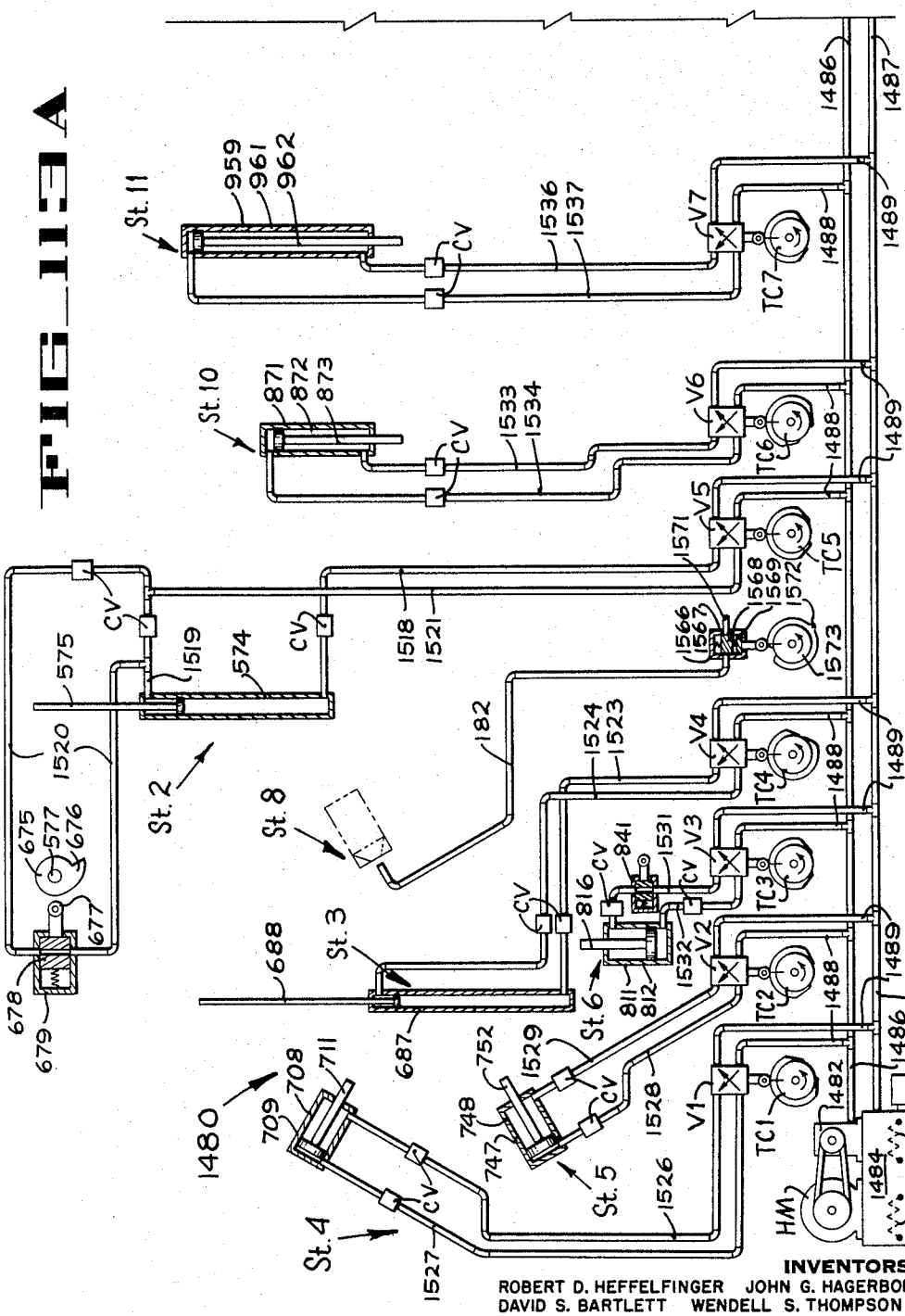
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FIG. 113A



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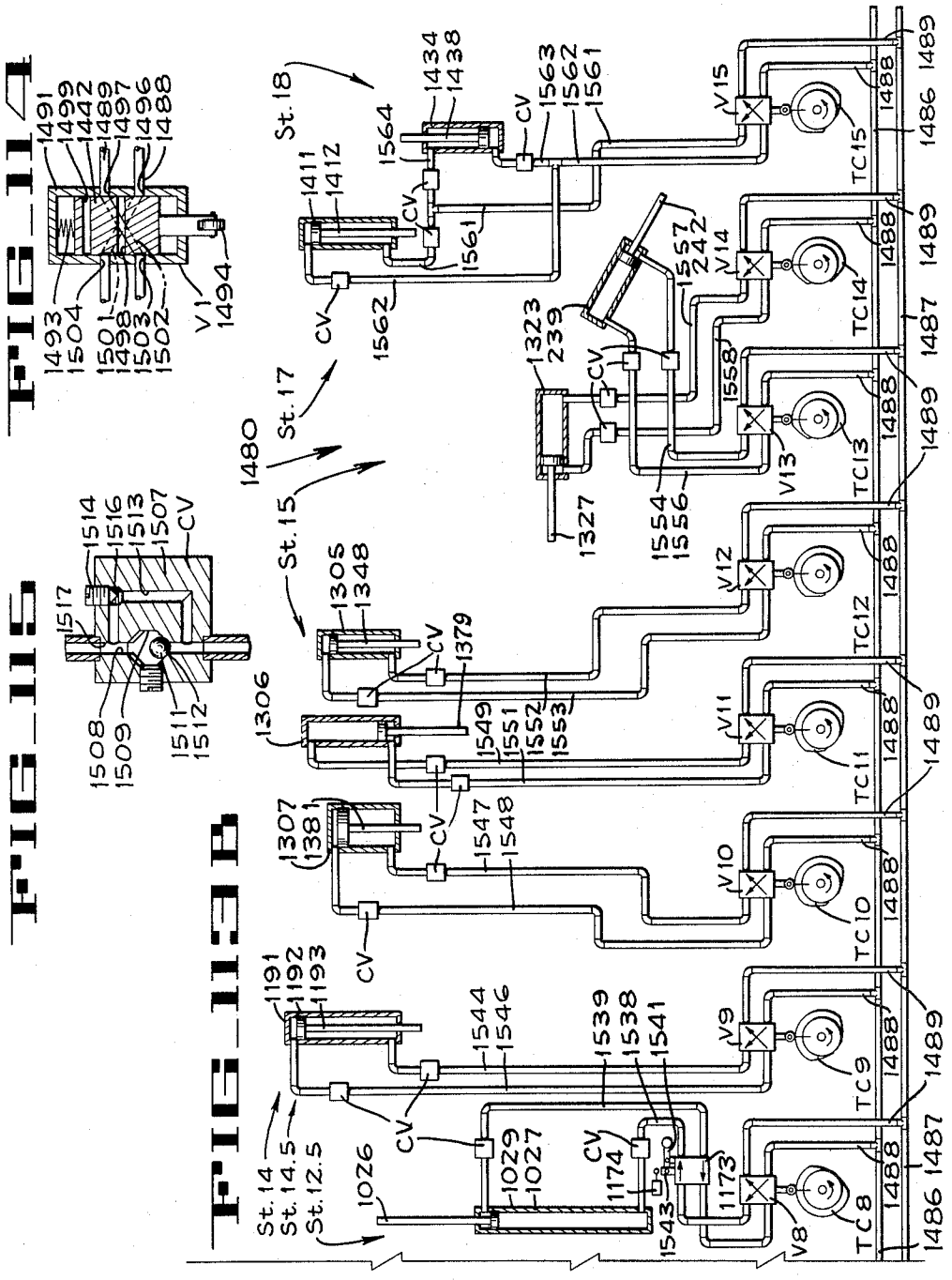
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FIG_11A

FIG_11B



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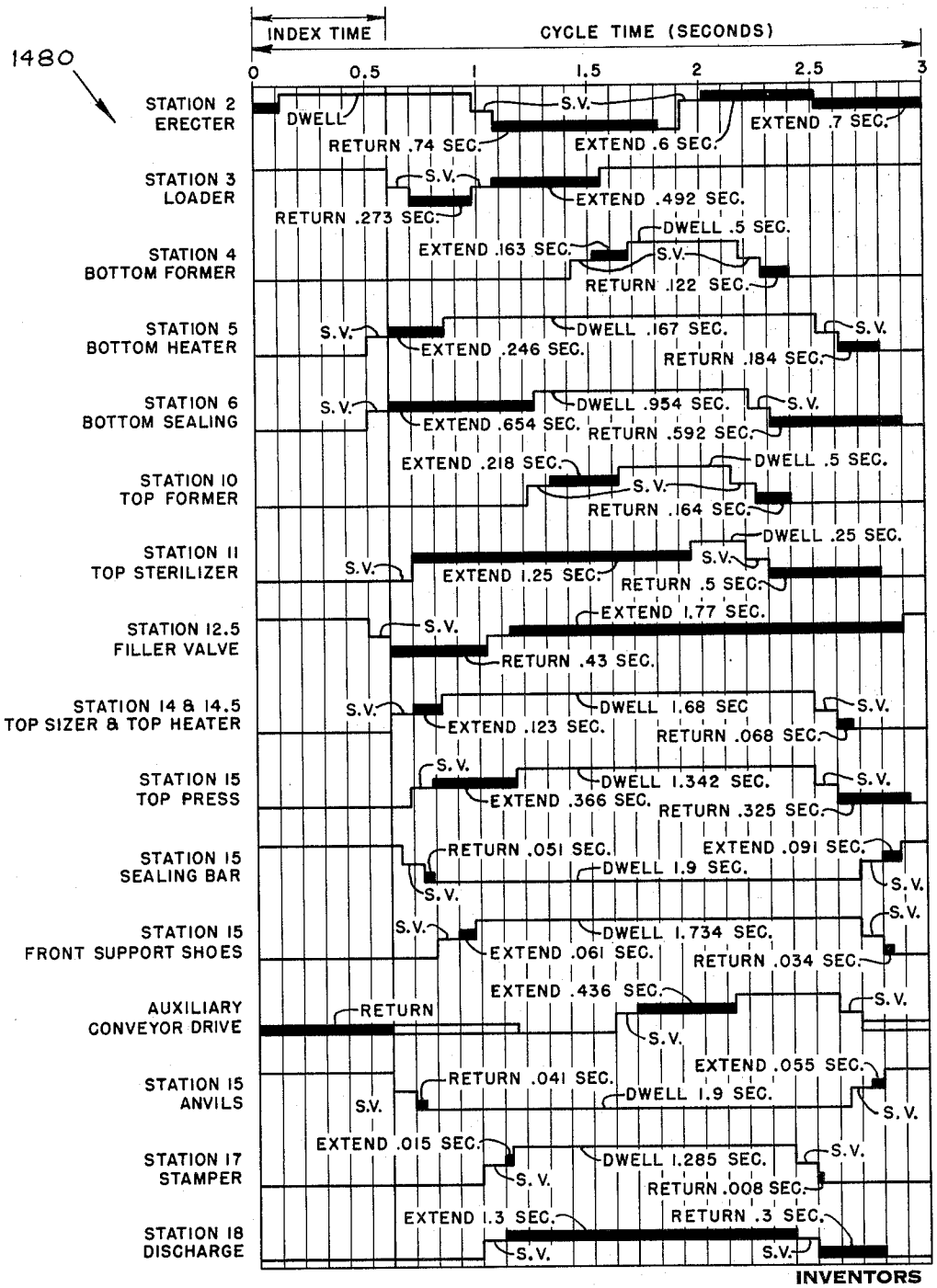


FIG_116

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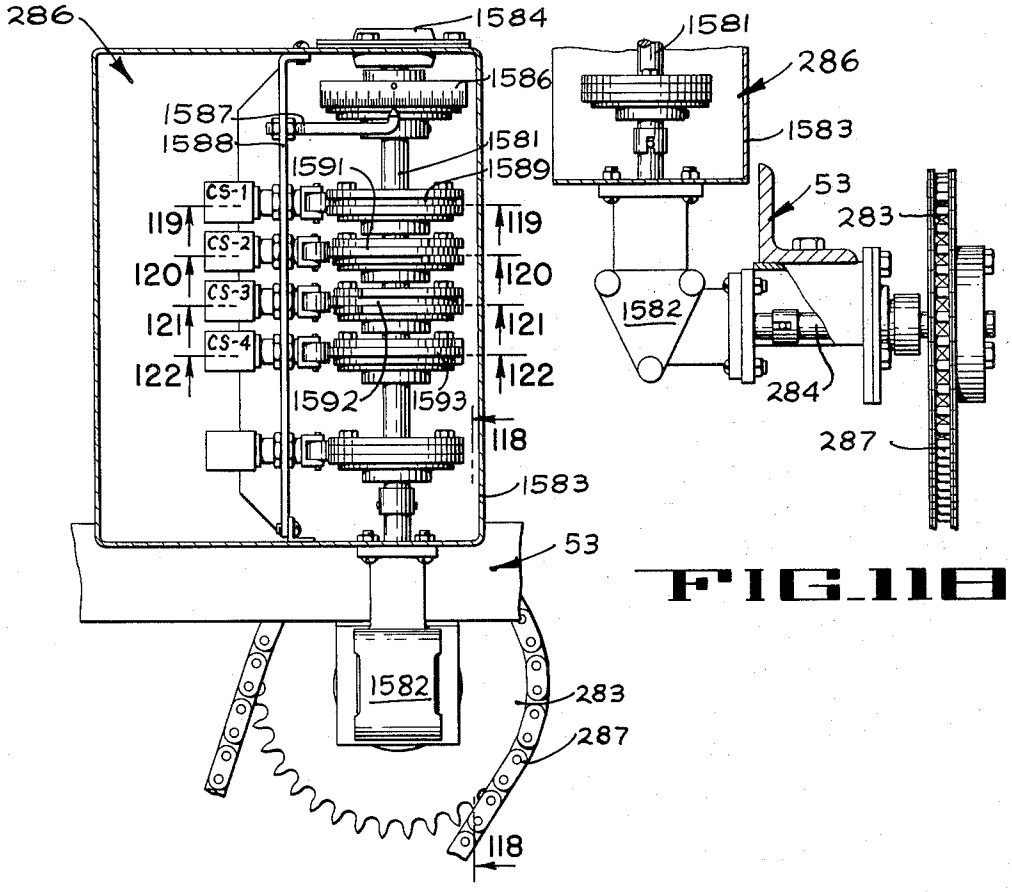


FIG_118

FIG_117

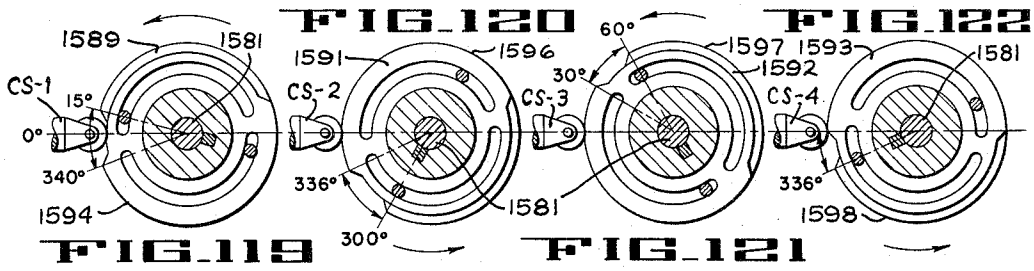


FIG_119 FIG_120 FIG_121 FIG_122

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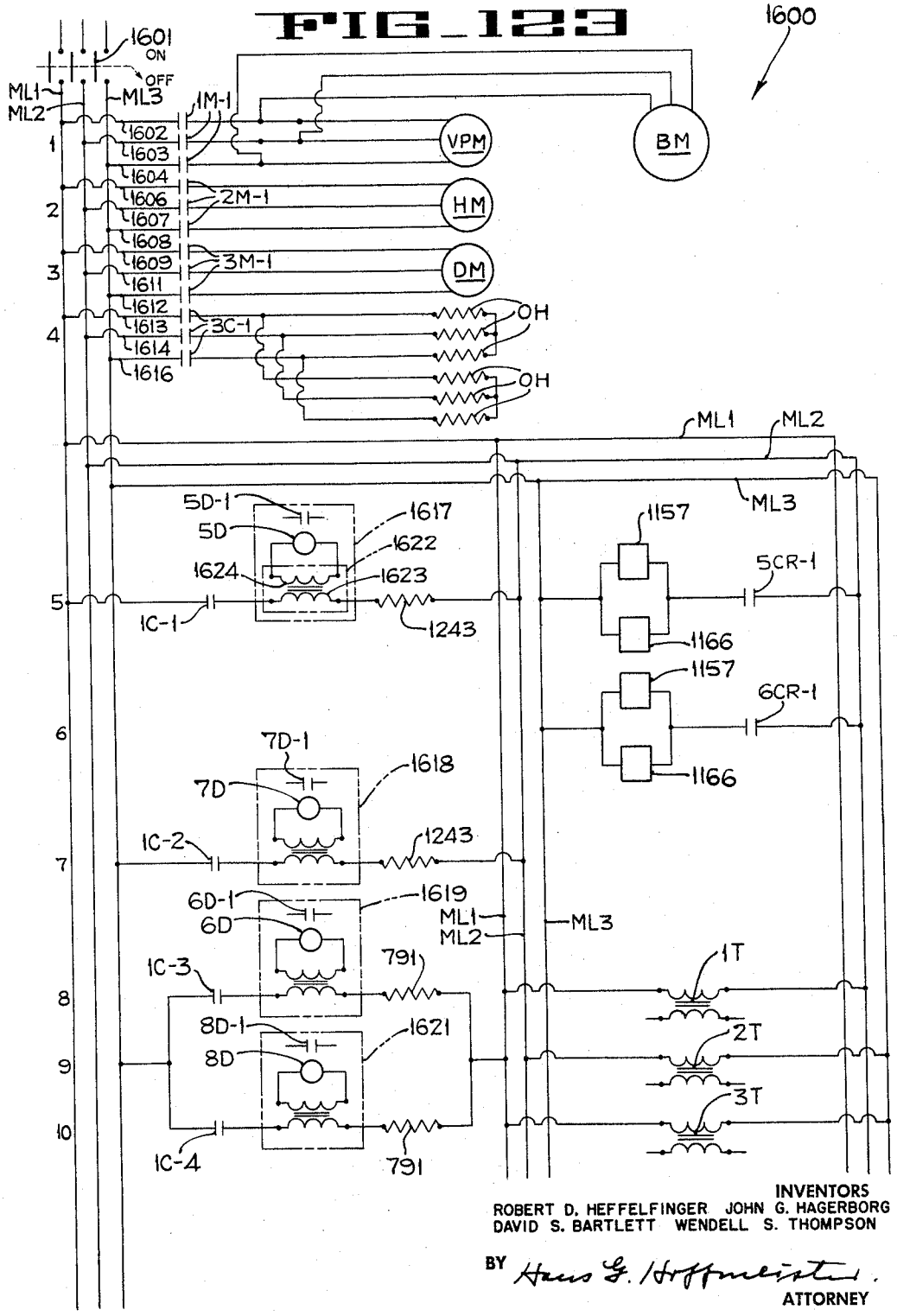
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FIG_123



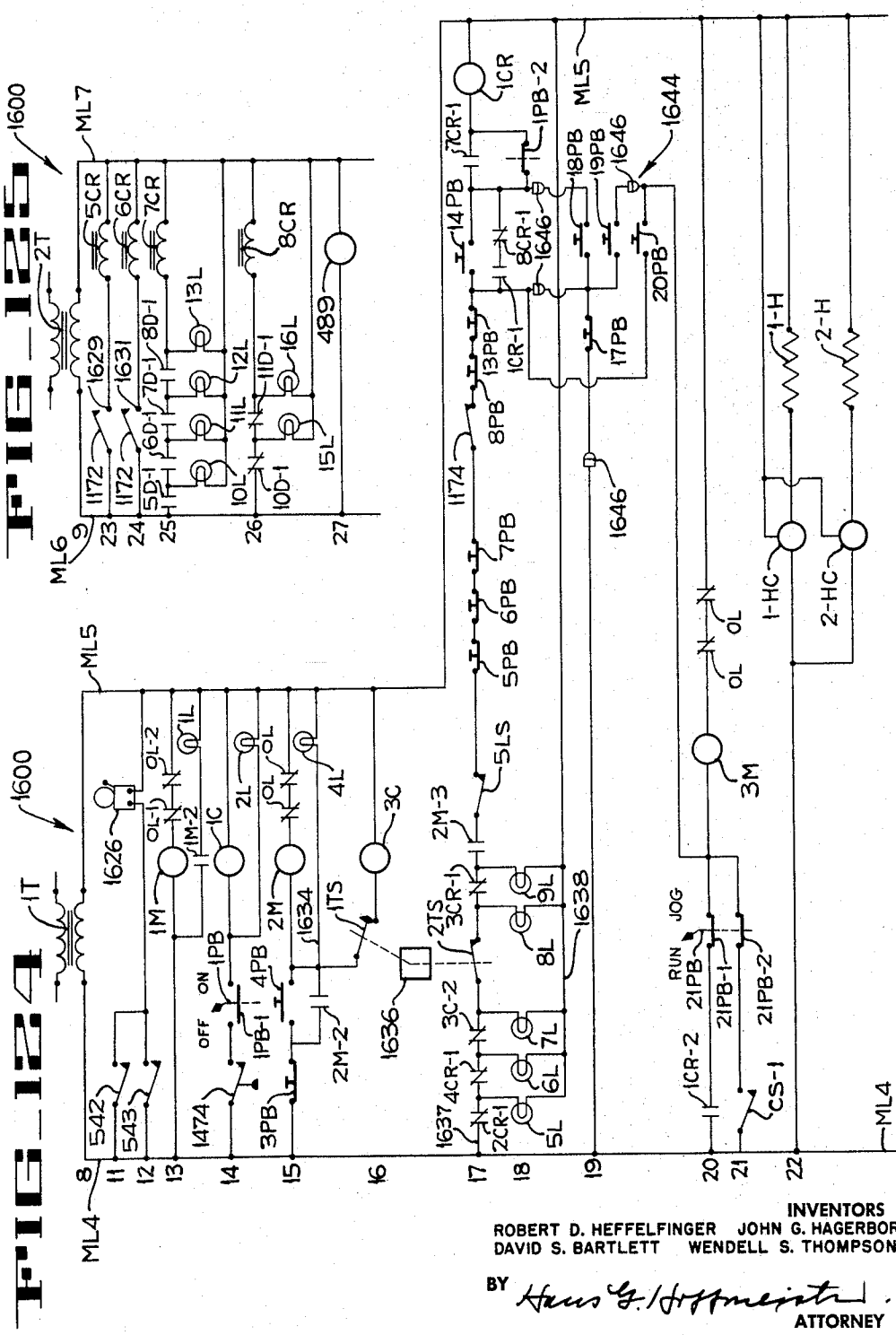
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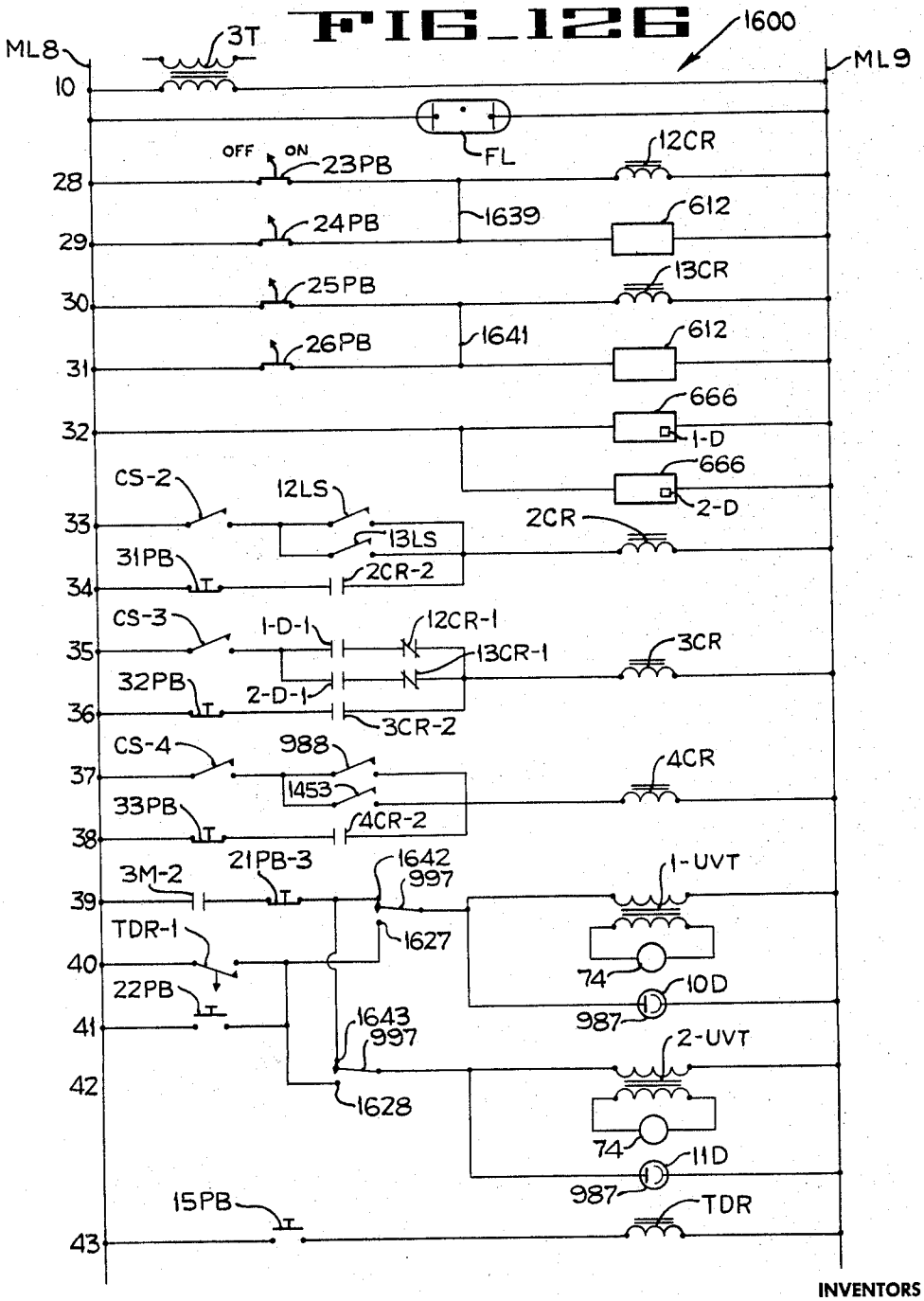
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FIG_126



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United States Patent Office 3,248,841 Patented May 3, 1966

3,248,841

METHOD OF AND MACHINE FOR FORMING, FILLING AND CLOSING CONTAINERS

Robert D. Heffelfinger and John G. Hagerborg, Los Gatos, David S. Bartlett, San Jose, and Wendell S. Thompson, Los Gatos, Calif., assignors to FMC Corporation, San Jose, Calif., a corporation of Delaware

Filed Aug. 10, 1962, Ser. No. 216,248
17 Claims. (Cl. 53—29)

The present invention pertains to packaging equipment and more particularly relates to a method of and machine for forming containers, sterilizing and filling the containers with a sterile product such as milk or the like, and closing the filled containers.

Heretofore containers, hereinafter referred to as cartons, have been preformed by the carton manufacturer and shipped to the dairy in the assembled form for filling and closing. The carton forming and filling machine of the present invention is arranged to be installed at the dairy and is designed to handle collapsed cartons, hereinafter referred to as blanks, rather than preformed cartons, in order to save storage space, facilitate handling and reduce the cost of the cartons. The machine automatically erects the collapsed cartons, seals the bottoms of the cartons, sterilizes the cartons, fills the cartons with sterile milk, closes the upper end of each carton, stamps suitable codes or names on the cartons, and then discharges the filled and sealed cartons from the machine.

Since the outputs of dairies vary considerably, the carton forming and filling machine has been designed so that its capacity can easily be changed by changing the number of production lines in the machine.

The construction of the carton handled by this machine is not a part of the present invention. In its preferred form the carton to be described herein is of the two quart capacity, and is made of a thermoplastic laminate, including a laminated cardboard inner base layer with a polyethylene coating on both the outside and the inside of the base layer.

Polyethylene coated milk cartons have been used heretofore, however, many of these cartons leak excessively and frequently the top closure opens when handled by clerks and customers.

It is, therefore, one object of the present invention to provide a carton forming and filling machine capable of forming sturdy cartons which do not leak.

Another object is to provide an improved method of forming, filling, and closing cartons.

Another object is to provide an improved carton forming and filling machine for handling heat sealed cartons.

Another object is to provide a carton forming and filling machine adapted to intermittently move a line of cartons along an arcuate path past a first plurality of processing stations and along a linear path past a second plurality of processing stations.

Another object is to provide a carton forming and filling machine having a plurality of bottom forming stations disposed in an arcuate array around a turret and another plurality of stations disposed along the linear path of a conveyor and adapted to perform functions associated with the upper end of the cartons.

Another object is to provide an improved drive mechanism for intermittently driving a carton carrying conveyor so as to eliminate backlash and to effect a gentle starting and stopping of the conveyor to prevent spillage of milk.

Another object is to provide a carton carrying conveyor having improved carton retaining lugs.

Another object is to provide an improved easily loaded magazine.

Another object is to provide a carton erecting apparatus having a carton singulating gate.

Another object is to provide a carton erecting apparatus arranged to bend carton blanks to compensate for the inherent resilience at the carton seam lines.

Another object is to provide an improved carton erecting apparatus.

Another object is to provide an improved method of erecting a tubular carton from a folded carton blank.

Another object is to provide an improved method of sealing the bottom of a carton.

Another object is to provide an apparatus for providing a leakproof bottom closure of a carton.

Another object is to provide an improved die for preforming the bottom closure of a carton.

Another object is to provide an improved apparatus for forming a carton from a folded carton blank and sealing its bottom closure.

Another object is to provide an improved method of forming a carton and sealing its bottom closure from a folded carton blank.

Another object is to provide a bottom sealing head having means therein for breaking the natural seam lines to prevent flow of fluid therepast.

Another object is to provide an improved bottom heating head for directing hot air only at those surfaces of the bottom closure which are to be sealed together.

Another object is to provide an improved apparatus for ejecting a carton from a turret to a conveyor while simultaneously rotating the carton 90° about its longitudinal axis and moving the carton from an inverted to an upright position.

Another object is to provide an apparatus for breaking and preforming the top of the cartons.

Another object is to provide improved apparatus for sterilizing the interior of the cartons.

Another object is to provide an improved filling valve for filling an accurately measured quantity of milk into each carton.

Another object is to provide an improved filling valve having a filling tube arranged to discharge milk into a carton below the level of milk therein.

Another object is to provide improved apparatus for forming, heating and sealing the top of each carton.

Another object is to provide an improved method of forming, heating and sealing the top of a carton.

Another object is to provide an improved top forming head.

Another object is to provide an improved top heating head for directing hot air at only those surfaces of the top closure which are to be sealed together.

Another object is to provide an improved apparatus for first folding the top flaps of a carton and thereafter for forcing the flaps together into sealed engagement.

Another object is to provide improved apparatus for stamping identifying indicia on the filled and sealed carton.

Another object is to provide improved apparatus for discharging the filled and sealed cartons from the machine.

These and other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, in which:

FIGURE 1 is a perspective of the carton forming and filling machine of the present invention, the view being taken looking at the elongate left side and the relatively narrow rear end of the machine.

FIGURE 2 is a diagrammatic elevation of the right side of the carton forming and filling machine, certain protective housings being removed.

FIGURE 3 is a diagrammatic plan of the machine of FIGURE 2.

FIGURE 4 is a diagrammatic front elevation of the machine of FIGURE 2, taken looking in the direction of arrows **4—4** of FIGURE 2.

FIGURE 5 is a perspective showing the upper end of a stack of folded carton blanks of the type supplied to the machine for processing.

FIGURE 6 is a perspective of a single folded carton blank.

FIGURE 7 is a perspective of a filled and sealed carton.

FIGURE 8A is a perspective showing the bottom flaps of the carton after certain breaking and forming operations have been performed thereon.

FIGURE 8B is a perspective, of the completely formed and sealed bottom of the carton with the channel breaking depressions shown therein.

FIGURES 9A, 9B, and 9C are perspectives of the top of the carton showing progressive positions of the upper carton flaps after certain forming operations have been performed thereon.

FIGURE 9D is a side elevation showing the top of the carton when completely closed.

FIGURE 10 is an enlarged transverse vertical section of the turret taken along lines **10—10** of FIGURE 3, certain parts being cut away and other parts being shown in section.

FIGURE 11 is a vertical section taken along lines **11—11** of FIGURE 10.

FIGURE 12 is a transverse section of one of the mandrels taken along lines **12—12** of FIGURE 10.

FIGURE 13 is an end elevation of one of the mandrels looking in the direction of arrows **13—13** of FIGURE 10.

FIGURE 14 is a vertical section taken along lines **14—14** of FIGURE 10 showing an air inlet manifold.

FIGURE 15 is a schematic vertical section taken along lines **15—15** of FIGURE 3 and illustrating the drive connection between the turret and the conveyor, certain parts being broken away and other parts being removed.

FIGURE 16 is a plan of the machine of FIGURE 15 with the carton supporting conveyors being removed to better illustrate the drive parts.

FIGURE 17 is an enlarged longitudinal section taken along lines **17—17** of FIGURE 16 and illustrating an auxiliary conveyor drive unit.

FIGURE 18 is a transverse section taken along lines **18—18** of FIGURE 16.

FIGURE 18A is an enlarged section taken along lines **18A—18A** of FIGURE 18.

FIGURE 19 is a vertical longitudinal section of the conveyor and carton guides taken along the lines **19—19** of FIGURE 21, the operative apparatus at each station being omitted.

FIGURE 20 is an enlarged section taken along lines **20—20** of FIGURE 19 showing a guide rail elevating mechanism.

FIGURE 21 is an enlarged vertical transverse section of the conveyor assembly taken along lines **21—21** of FIGURE 19.

FIGURE 22 is an enlarged fragmentary transverse section taken along lines **22—22** of FIGURE 19.

FIGURE 23 is an enlarged horizontal section, with parts broken away, of one of the idler support brackets taken along the lines **23—23** of FIGURE 19.

FIGURE 24 is a plan of the discharge end of the machine showing the discharge conveyors, that portion of the discharge apparatus disposed above the level of the conveyors being removed.

FIGURE 25 is a transverse section of the discharge conveyors taken along lines **25—25** of FIGURE 26.

FIGURE 26 is a longitudinal section of the discharge conveyors taken along lines **26—26** of FIGURE 24.

FIGURES 27A and 27B when placed side-by-side form a plan of the magazine, and the carton erecting and turret loading apparatus, certain parts being cut away and others being shown in section.

FIGURE 27C is a diagrammatic view showing the vacuum supply conduit system for the suction cups.

FIGURE 28 is a transverse section of the magazine taken along lines **28—28** of FIGURE 27A, a pair of cartons being shown in phantom lines.

FIGURE 29 is a transverse section of the magazine taken along lines **29—29** of FIGURE 27B.

FIGURE 30 is a perspective of the magazine showing the structure for advancing the cartons in full lines and showing certain frame parts in phantom.

FIGURE 31 is an enlarged horizontal section taken along lines **31—31** of FIGURE 28 and showing one of the carton advancing fingers of the magazine.

FIGURE 32 is a transverse section of a portion of the magazine and of the carton erecting mechanism taken along lines **32—32** of FIGURE 27B.

FIGURE 33 is a fragmentary transverse central section taken along lines **33—33** of FIGURES 27A and 27B and showing certain operative structure of the carton erecting mechanism, certain associated parts being shown in phantom.

FIGURE 34 is a perspective of a portion of the carton erecting apparatus illustrating carton controlling gates which aid in the timed removal of cartons from the magazine, certain parts being removed and others being shown in section.

FIGURE 35 is an enlarged fragmentary elevation of a carton showing the points of engagement of carton erecting fingers with the carton.

FIGURE 36 is an enlarged section taken along lines **36—36** of FIGURE 32 showing the gates of FIGURE 34.

FIGURE 37 is a section taken along lines **37—37** of FIGURE 34 showing the gates in two operative positions.

FIGURE 38 is a perspective similar to FIGURE 34 but showing the suction cup assembly and associated parts, certain parts being removed and other parts being shown in section.

FIGURE 38A is a diagrammatic plan showing various operating positions of the suction cup support mechanism.

FIGURE 39 is a horizontal section taken substantially along the lines **39—39** of FIGURE 38 schematically illustrating an air control valve in central section.

FIGURE 40 is a perspective taken in the same direction as FIGURES 34 and 38 but showing mechanism for maintaining each carton in squared position as the carton is moved onto a mandrel, certain parts being removed and other parts being shown in section.

FIGURE 41 is a horizontal section taken substantially along the lines **41—41** of FIGURE 40 and showing a rack housing in central section.

FIGURE 42 is an enlarged horizontal section taken along lines **42—42** of FIGURE 33 and showing a sonic sensing unit for detecting improperly erected cartons.

FIGURE 43 is a section taken along lines **43—43** of FIGURE 42.

FIGURE 44 is a horizontal section taken along lines **44—44** of FIGURE 40 and showing a speed control valve.

FIGURES 45 through 48 are operational views showing the progressive stages in the operation of the carton erecting mechanism.

FIGURE 49 is a schematic operational view showing the turret loading mechanism in two operative positions.

FIGURE 50 is an enlarged plan taken looking in the direction of arrows **50—50** of FIGURE 2, showing the bottom forming apparatus in a retracted position.

FIGURE 51 is a vertical section taken along lines **51—51** of FIGURE 50.

FIGURE 52 is a perspective showing one of the bottom forming dies of the bottom forming apparatus.

FIGURE 53 is a schematic section taken along lines **53—53** of FIGURE 52 and showing two operative positions of the die that is bending the flaps of a carton on one of the mandrels.

FIGURE 54 is a schematic section taken along lines **54—54** of FIGURE 52 and showing two operative positions of the die.

FIGURE 55 is a top view of the bottom heating apparatus, the view having been taken looking in the direction of the arrows **55—55** in FIGURE 2.

FIGURE 56 is a section taken along lines **56—56** of FIGURE 55.

FIGURE 57 is an enlarged perspective of one of the bottom heating heads of the bottom heating apparatus, certain parts being broken away and other parts being shown in section.

FIGURE 58 is a section taken along lines **58—58** of FIGURE 57.

FIGURE 59 is a section taken along lines **59—59** of FIGURE 55 showing the heating element of the bottom heating heads.

FIGURE 60 is an enlarged horizontal section taken along lines **60—60** of FIGURE 2 showing the bottom sealing apparatus.

FIGURE 61 is a vertical section taken along lines **61—61** of FIGURE 60.

FIGURE 62 is a perspective of a bottom sealing die used in the bottom sealing apparatus.

FIGURE 62A is an enlarged section taken on line **62A—62A** of FIGURE 62.

FIGURES 63, 64, and 65 are operational views showing the carton in different operative positions.

FIGURE 66 is a vertical section through a mandrel and through the carton, taken along lines **66—66** of FIGURE 67, and showing the manner in which the carton flaps of the bottom closure are compressed.

FIGURE 67 is a section taken along lines **67—67** of FIGURE 66 showing the interior construction of the bottom closure.

FIGURE 68 is an enlarged vertical section taken along lines **68—68** of FIGURE 2 showing the top forming apparatus.

FIGURE 69 is a fragmentary plan of the top forming apparatus of FIGURE 68.

FIGURE 70 is a fragmentary vertical section taken along lines **70—70** of FIGURE 68.

FIGURE 71 is an enlarged perspective of one of the top forming heads, certain parts being broken away and other parts being shown in section.

FIGURE 72 is a transverse diagrammatic central vertical section of one of the top forming heads showing certain parts thereof in their fully actuated position.

FIGURE 73 is a diagrammatic longitudinal section of one of the top forming heads showing certain parts thereof in their fully actuated positions.

FIGURE 74 is an enlarged vertical section taken along lines **74—74** of FIGURE 2 showing the sterilizing apparatus.

FIGURE 75 is a plan of the sterilizing apparatus of FIGURE 74.

FIGURE 76 is a side elevation with parts broken away of the sterilizing apparatus of FIGURE 74.

FIGURE 77 is an enlarged plan of a no-carton no-light device looking in the direction of the arrows **77—77** in FIGURE 76, certain parts being broken away and other parts being shown in phantom.

FIGURE 78 is a section taken along lines **78—78** of FIGURE 77.

FIGURE 79 is an enlarged vertical section taken along lines **79—79** of FIGURE 2 showing the carton filling apparatus.

FIGURE 80 is an elevation of the right side of the carton filling apparatus of FIGURE 79.

FIGURE 81 is a vertical central section taken along lines **81—81** of FIGURE 80 showing the support column of the filling apparatus.

FIGURE 82 is an enlarged horizontal section taken along lines **82—82** of FIGURE 81.

FIGURE 83 is an exploded perspective of the mechanism for guiding the filling valve for vertical movement.

FIGURE 84 is an enlarged elevation looking in the direction of the arrows **84—84** of FIGURE 79 showing a portion of the actuating mechanism of the milk measuring mechanism.

FIG. 85 is an enlarged vertical section taken along lines **85—85** of FIGURE 79.

FIGURE 86 is an enlarged vertical section taken along lines **86—86** of FIGURE 80.

FIGURE 87 is an enlarged side elevation looking in the direction of the lines **87—87** of FIGURE 80 and showing the mechanism for operation of the foot valve of the carton filling apparatus.

FIGURE 88 is a horizontal section taken along lines **88—88** of FIGURE 87.

FIGURE 89 is an enlarged transverse section taken along lines **89—89** of FIGURE 2 showing the top sizing apparatus and the top heating apparatus.

FIGURE 90 is a plan of the apparatus shown in FIGURE 89.

FIGURE 91 is a vertical section taken along lines **91—91** of FIGURE 89.

FIGURE 92 is an enlarged vertical central section of the top sizing head taken along lines **92—92** of FIGURE 91, the operating mechanism of the head being shown in a different position.

FIGURE 93 is a section taken along lines **93—93** of FIGURE 92.

FIGURE 94 is a perspective of one of the top heating heads.

FIGURE 95 is an enlarged vertical section taken along lines **95—95** of FIGURE 90 of one of the top heating heads.

FIGURE 96 is a perspective of the top closure of one of the cartons in the position it assumes before entering the heating head.

FIGURE 97 is an enlarged transverse section taken along lines **97—97** of FIGURE 2 showing the top sealing apparatus, certain parts being cut away and other parts being shown in section.

FIGURE 98 is a plan of the top sealing apparatus of FIGURE 97.

FIGURE 99 is a side elevation of the top sealing apparatus.

FIGURE 100 is an enlarged vertical section taken along lines **100—100** of FIGURE 99, and showing a fragment of the top sealing apparatus with certain parts thereof being in a different operative position.

FIGURE 101 is a section taken along lines **101—101** of FIGURE 100.

FIGURE 102 is an enlarged vertical section taken along line **102—102** of FIGURE 97.

FIGURE 103 is a vertical section taken along lines **103—103** of FIGURE 97 showing certain parts of the top sealing apparatus in an initial operative position.

FIGURE 104 is an enlarged section similar to FIGURE 103 but showing the parts in a different operative position.

FIGURE 105 is a section taken along lines **105—105** of FIGURE 97.

FIGURE 106 is an enlarged exploded view of certain parts of the top sealing apparatus shown out of normal operating position, certain embossing parts and the corresponding depressions in the carton being greatly exaggerated in thickness.

FIGURE 107 is an enlarged transverse section taken along lines **107—107** of FIGURE 2 showing the top stamping apparatus.

FIGURE 108 is a vertical section taken along lines **108—108** of FIGURE 107.

FIGURE 109 is an enlarged transverse section taken along lines **109—109** of FIGURE 2 showing the discharge apparatus.

FIGURE 110 is a plan of the discharge apparatus.

FIGURE 111 is a section taken along lines 111—111 of FIGURE 109.

FIGURE 112 is a diagrammatic elevation showing a low pressure air distribution system for the bottom and top heating apparatus.

FIGURES 113A and 113B when placed side-by-side illustrate the hydraulic system of the carton forming and filling machine.

FIGURE 114 is a central section through one of several four-way hydraulic valves used in the hydraulic system.

FIGURE 115 is a central section through one of several speed control valves in the hydraulic system.

FIGURE 116 is a chart illustrating the timing of the several hydraulic rams used in the hydraulic system.

FIGURE 117 is a vertical section taken along lines 117—117 of FIGURE 2 showing a cycle timer of the electrical control system.

FIGURE 118 is a section taken along lines 118—118 of FIGURE 117.

FIGURES 119, 120, 121 and 122 are horizontal sections taken along lines 119—119, 120—120, 121—121, and 122—122, respectively, of FIGURE 117, and showing the cycle timing cams in the position they assume immediately before the indexing operation is begun.

FIGURES 123, 124, 125, and 126, when combined illustrate the wiring diagram of the electrical control system.

General description

Although the carton forming and filling machine 50 (FIGS. 1 to 4) of the present invention will be shown and described as a machine for packaging milk in half gallon cartons C, it will be understood that it is within the scope of the present invention to fill other liquids into either half gallon or other size cartons. Because of the numerous operations performed on the cartons as they pass through the machine, the different sections of the machine at which successive operations on the carton are carried out will be identified as consecutively numbered stations St. 1 through St. 18.

As best shown in FIG. 3, the illustrated embodiment of the machine has two processing lines L1 and L2, each of which processes cartons at the rate of twenty cartons per minute. In the description to follow, when parts associated with the lines L1 and L2 are identical, only those parts associated with one of the lines will be described in detail. It is to be understood that it is within the scope of the invention to provide as many lines as needed to achieve the desired rate of discharge.

The carton forming and filling machine 50 has two main sections: a carton erecting section which is disposed at the front or left hand end of the machine (FIGS. 2 and 3) and includes stations St. 1–St. 8, and a carton filling and closing section which includes stations St. 9–St. 18. In general between stations St. 1 and St. 8 a carton is erected and placed on a turret 51 and its bottom is closed and sealed. In the carton filling and closing section, a conveyor assembly 52 is mounted on a frame 53 and includes two endless chain, carton supporting conveyors 52*a* and 52*b* (FIG. 3) which advance the cartons along the lines L1 and L2, respectively. A magazine 54 at Station 1 is mounted on the frame 53 and is arranged to receive a stack of tubular carton blanks 56 (FIG. 5) in flat folded form. In the magazine, the blanks are held in upright position extending transversely of the magazine with the end of the blank, which forms the top of the carton when it is erected, disposed lowermost in the magazine. The magazine 54 includes means for urging the carton blanks 56 rearwardly in the machine toward a carton erecting and turret loading apparatus 57 (FIG. 2) at Station 2. This erecting and loading apparatus 57 removes one carton blank at a time from the magazine, for each line, squares each carton blank into an open ended rectangular tube, and moves each of the squared tubular carton blanks downwardly at Station 3 over one of six carton forming mandrels 58 in the associated processing line which are carried by and are evenly spaced around the turret 51.

The turret 51 and conveyors 52*a* and 52*b* are intermittently driven by a drive mechanism 59 which is timed so as to require approximately six-tenths of a second for each increment of movement and to allow each carton to remain at each station for approximately two and four-tenths seconds. As shown in FIG. 2, intermittent indexing of the turret 51 advances the cartons along an arcuate counterclockwise path from Station 3 to Station 8 during which time operations are performed on the bottom of the cartons, and intermittent movement of the conveyor 52*a* and 52*b* advances the cartons along a linear path from Station 9 to Station 18 during which time operations are performed on or are associated with the tops of the cartons. It will be understood that the drive mechanism 59 drives the turret 51 so that each indexing motion of drive 59 advances each mandrel 58 from one station to the next, however, each indexing motion only advances the conveyors 52*a* and 52*b* in half-station increments and therefore cartons on conveyors 52*a* and 52*b* will come to rest between stations.

When a carton is positioned at Station 4, a bottom forming apparatus 62 is actuated to force a bottom forming die 63 against the lower end flaps of the carton thereby causing the end flaps to bend at their score lines as shown in FIG. 8A. At Station 5, a bottom heating apparatus 64 (FIG. 2) is placed into operation and directs hot air at only those surfaces of the bottom flaps which will subsequently be sealed together by a bottom sealing apparatus 66 (FIG. 4) at Station 6. The carton with its bottom flaps sealed together at Station 6 is then moved past Station 7 (FIG. 2) which is a vacant Station, and into Station 8 at which time high pressure air is directed against the interior face of the bottom wall of the carton through the associated mandrel 58 to eject the carton from the mandrel.

The ejected carton C is guided by a carton transfer and turning mechanism 68 which moves the carton from the inverted to an upright position while at the same time turning the carton 90° about its longitudinal axis. The so-turned carton is received at Station 9 between two adjacent drive lugs 69 of the associated conveyors 52*a* and 52*b*.

While at Station 10, a top forming apparatus 71 moves a top forming head 72 downwardly against the upper flaps of the carton to bend these flaps along the score lines so that the upper end of the carton assumes the position shown in FIG. 9A. The carton is then indexed to Station 11 where a sterilizing apparatus 73 moves an ultraviolet light 74 into the carton to thoroughly sterilize the interior of the carton. After the carton has been sterilized, it is moved to Station 12.5 where a carton filling apparatus 76 fills the carton with milk. The filled carton is then moved to Station 14 under a top sizing apparatus 77 which operates to bend additional portions of the top closure into the proper position for heating.

The carton is then moved by the associated conveyor 52*a* or 52*b* into Station 14.5 where a top heating apparatus 78 lowers a heating head 79 over the top flaps of the carton, which head 79 is formed so as to direct hot air only at those surfaces of the top flaps which are to be pressed together to seal the top of the carton. After the top flap surfaces have been properly heated, the associated conveyor indexes the carton to Station 15 where a top sealing apparatus 82 forces the heated surfaces of the flaps together to seal the top of the carton.

The conveyor then advances the filled carton to Station 16, which is a vacant station where sample cartons may be removed from the conveyor for testing if desired. When the carton is moved to Station 17, a top stamping apparatus 83 impresses suitable identifying indicia thereon. The filled, sealed, and marked carton is finally advanced to Station 18 where it is moved laterally off the conveyor

by a discharge apparatus **84** onto one of two high speed discharge conveyors **86** which are parallel to conveyors **52***a* and **52***b* and discharges the carton from the carton forming and filling machine **50** of the present invention.

The carton.—Although the carton C, itself, does not form a part of the present invention, it will be described in detail in order to facilitate the understanding of the machine **50** of the present invention.

The material from which carton C is formed is cardboard having a polyethylene coating on both surfaces to provide a finished carton of five barrier construction with a polyethylene coating on its outside and inside surfaces. Each carton blank **56** (FIGS. 5 and 6) is supplied in folded tubular form by the carton manufacturer. The carton blank **56** has four walls **91**, **92**, **93** and **94** (FIG. 6), with the walls **92** and **93** being connected together by a flange **95** (FIG. 9A) which is connected to wall **93** along fold line **95***a* and is heat sealed to the wall **92**. The front wall **91** (FIG. 6) is provided with a longitudinally extending score line **96** and an inverted V-shaped score line **97** to facilitate slight bending of the carton when milk is to be poured therefrom by the consumer. Transverse score lines **98** and **99** are formed across the lower end and upper end, respectively, of each wall **91**, **92**, **93** and **94** to facilitate the bending of the bottom closure **100** and top closure **101** relative to the side walls. The bottom closure **100** includes a front flap **102** (FIG. 8A) projecting from wall **91** and a rear flap **103** projecting from wall **93** each flap being provided with V-shaped score lines **104** to facilitate the inward bending of these flaps. The bottom closure also includes a flap **106** of one side that is slightly longer than the opposed bottom flap **108** so as to provide a lip **107** (FIG. 8B) which is adapted to overlap and be subsequently sealed to the bottom flap **108**.

The bottom flaps **102** and **103** include a triangular portion **102***a*, **102***b* and **103***a*, **103***b*, respectively. The lip **107** is connected to the flap **106** by a connecting portion **106***a*, which as will be made apparent hereinafter, is deformed when it is sealed against the edge **108***a* of the flap **108**.

The top closure **101** (FIGS. 7 and 9A) includes a front flap **109** projecting from wall **91**, a rear flap **111** projecting from wall **93**, a side flap **112** and an opposed side flap **113**. Each upper flap includes an upper transverse score line **114** which is disposed above and is parallel to an adjacent score line **99**. The cardboard base, but not the polyethylene coating, at the score line **114** on the front flap **109** and portions of the score line **114** on the flaps **112** and **113** adjacent flap **109** are partially perforated to weaken this area so that the top closure can easily be opened by the consumer by tearing along this perforated line. As shown in FIG. 9A, tabs **116** and **117** on the front and rear flaps, **109** and **111**, respectively, are bent outwardly, while oblique score lines **118** on the front and rear flaps permit the upper flaps to be bent inwardly. Shallow ears **119** projecting from the front and rear flaps on the side adjacent the flap **112**, longer ears **121** on the other side of the front and rear flaps, a narrow lip **122** on the flap **113**, and a wide lip **123** on the flap **112** cooperate when the top of the carton is closed to provide a rigid interlaced joint for the top closure **101**.

The turret.—The turret **51** (FIGS. 10 and 11) carries two identical mandrel units **130**, each unit including six equally spaced, radially projecting mandrels **58** that move in a vertical plane and are adapted to serve one of the processing lines L1 or L2. At each Station **3**, each mandrel receives a carton which has been opened and dropped onto the mandrel at Station **3** with its bottom end uppermost. The turret **51** is intermittently driven so that each mandrel **58** is indexed step by step from Station **3** to Station **8** (FIG. 11) during which time the bottoms of the cartons carried on the mandrels **58** are sealed so that the cartons may be discharged by high pressure air from the turret **51** at Station **8**.

The turret **51** comprises a shaft **142** (FIG. 10) which is journalled in bearings **143** and **144** bolted to the frame **53** of the machine. Intermediate the ends of shaft **142**, a hub **146** is connected thereto by a key **147** fitted in a keyway **148** in the shaft **142**. A pair of hexagonal mandrel hubs **149** are positioned on opposite sides of the gear hub **146**, and each mandrel hub **149** is keyed to the shaft **142** by a key **151**. A cam hub **152** is also keyed to the shaft **142** by an extension of one of the keys **151**. The above mentioned hubs are held from axial movement along the shaft **142** by a snap ring **153** which is fitted in a groove near one end of the shaft **142** and a nut **154** which is screwed on the shaft **142** near its other end and locked in position by a lock ring **156**.

Six of the mandrels **58** are bolted to each hexagonal mandrel hub **149** and project radially outwardly therefrom at evenly spaced intervals as indicated in FIGURE **11**. Each mandrel **58** includes a body **161** (FIG. 10) having rectangular end portions and an X-shaped intermediate portion as indicated in FIGURES 12 and 13. An air passage **163** extends longitudinally through the center of the body **161** and communicates with four passages **164** (FIG. 13) which are formed in the upper rectangular end of the body **161** and project radially outward relative to the passage **163**. A rectangular mandrel head **166** is bolted to the outer end of the body **161** and has four inwardly angled holes **167** therein each of which communicates with one of the passages **164**. A V-shaped die **168** (FIG. 13) is mounted on the outer surface of the head **166** and projects outwardly of this surface so as to engage the carton during the bottom sealing operation to compensate for the absence of two thicknesses of carton material in this area due to the manner of folding the bottom flaps of the carton. The V-shaped die thus effects an increased pressure at its area of contact with the carton thereby preventing leakage through this area.

A carton stop plate **169** is bolted to the inner rectangular end of the mandrel body **161** and engages the edge of the narrow lip **122** (FIG. 9A) of the carton to terminate the downward movement of the carton when the carton is placed on the mandrel. Tab engaging cams **170** (FIGS. 11 and 13) are bolted to the inner end of the body **161** and serve to bend the carton tabs **116** and **117** (FIG. 9A) outwardly when the carton is seated on the mandrel **58**.

An air distributor ring **171** (FIG. 10) is mounted on the shaft **142** and is keyed to the shaft by one of the keys **151** which is slotted to receive the snap ring **153**. An air sealing ring **172** is secured, as by bolting, to the distributor ring **171** and slidably engages an air inlet manifold **173** which is slidably supported on a flange **174** of the bearing **144**. A pin **176**, which holds the manifold from rotation, is fitted in the manifold and is slidably received in a hole **177** in the housing **178** of the bearing **144**. A plurality of springs **179** (FIG. 14) are fitted in holes **180** in the manifold **173** and in mating holes **181** (FIG. 10) in the housing **178** of the bearing **144**.

As mentioned previously, each carton is blown off its associated mandrel **58** when the mandrel is positioned at Station **8**. Accordingly, a port **183** is formed in the manifold **173** at Station **8**, and high pressure air, under control of a valve to be described presently, is directed from port **183** into the particular one of six equally spaced passages **184** of the mandrel **58** (FIGS. 10 and 11) which is stopped at Station **8**. Each passage **184** extends parallel to the shaft **142** through the rings **171** and **172** and through the hubs **146** and **149**. The cam hub **152** closes the free end of the passages **184** as indicated in FIGURE 10 and each passage **184** is connected to the passages **163** in the associated mandrels **58** of lines L1 and L2 by ports **186**. O-rings **187** are fitted between the mating surfaces of the several parts through which the passages **163** and **184** extend and serve to provide an air tight seal at these surfaces.

A large diameter conveyor drive gear **188** is bolted and pinned to the hub **146**, and six equally spaced cam fingers

189 (only two being shown in FIGURE 10) are bolted to the cam hub 152 and project radially outward from the shaft 142 in directions parallel with the axes of the associated mandrels 58. The function of the cam fingers 189 will be made apparent hereinafter in connection with the hydraulic system.

Turret and conveyor drive mechanism.—As mentioned previously, the turret 51 and conveyors 52*a* and 52*b* are driven intermittently, each movement of the turret moving a carton from one station to the next, while each indexing movement of the conveyors advances cartons thereon only one-half the normal distance between the stations along the conveyors. The length of each indexing movement of the conveyors will be referred to hereinafter as a half-station increment. The drive mechanism 59 (FIGS. 2, 3, 4, and 15–18) is so timed that approximately six tenths of a second is required for each intermittent movement, and the cartons remain in each station or between stations along conveyors 52*a* and 52*b*, for approximately two and one half seconds.

The drive mechanism 59 (FIGS. 2, 3 and 4) comprises a drive motor DM which is connected to a gear reducer 192 by a belt drive 193. The motor DM is mounted on a plate 194 (FIG. 4) which is pivoted at its rearward end on a pair of stubshafts 195 projecting from a fixed bracket 200, and has its forward end supported for vertical adjustment by a bolt 196 which is pivoted to the motor plate 194 and extends through a horizontal plate portion of the bracket and is locked in adjustable position by nuts 198. One output shaft (not shown) of the gear reducer 192 is coupled to a Ferguson drive 199 which drives its output shaft 201 intermittently.

The output shaft 201 is coupled to the turret shaft 142 by a coupling 202. The coupling 202 comprises identical axially aligned sprockets 203 and 204 which are keyed to the shafts 142 and 201, respectively, and have a double chain 206 trained therearound. A connector 207 is used to clamp the ends of the chain 206 together, with the chain fitted firmly around the sprockets 203 and 204.

The conveyors 52*a* and 52*b* (FIGS. 15 and 16) are accurately timed with the turret and are partially driven directly from the turret 51 by the gear 188 which is keyed to the shaft 142. Also, a driving force is also applied to the discharge end of the conveyors 52*a* and 52*b* by auxiliary drive units 210 to be described presently.

The gear 188 meshes with a first idler gear 208 which, in turn, meshes with a second idler gear 209. The idler gears 208 and 209 are journalled on stub shafts 211 and 212, respectively, which are welded to slide blocks 213 and 214, respectively. The slide blocks 213 and 214 are connected for vertical adjustment to a common fixed bracket 216 (FIG. 16) which is bolted to fixed transverse members 217 and 218 of the frame 53. To assure the proper meshing of the gears, the slide blocks 213 and 214 are vertically adjusted by adjustment bolts 219 (FIG. 15) which are threaded into the frame members 217 and 218 and engage the lower surfaces of the slide blocks 213 and 214. The blocks are locked in place by cap screws 221 (only two being shown in FIG. 15) which extend through slots 222 in the blocks 213 and 214 and are screwed into the fixed bracket 216, and by cap screws 223 (FIG. 16) which extend through slots (not shown) in the bracket 216 and are threaded into their respective blocks 213 or 214.

The second idler gear 209 meshes with a conveyor drive gear 226 that is keyed to a conveyor drive shaft 227. The shaft 227 (FIG. 16) is journalled in bearings 228 and 229 which are adjustably mounted on vertical side plates 231 and 232, respectively, of the frame 53 said shaft 227 having conveyor sprockets 237 and 238 keyed thereon. A driven shaft 233 is journalled in bearings 234 and 236 which are adjustably mounted on the vertical side plates 231 and 232, respectively.

The previously referred-to auxiliary drive units 210 (FIGS. 16, 17 and 18) for the conveyors 52*a* and 52*b* are associated with the driven shaft 233 and are provided to assure that the upper runs of the conveyors 52*a* and 52*b* will be taut at all times even in the even considerable wear should occur to the conveyors after long usage. Since the auxiliary drive units are substantially the same, the description of the unit which operates the conveyor 52*b* will suffice for both.

Each auxiliary drive unit 210 includes a hydraulic power unit 239 having a cylinder 241 (FIG. 17) pivotally connected to the frame 53 of the machine and having a piston rod 242 pivotally connected to an arm 243 that is welded to a movable housing 244 of an overrunning clutch 246 of standard well known design. A stationary housing 247 (FIG. 18) of the clutch is anchored in fixed position to the frame 53 of the machine by a link 248. A clutch spindle 249 having a flanged end wall 251, to which a conveyor sprocket 252 of the conveyor 52*b* is bolted, is suitably bushed and is journalled on the shaft 233. An end cap 253 is bolted to the other end of the spindle 249 and cooperates with a lip 254 on the wall 251 to support the housings 244 and 247 in end-to-end relation. The usual, well known overrunning clutch drive unit 258 is connected to the spindle 249 by key 259 and cooperates with the movable housing 244 to drive the spindle and the sprocket 252 in a clockwise direction when the housing is moved in a clockwise direction (FIG. 17) by the hydraulic power unit 239. The drive unit overruns the spindle 249 when the housing 244 is moved in the opposite direction. Similarly, a well known overrunning brake element 261 is connected by a key 262 to the spindle and cooperates with the stationary housing 247 to lock the spindle and sprocket 252 from movement in a counterclockwise direction (FIG. 17) at all times and to permit their movement in the clockwise direction. Thus whenever the power cylinder 241 is actuated in a direction to drive the sprocket 252 clockwise, the brake 261 permits such rotation, and when the power cylinder 239 tends to drive the sprocket counterclockwise, the brake prevents such rotation.

The overrunning clutch drive units 258 and the overrunning brake element 261 are identical except they are arranged to operate in opposite directions. Accordingly, a brief description of the element 258 will suffice for both.

As shown in FIGURES 18 and 18*a*, the clutch unit 258 includes a U-shaped inner ring 260 having apertured side walls which retain rollers 260*a* and cooperating resiliently-loaded flat stop members 260*b* therein. The bight section of the U-shaped ring has wedging surfaces 260*c* (FIG. 18*a*) formed thereon which cause the rollers to lock between the inner surface of the movable housing 244 and the associated wedging surfaces 260*c* when the housing is rotated in a counterclockwise direction, FIG. 18*a* (which corresponds to clockwise direction in FIG. 17) thereby driving the sprocket 252. When the housing 244 is moving in the opposite direction the rollers 260*a* are moved against the resistance of the stop members 260*b*, out of wedging contact between the housing 244 and the associated wedging surfaces 260*c*.

The spindle 249 of the drive unit 210 associated with the conveyor 52*b* is connected to a collar 263 that is rigidly clamped on the shaft 233 by a pin 264. Accordingly, rotation of the spindle 249 causes rotation of the shaft 233. A spacer 265 is disposed between the two auxiliary drive units 210, and a collar 266 is clamped to the shaft 233 and cooperates with the collar 263 and spacer 265 to hold the two clutches in proper spaced relation. The collar 266 is not pinned to the spindle of the drive unit 210 associated with the conveyor 52*a* so that the conveyor sprocket 267 bolted thereto may be moved independently of the sprocket 252.

The carton conveyor 52*a* (FIG. 15) is trained around the sprockets 237 and 267, and the conveyor 52*b* is trained around the sprockets 238 and 252. The details

of the carton supporting conveyor chains 52*a* and 52*b* will be described hereinafter.

In order to accurately time the operation of the turret 51 and conveyors 52*a* and 52*b* with the operating components at the different stations, a second output shaft 268 (FIG. 4) of the gear reducer 192 has a sprocket 269 keyed thereon which is connected to a driven sprocket 270 (FIG. 2) by a chain 271. The driven sprocket 270 is keyed on an idler shaft 272 which is journalled in a bracket 273 bolted to the frame 53. A large diameter cam shaft drive sprocket 274 and a small diameter cycle timer drive sprocket 275 are keyed on the idler shaft 272. A chain 276 (FIG. 4) is trained around the large diameter sprocket 273, around a sprocket 277 keyed to a cam shaft 278, and around an idler sprocket 279 that is journalled on a shaft 280 secured to the frame 53. The cam shaft 278 extends the full length of the machine 50 (FIG. 2) and is journalled in spaced brackets 281 secured to the frame 53. A plurality of timing cams TC are secured at spaced intervals along the cam shaft 278 and control the actuation of the hydraulic components, to be described hereinafter, of the machine.

The small diameter sprocket 275 (FIGS. 2 and 4) is connected by a chain 287 to a sprocket 283, which is secured to a cam shaft 284 of an electrical cycle timer 286 (FIG. 2) and controls the actuation of electrical impulses to certain portions of the machine.

Thus, it will be seen that the drive mechanism 59 intermittently drives the turret 51 and the conveyors 52*a* and 52*b* simultaneously, and also continuously rotates the cam shafts 278 and 284 to control the actuation of certain hydraulic and electrical components in timed relation with the movement of the turret 51 and conveyors 52*a* and 52*b*.

Conveyor assembly. — The conveyor assembly 52 (FIGS. 19 to 26) includes the conveyors 52*a* and 52*b*, the discharge conveyors 86, and carton guiding units 290 which guide the cartons along the conveyors 52*a* and 52*b*. The conveyors 52*a* and 52*b* intermittently advance the cartons from Station 10 to Station 18 in half station increments during which time the cartons are sterilized, filled, marked, and sealed. Since the parts associated with the conveyors 52*a* and 52*b* are identical, only the parts associated with the conveyor 52*a* will be described in detail.

As previously mentioned, the endless chain conveyor 52*a* is mounted on sprockets 237 and 267. The conveyor 52*a* is formed of a plurality of links 291 (FIG. 19) pivotally connected together by pins 292. Each link 291 (FIG. 20) includes a carton supporting plate 293 which is secured to the horizontal flanges of two opposed chain links 294 which receive the pins 292. The U-shaped carton pushing lugs 69 are secured to and project upwardly from certain links 291. As seen in FIG. 19, in a group of three adjacent links 291, a lug 69 is secured to the leading edge of one link, a lug is secured to the trailing edge of the link next behind, and the third link of the series carries no pusher lug. The U-shaped lugs 69 (FIG. 21) engage the cartons near the corners of the carton walls, permitting the center portions of the leading and trailing walls to bow outwardly when the cartons are filled. This bowing, in effect, permits the level of the milk in the carton to lower and minimizes any tendency for the milk to spill from the cartons during intermittent movement of the conveyor.

In order to accurately guide the movement of the upper run of the conveyor 52*a*, the carton supporting plates 293, when in the upper run, are supported by and slide along a pair of three-section guide rails 295 which are bolted to a longitudinally extending plate 296. The plate 296 is bolted to a plurality of transversely-extending U-shaped frame members 297 which are spaced longitudinally along the conveyor assembly 52. Cover plates 298, 299 and 301 (FIG. 21) are also bolted to the plates 296 and serve as guards for the portion of the conveyor positioned therebelow.

The carton supporting plates 293 of each link 291 are resiliently held down against the guide rails 295 (FIG. 22) by compression springs 303 which are coiled around bolts 304. The bolts are each secured at spaced intervals to one of several transversely extending straps 306. The springs 303 are held under compression between the plates 306 and nuts 307 screwed on the bolts 304. A pair of longitudinally extending angle rails 309 are bolted on the straps 306 and include lips 311 which extend over and engage rollers 312 journalled on the pins 292 of the conveyor chain. It will be seen that, while they are in their upper run, the carton supporting plates 293 are firmly held down against the rails 295 by the above arrangement and that the cartons supported thereon will project upwardly generally perpendicular to the plane of the carton supporting plates 293.

As will be described hereinafter, certain parts of the top sealing apparatus 82 at Station 15 requires that the elevation of the cartons in this Station be quite accurately determined so as to assure proper sealing of the top closures of the cartons. Accordingly, rail elevating devices 313 (FIGS. 19 and 20) are provided at periodic intervals along the length of the central section of the rails 295.

Each elevating device 313 (FIG. 20) comprises an upstanding stud 314 having a support foot 316 welded intermediate its ends and having both of its ends threaded. Each device is rigidly secured to the plate 296 by a nut 317 screwed onto the lower end of the stud. A sleeve 318 having a small diameter cylindrical upper end 319 and a large hexagonal lower end 321 is screwed on the upper end of the stud 314. The small diameter cylindrical end 319 of the sleeve 318 is journalled in a hole in the associated rail 295 which bears against the upper edge of the large hexagonal end 321. Very accurate vertical adjustments of the rails 295 can be achieved by screwing the sleeve 318 up or down on its stud 314.

The lower run of the conveyor 52*a* is supported by rails 326 (FIGS. 19, 21 and 23) which extend between and are supported by two idler support brackets 327 which are disposed adjacent opposite ends of the conveyor. The rails 326 slidably engage the carton supporting plates 293 and are stiffened by rods 328 that are bolted to each idler support bracket 327. The idler support brackets 327 are identical, therefore, the description of one will suffice for both.

Each idler support bracket 327 includes a rigid box 329 (FIGS. 21 and 23) having an upper horizontal wall 331 welded to two vertically extending legs 332 and 333 to which the rods 328 are bolted. An idler sprocket 334 is journalled on a stub shaft 336 which is secured to the vertical legs 332 and 333. The box 329 is connected to a vertical plate 337 of a stationary intermediate bracket 338 by cap screws 339 which extend through vertical slots 341 (FIG. 19) in the plate 337 and are screwed into the leg 332. A plurality of ears 342 are rigidly secured to the plate 337 and straddle an associated one of the U-shaped frame members 297. Cap screws 344, which extend through holes in the ears, are screwed into the associated U-shaped frame member 297 to rigidly secure the intermediate bracket 338 thereto.

As best shown in FIG. 19, an abutment block 346 is welded to the plate 337 and is engaged by a take-up bolt 347 which is threaded into an angle member 348 that is secured to the leg 332 of the box 329. It will, therefore, be seen that rotation of the take-up bolt 347 will move the box 329 vertically and thereby provide the proper tension on the conveyor 52*a*. The box 329 is subsequently locked in adjusted position by tightening the cap screws 339 and by tightening lock nuts 349 on the take-up bolts 347 against the angle member 348.

The carton guiding units 290 (FIGS. 19 and 21) are provided for the conveyors 52*a* and 52*b* in order to guide each carton and to assure proper lateral positioning of

each carton at certain stations. The two carton guiding units **290** are identical, therefore, the description of the unit associated with the conveyor **52***a* will be sufficient to disclose the construction and operation of the other unit also.

The carton guiding unit **290** comprises a two-section right side fence (FIGS. 19 and 21) including sections **353***a* and **353***b* and a two-section left side fence which includes sections **354***a* and **354***b*. The sections of the fences are interconnected by straps **356** disposed above the level of the cartons being advanced by the conveyor. Upper longitudinal rails **357** and lower longitudinal rails **358** of each side fence are rigidly held in vertically spaced relation by a pedestal **359** composed of tubular spacers **361**, **362**, and **363** which are vertically aligned and have an elongate threaded rod **364** extending therethrough, and through the straps **356** and the rails **357** and **358**. A nut **366** on the lower end of each rod secures each fence to the longitudinally extending plate **296**. The foremost pedestal **359** has a one piece elongated spacer **360** and the rearmost pedestal of the first section **353***a* of the carton guiding unit differs from the other in that the upper spacer **361** and strap **356** are omitted.

As shown in FIG. 21, the rails **357** and **358** of each fence are normally spaced from the cartons and permit the cartons to move freely therepast. However, the cartons are transversely centered at the filling Station **12.5**, at the top sizing Station **14**, and at the top stamping Station **17** by longitudinally extending nylon guide shoes **367** (FIG. 19) which are placed between the associated rails and straps **368**, and are clamped in adjusted position by screws **369** that are threaded into the straps.

The carton guiding unit **290** also includes a lead-in portion **370** (FIG. 19) at Stations **9** and **10** which include upper guide rails **371** and lower guide rails **372** each having outwardly flared forward ends to aid in guiding the cartons therebetween. The rails **371** and **372** are welded to the elongated spacers **360** of the foremost pedestals **359** and to the tubular spacer **362** of the next rearward pedestals **359**. Nylon guide shoes **367***a* which are similar to the shoes **367** are secured to the rails **371** and **372** and center the cartons at Station **10**.

Thus, the guide shoes **367** and **367***a* of each carton guiding unit **290** are arranged to engage the cartons near the tops and bottoms thereof when the cartons are positioned at Stations **10**, **12.5**, **14** and **17**, to accurately center the cartons laterally of the conveyors at these stations. Since the cartons are normally engaged only at the above stations and not throughout the entire length of the carton guiding units, the surfaces of the carton are not marred or dulled as would occur if prolonged sliding contact were permitted.

As mentioned previously, at Station **18** a discharge apparatus **84**, which will be described hereinafter, moves the cartons laterally off the longitudinally moving conveyors **52***a* and **52***b* and positions them on one of two longitudinally moving discharge conveyors **86**. Since the discharge conveyors **86** are identical, the description of the discharge conveyor which receives cartons from the conveyor **52***a* will suffice for both.

The discharge conveyor **86** (FIGS. 24, 25 and 26) comprises a pair of longitudinally extending side walls **376** and **377** which are rigidly connected in parallel spaced relation by bars **378** and **379**. A belt slide plate **381** is bolted to the top of the walls **376** and **377** to provide a rigid frame structure and a surface for supporting the upper run of an endless belt **382** which is trained around a drive roller **383**, a take-up roller **384**, and idler rollers **385** and **386** and has a carton-receiving end portion **382***a* at Station **18** alongside the discharge end of the associated conveyor **52***a* or **52***b*. The drive roller **383** is keyed to a drive shaft **387** which is journalled in the side walls **376** and **377** and is also in ears **388** and **389** of a bracket **391** that is bolted to the end wall **390** of the frame **53**. It will be noted that the drive shaft **387** also drives the discharge conveyor associated with the conveyor **52***b*.

The take-up roller **384** (FIGS. 25 and 26) is journalled on a shaft **393** that is secured to upwardly projecting ears **394** of a lever arm **396**. The arm **396** is journalled on a shaft **397** which is secured to and extends between the side walls **376** and **377**. The take-up roller **384** is urged against the belt **382**, to tighten the same, by a cap screw **398** that is screwed into a threaded cross-member **399** of the arm **396** and abuts a stop **401** secured to and extending between the walls **376** and **377**. The cap screw **398** is locked in adjusted position by a nut **402** screwed on the cap screw and tightened against the cross-member **399**. The idler rollers **385** and **386** are journalled on shafts **403** and **404**, respectively, which extend between and are rigidly secured to the walls **376** and **377**.

Since the walls **376** and **377** are journalled on the drive shaft **387**, the forward end of each discharge conveyor **86** may be pivoted upwardly about the axis of the shaft **387**. In this way certain parts of the machine may be exposed for cleaning or repairs. A handle **405** (FIG. 25) is bolted to the wall **376** to aid in manually raising and lowering the forward end of the conveyor **86**. An adjustment bolt **406** (FIG. 26) is screwed into the bracket **391** and abuts the bar **379**. It can be seen that rotation of the bolt **406** will effect a raising or lowering of the forward end of the discharge conveyor **86** to position this end of the conveyor **86** at the optimum elevation for receiving the cartons from the conveyor **52***a*.

A left carton guide **411** (FIGS. 25 and 26) and a shorter right carton guide **412** are provided to guide the cartons as they are moved along the discharge conveyor **86**. The carton guides **411** and **412** are provided with vertical slots **413** in their lower edges which fit over the shanks **414** of pins **416** secured to the wall **377**. Enlarged heads on the pins hold the carton guide **411** firmly against the wall **376**. The carton guide **411** extends forwardly to Station **18** and will maintain the cartons upright in the event they tend to overturn when they are pushed from the conveyor **52***a* to the associated discharge conveyor **86**.

The cartons are advanced by the discharge conveyor **86** over a removable bridge **421** which directs the cartons onto any suitable discharging means, such as a laterally extending conveyor (not shown) which removes the cartons from the carton forming and filling machine **50**. The bridge **421** comprises a slide plate **422** which is welded to spaced parallel arms **423** and **424**. The bridge is supported by pins **427** (FIG. 26) projecting from the walls **376** and **377**. The forward pins **427** are fitted in slots **429** in the upper edges of the arms **423** and **424**, and the rear pins are fitted against shoulders **430** on the lower edges of the arms **423** and **424**.

The upper runs of the discharge conveyors **86** are driven toward the right (FIG. 24) by a drive train **431**. The drive train **431** receives power from the camshaft **278** and includes a chain **432** trained around a sprocket **433** keyed to the camshaft **278** and around a sprocket **434** keyed on the input shaft **435** of a right angle gear box **436**. An output shaft **437** of the gear box is connected to the drive shaft **387** by a flexible coupling **438**. The gear box **436** is bolted to a horizontal ledge **439** of the bracket **391**. A take-up sprocket **441** engages the chain **432** and is journalled in a bracket **442**. The bracket **442** is vertically adjustable and is connected to the vertical side plate **232** of the frame **53** by cap screws which extend through vertical slots in the plate **232** and are screwed into the bracket **442** to lock the bracket in adjusted position.

Thus, it is apparent that the conveyor assembly **52** includes two carton advancing conveyors **52***a* and **52***b* which are intermittently driven and which are accurately guided along horizontal paths to assure that the cartons stand vertically upright. Additionally, the cartons are held from lateral movement by nylon shoes **367** and **367***a* at Stations **10**, **12.5**, **14** and **17** to assure that the cartons at these stations are properly centered. The carton advancing lugs **69** engage the cartons in such a way that the sides of the cartons are permitted to bow outwardly when filled with milk thereby lowering the level

of the milk in the cartons as compared to the level in cartons having sides held in flat upright planes. The filled and sealed cartons are then pushed laterally off the conveyors **52***a* and **52***b* onto the associated continuously driven discharge conveyors **86** which discharge the cartons from the carton forming and filling machine **50**.

Carton supply magazine.—The magazine **54** (FIGS. 1 and 2) at Station **1** is arranged to hold a supply of collapsed cartons and to move them into position to be removed individually by the carton erecting apparatus. Two rows of collapsed cartons are manually loaded into the magizine, each carton extending transversely of the row and resting on the end flaps which will eventually form the top wall of the closed carton. The collapsed cartons are urged toward the carton erecting and turret loading apparatus **57** which picks off the foremost folded cartons from each row, opens the cartons to define a tube having a square cross-section, and forces each squared carton down over one of the mandrels **58** which is at that time projecting vertically upwardly at Station **3**.

More particularly, the magazine **54** (FIG. 30) comprises a W-shaped end plate **471** at the inlet end of the magazine and a W-shaped end plate **472** at the discharge end of the machine, said end plates being connected by bolts to a floor plate **473** having flanged end portions **476**. Upstanding side walls **477** (FIG. 28) and a central wall **478** of I-shaped cross section are bolted to the floor plate **473** and to the upstanding legs **479** (FIG. 30) of the end plates **471** and **472** to provide a rigid magazine frame structure. As best shown in FIGURE 30 the W-shaped end plate **472** and the floor plate **473** are secured to and supported by the frame **53** of the machine **50**.

The rows of folded cartons in line **L1** and **L2** are each guided by four rods, two rods **481** and **482** (FIGS. 27A, 27B and 28) being arranged to support the cartons and two rods **483** and **484** being arranged to contact and guide the side of the upright collapsed cartons. The rods **483** and **484** are welded to brackets **486** (FIG. 28) which are bolted to the tops of the associated legs **479** of the W-shaped end plates **471** and **472**. The rods **481** and **482** are held in place by threaded studs **487** (FIGS. 28 and 32) which are welded to the rods near each end thereof and project through the floor plate **473** to receive nuts **488**.

In order to facilitate movement of cartons along the rails **481**, **482**, **483** and **484**, the carton supporting rails **481** and **482** are vibrated by a vibrator **489** (FIG. 29). The vibrator **489** may be of any suitable electrically operated type and is bolted to one end of a laterally-projecting lever **491** which is pivotally mounted on a pin **492** secured in spaced blocks **493** and **494** (FIG. 33) bolted to the lower surface of the floor plate **473**. Supports **496** and **497**, which are T-shaped in cross-section (FIG. 29), are welded to the associated rods **481** and **482** in lines **L1** and **L2**, respectively, and are bolted to the lever **491** on opposite sides of the pivot pin **492**. A threaded stem **498** is secured to the lever **491** above the vibrator **489** and projects upwardly through a hole in a channel member **499** of the frame **53**. A resilient bushing **501** fitting over the stem **498** and a nut screwed on the stem secures the vibrator **489** to the frame **53** in a manner which substantially isolates the vibrations from the frame and transmits them to the lever **491** and support rods **481** and **482**.

As best shown in FIGURES 30 and 33, the cartons in each line **L1** and **L2** are urged toward the carton erecting and turret loading apparatus **57** by counterweights **506** connected to pusher units **507** by cables **508**. Except for right hand and left hand differences, the pusher units **507** are substantially identical, therefore, the description of one will disclose the construction of both.

Each pusher unit **507** (FIGS. 28 and 30) comprises a body **509** having a bushing **511** press-fitted into an opening therein, each of said bushings being slidably mounted on one of four rods **512** secured to and extending between associated legs **479** of the W-shaped end plates **471** and **472**. A cable attachment bracket **513** is secured by bolts, not shown, to the lower end of each body **509** and has one of the cables **508** secured thereto. A handle bracket **514**, which is bolted to the upper end of each body **509**, has a handle **516** welded thereto. The free ends of the handles associated with each line **L1** or **L2** are disposed closely adjacent each other so that both handles associated with one line can easily be gripped by one hand of an operator as he places a supply of collapsed cartons into the magazine **54**.

A cam follower roller **518** is journalled on a shouldered bolt **519** secured to each cable attachment bracket **513** and rides in a linear slot **521** formed in the associated wall **477** or **478** of the magazine and serves to hold the body **509** in a vertical position. Each body **509** has two identical carton advancing fingers **522** (FIGS. 30 and 31) pivotally connected thereto by pins **523**. Each finger **522** is resiliently urged outwardly by a leaf spring **524** which is connected to the body **509** by a screw **526**. An abutment edge **527** of each finger **522** engages the associated body **509** to limit the amount of outward pivotal movement permitted thereby.

As shown in FIGURE 31, each finger **522** has a carton engaging surface **528** which is normally positioned to engage the rearmost collapsed carton in the magazine **54**. When the supply of cartons in the magazine needs replenishing, the operator places a group of cartons into the open forward end of the magazine rearwardly of the pushers and then grips, with one hand, both handles **516** of the pusher units **507** associated with the line **L1** or **L2** being filled, and pulls the two units rearwardly toward the inlet end of the magazine past the newly inserted group of cartons, while preventing motion of the newly added carton blanks with the other hand. During this time, the fingers **522** retract against the urging of the springs **524** permitting the new group of cartons to attain a position forwardly of the fingers **522**. The cartons are prevented from free movement out of the discharge end of the magazine by an upper carton arresting finger **531** (FIG. 34) and a lower carton arresting finger **532**, which fingers and other parts of the carton erecting apparatus **57**, soon to be described, engages certain surfaces of the forwardmost carton in each line **L1** and **L2** and resists its movement out of the magazine.

The pusher units **507** and the cartons in the magazine are moved toward the carton erecting and turret loading apparatus **57** by the counterweights **506** (FIG. 30) which are connected to the cable attachment bracket **513** by the cables **508**. The cables are trained around suitable direction-changing grooved pulleys **539** and **541** and around vertical pulleys **536** journalled on brackets **537** (FIG. 32) that are connected to the floor plate **473**. After passing over a vertical pulley **536**, each cable passes through a slot **538** (FIG. 27B) in the floor plate **473**. As illustrated in FIGURE 30 all the counterweights **506** are disposed in a common longitudinally extending plane on the left side of the machine **50**.

In order to warn the operator in the event the supply of empty cartons in the magazine **54** nears depletion, a pair of limit switches **542** and **543** (FIG. 27B) are mounted on the side walls **477**. The actuating element of each switch is in position to be engaged by one of the pusher units **507** associated with one of the lines **L1** and **L2** when the units **507** move to a position closely adjacent the discharge end of the magazine **54**. The switches **542** and **543** are electrically connected to a buzzer in a manner to be described hereinafter.

From the above description it will be apparent that the magazine **54** includes pusher units **507** which are effective in simplifying the reloading operation and that these units, aided by the vibrator **489**, constantly urge the collapsed cartons toward the carton erecting apparatus **57** with a predetermined force.

Carton erecting and turret loading apparatus.—The carton erecting and turret loading apparatus **57** (FIG.

27B) is positioned forwardly of the magazine 54 and includes a carton erecting mechanism 546 and a turret loading mechanism 547. The carton erecting mechanism 546 removes one collapsed carton at a time from each lane and unfolds the carton to form a rectangular tube. Thereafter, the turret loading mechanism 547 forces each inverted tubular carton down onto a mandrel 58 of the turret 51 which is temporarily positioned therebelow.

The carton erecting and turret loading apparatus 57 includes a generally box-like sub-frame 550 (FIG. 34) which is secured to the frame 53 of the machine 50 and acts as a support for the various operating members of the apparatus 57. The frame 550 includes a side wall 552 (FIG. 34), a rear wall 553 which has an inturned lower end, a second side wall 551 (FIG. 27B), a forward wall 554, and a top wall 555 all connected together to provide a rigid support structure. The forward wall 554 is a frame member and includes an upper horizontal member 556 (FIG. 34), a lower horizontal member 557, a central vertically disposed member 561, and vertical side members 558 and 559 (FIG. 27B). The central member 561 extends below the other parts of the subframe 550 as shown in FIGURE 32. The members of the forward wall 554 are spaced so as to define large openings 562 and 563 (FIG. 34) through which the inverted, folded cartons in lines L1 and L2, respectively, pass.

Since the operative structure of the carton erecting mechanism 546 associated with lines L1 and L2 are in most cases identical, the description of the structure associated with line L2 will serve to disclose the construction and operation of the mechanism associated with both lines.

The previously mentioned carton arresting fingers 531 and 532 (FIG. 34) are mounted on the upper member 556 and lower member 557, respectively, of the frame wall 554. As indicated in FIG. 35, each carton C is pushed out of the magazine with panels 91 and 94 facing forwardly and with bottom closure flaps 102, 103, 106 and 108 uppermost. The upper finger 531 engages the lip 107 (FIG. 6) of the bottom flap 106 of the foremost carton, and the lower finger 532 engages an exposed portion of the narrow lip 122 of the flap 113 (FIG. 35) of the top closure 101. It will be noted that these flaps are positioned rearwardly against the other cartons in the magazine, allowing the foremost walls 91 and 94 of the carton to be subsequently swung out to square the foremost carton by structure soon to be described.

The foremost carton in line L2 is guided through the opening 562 in the rear wall 554 by a lower right guide 564 and a lower left guide 566 (FIG. 36), guide 564 being secured to a bracket 565 that is bolted to the vertical central member 561, of wall 554 and guide 566 being secured to the vertical side member 558. A pair of upper guides, which are identical to the lower guides 564 and 566, are secured in space relation above the guides 564 and 566. The upper left guide corresponding to lower guide 566 is shown in FIG. 34 and identified by numeral 566*a*. An inclined vertical abutment surface 568 (FIG. 36) extends upwardly along one side of the opening 562 immediately adjacent the carton guide 564 and the corresponding guide disposed in spaced relation above guide 564. This inclined abutment surface is formed on a member 567 which is secured between the brackets 565, which holds the upper and lower right side guides in place. The slanted abutment surface prevents free advancement of the cartons through the opening 562 and provides a pivot about which the carton is subsequently squared.

The left guides 566 guide the left edge of the foremost folded carton first against a camming surface 569 and thereafter against an abutment lip 570 of a pivotal gate 571. The camming surface 569 of the gate moves the cartons toward the right with the right edge of the foremost carton firmly seated behind the inclined vertical abutment surface 568. The gate 571 (FIG. 34) is pivotally supported in an upper and lower bracket 572 which are bolted to the upper horizontal member 556 and the lower horizontal member 557 (respectively). A link 573 pivotally connects the gate 571 associated with line L1 to the gate 571 of line L2.

The gate 571, and other operative parts of the carton erecting mechanism 546, are operated by a hydraulic power cylinder 574 which is pivotally connected at one end to the L-shaped back wall 553 of the sub-frame 550. The free end of the piston rod 575 of the hydraulic cylinder 574 is pivotally connected to a crank arm 576 that is keyed to a vertical cam shaft 577. The cam shaft 577 is journalled in ears 578 and 579 secured to the left side wall 552 of the sub-frame 550. An eccentric cam disc 581 (FIGS. 34 and 37) is locked on the cam shaft 577 and has an eccentric strap 582 journalled thereabout. The eccentric strap 582 is pivotally connected by a link 583 to an arm 584 rigid with and projecting outwardly from the gate 571.

When the piston rod 575 is projected out of its cylinder to its full extent, the gate 571 is held in its carton arresting position shown in solid lines in FIGURE 37. As the piston rod 575 moves to the retracted position, the abutment lip 570 is gradually moved by the cam disc 581 from the solid line position to the dotted line position, and the camming surface 569 moves the foremost carton in the stack laterally to cause the right side edge of the foremost carton to be firmly seated behind the abutment 568 (FIG. 36). At the same time the forward walls 91 and 94 of the foremost carton are sprung outwardly a short distance away from the rearmost walls. At this time, the following cartons which are in contact with the camming surface 569 are frictionally held thereby and are moved firmly against the right side guide 564.

Shortly after the gate 571 has moved to the dotted line position to spring the forward wall of the foremost carton outwardly, a suction cup assembly 588 (FIG. 38) is moved into position to grip the left hand wall 91 of the foremost carton. It will be noted that, in the carton-discharging position of FIG. 37, the lip 570 of the gate 571 is angled so that the suction cup assembly can easily pull the left edge of the bowed carton free from the lip.

The suction cup assembly 588 comprises a manifold 589 having six suction cups 590 (FIGS. 4 and 38) connected thereto and communicating with a flow passage therein. The suction cup assembly 588 is connected to an overhead parallelogram linkage 591 (FIG. 38) by a pair of rods 593 and 594 that are journalled in and project upwardly from the manifold 589. Snap rings 595 (FIG. 32) on the rods 593 and 594 prevent axial displacement of the suction cup assembly 588 from the rods. The rods are rigidly secured in the outer ends of arms 596 and 597 (FIG. 38) of the parallelogram linkage 591. At its inner end each of the arms 596 and 597 has spaced inwardly projecting flanges 600, the flanges 600 of arm 597 having aligned apertures in which a shaft 599 is rigidly secured, and the flanges of arm 596 having aligned apertures in which a shaft 598 is secured. Pinions 601 and 602 are keyed to the upper portions of shafts 598 and 599, respectively. The shafts 598 and 599 are journalled for rotation in an L-shaped block 603 that is bolted to the upper horizontal member 556 of the subframe 550, and extends to a position between the flanges 600 of arms 596 and 597. A slide block 604 is bolted on the L-shaped block 603 and is slotted to slidably receive a bar 606 that is bolted to one end of an elongated, transversely extending rack 607. The other end of the rack 607 is similarly mounted for sliding movement, and the teeth of the pinions 601 and 602 mesh with the teeth of the rack. The shaft 598, which extends upwardly beyond the pinion 601 and has an arm 608 rigidly secured thereto, is journalled in a bracket 609 bolted to the slide block 604. The arm 608 is pivotally connected by a link 610 to an actuating arm 611 which is clamped to the pre-

viously mentioned cam shaft 577. It will be seen that pivotal movement of the cam shaft 577 through a complete cycle, from the fully extended position of the piston rod 575 shown in FIGURE 38 through the fully retracted position and returned to the fully extended position will oscillate the lever 611, causing it to move clockwise about 90° and then counterclockwise. During the first part of the clockwise movement the links 610 and 611 move to a straight line position causing the parallelogram arms to swing clockwise and carry the suction cup from the neutral position P (FIG. 38A) to an "overbend" position P1. Continued clockwise movement of lever 611 swings the cups back through neutral position to the carton pick-up position P2. When the lever 611 is swung counterclockwise, the cups are moved to neutral position P, then to overbend position P1 and then returned to neutral position.

Each of the manifolds 589 (FIG. 27B) of the suction cup assemblies 588 of lines L1 and L2 is connected by a flexible conduit 614 (FIG. 27C) to a conduit 615 which communicates through a valve 613 with a conduit 616 leading to a source of vacuum. The air valve 613 is mechanically actuated to alternately connect each manifold 589 to the source of vacuum and then to open the cups to atmosphere. A solenoid valve 612 is disposed in each conduit 614. Each valve 612 is normally open and may be closed separately or in unison with the other valve 612 so as to prevent removal of carton blanks from one or both lines L1 and L2, thereby permitting all the other components of the machine to be operated without cartons being present.

The air valve 613 is operated by a cam 620 (FIGS. 38 and 39) that is keyed to the cam shaft 577. An actuating arm 617 is pivotally mounted by a cap screw 618 and a tubular spacer 619 to the upper ear 578 of the housing 550. One end of the actuating arm 617 is pivotally connected to an extension of the core 621 of the valve 613, and the other end of the arm 617 is forked and extends around the cam 620. Abutment screws 622 and 623 screwed into the legs 624 and 626 of the forked end of the arm 617 are positioned to engage a lobe 627 on the cam 620 immediately prior to termination of movement of the cam shaft 577 in opposite directions.

When the piston rod 575 of the hydraulic cylinder 574 is fully extended as shown in FIGURE 38, the abutment screw 622 (FIG. 39) engages the lobe 627 of the cam 620 and actuates the arm 617 to move the core 621 of the valve 613 to the position shown in FIGURE 39. When the core 621 is in this position, the conduit 615 that communicates with the suction cup assembly 588 is aligned with a passage 631 in the core 621 which communicates with a vent passage 632 that is open to the atmosphere. A ball detent 633 holds the core 621 in adjusted position until the cam shaft 577 is rotated to a position wherein the abutment screw 623 engages the cam lobe 627 and shifts the core to a position where the manifolds 589 are connected to a source of vacuum by means of the conduits 614 and 615, a passage 634 in the core 621, and the conduit 616 that is connected to the source of vacuum.

Thus, it will be see that the suction cups 590 will be vented to the atmosphere while the cups 590 are moved from the neutral position P shown in FIGURE 38 to the overbend position P1 and then, as the cups approach the folded carton the lobe 627 engages lever 617 and shifts core 621 so that the suction cups will be connected to a source of vacuum when the cups engage the carton. Then during counterclockwise rotation of cam shaft 577, the gripped carton is moved through neutral position P, to the overbend position P1 and back to neutral position. Just as the carton reaches neutral position, the lobs 627 engages lever 617 and shifts the valve core 621 to vent the suction cups, causing them to release the carton.

In order to maintain the carton in squared condition and to aid in guiding the carton onto the mandrel 58 (FIG. 33) positioned therebelow, a pair of pivotal guide wings 636 and 637 (FIG. 40) are moved against opposite sides of the carton immediately before the carton is released by the suction cups.

The wings 636 and 637 are pivotally mounted by pins 638 on a bracket 639 that is bolted to the top wall 555 of the sub-frame 550. The wings 636 and 637 are moved between the solid line and the dotted line positions shown in FIGURE 41 by the lobe 641 (FIG. 40) of a cam 642, that is rigidly secured to the cam shaft 577. The cam 642 engages a cam follower 643 journalled on one end of an actuating arm 644 that is pivotally connected to the top wall 555 of the sub-frame 550 by a cap screw 646. A torsion spring 647, connected between the cap screw 646 and the arm 644, normally urges the arm 644 in a clockwise direction (FIG. 41). The other end of the arm 644 is pivotally connected to a rack 648 and to a pair of links 649 and 651 by a bolt 652, which extends through a slot 653 in the arm and through holes in the rack 648 and in the links 649 and 651. The link 649 is pivotally connected to the wing 636, and the link 651 is pivotally connected to the wing 637.

The rack 648 is slidably mounted in a hosuing 654 and serves as drive means for the wings 636 and 637 associated with the line L1. As best shown in FIGURE 27B, a two-piece shaft 656 is connected together by a coupling 657 and has pinions 658 and 659 keyed near opposite ends thereof. The two-piece shaft 656 is journalled in ears 661 projecting upwardly from the housing 654 associated with the line L1 and an identical housing associated with the line L2. The pinion 658 is driven by the rack 648 and transmits power to the pinion 659 which drives a rack in the housing associated with the line L1. Thus, the wings associated with line L1 operate at the same time and in the same manner as the wings associated with line L2.

As will be apparent from the shape of the cam 642 which is best shown in FIGURE 41, the wings 636 and 637 are disposed in parallel carton guiding relationship only when the piston rod 575 is in or near the fully extended position. At all other times, the wings are angled outwardly as indicated in FIGURE 45. It will also be noted that the wing 637 cooperates with a tongue 662 (FIG. 40) which projects rearwardly from and is integral with the vertical member 567 and aids in guiding the squared carton onto the mandrel 58 positioned therebelow.

In the event a carton should not be opened in the intended manner to form a tubular square as indicated in solid lines in FIGURE 42 but should be bent in an L-shape as indicated by dotted line in FIGURE 42, an ultrasonic sensing unit 666 (FIGS. 42 and 43) detects the presence of such an improperly bent carton and stops the machine.

Two ultrasonic sensing units 666 are provided with one unit being associated with the line L1 and the other being associated with the line L2. Since the units are identical, the description of the unit associated wtih line L2 will suffice for both.

The ultrasonic sensing unit 666 comprises an electrically operated sound transmitter 667 and a sound receiver 668 of standard design such as the type manufactured by Delavan Manufacturing Company. The transmitter is connected by flexible tubing 669 to one end of an angled passage 670 (FIG. 43) in an adaptor 671 which is welded to the pivotal carton guide wing 636. The other end of the angled passage 670 communicates with an opening 672 in the wing 636 and with a second angled passage 673 which is connected by a flexible tube 674 to the sound receiver 668.

When a carton is properly squared with one wall thereof covering the opening 672, sound transmitted from the transmitter 667 bounces off the carton and is transmitted

to the receiver 668 in the desired manner. If, however, a carton is bent in an L-shape rather than in a square configuration, the opening 672 will not be closed and accordingly, the major portion of the sound will be transmitted through the opening 672 and will not be directed into the receiver 668. The receiver then actuates certain electrical components, to be described later, which causes the drive motor DM of the machine to stop until the defective carton is removed and the motor is restarted.

It has been determined that the carton erecting mechanisms 546 operate more satisfactorily if there is a slight dwell at the moment the suction cup assembly 588 grips the carton, and if the operative speed of the hydraulic cylinder 574 is restricted immediately after the dwell for approximately the first 45° of movement of the suction cup assembly 588 away from the magazine 54 after the suction cup assembly 588 has gripped the foremost carton in the magazine. Accordingly, a cam 675 (FIG. 44) is secured on the shaft 577 and has an arcuate lobe 676 which engages a cam follower 677 journalled on the core 678 of a two-way valve 679. The valve 679 is bolted to the side wall 552 (FIG. 27B) of the subframe 550. Actuation of the valve core 678 by the lobe 676 causes hydraulic fluid being discharged from the power cylinder 574 to be directed through a highly restricted passage thereby reducing the speed of the cylinder. After the cam follower has been moved away from the core thereby repositioning the valve core 678, the restrictions in the flow passages are reduced causing hydraulic fluid to flow out of the cylinder at a higher rate of speed thereby causing the cylinder to move at the normal speed. The hydraulic circuit for the cylinder 574 will be described in more detail hereinafter with the other hydraulic components of the machine 50.

After the cartons in liness L1 and L2 of Station 2 have been squared or erected, they are each forced downwardly at Station 3 onto a mandrel 58 of the turret 51 by the turret loading mechanism 547 (FIGS. 32, 33, and 40). The turret loading mechanism 547 comprises a vertically reciprocable pusher head 680 which includes a tubular body 681 that is slidably mounted on a vertically extending shaft 682 (FIG. 33) that is rigidly secured to the upper horizontal member 556 and to the lower end of the vertical central member 561 of the wall 554 of the sub-frame 550. A stub shaft 683 welded to the body 681 has a cam follower 684 journalled on one end and received in a vertically extending slot 686 in the central member 561, thereby preventing rotation of the tubular body 681. The body 681 is vertically reciprocated by a hydraulic cylinder 687 having its piston rod 688 connected to the stub shaft 683 and having its cylinder 689 connected to a support rod 691 which is connected to the frame 53 of the machine 50 by nuts 692.

A transversely extending bar 693 (FIG. 40) is secured to the tubular body 681 by a bracket 694. A flap engaging head 696 is bolted to each end of the bar 693 and includes slots 697 and 698 arranged to engage the bottom flaps 106 and 108, respectively, of the associated cartons. It is to be noted that the slots 697 and 698 in each flap engaging head 696 are disposed at different elevation to compensate for the difference in length of the flaps 106 and 108.

The flap engaging heads 696 are normally positioned above the cartons and are moved down against the carton after the cartons have been released by the suction cups 590 and are held in square tubular positions by the associated wings 636 and 637 and the tongue 662. Upon continued downward movement of the heads 696, the carton in each line L1 and L2 is guided downwardly between a pair of spaced U-shaped guides 699 and 701 (FIG. 32) and onto the mandrel 58 positioned therebelow. The U-shaped guides are bolted to the box-frame as shown in FIGURE 32, and the forward wall 702 of the guide 699 is relieved to permit the upper end of a carton positioned on a mandrel 58 to subsequently be swung out through said relieved portion. It will be noted that the wings 636 and 637 are spaced from the tongue 662, and that the U-shaped guides 699 and 701 are sufficiently spaced from each other to permit the heads 696 to pass therebetween.

Although the operation of the carton erecting and loading apparatus 57 has been covered in the above description of the apparatus, a summary of the operation on one carton will now be described having reference to FIGURES 27B and 45 to 49 inclusive.

Upon retraction of the piston rod 575 of the hydraulic power cylinder 574, the suction cup assembly associated with line L2 swings clockwise from the neutral position P over the carton guides 699 and 701 as shown in FIGURE 45, through the dotted line "overbend" position P1, and thereafter swings counter-clockwise through the neutral position to the position P2 shown in FIGURE 46 wherein the gate 571 is pivoted counter-clockwise toward the foremost carton to bow or spring the forward walls thereof slightly away from the rear walls thereof. The rear walls of the carton are held in position by the fingers 531 and 532 while the suction cups engage and grip the left hand forward wall (FIG. 46) of the carton to move the left edge of the carton away from the lip 570 and to move the left wall forwardly and toward the right. As the suction cup assembly 588 begins to open the cartons, the carton pivots about the vertical abutment 568, and the rear wall is pulled out of engagement with the carton arresting fingers 531 and 532. Because of the inherent resilience in the carton, the carton is then moved past its normal open position and is "overbent" as illustrated in FIGURE 47 so as to reduce the stresses present in the carton. As the carton is moving back to the neutral position shown in FIGURE 48 directly above the carton guides 699 and 701, the wings 636 and 637 close in upon the carton to hold it in its squared position slightly before the suction cups 590 release the carton.

With the carton erected and positioned above the guides 699 and 701, the associated flap engaging head 696 of the turret loading mechanism 547 (FIG. 49) forces the erected carton down through the guides 699 and 701 and onto the turret mandrel 58 positioned therebelow as shown in dotted lines in FIGURE 49. The head 696 then returns to its uppermost position and the turret then swings the squared carton from Station 3 to Station 4. The carton erecting and turret loading apparatus 57 is then ready to repeat the above described cycle of operation on another carton.

Bottom forming apparatus.—After the turret loading operation has been completed at Station 3, the turret 51 (FIG. 11) is indexed so that the two cartons on the mandrels 58 in lines L1 and L2 are moved along an arcuate guide rail 706 secured to the frame 53 and each carton is positioned at Station 4 in alignment with one of the bottom forming dies 63 of the bottom forming apparatus 62. The bottom forming dies 63 bend the bottom flaps of the bottom closures 100 of the associated cartons about the score lines prior to the heating and sealing of the bottom closure at Stations 5 and 6, respectively.

The bottom forming apparatus 62 (FIGS. 50 to 54) comprises a bracket 707 which is bolted to the frame 53 and is inclined downwardly toward the mandrels 58 at Station 4. The cylinder 708 of a hydraulic power unit 709 is bolted to the bracket 707 and its piston rod 711 projects outwardly and downwardly therefrom in a direction parallel to the longitudinal axes of the two mandrels 58 at Station 4. The piston rod 711 carries a U-shaped support 712 which has one of the bottom forming dies 63 bolted on each side thereof in axial alignment with the asociated mandrel 58. The U-shaped support 712 is held from rotation about the axis of the piston rod 711 by a guide rod 713 which is secured to the U-shaped support 712 and is slidably received in blocks 714 welded to the bracket 707.

The two bottom forming dies **63** are identical, therefore, the description of one will suffice for both. Each bottom forming die **63** comprises an end plate **716** (FIGS. 52 and 53) to which a pair of flap bending, generally triangular walls **717** and **718** are bolted. A pair of arms **719** and **721** (FIG. 54) are pivoted at **722** and **723** to forked angle brackets **724** and **726** that are secured to the end plate **716**. A flap engaging finger **727** and a cam **728** are connected to one end of each arm **719** and **721** by screws **729** which extend through slots **731** in the cams **728** to permit adjustment of the same. A spring **732** is connected to the outer ends of the arms **719** and **721** and urges the fingers **727** outwardly away from the carton. The amount of outward movement of each finger **727** is limited by an abutment screw **733** which is screwed in the associated arm and abuts the associated bracket **724** and **726**. Nuts **734** lock the screws in adjusted position.

The arm **719** is actuated by a cam follower roller **736** (FIG. 54) which is positioned in the path of movement of the associated cam **728** as it moves toward the end of the carton, said follower roller **736** being journalled in a bracket **737** bolted to the arcuate rail **706**. Similarly, the arm **721** is actuated by a cam follower **738** which is positioned to engage the other cam **728** and is journalled on a bracket **739** that is bolted on an arcuate rail **741** which extends between Station **4** and Station **5** and is secured to the frame **53** as shown in phantom lines in FIG. 33.

In the operation of the bottom forming apparatus **62**, the hydraulic cylinder **709** is actuated after the cartons in lines L1 and L2 are positioned at Station **4** to move the dies **63** along paths parallel to the longitudinal axes of the associated mandrels **58**. As each die **63** moves downwardly, the fingers **727** contact the bottom flaps **102** and **103** (FIGS. 53 and 54) and move them inwardly in response to actuation of the cams **728** by the cam followers **736** and **738**. Shortly after the fingers **727** have started to bend the bottom flaps **102** and **103** inwardly, the bottom flaps **106** and **108** are contacted by the triangular walls **717** and **718**. As downward movement of the bottom forming die **63** continues from the intermediate position shown in solid lines in FIGURES 53 and 54 to the fully extended position shown in phantom lines, the fingers **727** and triangular walls cooperate with the chamfered edges of the mandrel head **166** to sharply bend the carton flaps of the bottom closure **100** about the score lines **98** and **104**.

The piston rod **711** is then retracted and the turret **51** is indexed to move the two mandrels **58** in lines L1 and L2 with the cartons having the partially closed bottom closures **100** thereon into Station **5**.

Bottom heating apparatus.—The bottom heating apparatus **64** (FIGS. 55–59) at Station **5** includes a heating head **746** for each line L1 and L2. The heads **746** are moved into position to direct hot air against only those surfaces of the polyethylene coated cartons which are to be sealed together at Station **6**.

The heads **746** are moved toward and away from the preformed cartons on the mandrels **58** at Station **5** by a hydraulic power cylinder **747** (FIGS. 55 and 56) which includes a cylinder **748** that is rigidly secured to an upwardly inclined bracket **749** bolted to the frame **53** of the machine. A head supporting bracket **751** is connected to the piston rod **752** of the power cylinder **747** by nuts **753**. The bracket **751** is held from rotation about the axis of the piston rod **752** by a guide rod **754** (FIG. 56) which is rigidly secured to the bracket **751** and is slidably received in blocks **756** welded to the inclined bracket **749**.

Since the two bottom heating heads **746** are identical, the description of one head and its operation will suffice for both. In general, the head includes a central heating unit **769**, which extends into the open end of the partially closed carton to direct heated air against internal surfaces of the flaps, and two outer units **766** which are disposed outside the carton and direct heated air against the outer surfaces of two flaps. Each head **746** (FIGS. 57, 58 and 59) also includes a transversely extending rear plate **757** which may be formed as part of the bracket **751**. A generally rectangular housing **758** (FIG. 58) defines a plenum chamber **758***a* and is formed by four walls **759** conected together and to an end plate **761** in air tight relation. Threaded studs **762** project from the housing **758** through the plate **757** and have wing nuts **763** screwed thereon which hold the plenum chamber in air tight engagement against plate **757**.

Hot air flows from the plenum chamber through generally triangular openings **764** in the plate **761** into the upper and lower outwardly projecting exterior air distribution heating units **766**. The housings of the units **766** are welded to the plate **761** and have generally V-shaped inner surfaces formed by two inclined walls **767** which diverge outwardly from the plate **761** to conform to the shape of the bottom flaps **102** and **103** (FIGS. 55 and 56) when positioned over these flaps. A plurality of perforations **768** are formed in the inner walls **767** so as to direct hot air at all of the outer surfaces of the flaps **102** and **103** since these flaps are subsequently folded so that the entire outer surface of each flap is utilized as a sealing surface.

The air distribution unit or housing **769** (FIGS. 57, 58 and 59) for heating the interior walls of the bottom closure **100** is welded to the end plate **761** of the housing **758** and communicates with the plenum chamber through two openings **771** (FIG. 58). The effective size of the openings is controlled by adjustable gates **772** which are locked in adjusted position by screws **773**. The gates **772** provide means for controlling the proportions of hot air distributed into the interior air distribution housing **769** as compared to the air entering the exterior housings **766**.

The interior housing **769** (FIG. 57) is defined by opposed V-shaped walls **774**, opposed planar walls **776**, U-shaped corner members **777** and an end closure plate **778**. These walls are all secured together in air tight relation. Perforations **779** are provided in the walls **774** and **776** and in the U-shaped corner members **777** in a pattern which concentrates the flow of hot air to those inside surfaces of the bottom closure **100** which contact and seal against other surfaces of the bottom closure. It should be particularly noted that the U-shaped corner members **777** will assure that sufficient hot air is directed into the carton corners to heat the polyethylene to the desired temperature.

As best shown in FIGS. 57 and 59, V-shaped flap guides **780** and beveled corner guides **781** are welded to the end closure plate **778** and function to guide the inner heating unit **769** into the partially closed bottom closure **100**. Arms **782** are bolted to opposed walls of the plenum chamber **758***a* and have wire fingers **783** welded to the free ends thereof and positioned closely adjacent the apex of the associated V-shaped walls **767**. The fingers **783** serve to guide the walls of the bottom closure **100** into the head **746** and to space the carton walls **102** and **103** from the V-shaped walls **767** to assure proper distribution of hot air. Flat walls **786** and **787** are bolted to the plate **757** and extend outwardly to a position wherein its outer end is even with the ends of the heating units **766** to and in confining the hot air within the bottom heating head **746**.

Sterile air is supplied to each bottom heating head **746** (FIG. 59) at the rate of 20–40 cubic feet per minute at a pressure of approximately two inches of water and is heated to a temperature of 650° F. to 750° F., preferably to approximately 675° F., which temperature is effective to heat to approximately 215° F. those surfaces of the bottom closure which are subsequently sealed together. The air is supplied by an electrically powered blower (to be described hereinafter) and directs the air to a heater **791** through a conduit **792**. The heater **791** comprises a

tubular body **793** (FIG. 59) that is rigidly connected to the plate **757** by a collar **794**. The collar **794** is welded to the plate **757** and is connected to the tubular body **793** by set screws **796**. An electrical heating coil **797** is fitted on an insulator **798** that is bolted to a disc **799**. The disc **799** is clamped in the counterbore of a hole **801** in the plate **757** by the tubular body and has arcuate slots **802** therein through which the heated air passes as it enters the plenum chamber **758***a*. The upper end of the insulator **798** projects through a centrally apertured disc **803** which is secured to the other end of the tubular body **793** and provides an end seal for the body. A water proof electrical conduit box **804** is rigidly secured to the tubular body **793** to protect leads projecting from the coil **797**. A tubular insulator **806** is disposed between the coil **797** and the inner wall of the tubular body **793**.

In the operation of the bottom heating apparatus **64**, the hydraulic power unit **747** (FIGS. 55 and 56) is actuated to move the two heads **746** toward the carton carrying mandrels **58** that have been positioned at Station **5**. The flaps **102** and **103** are guided between the associated walls **767** and **774** of each head **746** by the rods **783**. Hot air at approximately 675° F. is then discharged from the perforations **768** and **779** against the surfaces of the lower flaps which will eventually be sealed together. The heads are then withdrawn by the hydraulic cylinder **747** to the retracted position shown in FIGURES 55 and 56 and the heated cartons are then advanced to Station **6** where the bottom closure is sealed.

Bottom sealing apparatus.—The bottom sealing apparatus **66** (FIGS. 60–67) at Station **6** is provided to perform the final folding of the bottom flaps of the cartons and to apply pressure to these bottom flaps to cause the same to seal together in a liquid tight closure. Since the bottom sealing apparatus **66** for each line L1 and L2 is identical, the description of the bottom sealing apparatus **66** associated with line L1 will suffice for both.

The bottom sealing apparatus **66** (FIGS. 60, 61 and 62) comprises a hydraulic power unit **811** having its cylinder **812** bolted to the transversely extending member **813** of the frame **53**. A guide support block **814** is bolted to the upper end of the cylinder **812** and is apertured to permit the piston rod **816** of the power cylinder to pass therethrough. A pair of curved bottom flap guides **817** and **818** are welded to vertical shanks **819** and **821** which are rigidly clamped to the block **814** and serve to plow the bottom flaps of the carton to a substantially closed position as the carton is being moved by the turret **51** to an indexed position directly above the cylinder **811** as shown in FIGURES 63, 64 and 65.

The bottom sealing die **822** is screwed on the upper end of the piston rod **816** and is locked in place by a lock nut **823** (FIG. 61). The die **822** is prevented from rotation about the axis of the piston **816** by a pin **825** screwed in the die and slidably received in a slot **814***a* in the block **814**. The die **822** is made up of an upper and a lower section **824** and **826** and additionally includes side guides **827** and **828**. The guides **827** and **828** and the upper and lower sections are connected together by light screws **829** which are adapted to shear in the rare event that the timing between the turret **51** and the hydraulic power unit **811** should become disturbed and the die **822** should become positioned in the path of movement of a moving mandrel **58**. If this should occur, the mandrel **58** would strike the upper sections **824** of the die and shear the screws **829** thereby preventing the possibility of more serious damage occurring to the machine. It is noted that the mating surfaces of the upper and lower sections **824** and **826** are inclined to prevent the arcuate path of travel of the mandrel **58** from causing the upper section **824** to wedge against the lower section **826** in the event such interference should occur.

The side guides **827** and **828** are chamfered and accurately spaced so as to assure that the bottom flaps are square and that the V-shaped edges of the folded flaps **102** and **103** (FIG. 67) abut one another when the die **822** is forced up against the heated flaps of the carton to seal the heated surfaces together. In order to prevent an undue rise in temperature of the die **822**, the die is cooled by a stream of water which enters the die through a conduit **830**, flows through a passage **831** (FIG. 60) in the lower section **826**, and is discharged from the die through a conduit **832** connected to the passage **831**.

A shallow longitudinal groove **833** (FIG. 58) is formed in the upper face **834** of the die. As seen in FIG. 62A the groove receives the lip **107** of the bottom flap **106** when the bottom flaps have subsequently been closed and pressed into sealed engagement. It is to be noted in FIGURE 62A that, even though the side edges of the triangular portions **103***a* and **103***b* of flap **103** abut, a potential flow passage is formed at X between these edges and between the edges of flap **108** and flap **106**. It is important therefore that the edge **836** of the groove **833** is so located that it forces the portion **106***a* adjacent the connection of lip **107** to flap **106** into sealing engagement with the edge **108***a* of flap **108** and with the section **103***b'* of flap portion **103***b*. In FIGURE 62A the groove edge **836** is illustrated in a position slightly to the right and below the edge **108***a* of flap **108** for effectively forcing material into the corner thereabove. It is to be understood that the location of this groove edge **836** may be moved to the left (FIG. 62*a*) to a position wherein the groove edge **836** is in alignment with the edge **108***a* of flap **108**. When in this position, both the connecting portion **106***a* and the edge **108***a* are deformed for forcing material into the corner thereabove.

It will also be apparent that the potential flow passage X extends past the abutting edges of the triangular portions **102***a* and **102***b* (FIG. 8A) and that the portion of the passage X is sealed in the above described manner.

In order to provide a leak proof bottom closure, raised buttons **837** are positioned on the face **834** of the die **822** in position to engage the several seam lines **838** (FIG. 67) and crush the carton material to block the potential flow passages which occur at these seam lines. The aforementioned V-shaped die **168** (FIGS. 66 and 67) on each mandrel **58** is so positioned on the mandrel that it fits within the apex of one of the V-shaped recesses **839** formed in the bottom of the carton by the folded walls **102** and **103**. The die **168** compensates for the added thickness of these walls so that, it forms a backup member for wall **108** just as the bottom of the mandrel forms a back-up member for the wall portions **102** and **103**. Accordingly, with these back-up members in place, sufficient pressure can be applied to the carton to seal it.

As further protection against accidental interference between the mandrels **58** and the die **822**, a two-way, normally closed hydraulic valve **841** (FIG. 60) is included in the hydraulic system to be described hereinafter, and is opened only when one of the mandrels **58** is in, or is immediately, adjacent the indexed position at Station **6**. The valve **841** is actuated by the previously mentioned cam fingers **189** (FIGS. 10 and 60), one finger being provided for each mandrel in line L1.

In the operation of the bottom sealing apparatus **66**, the flap guides **817** and **818** (FIGS. 63, 64 and 65) guide the carton from Station **5** to Station **6** and plow the carton flaps **106** and **108** into a relatively flat folded condition before releasing the flaps onto the die **822**. As the mandrel **58** (FIG. 61) and the carton becomes aligned at Station **6**, the hydraulic valve **841** (FIG. 60) is opened by the cam finger **189** permitting hydraulic fluid to enter the cylinder **812** and force the die **822** upwardly, thereby applying a pressure of approximately 450 p.s.i. against the carton flaps of the bottom closure which is firmly clamped between the mandrel **58** and the die. The side guides **827** and **828** serve to square the bottom end closure **100** and to hold different flaps thereof into abutting ralation. The bottom closure is held in clamped position for approximately 2.3 seconds

to assure the proper adhesion and cooling of the several heated walls of the bottom closure. The bottom closure of the carton is then released upon downward movement of the piston 816 and die 822 to their retracted position.

The mandrel 58 having the carton with the sealed bottom closure thereon is then advanced to Station 7 (FIG. 11) which is an open station that may be used for other functions performed on the bottom of the carton. For example, if it is desired to mark the bottom of the carton with a code number or the like, a marking apparatus may be positioned at Station 7. The carton is then moved to Station 8 which is a carton ejecting station. During its motion between Station 6 and Station 8, the cartons in lines L1 and L2 are guided by arcuate rails 842 (FIGS. 1 and 11) which are secured to brackets 843 bolted to the frame 53 of the machine.

Carton transfer and turning mechanism.—The carton transfer and turning mechanism 68 (FIGS. 1, 2 and 3) is effective to guide each carton with its sealed bottom closure onto the associated conveyor 52*a* or 52*b* at Station 9 after it has been blown off the associated mandrel at Station 8. During transit from Station 8 to Station 9, the mechanism 68 twists the carton 90° about its longitudinal axis so that the short flap 113 (FIG. 9A) is foremost on the conveyors, and deposits the carton on the conveyor with its bottom closure contacting the conveyor.

As has already been mentioned in the description of the turret 51 (FIGS. 10–14), when the turret positions a pair of mandrels 58 at Station 8, high pressure sterile air at approximately 60–80 p.s.i. is directed into the passages 163 in those mandrels at Station 8 through the conduits 182 (FIG. 14), the port 183, the associated passage 184 (FIG. 10) and the ports 186. The timing of the discharge of the air through the above passages is controlled by an air valve to be described hereinafter, that is controlled by a cam on the cam shaft 278 (FIG. 2). The air in the passages 163 of the mandrels 58 at Station 8 flows into the passages 164 (FIG. 13) in the upper rectangular end of the body 161, through the angled holes 167 in the mandrel heads 166 and is discharged against the closed bottom closure of the cartons to discharge the cartons from their associated mandrels 58 and rapidly propel the cartons to Station 9.

The cartons in lines L1 and L2 are guided between Station 8 and Station 9 by carton turning mechanisms 848 (FIGS. 1, 2 and 3). The mechanisms 848 associated with lines L1 and L2 are identical, therefore, the description of one will suffice for both.

Each mechanism 848 comprises a U-shaped support 849 which is connected by a bracket 851 to the frame 53 near Station 8. The inlet ends of a plurality of carton guide rails 852 are welded to the support 849 and the guide rails are curved and twisted so as to direct the carton bottom end toward the associated conveyor 52*a* or 52*b*. The other end of the rails 852 are welded to a a tubular chute 853 of rectangular cross section which has its front and rear end walls 854 and 856 cut away to permit movement of the conveyor drive lugs 69 through the lower portion of the chute 853. The intermediate portions of certain ones of the guide rails 852 are welded to a generally U-shaped strap 857 which adds rigidity to the carton turning mechanism 848. The chute 853 is supported by a bracket 858 that is bolted to the support structure 859 of the top forming apparatus 71 at Station 10.

In the operation of the carton transfer and turning mechanism 848, the cartons with their bottom closures sealed are blown off the associated mandrel 58 at Station 8 into the turning mechanism 848 which turns the cartons ninety degrees clockwise, as viewed from the rear of a carton moving through the turning mechanism, and deposits the cartons on the associated conveyor 52*a* or 52*b* at Station 9 between adjacent drive lugs 69 of the associated conveyor.

While on the conveyors 52*a* and 52*b* which are intermittently driven in half-station increments, the carton top closures are preformed at Station 10, sterilized at Station 11, filled at Station 12.5, sized at Station 14, heated at Station 14.5, sealed at Station 15, stamped at Station 17, and discharged onto the associated discharge conveyor 86 at Station 18.

Top forming apparatus.—The top forming apparatus 71 (FIGS. 68–73) at Station 10 is provided for breaking or preforming the various flaps and tabs of the top closure of each carton. The apparatus 71 includes two identical top forming heads 72, one head being associated with line L1 and the other head being associated with the line L2. Since the top forming heads 72 are identical the description of the head associated with line L1 will serve to disclose the construction of the other head also.

The support structure 859 of the top forming apparatus 71 (FIGS. 68, 69 and 70) includes a pair of pedestals 867 and 868 having a bridge plate 869 extending between and bolted to the upper ends of the pedestals. The lower ends of the pedestals 867 and 868 are bolted to the vertical side plates 231 and 232, respectively, of the frame 53. A hydraulic power unit 871 has its cylinder 872 bolted to the bridge plate 869 with its piston rod 873 projecting downward through a hole in the bridge plate 869. The piston rod 873 is connected by nuts 874 to a horizontal mounting plate 876 of a carrier 877, which carrier includes a pair of upstanding arms 878 and 879 to which racks 881 and 882, respectively (FIG. 69), are secured. The arms 878 and 879 are secured to the ends of the plate 876, project through openings in the bridge plate 869 and have keys 883 and 884 bolted thereto. The carrier 877 is guided for vertical movement by vertically slotted slide blocks 886 and 887 which are bolted to the bridge plate 869 and are slidably engaged by the keys 883 and 884, respectively.

In order to maintain the mounting plate 876 of the carrier 877 horizontal, a stabilizing shaft 888 having pinions 889 and 891 keyed thereon is journalled in bearings 892 and 893 bolted to the bridge plate 869. The pinions 889 and 891 mesh with the racks 881 and 882, respectively, and assure that the ends of the plate 876 move equal distances during movement of the carrier 877.

The top forming head 72 is moved downwardly by the carrier 877 to preform the flaps of the top closure of the cartons positioned therebelow and then is moved upwardly to a position above the path of movement of the cartons to permit the next cartons to be indexed therebelow.

The top forming head 72 (FIGS. 68 and 71) associated with line L1 comprises a body 896 (FIG. 68) having studs 897 secured thereto and projecting upwardly through holes in the plate 876. The body 896 is connected for easy removal from the plate 876 by wing nuts 898 screwed on the studs 897.

Four legs 899 (FIG. 71) of the body 896 project downwardly and have two shafts 901 journalled therein and extending longitudinally of the machine 50. A generally trapezoidal shaped flap engaging shoe 902 is welded to each shaft 901 and projects upwardly therefrom for engagement with the side flap 109 and 111 of the carton C (FIG. 72). A torsion spring 903 on each shaft 901 is connected between the associated shoe 902 and one of the legs 899 to resiliently urge the shoes 902 away from each other. A stop finger 904 is secured to each shaft 901 and each stop finger 904 engages a pin 905 (only one being shown in FIG. 71) on an associated leg 899 to limit the extent of outward movement of the shoes 902. Each shaft 901 has a cam finger 906 welded thereon and each finger has an internal camming surface 907 which engages a cam follower 908 (FIG. 70) upon downward movement of the head 72 causing the shoes 902 and flaps 109 and 111 to move inwardly.

To assure bending of the flaps 109 and 111 at the score lines 99, two internal brake bars 909 (FIG. 71) are inserted within the carton to support the walls 91 and

93 below the score line 99. Each bar 909 is welded to the end of one arm of a generally U-shaped member 910 which has a pivot pin 911 welded near its midpoint. The pins are journalled in spaced bearing blocks 912 that are bolted to the body 896. A cam-engaging end surface is formed on the end of the other arm of each U-shaped member 910. The members 910 are urged toward each other by compression springs 914, each spring extending and having one end projecting through a hole 916 in the body 896 and bearing against the horizontal mounting plate 876 and the other end bearing against a tab 917 projecting outwardly from the associated arms 910. A V-shaped block 918 bolted to the body 896 is provided with slanted abutment surfaces 918*a* and 918*b* which act as stops to limit the amount of inward pivotal movement of the end surfaces 913 of the arms 910. When the top forming head 72 is moved downwardly, the camming end surfaces 913 engage cam followers 919 (FIG. 70) to pivot the arms 910 to the position shown in FIG. 72. When in this position, it will be noted that an intermediate portion 921 of the arms 910 engage and bend the tabs 116 and 117 of the carton outwardly.

The top forming head 72 also includes transverse flap breaking shoes 922 (FIGS. 71 and 73) which contact the flaps 112 and 113 immediately above the score line 99. Each shoe 922 is pivotally mounted on a pair of arms 923 and 924, and each pair of arms 923 and 924 are secured to a shaft 926 which is journalled in blocks 927 bolted to the legs 899. The shoes 922 are urged outwardly by torsion springs 928 and the extent of such movement is limited by pins 929 (FIGS. 68 and 73) which are secured to and project outwardly from the lower end portions of the arms 924 into position to engage certain ones of the legs 899. The pins 929 also limit the amount of pivotal movement of the shoes 922 relative to their support arms 924 and 923 by engaging the rear surface of the shoes. A cam follower 931 (FIGS. 70 and 71) is journalled on an extension 932 of each arm 924 and engages a fixed cam bar 933 upon downward movement of the head 72 to bend the flaps 112 and 113 inwardly as shown in FIG. 73.

The structure 934 (FIG. 68) for supporting the cam bar 933, the cam follower 908, and the cam follower 919 which are associated with the right side of the top forming head 72 is similar to the structure 936 (FIG. 68) for supporting the equivalent parts on the left side of the head. Therefore, the description of the right structure 934 will suffice for both.

The support structure 934 (FIG. 70) comprises a plate 937 which is bolted to the guide rails 371 and 372. The cam follower 908 is journalled on a vertical arm 938 that is connected to the plate by cap screws 939 which extend through slots in the arm 938 thereby permitting vertical adjustment of the cam follower 908. Similarly, the cam follower 919 is journalled on a vertical arm 942 that is connected to the plate 937 by cap screws 943 which extend through slots in the arm 942 thereby permitting vertical adjustment of the cam follower 919. The arms 938 and 942 are adjusted by cap screws 946 and 947, respectively, that are threaded in a lip 948 projecting outwardly from the plate 937 and engage the lower ends of the arms. The abutment bar 933 is secured in adjusted position by cap screws 949 which extend through vertical slots in the bar 933.

During operation of the top forming apparatus 71, the hydraulic cylinder 871 holds the heads 72 above the cartons until the cartons have been indexed thereunder. The flap engaging mechanisms of the head are in the positions shown in FIG. 68. The cylinder then lowers the heads 72 in lines L1 and L2 onto the cartons therebelow. As each head 72 is lowered, the internal brake bars 909 enter the associated carton. The cam rollers 908 and 919 then engage the cam surfaces 907 and 913 of the fingers 906 and arm 910, respectively, at approximately the same time, as shown in FIG. 72, to begin bending the flaps 109 and 111 inwardly. Shortly thereafter, the cam bar 933 (FIG. 70) engages the top surface of cam follower 931 to move the shoes 922 inwardly. Upon termination of downward movement of each head 72, the shoes 909 and the shoes 902 assume the position shown in FIGURE 72 to bend the flaps 109 and 111 of the carton sharply about the score line 99 and to bend the tabs 116 and 117 downwardly. Simultaneously therewith, the shoes 922 (FIG. 73) sharply bend the flaps 112 and 113 about the score lines 99. It will be appreciated that since the trapezoidal flap engaging shoes 902 are approximately the same size and shape as the flaps 109 and 111 that these flaps will bend sharply about the score lines 118 (FIG. 73). The hydraulic cylinder 871 then raises the heads 72 upwardly away from the cartons permitting the flap-engaging members of the heads to return to their normal spring-urged positions.

Sterilizing apparatus.—After being preformed at Station 10, the cartons in Lines L1 and L2 are indexed at Station 11 at which station the interiors of the cartons are sterilized by the ultra-violet lights 74 (FIGS. 74, 75 and 76) of the sterilizing apparatus 73.

The sterilizing apparatus 73 comprises a support structure 955 which includes a pair of pedestals 956 and 957 having a bridge plate 958 extending between and bolted to the upper ends of the pedestals. The lower ends of the pedestals 956 and 957 are bolted to the vertical side plates 231 and 232, respectively, of the frame 53. A hydraulic power unit 959 has its cylinder 961 bolted to the bridge plate 958 with its piston rod 962 projecting downward through a hole in the bridge plate. The piston rod 962 is connected by nuts 963 to a horizontal mounting plate 964 of a carrier 966 which carrier includes a pair of upstanding arms 967 and 968 to which racks 969 and 971 (FIG. 75), respectively, are secured. The arms 967 and 968 are bolted to the ends of the plate 964, project through openings in the bridge plate 958, and have elongated keys 972 and 973 bolted thereto. The carrier 966 is guided for vertical movement by vertically slotted slide blocks 974 and 976 which are bolted to the bridge plate 958 and are slidably engaged by the keys 972 and 973, respectively.

In order to maintain the mounting plate 964 of the carrier 966 horizontal, a stabilizing shaft 979 having pinions 981 and 982 keyed thereon is journalled in bearings 983 and 984 that are bolted to the bridge plate 958. The pinions 981 and 982 mesh with the racks 969 and 971, respectively, and assure that the ends of the plate 964 move equal distances during movement of the carrier 966.

A pair of the ultraviolet lights 74 are inserted into each carton indexed at Station 11 upon downward movement of the carrier 966 and moved to within approximately one-half inch of the bottom of the carton. The ultraviolet lights 74 are bolted to the carrier 966 and are connected to a high voltage source of electricity through leads which are disposed within conduits 986. A photoelectric burn-out detector 987 is electrically connected with each pair of lights 74 and is positioned to scan the associated pair of ultraviolet lights 74. In the event a light should break or burn out, the associated photoelectric burn-out detector 987 opens the circuit to the drive motor DM (FIG. 2) thereby stopping the machine 50.

A normally closed limit switch 988 is mounted on a bracket 989 bolted to the bridge plate 958 and includes an actuating arm 991 positioned to engage a pin 992 projecting outwardly from the arm 968 when the carrier 966 is in its uppermost position and the ultraviolet lights 74 are above the path of movement of the cartons. Opening of the limit switch 988 permits the energization of the drive motor DM and movement of the conveyors 52*a* and 52*b* to the next indexed position. If the switch is not opened upon termination of upward movement of the carrier 966, indicating that the bottom of the ultraviolet lights 74 lie in the path of movement of the cartons, a circuit is closed which prevents energization of the motor DM.

During normal operation, the lights **74** are on at all times, being shielded from the operator's eyes when in the elevated position by a sheet metal closure **993** (FIG. 1) and being shielded from the operator's eyes when in the lower position by the walls of the carton. In order to protect the eyes of the operator when a carton is not present at Station **11**, a no-carton no-light device **994** (FIGS. 74, 77 and 78) is provided in each line **L1** and **L2** and is connected in the circuit of the associated pair of lights **74** to turn the lights off.

Since the no-carton no-light devices **994** associated with lines **L1** and **L2** are substantially the same, only the device **994** associated with line **L1** will be described.

The device **994** (FIGS. 77 and 78) comprises a box-like housing **996** which is bolted to the frame **53** and which has a double pole limit switch **997** connected thereto. A U-shaped arm **998**, having a carton engaging finger **999** connected thereto, is pivoted on a shaft **1001** that is bolted to the housing **996**. An L-shaped bracket **1002** (FIG. 77) is rigidly connected to the housing and has a stop bolt **1003** locked therein, which bolt engages an extension **1004** of the arm **998** to limit the movement of the finger **999** toward the conveyor **52***a*. The finger **999** is urged toward the conveyor **52***a* by the actuating element **1006** of the switch **997** which is spring loaded and engages the U-shaped arm **998**. Since the cartons travel substantially end-to-end along conveyors **52***a* and **52***b*, the switch **997** will always be closed due to the cartons contacting lever **999**. If a carton is missing, the lever swings inwardly, opening the switch and turning off the lights.

In the operation of the sterilizing apparatus **73** (FIG. 74), the hydraulic power cylinder **959** is actuated to move the pairs of ultraviolet lights **74** downward into the associated carton C therebelow immediately after these cartons have been indexed in Station **11**. The high intensity ultraviolet lights completely sterilize the interior of the associated cartons and are then withdrawn from the cartons. The sterilized cartons are then moved away from Station **11** and new cartons are moved into Station **11** at which time the cycle of operation is repeated.

The ultraviolet lights **74** are operating constantly unless a carton is not present at Station **11** in one or both of the lines **L1** or **L2** in which case the no-carton no-light device **994** turns off the appropriate pair or pairs of lights. The conveyors **52***a* and **52***b* are also intermittently driven at a constant rate unless one of the ultraviolet lights **74** is broken or burned out in which case the associated photoelectric detector **987** opens the circuit to the drive motor DM (FIG. 2) thereby stopping the conveyors **52***a* and **52***b*. The conveyors are also stopped in the event the carrier **966** is not raised to a position wherein the switch **988** is opened indicating that the lights **74** are positioned above the path of movement of the cartons.

The electrical and hydraulic circuits which control the operation of the sterilizing apparatus **73** will be described in detail hereinafter.

Carton filling apparatus.—After the cartons in lines **L1** and **L2** have been sterilized at Station **11**, they are indexed by three intermittent movements of the conveyors **52***a* and **52***b* into Station **12.5** under the filling apparatus **76** (FIGS. 79 to 88). The filling apparatus includes a vertically movable filling head **1021** (FIGS. 79 and 80) servicing each line **L1** and **L2**, each head featuring a filling tube **1022** which is projected down into the carton being filled to within approximately one-half inch from the bottom of the carton before a foot valve **1023** is opened to release the milk from the tube. After the initial portion of milk enters the carton, the filling head is raised allowing the remaining portion of the milk to enter the carton while the lower end of the tube **1022** is below the surface of the milk. This "bottom filling" feature permits rapid filling of the carton without foaming.

Each filling head **1021** is secured to a cross head **1024** (FIGS. 79 and 81) which is connected to the piston rod **1026** (FIG. 81) of a hydraulic power unit **1027** by a yoke **1028**. The cylinder **1029** of the power unit **1027** is connected to a base plate **1031** which is bolted to the frame **53** of the machine. The cross head **1024** includes a slide block **1032** (FIG. 83) that is slidably received within a tubular pillar **1033** (FIG. 82) of rectangular cross section. The side walls **1034** and end walls **1036** of pillar **1033** are bolted together and to a head plate **1037** (FIG. 81) and to the base plate **1031** to provide a rigid guide for the cross head **1024**.

In order to assure accurate sliding movement and transverse positioning of the cross head **1024**, the slide block **1032** is provided with four angled corner slides **1038** (FIGS. 82 and 83) of a self-lubricating bearing material. Each angle slide **1038** is connected to the body **1039** of the slide block **1032** by cap screws **1041** which extend through horizontal slots **1042** in the angle slide **1038** and permit horizontal adjustment thereof. Accurate horizontal positing of cooperating pairs of the angle slides **1038** is achieved by wedges **1043** which contact angled edges **1044** of the slides **1038** and are connected to the body **1039** of the slide block **1032** by cap screws **1046** which extend through vertical slots **1047** in the wedges and are screwed into the body **1039**. The wedges are locked from vertical movement by set screws **1048** that abut the wedges and are screwed in tabs **1049** welded to the body **1039**. The set screws **1048** are locked in fixed position by jam nuts **1051**.

The cross head **1024** includes a tubular member **1052** that is welded to the body **1039** and projects outwardly from the pillar **1033** through slots **1053** in the side walls **1034** thereof. Mounting blocks **1054** (FIG. 79) are welded to each end of the member **1052** and each block **1054** has one of the filling heads **1021** bolted thereto.

The two filling heads **1021** and the structure for operating each head are identical, therefore, the description of the head associated with line **L1** will suffice for both.

The filling head **1021** (FIGS. 79 and 80) associated with line **L1** receives milk at a relatively low pressure from a conduit **1057** connected between a surge tank or the like (not shown) and a valve housing **1058**. The milk enters a central inlet passage **1059** (FIGS. 85 and 86), the outlet of which communicates alternately with one of two upwardly inclined passages **1061** and **1062** in response to periodic rotation of a directional control valve **1063** having a fluid deflecting web **1063***a* therein which is integral with two circular end walls **1063***b* that are mounted for rotation in the housing **1058**. When the web **1063***a* of the valve **1063** is positioned to establish communication between the inlet passage **1059** and either one of the inclined passages **1061** or **1062**, the valve also establishes communication between the other inclined passage and a discharge port **1064**. The discharge port **1064** (FIG. 86) communicates with the filling tube **1022** which is bolted to the lower end of the housing **1058** and which is normally closed by the foot valve **1023** so that all the passages will at all times be filled with milk and accordingly be free of air.

In order to accurately determine the volume of milk to be filled into the cartons, a measuring cylinder **1066** (FIGS. 85 and 86) is formed in the housing **1058** and has a free floating piston **1067** therein. The upper ends of the inclined passages **1061** and **1062** communicate with opposite ends of the measuring cylinder **1066**.

The piston **1067** includes a central dividing wall **1068** having cylindrical skirts **1069** projecting outwardly from each side thereof. A plurality of discharge holes **1071** are formed in each skirt **1069** so as to permit rapid transfer of milk between the cylinder **1066** and the inclined passages **1061** and **1062** when the piston is at either end of its stroke. One end of the cylinder **1066** is closed by an end cap **1072** which is sealed to the wall of the cylinder **1066** by an O-ring **1073**. A central stem **1074** of the end cap **1072** acts as an abutment to limit the amount of movement of the piston **1067** to the left (FIG. 85). An

angle tap **1076** formed on end cap **1072** projects over the cylinder wall and has a threaded aperture to receive a threaded stud **1077** having a resilient plug **1078** secured to one end and a wing nut **1079** secured to the other end. The resilient plug **1078** is normally seated in an air vent **1080** in the wall of the cylinder **1066** to close the vent. During initial filling of the cylinder with milk, this vent may be opened to bleed air from the left end (FIG. 85) of the cylinder.

The other end of the cylinder **1066** is closed by a centrally apertured end cap **1081** which is threaded to receive a stroke adjusting abutment screw **1082**. The screw **1082** is sealed to the end cap **1081** by an O-ring **1083**, and the end cap **1081** is sealed to the wall of the cylinder **1066** by an O-ring **1084**. A vent **1086** in the right end of the cylinder is closed by a resilient plug **1087** that is secured to a threaded stud **1088** screwed into a tab **1089** of the end cap **1081**. A wing nut **1091** secured to the stud **1088** provides means for easily opening and closing the vent **1086**. The stroke of the piston **1067** may be easily varied and, accordingly, the volumetric capacity of the measuring cylinder may be changed by screwing the stroke adjustment screw **1082** in or out and by locking the screw in adjusted position by a wing nut **1092**. The end caps **1072** and **1081** are locked in position by rods **1093** (FIGS. 79 and 80) having reduced portions which are fitted in slots **1094** in the cap **1072**, and threaded end portions which are fitted in slots **1096** in the end caps **1081**. Wing nuts **1097** screwed on the threaded end portion hold the end caps **1072** and **1081** firmly against the cylinder **1066**.

The directional control valve **1063** (FIG. 86) is held from lateral movement in the housing **1058** by one of the mounting blocks **1054** and by a plate **1101** which is bolted to the housing **1058**. One end of the conduit **1057** is welded to the upper end of the plate in register with a hole **1102** which communicates with the aforementioned inlet passage **1059**. The lower end of the plate **1101** is apertured and fitted around a large diameter portion of the stem **1103** of the valve **1063**. A spacer ring **1104** is fitted around an intermediate diameter portion of the stem **1103** and bears against a ratchet **1106** (FIGS. 84 and 86) which is keyed to a small diameter portion of the stem **1103**. A pawl-carrying valve actuating arm **1107** is welded to a sleeve **1108** which is journalled on the small diameter portion of the stem **1103**. Suitable bearing rings **1109** are provided to facilitate relative rotation between the valve **1063** and the plate **1101**, and to facilitate relative rotation of the arm **1107** between the ratchet **1106** and an end plate **1111** that is secured to the stem **1103** by a wing bolt **1112**. The arm **1107** is urged in a clockwise direction (FIG. 84) by a torsion spring **1113** which is connected between the arm **1107** and a cap screw **1114** secured to the plate **1101**. The extent of pivotal movement of the arm **1107** is limited by a pin **1116** secured to the plate **1101**.

A stub shaft **1117** is welded to the actuating arm **1107** and pivotally carries a pawl **1118** which is resiliently urged against the ratchet **1106** by a torsion spring **1119** connected between the arm **1107** and the pawl **1118**.

The foot valve **1023** (FIG. 86) includes a disc **1122** having an O-ring **1123** on its periphery which seals against the beveled lower end **1124** of the filling tube **1022**. The foot valve **1023** includes diametrically extending pins **1126** which hold the foot valve centrally in tube **1022** as the valve moves between the open and closed position.

The foot valve **1023** is pivotally connected to an actuating mechanism **1127** by a link **1128**. The actuating mechanism **1127** (FIGS. 87 and 88) is of the overcenter-lock type and includes a shaft **1129** journalled in a support housing **1131** which is bolted to and may be considered part of the filling tube **1022**. A lever **1132**, to which the link **1128** is connected, is rigidly secured to one end of the shaft **1129** (FIG. 88). An actuating arm **1133** is clamped at an intermediate point to the other end of the shaft and has a cam follower **1134** journalled on one end. The other end of the actuating arm **1133** is slotted to define a fork **1136** (FIG. 87) which receives a pin **1137** projecting outwardly from an overcenter locking arm **1138**. The arm **1138** is pivoted intermediate its ends on a shouldered bolt **1139** which is screwed into the housing **1131**. A spring **1141** is connected between the slotted end of a cap screw **1142** that is secured to the other end of the locking arm **1138**, and the slotted end of a cap screw **1144** secured to the actuating arm **1133** at a point between the shaft **1129** and the cam follower **1134**.

It will be apparent that the spring **1141** will lock the actuating lever **1133** and foot valve in the closed position as indicated in solid lines in FIGURES 86 and 87 when the line of action of the spring **1144** lies below the axis of the shaft **1129**. Conversely, the spring **1144** will lock the actuating lever **1133** and the foot valve in the open position as indicated in dotted lines in FIGURES 86 and 87 when the line of action of the spring **1144** lies above the axis of the shaft **1129**.

During normal operation of the carton filling apparatus **76** (FIGS. 79 and 80) the control valve **1063** is rotated 90° during each downward movement of the filling tube **1022** into a carton and completes such rotation slightly before the tube reaches the bottom of its stroke. The control valve **1063** is rotated upon engagement of the actuating arm **1107** with a cam follower **1148** (FIG. 79) that is journalled on the upper end of an arm **1149**. The arm **1149** is pivotally mounted on a shouldered bolt **1150** that is screwed into a bracket **1151** secured to the tubular pillar **1033**. A stop **1152** that is bolted to the bracket **1151** is secured to the pillar **1033** and engages the lower end of the arm **1149** to limit the amount of counterclockwise movement of the arm **1149**. A leaf spring **1154** is mounted on the bracket **1153** and normally urges the arm **1149** against the stop **1152**.

In the event a carton is not indexed into filling position at Station **12.5** a no-carton no-fill device **1156** (only the device associated with line L2 being shown in FIG. 79) will sense the absence of the carton and will send a signal to a solenoid **1157** to energize the same. Energization of the solenoid **1157**, which solenoid is connected to the arm **1149** and is mounted on the bracket **1151**, pivots the arm **1149** clockwise (FIG. 80) thereby moving the cam follower **1148** out of the path of movement of the actuating arm **1107**. Accordingly, when a carton is not present at the filling Station **12.5**, the associated valve **1063** will not be rotated upon vertical reciprocal movement of the filling head **1021**.

Since the structure for operating the foot valve **1023** associated with line L2 is better illustrated in FIG. 79 than the identical structure for operating the foot valve of line L1, the line L2 structure will be referred to in describing the operation of the foot valve **1023**. During normal operation, immediately before the filling tube **1022** reaches the bottom of its stroke, the cam follower **1134** engages a cam arm **1159** which moves the actuating mechanism **1127** to the position shown in dotted lines in FIGURE 87 thereby opening the foot valve **1023** (FIG. 79) allowing milk to enter and fill the carton as the tube is being raised. Immediately, before the tube reaches the top of its stroke, the cam follower **1134** contacts a cam **1161** that is integrally formed on one end of a bracket **1162** bolted to the pillar **1033**. Contact of the cam follower **1134** with the cam **1161** actuates the mechanism **1127** to close the foot valve **1023**.

The cam **1161** is spaced from the pillar and from a spacer block **1163** of the bracket to permit the actuating arm **1133** and cam follower **1134** to move freely past the cam during the next downward stroke of the filling head **1021**.

In the event a carton is not indexed at Station **12.5** under the associated filling head **1021**, the foot valve **1023** will not be opened as above described. As indicated in

FIGURE 79, the cam arm **1159** is pivotally mounted on a shouldered cap screw **1164** that is connected to the pillar **1033**. The cam arm **1159** is pivotally connected to a solenoid **1166** by a link **1167**. The solenoid is mounted on a bracket **1168** bolted to the pillar **1033**. The cam arm **1159** is normally held in the solid line position of FIGURE 79 against a stop **1169** projecting outwardly from the bracket **1168** by a spring **1171** which is connected between the cam arm **1159** and the bracket **1168**.

When a carton is not present at Station **12.5** in one of the lines **L1** or **L2**, the associated no-carton no-fill device **1156** sends a signal to the solenoid **1166** associated with that line to energize the solenoid and pivot the cam arm **1159** out of the path of movement of the cam follower **1134** as indicated in dotted lines in FIGURE 79.

The no-carton no-fill carton sensing devices **1156**, one being provided for each line **L1** and **L2**, are substantially the same as the previously described no-carton no-light devices **994** shown in FIGURES 77 and 78. The only difference between the devices **994** and **1156** being that the limit switches **1172** of the devices **1156** are single pole switches while the limit switches **997** of the devices **994** are double pole switches. Accordingly, the no-carton no-fill devices will not be described in detail.

Certain components in the hydraulic system to be described in detail hereinafter control the speed of the filling heads **1021** so that they move down quite rapidly and move through their upward strokes at a slower rate. The timing of the filling heads **1021** relative to the conveyors **52***a* and **52***b* is such that the filling tubes **1022** complete the upward stroke shortly after the cartons are filled and the foot valves **1023** are closed and, immediately thereafter, the conveyor moves other cartons into Station **12.5**. This timing allows maximum time for filling, and permits sufficient time to carry the drop of milk which gradually forms on the end of each foot valve **1023** into the next carton.

A manually operated hydraulic valve **1173** (FIG. 2) is also provided in the hydraulic system adjacent Station **12.5** to enable the operator to operate the filling heads **1021** when the machine is not running. This manual operation of the filling heads **1021** permits the operator to purge air from the heads when the heads are being initially filled with milk. An electrical safety switch **1174** associated with the manual valve **1173** prevents automatic operation of the machine unless the manual valve **1173** is returned to its normal position.

In the operation of the carton filling apparatus **76** (FIGS. 79 and 80), immediately after cartons on the conveyors **52***a* and **52***b* have been indexed into Station **12.5** under the filling heads **1021**, the filling heads **1021** are rapidly lowered. The valves **1063** in each head are rotated 90° upon contact with the cam follower **1148** to move the valve web **1063***a* (FIG. 85) to the dotted line position. Immediately thereafter the roller **1134** of the actuating mechanism **1127** (FIG. 79) contacts the cam arm **1159** and opens the foot valve **1023** to release milk into the carton which raises to a level above the bottom of the filling tube **1022**. The carton is completely filled with milk as the filling head **1021** moves upward and during this time the lower end of the filling tube **1022** is always positioned below the level of the milk in the carton being filled. With the web **1063***a* of the valve **1063** being in the dotted line position shown in FIGURE 85 during this filling cycle, a portion of the accurately measured quantity of milk in the cylinder **1066** on the left side of the dividing wall **1068** of the piston **1067** flows through the passage **1061**, past the valve **1063**, through the port **1064**, and through the filling tube into the carton. During this time, a fresh supply of milk enters the right end of the cylinder **1066** though the conduit **1057** (FIG. 86), the inlet passage **1059**, the valve **1063** (FIG. 85), and through the passage **1062** into the cylinder, thereby moving the piston **1067** against the stem of the end cap **1072** assuring that the right end of the cylinder contains an accurately measured quantity of milk. Upon rotation of the valve **1063** through 90° during the next cycle of operation of the carton filling apparatus **76**, a portion of this milk is discharged into the empty carton positioned at Station **12.5**.

If an empty conveyor pocket is indexed at the filling Station **12.5**, the associated no-carton no-fill device **1156** will assure that no milk is discharged from the filling head **1021** associated with that conveyor.

Top sizing and top heating apparatus.—After the cartons have been filled with milk at Station **12.5**, the conveyors **52***a* and **52***b* advance the cartons first to Station **14** which is the top sizing station and thereafter to Station **14.5** which is the top heating station. The top sizing apparatus **77** (FIGS. 89–93) reshapes the top closure **101** of the cartons in each line **L1** and **L2** immediately before the top closure is heated by the associated top heating head **79** (FIGS. 94 to 96) of the top heating apparatus **78** at Station **14.5**. Since the top sizing apparatus **77** and the top heating apparatus **78** are provided with a common support structure **1186** (FIGS. 89, 90 and 91) and are cooperatively related, they will be described together.

The support structure **1186** comprises a pair of pedestals **1187** and **1188** having a bridge plate **1189** extending between and bolted to the upper ends of the pedestals. The lower ends of the pedestals **1187** and **1188** are bolted to the vertical side plates **231** and **232**, respectively, of the frame **53**. A hydraulic power cylinder **1191** has its cylinder **1192** bolted to the bridge plate **1189** and its piston rod **1193** projecting downward through a hole in the bridge plate **1189**. The piston rod **1193** is connected by nuts **1194** to a horizontal mounting plate **1196** of a carrier **1197**, which carrier includes a pair of upstanding arms **1198** and **1199** to which racks **1201** and **1202**, respectively, are secured. The arms **1198** and **1199** are secured to the ends of the plate **1196**, project through openings in the bridge plate **1189**, and have elongated keys **1203** and **1204** bolted thereto. The carrier **1197** is guided for vertical movement by vertically slotted slide blocks **1206** and **1207** which are bolted to the bridge plate **1189** and are slidably engaged by the keys **1203** and **1204**, respectively.

In order to maintain the mounting plate **1196** of the carrier **1197** horizontal, a stabilizing shaft **1208** having pinions **1209** and **1211** keyed thereon is journalled in bearings **1212** and **1213** bolted to the bridge plate **1189**. The pinions **1209** and **1211** mesh with the racks **1201** and **1202**, respectively, and assure that the ends of the plate **1196** move equal distances during vertical movement of the carrier **1197**.

The top sizing apparatus **77** includes two identical sizing heads **1216**, one head being associated with line **L1** and the other head with line **L2**. Since the heads **1216** are identical, only head **1216** of line **L1** will be described.

The head **1216** (FIGS. 91, 92 and 93) comprises a base plate **1217** (FIG. 92) which is secured to the mounting plate **1196** of the carrier **1197** by wing nuts **1218** which are screwed on studs **1219** that are secured to the plate **1196** and project through holes in the base plate **1217**. A pair of yokes **1221** and **1222** are welded to the base plate **1217** and have a pair of sizing fingers **1223** and **1224** pivotally connected thereto by pivot pins **1226**. The upper end of the fingers **1223** and **1224** are forked and support cam followers **1227** (FIG. 93) which are journalled on pins **1228** secured to the forked ends. Leaf springs **1229** are bolted to the yokes and engage the forked ends of the sizing fingers **1223** and **1224** to urge the cam followers **1227** against a cam **1231**.

The cam **1231** is formed on the lower end of a vertical shaft **1232** which is screwed into an adaptor **1233** bolted to the bridge plate **1189**. The shaft **1232** projects downwardly through a slot in the bridge plate **1189** and is locked in the desired position by a lock nut **1234**.

Shortly after a filled carton is indexed at Station **14**, the carrier **1197** is lowered, thereby placing the top siz-

ing apparatus 77 in operation. At the start of the downward movement the members of each head are as shown in FIG. 89. As the sizing head 1216 moves downwardly relative to the fixed bridge 1189, the cam followers 1227 ride along an upper conical portion 1236 and a small diameter portion 1237 of the cam 1231, permitting the springs 1229 to widely separate the lower ends of the sizing fingers 1223 and 1224 so that they can engage the outer surfaces of the tabs 116 and 117 of the carton. Upon further downward movement of the sizing head 1216, the cam followers 1227 are moved outwardly by a lower conical portion 1238 of the cam and are held in the outermost position by a full diameter portion 1239 of the cam. Outward movement of the cam followers 1227 move the lower ends of the fingers inwardly to firmly press the tabs 116 and 117 against the flaps 109 and 111 respectively, and to bend the other flaps of the top closure 111 accordingly. This sizing of the top closure assures that the flaps and tabs of the top closure will fit properly within the associated heating head 79 of the top heating apparatus 78 when the carton is subsequently moved to Station 14.5. It also assures that the tabs 116 and 117 will remain directed outwardly and will not return to an inwardly directed position after they have been heated at Station 14.5 since heat tends to return the flaps and tabs to the positions they assumed before they were preformed at Station 10 and sized at Station 14.

After the top flaps and tabs have been sized at Station 14, the cartons in lines L1 and L2 are each indexed at Station 14.5 under the identical top heating heads 79 (FIGS. 94 and 95). Since the heads are identical the description and operation of the top heating head associated with line L1 will disclose the construction of both.

The top heating head 79 comprises an air distributing unit 1242 and an air heating unit 1243. The units 1242 and 1243 are connected to opposite sides of the mounting plate 1196 of the carrier 1197 by wing nuts 1244 (FIG. 95). The wing nuts 1244 are screwed onto studs 1246 that are secured to a centrally apertured base plate 1247 of the air distribution unit 1242 and extend through holes in the mounting plate 1196 and through holes in a flange 1248 of the air heating unit 1243.

The air distributing unit 1242 directs air against only those internal and external surfaces of the flaps and tabs of the top closure which are subsequently pressed together to provide the top seal. The air distributing unit 1242 comprises a generally L-shaped housing 1249 which defines a plenum chamber 1251 and a downwardly projecting end chamber 1252 provided with a perforated inner wall 1253 for heating the external surface of the narrow lip 122 of the foremost flap 113 (FIG. 96). Two downwardly projecting side housings 1254 (FIG. 94) are welded to the L-shaped housing 1249 and communicate with the plenum chamber 1251. Each housing 1254 comprises a perforated, generally V-shaped inner wall 1256 for heating the outer surfaces of the ears 119 and 121 of the flaps 109 and 111. Inwardly inclined perforated walls 1257 connect the lower end of the outer wall 1258 of each housing 1254 with the apex of the associated inner wall 1256. Air is directed through the perforations in the inclined walls 1257 against the outer surfaces of the tabs 116 and 117.

The appropriate inner surfaces of the top closure 101 are heated by hot air directed out of a central housing 1259 which is welded to the L-shaped housing 1249 and communicates with the plenum chamber 1251. End walls 1261 of the housing 1259 are perforated so as to direct hot air against the internal surface of the lips 122 and 123 and against those internal surfaces of the flaps 112 and 113 which are subsequently sealed against other surfaces of the top closure. Perforated side walls 1262 conform generally to the shape of the preformed and sized flaps 109 and 111 and direct hot air at the inner surfaces of the ears 119 and 121, and against the inner surfaces of those parts of the flaps 109 and 111 which subsequently contact other surfaces of the top closure 101. The end walls 1261 and side walls 1262 are connected together at their corners by perforated U-shaped walls 1263 which direct hot air into the associated corners of the top closure 101.

A U-shaped channel 1266 extends transversely through the central housing 1259 and is welded to and communicates with the housings 1249 and 1254. The end portions of the lower wall 1267 of the channel 1266 which projects outwardly of the central housing 1259 is perforated to direct hot air against the outer surfaces of the tabs 116 and 117. The U-shaped channel 1266 and spaced openings 1268 in an air distributing baffle 1269 welded in the plenum chamber 1251 to the walls of the housing 1249, cooperate to more evenly distribute air to the different chambers in the air distributing unit 1242.

Although the sizing operation performed at Station 14 shapes the top closure 101 so that the air distributing unit 1242 will enter the carton, inner flap guides 1271 and outer flap guides 1272 are provided to assure proper entry of the unit 1242. The inner flap guides 1271 are V-shaped and are welded to the bottom end plate 1273 of the central housing 1259 and deflect outwardly any surfaces of the top closure 101 which tends to contact the central housing 1259. The outer edges of the bottom end plate 1273 are beveled to aid in deflecting portions of the top closure therefrom. The outer guide flaps 1272 are welded to the lower ends of the side housings 1254 and serve to guide any outwardly misaligned portion of the bottom closure inwardly. Angle fingers 1274 are welded to the side housings and project over the inwardly inclined walls 1257 to contact the tabs 116 and 117 and hold the tabs and other surfaces of the top closure away from the walls of the air distributing unit 1242 to insure adequate spreading and coverage of hot air.

The air entering the distributing unit 1242 is heated and sterilized by the air heating unit 1243 (FIG. 95). The air enters the unit at a rate of 20–40 cubic feet per minute at a pressure of approximately two inches of water and is heated to a temperature between 650° F. and 750° F. Preferably the air is heated to approximately 675° F., which temperature is effective to adequately heat those surfaces of the top closure 101 which are subsequently sealed together to the optimum temperature for sealing.

The air is directed to the unit 1243 through a conduit 1277 connected to a tubular body 1278 of the unit 1243. The body 1278 is rigidly connected to the flange 1248 by a set screw 1279. An electrical heating coil 1281 is fitted on an insulator 1282 that is bolted to a disc 1283. The disc 1283 is clamped in the counterbore of a hole 1284 in the mounting plate 1196 by the lower end of the tubular body and has arcuate slots 1286 therein through which the heated air passes as it enters the plenum chamber 1251. The upper end of the insulator 1282 projects through a centrally apertured disc 1287 which is secured to the other end of the tubular body 1278 and provides an end seal for the body. A water proof electrical conduit box 1288 is rigidly secured to the tubular body 1278 to protect leads projecting from the heating coil 1281. A tubular insulator 1289 is disposed between the coil 1281 and the inner wall of the tubular body.

In the operation of the top heating apparatus 78, the hydraulic power cylinder 1191 (FIG. 92) is activated to lower the air distributing unit 1242 of the heads 79 downwardly about the different flaps, tabs and lips, of the top closure 101 at which time hot air is directed against all surfaces of the top closure which are to be subsequently pressed against other surfaces to form the top seal. After the above surfaces have been heated to the desired temperature, the hydraulic power cylinder 1191 moves the heads 79 above the path of movement of the cartons in lines L1 and L2. The conveyors 52*a* and 52*b* then advance the filled cartons with heated top closures 101 to Station 15 under the top sealing apparatus 82.

Top sealing apparatus.—Immediately after the top closures of the cartons in lines L1 and L2 have been heated at Station 14.5, they are moved to Station 15 between side guides 1300 where the top sealing apparatus 82 (FIGS. 97 to 106) first folds the several flaps and tabs of each of the top closures together and then applies pressure to these folded parts to seal them in liquid tight relation.

The portion of the top sealing apparatus 82 associated with each line L1 and L2 are identical, therefore, the parts in each line will be assigned the same numerals, and the description of the parts operating on one carton in one of the lines will suffice for both.

The top sealing apparatus 82 (FIGS. 97, 98, and 99) comprises vertically extending pedestals 1301, 1302 and 1303 which are disposed in a line transversely of the conveyors and are bolted to one of the U-shaped members 297 of the frame 53 of the machine. The conveyor 52*b* indexes a carton to be sealed between the pedestals 1301 and 1302, and the conveyor 52*a* indexes a carton to be sealed between the pedestals 1302 and 1303. A transversely extending bridge plate 1304 is bolted to the upper end of each pedestal and supports two flap-folding hydraulic power units 1305 (FIGS. 98 and 99), a centrally disposed lip folding hydraulic power unit 1306, and two hydraulic sealing units 1307, one unit 1305 and one unit 1307 being disposed above each line L1 and L2.

Each pedestal is of composite construction comprising a forward end plate 1308 (FIG. 99) and a rear end plate 1309 each of which is bolted to a pair of spaced, vertically extending guide members 1311 and 1312 (FIG. 97). The guide members 1311 and 1312 are suitably bushed to slidably receive a vertically extending push rod 1313. It will be noted that the center pedestal 1302 receives two push rods.

Side flap-supporting shoes or anvils 1314 are guided by a pair of spaced, upwardly inclined bearing blocks 1316 and 1317 that are bolted to the guide members 1311 and 1312, respectively. Each pair of bearing blocks 1316 and 1317 cooperates to accurately guide the associated anvils 1314 from the retracted position shown in FIGURE 97 to the extended or active flap-supporting and squaring position shown in FIG. 100.

Each side flap-supporting anvil 1314 (FIGS. 100 and 101) is bifurcated and is connected to the bifurcated upper end of the associated push rod 1313 by a link 1318 secured to pins 1319 and 1321 journalled in the bifurcated ends of the anvils 1314 and push rod 1313, respectively. It is noted that the lower bearing block 1316 and the guide member 1311 are vertically slotted to permit movement of the link 1318 therein.

In order to assure proper sealing and squaring of the closure 101 (FIG. 100), a pair of squaring pins 1322 are secured to and project out of the upper surface of each anvil 1314. When the anvils are moved into the active flap-supporting position shown in (FIG. 100), the pins 1322 engage the side edges of certain of the folded top closure flaps to accurately square the carton. The upper surface of each anvil 1314 is also slightly relieved at 1315 (FIG. 106) to receive the associated tab 116 or 117 (FIG. 96) which tabs do not extend to the side edge of the carton as clearly shown in FIGURE 100. Additionally, the right hand anvils 1314 associated with lines L1 and L2 are also relieved at 1315*a* to compensate for the extra thickness of the lip 95 (FIG. 96).

The anvils 1314 associated with both lines L1 and L2 are actuated by a hydraulic power unit 1323 (FIG. 99) which has its cylinder 1324 pivotally connected to a bracket 1326 bolted to the frame 53 of the machine. The piston rod 1327 is pivotally connected to an arm 1328 which is rigidly secured to a shaft 1329 journalled in bearings 1331 bolted to the frame 53 of the machine. Each push rod 1313 is pivotally connected to one end of a link 1332. The other end of each link is pivotally connected to an arm 1333 which is rigidly secured to the shaft 1329. Thus, retraction of the piston rod 1327 into the cylinder 1324 of the power unit 1323 moves the anvils 1314 to their active position shown in FIGURE 100, while extension of the piston moves the anvils to the retracted position shown in FIGURE 97. The side anvils are moved into the active position and soon as the conveyors 52*a* and 52*b* have moved the cartons to Station 15, and are moved to the retracted position immediately before the conveyors 52*a* and 52*b* are again placed into motion. A detailed description of the hydraulic circuit and means for controlling the actuation of the hydraulic power unit 1323 in timed relation with other parts of the top sealing apparatus 82 will be subsequently be described.

The above described side anvils 1314 provide the lower support above which the tabs 116, 117 (FIG. 96), the ears 119, 121 and the lips 122, 123 are first progressively folded as shown in FIGS. 9A to 9D, and are thereafter squeezed to provide a liquid proof seal. With the aid of the anvils 1314, the above tabs, ears and lips, of a carton in one of the lines L1 or L2 are moved into sealing position by a front support shoe 1336 (FIGS. 97, 103 and 104), a folding shoe 1337, and a sealing bar 1338. As the carton is positioned at Station 15, the front support shoe 1336 is in an elevated position, and the folding shoe 1337 is in lowered position and contacts the narrow lip 122 to fold the same as illustrated in FIGURE 103. Thereafter, the sealing bar 1338 moves downwardly against the rear flap 112 and wide lip 123 and substantially simultaneously therewith the front support shoe 1336 moves into contact with the flap 113 during which time the folding shoe 1337 moves out of engagement with the carton. The anvils 1314, the front support shoes 1336 and the sealing bar 1338 then accurately square and hold certain edges of the top closure in abutting contact. The sealing bar 1338 is then forced downwardly to squeeze the folded portions of the top closure between the anvils and the sealing bar 1338 to provide the necessary liquid proof seal.

Each front support shoe 1336 (FIGS. 97, 100, 103 and 104) comprises a solid plate 1339 which extends substantially the full width of the carton and includes arms 1341 journalled on a shaft 1342 having a rectangular central portion. The shafts 1342 are concentric and are journalled in the pillars 1301, 1302, and 1303. A centrally disposed tongue 1343 (FIGS. 97 and 103) is pivotally connected to one end of a yoke 1344 by a pin 1345. The other end of the yoke 1344 is pivotally connected to a second yoke 1346 (FIG. 103) that is screwed on the piston rod 1348 of the associated hydraulic power unit 1305. Major adjustments of the front support shoe 1336 are accomplished by screwing the second yoke 1346 greater or lesser distances onto the piston rod 1348. Minor adjustments are made by screwing three carton engaging self-locking set screws 1349 into or out of the plate 1339.

As mentioned previously, the timing of each front support shoe 1336 is such that the associated hydraulic power unit 1305 lowers the shoe into active carton engaging position immediately after the conveyors 52*a* and 52*b* indexes the carton into Station 15. The power units 1305 raise the shoes 1336 out of the path of movement of the cartons, as shown in dotted lines in FIGURE 104, immediately before the cartons are to be moved out of Station 15.

Each folding shoe 1337 (FIGS. 97 and 103) is of generally U-shaped construction comprising a carton engaging blade 1350 secured to two arms 1351 having hubs 1352 journalled on the associated shaft 1342. Each hub 1352 (FIG. 105) includes a pair of outwardly projecting fingers 1353 and 1354 that are threaded to receive abutment screws 1356 and 1357, respectively, said screws being locked in adjusted position by lock nuts 1358. The free end of each screw 1356 and 1357 is positioned to engage a tab 1359 projecting outwardly from a head 1360 that is connected to the body 1361 of the sealing bar 1338. The screws on each hub 1352 cooperate with

the tabs 1359 to provide a delayed action drive for the folding shoe 1337.

It will be seen that, when the sealing bar 1338 is in the inactive position shown in FIGURE 103, the screw 1357 engages the tab 1359 to lock the folding shoe 1337 in the active flap folding position. After the sealing bar swings approximately 45° from the position shown in FIGURE 103 toward the position shown in FIGURE 104, the tab 1359 engages screw 1356 and, upon completion of counterclockwise movement of the sealing bar 1338, moves the folding shoe 1337 to the retracted position shown in FIGURE 104.

The sealing bars 1338 (FIG. 106) associated with lines L1 and L2 each include one of the aforementioned bodies 1361 which is provided with a slot 1362 which slidably receives the rectangular central portion of the associated shaft 1342. The slot 1362 permits vertical movement of the sealing bar 1338 relative to the shaft 1342 when the sealing bar is in the position shown in FIGURE 104. A cam follower 1363 (FIG. 104) is journalled on the shaft 1342 and is received in a vertical slot 1364 in the body 1361. As shown in FIGURE 100, the sealing bar 1338 is resiliently urged towards its uppermost position relative to the shaft 1342 by two springs 1366 each of which is disposed between the shaft and a plug 1367 screwed into the head 1360. A plate 1369 (FIG. 103) is rigidly connected to the body and to the head 1360 by cap screws 1371. An angled flap squaring shoe 1372 is bolted to the lower end of the body 1361 and conforms to the shape of the folded carton.

In order to rotate the shafts 1342, and accordingly the sealing bars 1338, between the positions shown in FIGURES 103 and 104, arms 1373 (FIGS. 97 and 102) are keyed to the shafts 1342 and are pivotally connected to one end of a link 1374 (FIG. 102) by a pin 1376. The other end of the link 1374 is pivotally connected to a yoke 1377 by a pin 1378. The yoke 1377 is screwed on the end of the piston rod 1379 of the hydraulic power unit 1306.

After the top closure 101 has been folded and squared as indicated in FIGURES 100 and 104, the sealing bar 1338 is forced downwardly with a force of approximately 850 p.s.i. thereby squeezing the heated tabs, ears, and lips between the anvils 1314 and the sealing bar 1338 to seal the top closure 101. The sealing pressure is applied to the sealing bar 1338 by the associated hydraulic power unit 1307 which urges its piston rod 1381 downwardly causing an enlarged head 1382 screwed thereon to engage and force the sealing bar 1338 downwardly with sufficient force to provide the seal. The sealing force is applied to the head for approximately two seconds.

Since the heated top closure tends to transmit the heat to the sealing bar 1338, the sealing bar must be cooled and accordingly cold water is directed through a passage 1383 (FIG. 100) in the body. The cooling water is received from any suitable external source and is directed into the passage 1383 through a suitable conduit system 1384 which includes a flexible tube 1385. The water is discharged from the passage 1383 through a conduit 1387 (only a portion thereof being shown in FIGURE 97).

It has been discovered that the score lines and the several abutting portions of the top closure are more apt to permit leakage than other portions of the top closure 101. Accordingly, a raised pattern of bosses 1388 (FIG. 106) is formed on the carton engaging surface of the flap squaring shoe 1372 and are positioned to localize the force at certain points along the top closure to crush the carton and block the natural flow lines thereby preventing leakage from the carton.

In the operation of the top sealing apparatus 82 upon one of the cartons, the anvils 1314 are in the inactive position shown in FIGURE 97, and the front support shoe 1336, and folding shoe 1337 and the sealing bar 1338 are in the positions shown in FIGURE 103 as the conveyor moves a carton into Station 15. The folding shoe 1337 squares the foremost flap 113 and fold the tab 117, the ears 121 and the lip 122 downwardly as shown in FIGURE 103 as the carton is indexed into Station 15. The anvils 1314 are then moved inwardly relative to the carton to the active position shown in FIGURE 100 and the sealing bar 1338 and front support shoes 1336 are pivoted to the position shown in FIGURE 104 causing the folding shoe 1337 to move to its inactive position. While in this position, the flap-squaring shoe cooperates with the front support shoe 1336 and with the anvils 1314 to properly square the top closure 101 and butt the mating edges of the ears 119 firmly against the edge of the lip 122. The hydraulic power unit 1307 then forces the flap squaring shoe 1372 of the sealing bar 1338 into firm engagement with the carton to squeeze the previously heated tabs, ears, and lips together to provide, with the aid of the pattern of bosses 1388 on the shoe 1372, a liquid tight seal.

Top stamping apparatus.—After the filled and sealed cartons have been moved out of Station 15, they are moved into Station 16 which is an open station having no processing apparatus. While at Station 16, the cartons may be inspected, and selected cartons may be removed from the conveyors 52*a* and 52*b* for test purposes.

The conveyors 52*a* and 52*b* move the cartons from Station 16 to Station 17 and while the cartons are indexed at Station 17, the top stamping apparatus 83 (FIGS. 107 and 108) engraves or brands a code on the sealed top closure of the carton. The code may be for any desired purpose such as indicating the date of filling the cartons.

The top stamping apparatus 83 comprises a pair of pedestals 1406 and 1407 that are bolted to the side plates 231 and 232 of the frame 53, respectively. A bridge plate 1408 is bolted to the upper ends of the pedestals 1406 and 1407 and has the cylinder 1409 of a hydraulic power unit 1411 bolted thereto. The piston rod 1412 of the power unit 1411 has a yoke 1413 screwed on its lower end. A pin 1414 (FIG. 108) extends across the yoke 1413 and is received in a slot 1415 in an arm 1416 that is keyed to a shaft 1417. The shaft 1417 is journalled in bearings 1418 bolted to the bridge plate 1408.

Stamping head actuating arms 1419 are keyed to the shaft 1417 and each arm has a transverse pin 1421 therein. Each arm 1419 is positioned over one of the lines L1 or L2 and its pin 1421 engages a slot in a vertical rod 1422 of square cross-section which is guided for vertical movement in a bracket 1423 bolted to the bridge plate 1408. An electrically heated stamping head 1424 of any standard commercial design is secured to the lower end of each rod 1422. When the head 1424 is lowered onto the carton positioned therebelow in Station 17, it burns a translatable code into the top closure of the carton.

In the operation of the top stamping apparatus 83, after cartons in lines L1 and L2 have been indexed at Station 17 the power cylinder 1409 is actuated to force the stamping heads 1424 down upon the cartons positioned therebelow to burn the code in the upper surface of each carton. The power cylinder 1409 then withdraws the heads 1424 from the cartons and the cartons are indexed to Station 18 under the discharge apparatus 84.

Discharge apparatus.—The discharge apparatus 84 (FIGS. 109–111) is provided to transfer the filled, sealed and stamped cartons from the conveyors 52*a* and 52*b* onto the associated continuously driven discharge conveyors 86 which subsequently discharge the cartons from the machine 50.

The discharge apparatus 84 comprises a pair of pedestals 1431 and 1432 which are bolted to the side plates 231 and 232 of the frame 53, respectively. A channel

bridge 1433 is bolted to the upper end of the pedestals 1431 and 1432 and carries a horizontally disposed hydraulic power unit 1434. The cylinder 1436 of the power unit 1434 is pivotally connected to a bracket 1437 bolted to the bridge 1433. The piston rod 1438 of the unit 1434 is pivotally connected to an upstanding ear 1439 of a vertical carrier plate 1441. The ear projects through a slot 1442 (FIG. 110) in the bridge 1433 which is guided for horizontal movement by pairs of cooperating channel tracks 1444 and 1445 (FIG. 111). The channel tracks 1444 and 1445 are bolted to the bridge 1433 and receive rollers 1446 that are journalled on a bolt 1447 connected to the carrier plate 1441.

A pair of plates 1448 and 1449 (FIG. 109) having longitudinally extending pusher feet 1451 and 1452, respectively, welded thereto are provided to push cartons transversely off the converyors 52*a* and 52*b*, respectively, onto the associated discharge conveyors 86. A limit switch 1453 is mounted on the bridge 1433 and has an actuating element 1454 which engages a cam 1456 (FIG. 110) to open the switch 1453 when the pusher feet 1451 and 1452 are in the retracted position out of the path of movement of the cartons on the conveyors 52*b* and 52*a*, respectively. This permits the conveyors 52*a* and 52*b* to index another pair of cartons into Station 18. A carton guide plate 1457 (FIG. 111) is bolted to the down stream side of the bridge 1433 and projects downward to contact and guide the cartons as they are moved onto the discharge conveyors 86.

In the operation of the discharge apparatus 84, the power cylinder 1436 is activated immediately after the conveyors have indexed a pair of cartons at Station 18 to cause the pusher feet 1451 and 1452 to transfer cartons from conveyors 52*b* and 52*a*, respectively, to the associated discharge conveyor. The cylinder 1436 then returns the pusher feet 1451 and 1452 to the solid line position shown in FIG. 109 out of the path of movement of the cartons on the conveyors 52*a* and 52*b* thereby causing the cam 1456 to open the switch 1453 permitting the conveyors 52*a* and 52*b* to be indexed. In the event the pusher feet 1451 and 1452 are not retracted to positions out of the path of movement of the conveyors, the switch remains closed and prevents indexing of the conveyors. The protective circuit for the conveyors 52*a* and 52*b* will subsequently be described in detail.

Air supply.—As previously mentioned, hot air is supplied continuously to the heating apparatus 64 (FIG. 112) for heating the bottom closure members of the carton and to the top closure heating apparatus 78. This air is circulated by a blower 1466 which directs the air into each head 746 of the bottom heating apparatus 64 and into each head 79 of the top heating apparatus 78 at the rate of 20–40 cubic feet per minute and at a pressure of approximately two inches of water.

The blower 1466 is mounted on the frame 53 of the machine and is coupled to and driven by a motor BM. Air is drawn into the blower through a filter 1467 and is discharged into a conduit T 1468. One end of the T 1468 is connected by a flexible conduit 1469 to a T 1471 that is connected to the previously mentioned conduits 792 (FIGS. 55 and 112) of the bottom heating apparatus 64. It will be appreciated that the T 1471 and a portion of the flexible conduit 1469 are free to move with the bottom heating heads 746 during operation of the heads.

The other end of the T 1468 (FIG. 112) is connected by a flexible conduit 1472 to a T 1473 that is connected to the two top heating heads 79 by the previously mentioned conduits 1277.

In order to protect the heaters in the heads 746 and 79 from burning out due to an interruption of air directed thereto by the blower 1466, a pressure switch 1474 is connected to the T 1468 by a conduit 1476. If the blower inadvertently stops and the air pressure in the T 1468 is accordingly, reduced to atmospheric pressure, the pressure switch 1474 will sense the reduction in pressure and will activate certain controls in the electrical circuit, soon to be described, to deactivate the heaters.

As previously mentioned, the high pressure air that is directed into the mandrels at Station 8 to blow the cartons off the mandrels 58 is supplied from any suitable external source. The air is supplied at a pressure of approximately 80 p.s.i. and passes through suitable separators, filters and regulators of standard design (not shown).

Vacuum for the suction cup assembly 588 (FIG. 38) of the carton erecting apparatus 57 is supplied by a vacuum pump VP (FIGS. 2 and 3) that is driven by a direct drive vacuum pump motor VPM. The vacuum pump VP is of standard design and is connected to the valve 613 (FIG. 38) by a well known distribution system which includes the conduit 636.

Hydraulic system.—The several hydraulic power units which operate the mechanical components of the carton forming and filling machine 50 are incorporated in a hydraulic system 1480 (FIGS. 113A and 113B). The actuation of each of the several hydraulic power cylinders is timed relative to the intermittent movement of the conveyors 52*a* and 52*b* (FIGS. 2 and 3) by one of the plurality of timing cams TC1 to TC15 (FIGS. 133A and 133B) which operate four way hydraulic valves V1 to V15, respectively. The rate of movement of the piston rod of each power cylinder is controlled during extension and retraction by at least two speed control valves CV, one valve being placed in each conduit connected to the associated power cylinder to permit free entry of hydraulic fluid into the cylinder to restrict to a predetermined rate the discharge of fluid therefrom.

As diagrammatically illustrated in FIGURES 113A and 113B, the hydraulic system 1480 comprises a hydraulic pump 1482 which is continuously driven by a motor HM. The pump 1482 receives fluid from a sump 1484 and discharges high pressure fluid through a manifold 1486. The low pressure fluid is returned to the sump 1484 from the several power cylinders through a manifold 1487. Both the high pressure manifold 1486 and the low pressure manifold 1487 extend the full length of the machine as shown in FIGURES 113A and 113B so that each valve V1 to V15 can easily be connected thereto by high pressure conduits 1488 and return conduits 1489, respectively. A plurality of oil heaters OH are provided in the sump 1484 and are controlled so as to maintain the temperature of the hydraulic fluid between 105° F. to 140° F.

As diagrammatically illustrated in FIGURE 114, each valve V1 to V15 includes a housing 1491 having a shiftable core 1492 therein. A spring 1493 disposed between the core and housing normally urges a cam follower 1494 journalled on one end of the core against the associated timing cam TC1 to TC15. The associated high pressure conduit 1488 and return conduits 1489, are connected to ports 1496 and 1497, respectively, in the housing 1491. The port 1496 communicates either with a straight line passage 1498 extending centrally through the core 1492, or with a slanted or cross passage 1501 which extends along the periphery of the cylindrical core. Similarly, the port 1497 communicates either with a straight passage 1499 or with a slanted passage 1502 that is formed in the periphery of core 1492 on the opposite side of the core for peripheral passage 1501. With this arrangement, the hydraulic fluid can be selectively directed through discharge ports 1503 or 1504 in the housing 1491. It will be understood that each passage 1498, 1499, 1501 and 1502 are independent passages and do not communicate with each other.

The several speed control valves CV (FIGS. 113A and 113B) are identical in construction and accordingly the description of one will suffice for all. Each speed control valve CV (FIG. 115) comprises a housing 1507 having a straight line passage 1508 therethrough. An

enlarged portion 1509 of the passage 1508 has a ball check valve 1511 therein which rests against a seat 1512 to prevent flow of fluid downwardly (FIG. 115) through the passage 1508 but permits unrestricted flow upwardly (FIG. 115) through the passage 1508. A U-shaped control passage 1513 in the housing 1507 bypasses the ball valve 1511 and communicates with opposite ends of the straight line passage 1508. An adjustable needle valve 1514 cooperates with a frusto-conical seat 1516 in the control passage to restrict the downward (FIG. 115) flow of fluid therethrough to thereby control the rate of travel of the piston of the associated hydraulic power cylinder. It will be understood that the needle valve 1514 of each speed control valve CV will be adjusted so as to achieve the desired rate of travel of the piston of the associated power cylinder. It will also be understood that the speed control valves CV are all positioned so that the upper port 1517, rather than the lower port, is connected to the associated power cylinder.

The control of the hydraulic power cylinders at each station will now be described having reference to FIGURES 113A, 113B and 116.

In regard to the chart shown in FIGURE 116, it will be understood that the darkened areas indicate the time required for the piston rods of the associated pistons to move from the extended to the retracted positions or from the retracted to the extended positions and that pressure will be applied to the same side of the pistons in a dwell period after movement is completed until the associated cam TC shifts the associated valve V to its other position. The lines marked S.V. correspond to the sloping portions of the associated cams which shift the valves V1 to V15 between the cross-passage position and the straight passage position. The time required for the valves to shift from one position to the other will not be included in the description to follow but, as shown in FIGURE 116, each shifting of the valve requires approximately 0.1 second. In the description to follow, it will be understood that the term "cross-passage position" indicates the position at which the passages 1501 and 1502 register with the conduits 1488 and 1489, and the term "straight passage position" indicates the position at which the passages 1498 and 1499 register with the conduits 1488 and 1489.

As indicated at the top of FIGURE 116, the conveyor and turret indexing operation takes place in the first 0.6 second of the three second operating cycle, and the remaining time is utilized for performing the different operations on the cartons.

At Station 2, the piston rod 575 (FIG. 113A) of the hydraulic power cylinder 574 which operates the carton erecting apparatus is returning from the retracted to the extended position at the start of the indexing operation as indicated by the darkened area extending from 0 to 0.1+ on the chart shown in FIGURE 116. It will be recalled that a complete cycle of operation of the carton erecting apparatus consists of the retraction of the piston rod to move the suction cups from a neutral position to a carton pick up position and then the extension of the piston rod to move the suction cups from pick up position to an overbend position and return to neutral. After the piston has returned to the extended position, the timing cam TC5 (FIG. 113A) maintains the valve V5 in the cross-passage position for approximately 0.86 second so that high pressure fluid is directed from the manifold 1486 through the conduit 1488, through the valve V5, through a conduit 1518, speed control valve CV therein and into the hydraulic cylinder 574 on one side of the piston. Since pressurized fluid has already been discharged from the other side of the piston, the piston rod is held in extended position. At about 0.98 second in the cycle, the cam TC5 then shifts the valve V5 to the straight-passage position at which time the fluid flows through line 1521 into parallel conduits 1519 and 1520, each having a speed control valve CV therein, into the cylinder 574, causing the piston rod to be retracted. The rate of flow of the fluid leaving the unit 574 is controlled by the speed control valve CV in the conduit 1518 to complete the return of the piston in approximately 0.74 second. A short dwell of approximately 0.1 second before cam TC5 shifts valve V5 then permits the suction cup assembly 588 to grip the foremost carton in the magazine 54 (FIG. 38), and during this interval the normally open valve 679 is held closed by the cam 676.

The cam TC5 then returns the valve to the cross-passage position directing high pressure fluid into the cylinder 574 through the conduit 1518. The fluid in the cylinder on the other side of the piston is then discharged through the single speed control valve CV in conduits 1519 and 1521 to retard the speed of the piston rod 575 for approximately 0.6 second, after which time the cam 676 opens the valve 679 to permit fluid to flow through the speed control valve CV in conduit 1520 in parallel with the fluid in conduit 1519 to thereby increase the rate of travel of the piston rod 575. The piston rod 575 travels at this increased rate until the three second cycle of operation is completed. It is to be noted that at the end of this cycle, the piston rod has not been fully extended and, accordingly, the suction cups have not quite reached neutral position.

At Station 3, the piston rod 688 of the turret loading power cylinder 687 is moved, during the three second cycle, from an extended position to a retracted position to push the erected carton down on the mandrel and then is returned to its extended position. The piston rod is maintained in its extended position at the start of a cycle for approximately 0.7 second by the timing cam TC4 which holds the valve V4 in the cross-passage position. During this time, high pressure fluid communicates between one side of the piston in cylinder 687 and the high pressure manifold 1486, through the conduit 1488, through the valve V4, through a conduit 1523, and through a speed control valve CV to the conduit 1523. The fluid on the other side of the piston had previously been discharged through a conduit 1524 having a speed control valve CV therein, through the valve V4 and through the conduit 1489 to the return manifold 1487. After the indexing operation of the turret has been completed, the cam TC4 repositions the valve V4 to the straight passage position at which time fluid enters the opposite end of the hydraulic cylinder 687 causing the piston 688 to move to its retracted position. The speed control valve CV in conduit 1523 controls the rate of movement of the piston 688 so that the cylinder is completely retracted within approximately 0.273 second.

Shortly thereafter, the cam TC4 shifts the valve V4 to the cross-passage position at which time the piston rod 688 is returned to the extended position. The speed control valve CV in the conduit 1524 is adjusted to control the rate of flow of hydraulic fluid so that the piston rod is moved to the extended position in approximately 0.492 second. The valve V4 is maintained in the cross passage position thereby holding the piston 688 in extended position until the three second cycle is completed.

At Station 4, the piston rod 711 is moved out of the cylinder 709 at a predetermined interval during the cycle to cause the dies 63 to preform the bottom closure flaps and is then retracted into the cylinder. The piston rod 711 of the bottom forming power unit 709 at Station 4 is held in the retracted position by valve V1 which is held in the cross-passage position by the cam TC1 for approximately 1.5 seconds after the start of a cycle. High pressure fluid is directed into the cylinder 709 on one side of the piston through a conduit 1526 having a speed control valve CV therein, and is discharged from the cylinder 709 on the other side of the piston through a conduit 1527 having a speed control valve CV therein. The cam TC1 then shifts the valve V1 to the straight-

passage position thereby reversing the flow of hydraulic fluid and causing the piston rod, under control of the speed control valve CV in conduit **1526**, to move to its extended position in approximately 0.163 second and to remain in this position for an additional 0.5 second. The cam TC1 then shifts the valve to its original cross-passage position, and the speed control valve in the conduit **1527** causes the piston rod **711** to return to its retracted position in approximately 0.122 second and remain in this position until the three second cycle is repeated.

As previously mentioned, at Station **5** the piston rod **752** is moved out of cylinder **747** to move the bottom heating heads **746** into position enclosing the bottom closure flaps for heating them and is then retracted into the cylinder. The cylinder **747** of the bottom heating apparatus at Station **5** is connected to the valve V2 by conduits **1528** and **1529** having speed control valves CV therein. At the beginning of the cycle of operation the cam TC2 holds the valve V2 in the cross-passage position thereby holding the piston rod **752** in the retracted position until the indexing operation is completed which requires 0.6 second. The cam TC2 then shifts the valve V2 to the straight passage position and the speed control valve CV in the conduit **1529** throttles the fluid so that the piston rod **752** is moved to its extended position in approximately 0.246 second. The piston rod is held in this position for an additional 0.167 second after which time the cam TC2 shifts the valve V2 to the cross-passage position. The flow of hydraulic fluid to power cylinder **747** is then reversed and is controlled by the speed control valve CV in the conduit **1528** to return the piston rod **752** to the retracted position in approximately 0.184 second. The piston rod **752** is maintained in this position until the three second cycle is completed.

At Station **6**, the piston rods **816** are moved upwardly out of cylinders **811** to raise the bottom forming dies **822** into sealing engagement with the flaps of the bottom closures, and are then lowered. Each cylinder **811** is connected to the valve V3 by conduits **1531** and **1532** having speed control valves CV therein. The piston rod **816** of the bottom sealing cylinder **811** is held in the retracted position until the indexing operation has been completed by the cam TC3 which holds the valve V3 in the cross-passage position for the first 0.6 second of each cycle during which time the indexing is completed. As an additional safety feature, the normally closed mechanical-hydraulic interlock valve **841** (FIG. 60) is inserted in the conduit **1531** and is opened only after the turret **51** (FIG. 10) has completed its indexing movement by the associated cam finger **189**. The cam TC3 then shifts the valve V3 to the parallel-passage position and the speed control valve CV in the conduit **1531** controls the rate of fluid flow so that the piston rod reaches its extended position in 0.654 second after which time the piston is held in this position for an additional 0.954 second. The cam TC3 then shifts the valve V3 to the straight passage position to reverse the flow of hydraulic fluid and return the piston **816** to the retracted position under the control of the speed control valve CV in conduit **1532** in 0.592 second. The piston rod **816** is maintained in this position until the cycle is completed.

At Station **10**, the piston rod **873** is moved from a retracted position in cylinder **872** to an extended position to move the top forming heads into contact with the top closure flaps to preform them and is then retracted into this cylinder. The top forming power unit **871** at Station **10** is connected to the valve V6 by conduits **1533** and **1534** having speed control valve CV therein. The piston rod **873** of the top forming power unit **871** is held in the retracted position for approximately 1.2 seconds after the start of a cycle by the cam TC6 which holds the valve V6 in the cross-passage position. The cam TC6 then shifts the valve V6 to the straight-passage position and the speed control valve CV in the conduit **1533** controls the flow rate so that the piston rod **873** is moved to its extended position in 0.218 second. The piston rod is maintained in this position for approximately 0.5 second and thereafter the cam TC6 returns the valve V6 to the cross-passage position. The speed control valve CV in the conduit **1534** then restricts the rate of flow of hydraulic fluid so that it requires 0.164 second to return the piston rod **873** to its retracted position. The piston rod is maintained in this position until the cycle is completed.

At Station **11** the piston rod **962** is moved downwardly out of cylinder **959** to move the sterilizing lights down into the cartons and is then retracted upwardly. The cylinder **959** at Station **11** is connected to the valve V7 by conduits **1536** and **1537** having speed control valves CV therein. The piston rod **962** in cylinder **959** is held in the retracted position for approximately 0.6 second after the start of a cycle by the cam TC7 which holds the valve V7 in the cross-passage position. The cam TC7 then shifts the valve V7 to the straight line position and the speed control valve CV in the conduit **1536** controls the flow rate so that the piston rod **962** is moved to its extended position in approximately 1.25 seconds. The piston rod is maintained in this position for approximately 0.25 second and thereafter the cam TC7 returns the valve V7 to the cross-passage position. The speed control valve CV in the conduit **1537** then restricts the rate of movement of the piston rod so that the piston rod reaches its retracted position in 0.5 second. The piston rod **962** is maintained in this position until the cycle is completed.

As previously mentioned, at Station **12.5** the piston rod **1026** is moved from its extended position downwardly into cylinder **1027** to move filling tubes **1022** into the cartons and is then projected upwardly out of the cylinder. The cylinder **1027** which operates the carton filling apparatus at Station **12.5** is connected to the valve V8 by conduits **1538** and **1539** having speed control valves CV therein. The manually operated four-way valve **1173** is also positioned in the conduits **1538** and **1539** between the valve V8 and the speed control valves CV. The manual valve **1173** is normally in the straight-passage position as indicated in FIGURE 113B. The position rod **1026** of the cylinder **1027** is held in the extended position for approximately 0.6 second after the start of a cycle by the cam TC8 which holds the valve V8 in the cross-passage position. The cam TC8 then shifts the valve V8 to the straight-passage position and the speed control valve CV in the conduit **1538** controls the flow rate so that the piston rod **1026** is moved to its retracted position in approximately 0.43 second. The cam TC8 then returns the valve V8 to its cross-passage position and the rate of movement of the piston **1026** is controlled by the speed control valve CV in the conduit **1539** so as to require approximately 1.77 seconds for the piston to reach its fully extended position. The valve V8 remains in this position to the end of the cycle.

As mentioned previously, provision is made to operate the carton filling apparatus manually so as to bleed all air from the filling apparatus prior to placing the apparatus into automatic operation. Accordingly, the manual valve **1173** is provided and is the same as the valves V1 to V15 except that the manual valve **1173** is operated by a lever **1541** rather than by a cam. When the machine is not operating, the valve V8 is in the cross-passage position shown in FIGURE 113B. Accordingly, to manually operate the cylinder **1027**, the core of the manual valve is merely shifted between its parallel-passage position and cross-passage position by the lever **1541**. A limit switch **1174** is positioned to be opened by an extension **1543** of the valve core when the core of the valve **1173** is in the cross-passage position. As will be described later, the opening of the switch **1174** prevents automatic operation of the machine. Therefore, the core of the manual valve **1173** must be returned to the straight line position before the machine can be operated automatically.

At Stations **14** and **14.5** the piston rod **1193** is moved from a retracted position in cylinder **1191** to an extended position to move both the top sizer **77** and the top flap

heater 78 into operative engagement with the carton, and is then retracted. The cylinder 1191 is connected to the valve V9 by conduits 1544 and 1546 having speed control valves CV therein. The piston rod 1193 is held in the retracted position for approximately 0.7 second after the start of a cycle by the cam TC9 which holds the valve V9 in the cross-passage position. The cam TC9 then shifts the valve V9 to the straight-passage position and the speed control valve CV in the conduit 1544 controls the flow rate so that the piston rod 1193 is moved to its extended position in approximately 0.123 second. The piston rod 1193 is maintained in this position for approximately 1.68 seconds and thereafter the cam TC9 returns the valve V9 to the cross-passage position. The speed control valve in the conduit 1546 then restricts the rate of movement of the piston rod 1193 so that the piston rod reaches its retracted position in 0.068 second. The piston rod is maintained in this position until the cycle is completed.

It will be recalled that at Station 15, there are five power cylinders; two cylinders 1307 for applying pressure during the top sealing operation, a cylinder 1306 for rotating the sealing bar 1338, and two cylinders 1305 for controlling the movement of folding shoe 1336. The two hydraulic power cylinders 1307 (only one being shown in FIG. 113B) of the top sealing apparatus which applies the sealing pressure for the top closure at Station 15 are each connected to the valve V10 by conduits 1547 and 1548 having speed control valves CV therein. The piston rod 1381 of each cylinder 1307 is held in the retarded position for approximately 0.7 second after the start of the cycle by the cam TC10 which holds the valve V10 in the cross-passage position. The cam TC10 then shifts the valve V10 to the straight passage position and the speed control valve in the conduits 1547 controls the flow rate so that the piston rod 1381 of each cylinder is moved to its extended position in approximately 0.366 second. The piston rod 1381 of each cylinder is maintained in this position for approximately 1.342 seconds and thereafter the cam TC10 returns the valve V10 to the cross-passage position. The speed control valve in the conduits 1548 then restricts the rate of movement of each of the piston rods 1381 so that each piston rod reaches its retracted position in 0.325 second. The piston rods remain in this position until the cycle is completed.

The single hydraulic cylinder 1306 at Station 15, which operates the sealing bar of the top sealing apparatus, is connected to the valve V11 by conduits 1549 and 1551 having speed control valves CV therein. The piston rod 1379 of cylinder 1306 is held in the extended position for approximately 0.65 second after the start of the cycle by the cam TC11 which holds the valve V11 in the cross-passage position during this interval. The cam TC11 then shifts the valve V11 to the straight-passage position and the speed control valve CV in the conduit 1549 controls the rate of flow of hydraulic fluid so that the piston rod 1379 is moved to its retracted position in approximately 0.051 second. The piston rod 1379 is maintained in this position for approximately 1.9 seconds after which time the cam TC11 returns the valve V11 to the cross-passage position. The speed control valve CV in the conduit 1551 then restricts the rate of flow of fluid so that the piston rod 1379 reaches its fully extended position in 0.091 second. The piston rod 1379 remains in this position until the cycle is completed.

The power units 1305 (only one being shown in FIG. 113B) which operates the front support shoes 1336 of the sealing apparatus at Station 15 are each connected to the valve V12 by conduits 1552 and 1553 having speed control valves CV therein. The piston rod 1348 in each cylinder 1305 is held in the retracted position for approximately 0.8 second after the start of the cycle by the cam TC12 which holds the valve V12 in the cross-passage position. The cam TC12 then shifts the valve V12 to the straight passage position and the speed control valve CV in the conduits 1552 controls the flow rate so that the piston rod 1348 is moved to its extended position in approximately 0.61 second. The piston rod 1348 is maintained in this position for approximately 1.734 seconds and thereafter the cam TC12 returns the valve V12 to the cross-passage position. The speed control valve CV in the conduits 1553 then restricts the rate of movement of each of the piston rods 1348 so that each piston rod reaches its retracted position in 0.034 second. The piston rods then remain in this position until the cycle is completed.

The hydraulic power cylinders 239 (only one being shown in FIG. 113B) which operate the auxiliary conveyor drives are each connected to the valve V13 by conduits 1554 and 1556 having speed control valves CV therein. At the beginning of the cycle, the timing cam TC13 holds the valve V13 in the cross-passage position wherein fluid is directed into the cylinder in a direction which retracts the piston rod, thereby aiding in the driving of the conveyor. This amount of force applied to the piston rods 242 is controlled by the valve CV in conduit 1556 and this force is applied to the piston rods 242 for approximately 1.15 seconds. Each piston rod 242 is held in its retracted position for an additional 0.45 second. The cam TC13 then shifts the valve V13 to the straight-passage position and the speed control valve CV in the conduit 1554 controls the flow rate so that each piston rod 242 is moved to its extended position in approximately 0.436 second. The piston rod 242 of each cylinder is maintained in this position for approximately 0.47 second and thereafter the cam TC13 returns the valve V13 to the cross-passage position. The valve V13 is held in this position until the end of the cycle thereby applying a force to each piston rod 242 in a direction which tends to drive the conveyor.

At Station 15 the piston rod 1327 is moved from an extended position to a retracted position to move the anvils 1314 to a flap-supporting position and, after the flaps have been sealed, the piston rod 1327 is again moved to extended position to retract the anvils. The cylinder 1323 is connected to the valve V14 by conduits 1557 and 1558 having speed control valves CV therein. The piston rod 1327 is held in the extended position for approximately 0.6 second after the start of the cycle by the cam TC14 which holds the valve V14 in the cross-passage position during this interval. The cam TC14 then shifts the valve V14 to the straight passage position and the speed control valve CV in the conduit 1557 controls the rate of flow of hydraulic fluid so that the piston rod 1327 is moved to the retracted position in approximately 0.041 second. The piston rod 1327 is maintained in this position for approximately 1.9 seconds after which time the cam TC14 returns the valve V14 to the cross-passage position. The speed control valve CV in the conduit 1558 permits the piston rod 1327 to return to its extended position in 0.055 second. The piston rod remains in this position until the three second cycle is completed.

At Station 17 the piston rod 1412 is moved from downwardly out of cylinder 1411 to move the stamping heads 1424 into engagement with the top closure of the cartons, and is then retracted upwardly into the cylinder. At Station 18, piston rod 1438 is moved from a retracted position to an extended position to actuate the carton discharge apparatus and is then returned to retracted position. The power cylinder 1411 at Station 17 and the cylinder 1434 at Station 18 are both controlled by the valve V15 which is shifted by the cam TC15. The valve V15 is connected to the power cylinder 1411 by conduits 1561 and 1562 having speed control valves CV therein, and the cylinder 1434 is connected to the conduits 1561 and 1562 by conduits 1563 and 1564, respectively, having speed control valves CV therein. The piston rod 1412 of the cylinder 1411 and the piston rod 1438 of cylinder 1434 are both held in the

retracted position for approximately 1.0 second after the start of the cycle by the cam TC15 which holds the valve V15 in the cross-passage position during this period. The cam TC15 then shifts the valve V15 to the straight-passage position. The speed control valve CV in the conduit 1561 permits the piston rod 1412 of the hydraulic cylinder 1411 to move to the extended position in approximately 0.015 second and to remain in this position for approximately 1.285 seconds. The speed control valve in the conduit 1564 restricts the movement of the piston rod 1438 of the cylinder 1434 so that 1.3 seconds are required to move the piston rod to the extended position. The cam TC15 then shifts the valve V15 to the straight passage position. The speed control valve in conduit 1562 permits the piston rod 1412 to move to the retracted position in 0.008 second, and the piston rod 1412 is thereafter held in the retracted position until the three second cycle is completed. The speed control valve CV in conduit 1563 is adjusted to cause the piston rod 1438 to return to the retracted position in 0.3 second and the piston rod 1438 remains in the retracted position until the cycle is completed.

As shown in FIGURE 113A, a two way air valve 1566 is provided to control the release of high pressure air at Station 8 to blow the cartons off of the mandrels 58 (FIG. 2) and onto the associated conveyors 52*a* and 52*b* (FIG. 3) The previously mentioned conduit 182 (FIG. 14) which communicates with the interior of the mandrels 58 positioned at Station 8, is connected to the housing 1567 (FIG. 113A) of the air valve 1566. A shiftable core 1568 of the valve 1566 has a passage 1569 therein which is movable between a closed position and an open position wherein the conduit 182 communicates with a conduit 1571 that is connected to a high pressure air supply. The valve core 1568 is normally maintained in the closed position and is opened momentarily by engagement with a lobe 1572 on a cam 1573 after a pair of mandrels 58 have been indexed at Station 8.

Cycle timer.—As mentioned previously, the cycle timer 286 (FIGS. 117 and 118) is provided to control the actuation of certain electrical components of the machine. The cam shaft 1581 of the cycle timer 286 is continuously driven and rotates one revolution for each revolution of the cam shaft and for each three second cycle of operation of the machine.

The cam shaft 1581 of the cycle timer 286 (FIG. 118) is coupled to the shaft 284 by a right angle gear box 1582 which is supported by an angle member of the frame 53. A housing 1583 is bolted to gear box 1582 and extends upwardly therefrom to provide a support for a bearing 1584 within which the upper end of the cam shaft 1581 is journalled. A circular dial 1586 is secured to the shaft 1581 and has a 0°–360° angular scale imprinted on its periphery so that an operator can easily determine how many degrees the shaft has rotated from a 0° setting. The 0° setting indicates the beginning of a new three second cycle which starts within the indexing of the turret and conveyors as indicated in the hydraulic chart shown in FIGURE 116. A pointer 1587 is secured to a vertical strap 1588 in the housing 1583 and is disposed opposite the 0° mark on the dial 1586 when a new cycle is to begin.

Four cam switches CS–1, CS–2, CS–3 and CS–4 are mounted on the strap 1588 and are operated by cams 1589, 1591, 1592 and 1593, respectively, that are keyed to the shaft 1581. An extra switch and cam are also provided but are not operatively connected to the electrical circuit. The cam switch CS–1 (FIG. 119) is a normally-open, held-closed switch and is opened for 35° between the 340° and 15° position of the cam 1589 as indicated in FIGURE 119. A raised portion 1594 of the cam 1589 holds the switch CS–1 closed for the remaining portion of the cycle. The cam switch CS–2 (FIG. 120) is a normally-closed, held-open switch and is closed for approximately 36° between the 300° and 336° position of the cam 1591 as shown in FIGURE 120. A raised portion 1596 of the cam 1591 holds the switch CS–2 open for the remaining portion of the travel of the cam 1591. The cam switch CS–3 (FIG. 121) is a normally-closed, held-open switch and is closed for approximately 30° between the 30° and 60° positions of the cam 1592 as shown in FIGURE 121. A raised portion 1597 of the cam 1592 holds the switch CS–3 open for the remaining portion of travel of the cam 1592. The cam switch CS–4 (FIG. 122) is a normally closed, held-open switch and is closed for approximately 24° between the 0° and 336° positions of the cam 1593 as shown in FIGURE 122. A raised portion 1598 of the cam 1593 holds the switch CS–4 open for the remaining portion of travel of the cam 1593.

The functions performed by each of the switches CS–1, CS–2, CS–3 and CS–4 will be made apparent hereinafter when describing the electrical circuit 1600 and operation of the machine.

The operation of the several components of the carton forming and filling machine have been included with the description of these components. Accordingly, the operation to follow will be directed mainly to the protective devices in the machine and to the specific functions performed by an operator when operating the machine. Since the operation is closely related to the electrical circuit, the operation and circuit 1600 will be described together.

In order to more easily locate the different parts of the electrical circuit, reference numerals are placed near the left margin of FIGURES 123–126 and indicate horizontal reference lines which will be referred to in the description to follow. It should be noted that FIGURE 124 repeats reference line 8 of FIGURE 123 and shows the circuits energized through the transformer in line 8; FIGURE 125 repeats line 9 of FIGURE 123; and FIGURE 126 repeats line 10 of FIGURE 123.

The electrical circuit 1600 (FIGS. 123, 124, 125, and 126) is connected to a 240 volt source of power by a main magnetic switch 1601 (FIG. 123) which directs power through main lines ML1, ML2, and ML3. The blower motor BM and vacuum pump VPM are connected to the main lines ML1, ML2 and ML3; by leads 1602, 1063, and 1604 having normally open contacts 2M–1 of a relay 2M (line 15) therein. The drive motor DM is connected to the main line ML1, ML2 and ML3 by leads 1609, 1611 and 1612 having normally open contacts 3M–1 of relay 3M (line 20) therein. Relay 3M also includes a normally open contact 3M–2 (line 39). The oil heaters OH are connected to the main lines ML1, ML2 and ML3 by leads 1613, 1614 and 1616 having normally open contacts 3C–1 of relay 3C (line 16) therein.

Burn-out detectors 1617 and 1618 (lines 5 and 7) are provided for the top heaters 1243 of the top heating apparatus 78 (FIG. 89) in carton filling lines L1 and L2, respectively. Burn-out detectors 1619 and 1621 (FIG. 123) which are identical to the detectors 1617 and 1618 are provided for the bottom heaters 791 (FIG. 55).

The burn-out detector 1617 (FIG. 123, line 5) includes a transformer 1622, the primary coil 1623 of which is connected to main lines ML1 and ML2 in series with the heater 1243 and with a normally open contact 1C–1 of relay 1C (line 14). When the contact 1C–1 is closed and the heater 1243 is operating, current is transmitted to the secondary 1624 of the transformer 1622 thereby energizing a relay 5D which closes a contract 5D–1 (line 25). If the heater 1243 in filling line L1 is burned out, no current will be transmitted to the transformer and accordingly, the relay 5D will not be energized.

The burn-out detectors 1618 (FIG. 123, line 7), 1619, and 1621 are identical to the detector 1617 except that their transformers energize relays 7D, 6D and 8D, respectively, which close contacts 7D–1, 6D–1 and 8D–1 (line 25) when the associated heaters are all operating properly. When the relay contacts 5D–1, 6D–1, 7D–1 and 8D–1 are all closed, a burn-out detector relay 7CR is energized thereby closing contacts 7CR–1 (line 17).

Instrument lights 10L, 11L, 12L and 13L (line 25) are connected in series with the contacts 5D–1, 6D–1, 7D–1 and 8D–1, respectively, and are lighted when the associate contact is closed. Relay contacts 1C–2, 1C–3 and 1C–4 of relay 1C (line 14) are connected in series with the primary coils of the transformers in the burn-out detectors 1618, 1619 and 1621, respectively.

The solenoids 1157 and 1166 (line 5) in carton filling line L1 (FIG. 79) are connected in parallel to main lines ML2 and ML3 and have a normally open contact 5CR–1 of circuit relay 5CR (line 23) connected in series therewith. Similarly, the solenoids 1157 and 1166 (line 6) in carton filling line L2 are connected in parallel to main lines ML2 and ML3 and have a normally open contact 6CR–1 of circuit relay 6CR (line 24) connected in series therewith. The no-carton no-fill switches 1172 associated with lines L1 and L2 are normally closed switches which are held open when cartons are present. Accordingly when no cartons are present at the filling station in line L1, for example, the associated no-carton no-fill switch 1172 (line 23) closes to energize the relay 5CR which closes the relay contact 5CR–1 (line 5) thereby energizing the solenoids 1157 and 1166 in line L1 preventing the discharge of milk from the filler valve in line L1.

Step down transformers 1T (line 8, FIGS. 123 and 124), 2T (line 9, FIGS. 123 and 125) and 3T (line 10, FIGS. 123 and 126) are provided to reduce the voltage of the portions of the electrical circuit 1600 shown in FIGURES 124, 125 and 126, respectively, from 240 to 120 volts. The secondary coil of the transformer 1T directs current to main lines ML4 and ML5 (FIG. 124); the secondary coil of the transformer 2T directs current into main lines ML6 and ML7 (FIG. 125); and, the secondary coil of the transformer 3T directs current into main lines ML8 and ML9 (FIG. 126).

Before the carton forming and filling machine 50 is placed in operation, the operator prepares the machine as follows:

The manually actuated valve 1173 (FIG. 113B) at the filling Station 12.5 is checked to see that it is in the automatic position thereby assuring that the limit switch 1174 (FIG. 124, line 17) is closed and that the filling valves are in their elevated positions. As will be made apparent later, if the switch 1174 is open indicating that the filling valves are in their lower positions the drive motor DM can not be started.

A manually operated air heater switch 1PB (line 14) is placed in the "off" position to assure that the relay 1C connected in series therewith will not be energized and the relay contacts 1C–1, 1C–2, 1C–3 and 1C–4 (lines 5, 7, 8 and 10) will remain open. This assures that the top air heaters 1243 and bottom air heaters 791 will not be turned on prematurely.

A run-jog switch 21PB (line 20) is placed in the "run" position thereby closing switch contacts 21PB–1 (line 20) 21PB–2 (line 21) and 21PB–3 (line 39) which partially prepares a circuit having transformers 1–UVT and 2–UVT (lines 39 and 42) therein which operate the ultraviolet lights 74 in carton filling lines L1 and L2 (FIG. 74), respectively.

Manual vacuum control switches 24PB (lines 29, FIG. 126) and 26PB (line 31) are turned to the "on" position and are connected in series with the solenoid valve 612 in lines L1 and L2, respectively. By turning the switches 24PB and 26PB "on," vacuum will be transmitted to the suction cups 590 (FIG. 27B) in both lines L1 and L2 of the carton erecting mechanism 546.

The operator also puts a supply of carton blanks in each line L1 and L2 of the magazine 54 (FIG. 27B) thereby assuring that the magazine limit switches 542 and 543 (lines 11 and 12) are held open. The switches 542 and 543 are connected in parallel with each other and are in series with a buzzer 1626. If the supply of cartons in either line L1 or L2 of the magazine is low, the associated switch will be closed and the buzzer 1626 will sound.

With the carton forming and filling machine prepared as above described, the main switch 1601 is turned on thereby directing current through the main lines ML1, ML2 and ML3 to the transformers 1T, 2T and 3T (lines 8, 9 and 10) which directs 120 volt current through main line ML4, ML5 (FIG. 124), ML6, ML7 (FIG. 125) and ML8, ML9 (FIG. 126).

Turning the main switch 1601 on energizes relay contact 1M (line 13) through a circuit which includes normally closed overload contacts OL–1 and OL–2 thereby closing the contacts 1M–1 (line 1) thus starting the blower motor BM and vacuum pump motor VPM. Energization of the relay 1M also closes a normally open contact 1M–2 (line 13) thus completing the circuit to an instrument light 1–L which, when on, indicates that the motors BM and VPM are operating.

Closing the main switch 1601 also establishes a circuit which activates heaters 1–H and 2–H (line 22) of the stamping heads 1422 (FIG. 107) of the stamping apparatus 87 in lines L1 and L2, respectively. Rheostat type heat controllers 1–HC and 2–HC are connected in series with the heaters 1–H and 2–H of lines L1 and L2 and permit the operator to control the temperature of the heaters 1–H and 2–H to control the depth of the depression burned into the top of the cartons by the stamping heads.

The carton vibrator 489 (FIG. 29) of the magazine 54 is energized upon closing of the main switch 1601. The vibrator 489 (line 27) is connected to main lines ML6 and ML7 of FIG. 125. The ultrasonic sensing units 666 (FIG. 27B), which determine whether the carton erecting and loading apparatus 57 has properly squared the cartons, is also energized upon closing of the main switch 1601. The sensing units 666 in lines L1 and L2 includes relays 1–D and 2–D (line 32) which closes contacts 1–D–1 and 2–D–1 (line 35) when the cartons do not assume the properly squared condition.

When the main switch is closed, the ultraviolet light transformers 1–UVT (line 39) and 2–UVT (line 42) are deenergized since, at this time, the relay contact 3M–2 (line 39) is open and a time delay switch TDR–1 (line 40) of a time delay relay TDR (line 43) is open. The no-carton no-light switch 997 (lines 39 and 42) are shown in the positions assumed when cartons are present on the conveyor. It will be understood that during the start-up period these switches will engage terminals 1627 and 1628.

At this time, with no cartons on the conveyors, the no-carton no-fill switches 1172 (lines 23 and 24) will be closed against contacts 1629 and 1631 thereby energizing relays 5CR and 6CR. Energization of the relays 5CR and 6CR will close contacts 5CR–1 (line 5) and 6CR–1 (line 6) thereby preventing discharge of liquid from the filling apparatus 76 at Station 12.5. Closing of the main switch 1601 also establishes a circuit to a fluorescent light FL which illuminates the turret section of the carton forming and filling machine.

With the electrical control circuit 1600 partially prepared as above described, the next operation in the start-up procedure is to warm-up certain components of the machine.

In order to warm-up the ultraviolet light, the operator presses and releases a normally open ultraviolet light pushbutton switch 15PB (line 43) which completes a circuit to the time delay relay TDR. Energization of the time delay relay TDR closes switch TDR–1 (line 40) thereby closing the circuits to the ultraviolet light transformers 1–UVT and 2–UVT which circuits include the two no-carton no-light switches 997 that engage terminals 1627 and 1628, respectively. The time delay relay TDR holds the switch TDR–1 closed for five minutes which is sufficient time to warm up the ultraviolet lights 74 to a fully effective condition. At the end of the five minute warm up period the contact TDR–1 opens and the ultraviolet lights 74 are turned off. A press-to-test switch 22PB (line 41) is connected in parallel with the con-

tact RDR–1 and may be manually closed to test the lights 74 at any time when the conveyor is empty.

When the ultraviolet lights 74 in lines L1 and L2 are on, ultraviolet light burn-out detectors 10D (line 41) and 11D (line 42) which include photoelectric cells 987 (FIG. 74) are activated. The photoelectric cells 987 scan the light from the associated ultraviolet lights 74 (lines 40 and 42) and, if the lights should break or burn out, relays of the associated detectors 10D and 11D are energized. It is to be understood, however, that normal opening of the circuits to both the lights 74 and their detectors 10D or 11D, as by opening of the associated no-carton no-light switches 997 will not energize the relays in the detectors. Energization of the relay in detectors 10D and 11D opens the normally closed relay contacts 10D–1 and 11D–1 (line 26) which deenergizes relay 8CR and turns the instrument lights 15L and 16L off. Deenergization of the relay 8CR opens contacts 8CR–1 (line 18).

At the time the pushbutton switch 15PB (line 43) is actuated, the start switch 4PB (line 15) is also closed. Closing of the switch 4PB completes a circuit between main lines ML4 and ML5 which includes a normally closed pushbutton switch 3PB, the closed switch 4PB, the relay 2M and closed overload contact OL. The relay 2M is thus energized thereby closing relay contacts 2M–1 (line 2) and 2M–2 (line 15). Closing of relay contact 2M–1 completes the circuit to the hydraulic pump motor HM, while closing the contact 2M–2 completes a holding circuit 1634 across the switch 4PB, which switch is released, and which circuit 1634 includes an instrument light 4L. When the light 4L is lighted, it indicates that the hydraulic motor HM is operating.

A temperature controller 1636 (line 16) is connected to the sump 1484 (FIG. 113A) of the hydraulic system 1480 and includes a minimum temperature switch 1TS (line 16) that is mechanically interlocked with a maximum temperature switch 2TS (line 17). The switches 1TS and 2TS cooperate to maintain the temperature of the hydraulic fluid between 105° F. and 140° F. The switch 1TS is closed when the oil temperature is below 105° F. to complete a circuit to the relay 3C. Energization of relay 3C closes relay contacts 3C–1 (line 4) thereby operating the oil heaters OH which heat the hydraulic fluid to a temperature above 105° F., at which time the switch 1TS opens to de-energize relay 3C thereby opening the circuit to the oil heaters OH. The switch 2TS is normally closed and opens only if the temperature of the hydraulic fluid should exceed 140° F. Energization of the relay 3C also opens a normally closed contact 3C–2 (line 17) which prevents operation of the drive motor DM, as will be described hereinafter, until the oil temperature is heated to above 105° F. at which time the contact 3C–2 closes.

Instrument lights 5L, 6L, 7L, 8L and 9L (line 18) are connected in parallel between a series circuit 1637 (line 17) that is connected between main lines ML4 and ML5, and a lead 1638 connected to the main line ML5. The use of lights 5L to 9L will be described in more detail later. It will be sufficient at this point to explain that the light 5L will be lighted when a normally closed relay contact 2CR–1 is closed, and that the light 7L will be closed when the contact 2CR–1, 4CR–1 and 3C–2 are both closed which indicates that the temperature of the oil is above 105° F.

The operator then turns the air heaters switch 1PB (line 14) to the "on" position which closes contact 1PB–1 and opens contact 1PB–2 (line 18). The contact 1PB–1 is connected in series with the previously mentioned pressure switch 1474 (FIG. 112) which is closed by air pressure when the blower is operating and opens in the event the blower should stop. The pressure switch 1474 (line 14) and closed switch 1PB are connected in series with and accordingly energizes the relay 1C, which relay 1C has an instrument light 2L connected in parallel therewith. The instrument light 2L is lighted when the relay 1C is energized. Energization of the relay 1C closes contacts 1C–1, 1C–2, 1C–3 and 1C–4 (lines 5, 7, 8 and 10) which causes energization of the top heaters 1243 (lines 5 and 7) and bottom heaters 791 (lines 8 and 10).

Before describing the automatic operation of the machine, certain mechanically actuated limit switches will be described which preclude damage to the machine. When the machine is started, the mandrels 58 (FIG. 2) at Station 8 must be empty. Accordingly, a normally-open, held-closed limit switch 12LS (FIG. 2 and line 33, FIG. 126) is associated with line L1 and is closed when a carton is present on the mandrel at Station 8. A similar limit switch 13LS (line 33, FIG. 126) is provided for line L2 and is connected in parallel with the switch 12LS. The normally-closed, held-open timing switch CS–2 of the cycle timer 286 (FIG. 117) is connected in a series circuit with the parallel switch 12LS and 13LS and with a relay 2CR.

The switch CS–2 is closed for 36° when positioned between the 300°–336° positions FIGURE 120 of the cam 1591. If both mandrels at Station 8 are free of cartons as they should be at this time, the switches 12LS and 13LS will be open and, accordingly, the relay 2CR will not be energized. If, however, a carton is present on one or both of the mandrels at Station 8 at this time, a circuit will be closed to the relay 2CR thereby energizing the same. Energization of the relay 2CR will open relay contact 2CR–1 (line 17) thereby preventing actuation of the drive motor DM as will be explained more fully hereinafter. Opening of the contact 2CR–1 also opens the circuit to the instrument lights 5L through 9L. It will be noted that the cam 1591 (FIG. 120) holds the switch open during a majority of the cycle thereby permitting cartons on the mandrels which momentarily close the switches 12LS and 13LS, to be blown off the mandrels thereby opening the switches 12LS and 13LS before the switch CS–2 is closed. Thus, during normal operation the relay 2CR is not energized.

In the event the relay 2CR is energized, relay contacts 2CR–2 (line 34) is closed to establish a holding circuit for relay 2CR. The relay 2CR remains energized until the carton is removed from the mandrel or mandrels causing the difficulty, and a normally closed switch 31PB is manually opened to deenergize the relay 2CR.

As has been mentioned previously in regard to the discharge apparatus 84 (FIG. 110) at Station 18, the piston rod 1438 of the hydraulic power unit 1434 must be fully retracted thereby holding the normally closed switch 1453 (line 37) open before the conveyors can be indexed. Also, the sterilizing apparatus 73 (FIG. 74) must be in its fully elevated position thereby holding the normally closed limit switch 988 (line 37) open before the conveyor can be indexed. The switches 988 and 1453 are connected in parallel to each other and in series with the cam switch CS–4 and a relay 4CR. As shown in FIGURE 122, the cam 1593 permits the normally-closed, held-open switch CS–4 to open during the 24° range between 336° and 0° positions. Accordingly, if both switches 988 and 1453 are open at this time, indicating that the sterilizing apparatus and discharge apparatus have returned to their proper positions, the circuit to the relay 4CR will not be completed. If however, one or both of the switches 988 and 1453 are closed when the cam switch CS–4 is closed, the relay 4CR will be energized thereby opening relay contact 4CR–1 (line 17) and closing relay contact 4CR–2 (line 38). Opening of the relay contact 4CR–1 (line 17) prevents operation of the drive motor DM and opens the circuit to light 6L to 9L. Closing of the relay contact 4CR–2 (line 38) established a holding circuit for relay 4CR which includes a normally closed switch 33PB. The relay 4CR remains closed until the trouble is corrected and the switch 33PB is momentarily opened.

The relay contact 1–D–1 and 2–D–1 (lines 35) of the ultrasonic detector remain open when the cartons in lines L1 and L2, respectively, are properly squared, and are closed if the cartons are defectively bent in an L-shape. The relay contact 1–D–1 is connected in series with a normally closed relay contact 12CR–1, and the relay contact 2–D–1 is connected in series with a normally closed contact 13CR–1. These two pair of series connected relay contacts are connected in parallel in a series circuit which includes the cam switch CS–3 and a relay 3CR. The cam switch CS–3 is a normally-closed, held-open switch which is closed for 30° between the 30° and 60° position of the cam 1592 (FIG. 121). If during this time the ultrasonic detectors sense the presence of an improperly squared carton in one or both of the lines L1 and L2, either the relay contact 1–D–1 or 2–D–1, or both, contacts 1–D–1 and 2–D–1 will close to complete a circuit which energized the relay 3CR. Energization of relay 3CR will open relay contact 3CR–1 (line 17) thereby opening the circuit to the drive motor DM and opening the circuit to the instrument light 9L. Energization of the relay 3CR also closes a contact 3CR–2 (line 36). Closing of relay contact 3CR–2 established a holding circuit for relay 3CR which includes a normally closed switch 32PB. The relay 3CR remains closed until the trouble is corrected and the switch 32PB is momentarily opened.

The relay contacts 12CR–1 (line 35) and 13CR–1 are closed during normal operation of the machine and are opened only when it is desired to operate one or both of the lines L1 and L2 without cartons, or when the filling operation is to be terminated and the remaining containers in the machine are to be moved out of the machine. The relay 12CR (line 28) is connected in series with a switch 23PB which is closed when in the "off" position and open when in the "on" position. During normal operation, the switch 23PB is placed in the "off" position which energized the relay 12CR and closes the relay contact 12CR–1 (line 35). When it is desired to operate line L1 of the machine without cartons, the switches 23PB (line 28) and 24PB (line 29) are both turned to the "on" position thereby deenergizing the relay 12CR causing the relay contact 12CR–1 (line 35) to open, and closing the vacuum control switch 612 associated with line L1. A lead 1630 connects the switches 23PB and 24PB in parallel.

Similarly, the relay 13CR (line 30) is connected in series with a switch 25PB which is closed when in the "off" position and open when in the "on" position. During normal operation the switch 25PB is placed in the "off" position which energizes the relay 13CR and closes the relay contact 13CR–1 (line 35). When it is desired to operate line L2 of the machine without cartons, the switches 25PB and 26PB which are connected in parallel by lead 1641, are both turned to the "on" position thereby deenergizing the relay 13CR causing the relay contact 13CR–1 (line 35) to open, and closing the vacuum control switch 612 associated with line L2.

With the different parts of the control circuit 1600 preset as above described, the machine is prepared for normal automatic operation.

The operator then closes a start switch 14PB (line 17). Closing of the start switch then completes the series circuit 1637 (line 17) which includes the closed contact 2CR–1 of the carton ejection relay, the closed contact 4CR–1 of the ultraviolet light and discharge relay 4CR, the closed contact 3C–2 of the oil heater relay 3C, the closed high temperature switch 2–TS of the oil temperature controller 1636, the closed contact 3CR–1 of the ultrasonic detector relay 3CR, the closed relay contact 2M–3 of the hydraulic motor relay 2M, a closed switch 5LS which is a mechanical interlock switch on the door of the control panel which is closed when the door is closed and is opened when the door is open, closed emergency stop switches 5PB, 6PB, 7PB, 8PB and 13PB which are placed at different locations on the machine so that the machine may be quickly stopped in the case of an emergency, the closed switch 1174 which indicates that the manual filling valve 1173 (FIG. 113B) is in the automatic position, the closed contact 7CR–1 of the burnout detector relay 7CR (line 25) and a relay 1CR. Energization of relay 1CR closes relay contacts 1CR–1 (line 18), and closes contact 1CR–2 (line 20).

The closed relay contact 1CR–1 is in series with the closed relay contact 8CR–1 of the photoelectric cell relay 8CR and provides a holding circuit for the start switch 14PB which returns to the open position when released.

Closing of the relay contact 1CR–2 (line 20) closes a circuit to drive motor relay 3M which circuit includes the closed switch contact 21PB–1 and a pair of closed overload contacts OL. Energization of relay 3M closes relay contacts 3M–1 (line 3) thereby activating the drive motor DM. Energization of relay 3M also closes relay contact 3M–2 (line 39) which prepares a circuit to the ultraviolet transformers 1–UVT (line 39) and 2–UVT (line 42) which circuit is completed when cartons are moved under the ultraviolet lights 74 thereby closing the no-carton no-light switches 997 against terminals which close the circuit to the lights 74 for automatic operation after the five minute time period of the time delay relay TDR (line 43) has been terminated and the switch TDR–1 (line 40) has opened.

It will be recognized that during normal operation of the machine the no-carton no-light switches 997 will be closed against terminals 1642 and 1643 thereby activating the photoelectric detectors 10D and 11D which open contacts 10D–1 and 11D–1 and deenergize relay 8CR when one or more of the photoelectric lights have burned out, been broken, or are very low in intensity. Deenergization of relay 8CR opens relay contact 8CR–1 (line 17) in the holding circuit for the start switch 14PB thereby stopping the drive motor DM. When power is interrupted to the ultraviolet lights and corresponding photoelectric cells upon opening of one or both of the no-carton no-light switches 997, amplifying circuits in the photoelectric detectors 10D and 11D are arranged to prevent energization of the relay therein.

When drive motor DM starts, the machine begins its normal carton forming and filling operation with all mechanical, electrical and hydraulic components operating as above described. In the event any one or group of contacts or switches in the series circuit 1637 (line 17) should open before completion of a cycle of operation thereby deenergizing the relay 1CR, the relay 3M (line 20) will remain energized and the motor DM will remain running until the end of the cycle. The normally open, held closed cam switch CS–1 (line 21) is open only for 35° by the cam 1589 (FIG. 119) at the start and completion of the cycle. At all other times the switch CS–1 is closed thereby establishing a holding circuit for relay 3M (line 20) which includes the closed contact 21PB–2 of the run-jog switch 21PB. After completion of the cycle, the holding circuit is opened by the cam switch CS–1 and the relay 3M is deenergized thereby stopping the drive motor DM.

For set-up and maintenance purposes, provision is made to operate the machine through a remote control unit 1644 (line 19, FIG. 124). The unit 1644 is portable and is removably connected to the machine by plugs 1646 and includes a stop switch 17PB, a start switch 18PB, and a jog switch 19PB. A second jog switch 20PB, which is not a part of the remote control unit, is located on the door of the control panel. The plugs 1646 for the remote control unit 1644 are located within the control panel and accordingly the control panel door must be opened, thereby opening the door interlock switch 5LS (line 17), before the unit 1644 can be used.

When it is desired to run the machine under control of the unit 1644, the start switch 18PB (line 19) is closed thereby energizing the relay 1CR (line 17) through a

circuit which includes the stop switch 17PB, the start switch 18PB and either the closed contact 7CR–1 or the closed contact 1PB–2. If it is desired to operate the machine with the air heaters on, the switch 1PB (line 14) is placed in the "on" position thereby opening contact 1PB–2 (line 18) and completing the above circuit through the closed contact 7CR–1 of the energized burnout detector relay 7CR (line 25). If hot air is not required, the switch 1PB (line 14) is turned to the "off" position thereby closing the contact 1PB–2 (line 18) and completing the above circuit. The machine is stopped by opening the stop switch 17PB.

When it is desired to "inch" the machine through the indexing and operating cycles, the switch 21PB (line 20) is placed in the "jog" position thereby opening the contact 21PB–1 (line 20), 21PB–2 (line 21) and 21PB–3 (line 39). Opening of the contact 21PB–1 prevents operation of the motor in response to closing relay 1CR (line 17), opening of the contact 21PB–2 prevents the actuation of the drive motor when the cam switch CS–1 (line 21) is closed, and opening of the contact 21PB–3 (line 39) prevents the operation of the ultraviolet lights 74.

The jog switch 19PB (line 19) on the remote control unit 1644, or the jog switch 20PB on the control panel door, is then closed causing the drive motor to operate as long as the switch is held closed. If the jog switch 19PB on the remote control unit is used, the circuit which energizes relay 3M (line 20) includes the stop switch 17PB, the closed jog switch 19PB, the relay 3M (line 20) and the overload contacts OL.

If the machine is to be jogged by the jog switch 20PB (line 19) on the control panel door, the remote control unit 1644 is unpluged from the machine and is placed in its storage area within the control panel. The control panel door is then closed thereby closing the switch 5LS (line 17). The jog circuit then includes all the closed switches and contacts in the circuit 1637 (line 17) from main line ML4 through the closed stop switch 13PB, the held closed jog switch 20PB, the relay 3M (line 20) and the overload contacts OL.

The series of instrument lights 5L to 9L (line 18), 10L to 13L (line 25) and 15L, 16L (line 26) are provided and are suitably labeled to aid the operator in determining where a faulty functioning component of the machine is located. In each of the above series of lights, the first light off in the series from left to right indicates the source of interference.

From the foregoing description it is apparent that the carton forming and filling machine of the present invention is capable of forming cartons which are very sturdy and do not leak. The machine features bottom forming, bottom heating and bottom sealing apparatuses which cooperate to provide a bottom closure which is free of leaks and which is attractive in appearance. Similarly, the machine includes top forming, top sizing, top heating and top sealing apparatuses which provide a top closure which is attractive, is rugged and is free of leaks. The machine also includes an improved filling apparatus which accurately measures a quantity of milk and fills the cartons from the bottom thereby preventing foaming. Additionally, the filling valve is actuated in such a way that the milk, which gradually forms on the bottom of a filling tube after one carton has been filled and moved out of the filling station, does not drip from the tube until another empty carton is positioned therebelow.

While one embodiment of the present invention has been shown and described, it will be understood that various changes and modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

The present invention and the manner in which the same is to be used having thus been described, what is claimed as new and desired to be protected by Letters Patent is:

1. In a method of forming and sealing the top closure of a carton having flaps and tabs separated from each other and from the body of a carton by score lines, the steps of intermittently advancing the carton along a linear path into a plurality of processing stations, supporting the inside surfaces of a pair of opposed side walls of the carton body immediately adjacent the score line separating these walls from a first pair of opposed flaps, bending said first pair of flaps inwardly while supporting the inside walls of the carton body against inward movement, bending a second pair of opposed flaps inwardly simultaneously with the bending of said first pair of flaps, bending a pair of opposed tabs outwardly as said flaps are being bent inwardly, heating only those surfaces of the flaps and tabs which will subsequently be sealed together, engaging unheated surfaces of said flaps to fold the heated surfaces of the top closure together, supporting the unheated surfaces of said tabs, applying pressure to the flaps against the resistance of said supported tabs to seal the heated surfaces of said flaps together, and localizing the sealing pressure at certain areas above said tabs for deforming the material of said certain areas relative to the remaining area upon which said sealing pressure is being applied for blocking potential flow passages in the top closure.

2. In a method of forming and sealing the top closure of a carton having flaps and tabs separated from each other and from the body of a carton by score lines, the steps of supporting the inside surfaces of two pair of opposed side walls of the carton body immediately below the score line separating these walls from a first pair of opposed flaps, folding said opposed flaps inwardly while supporting the inside walls of the carton body, bending a second pair of opposed flaps inwardly simultaneously with the bending of said first pair of flaps, prebending a pair of opposed tabs outwardly as said flaps are being bent inwardly, releasing said tabs and flaps, engaging and bending said tabs firmly against the outer surface of the adjacent pair of flaps, directing hot air at an angle substantially normal to and at only those surfaces of the flaps and tabs which will subsequently be sealed together, engaging unheated surfaces of said flaps to fold the heated surfaces of the top closure together, supporting the unheated surfaces of said tabs, and applying pressure to the flaps against the resistance of said supported tabs to seal the heated surfaces of said flaps and tabs together.

3. In a method of forming and sealing the top closure of a carton having flaps and tabs separated from each other and from the body of a carton by score lines, the steps of supporting the inside surfaces of two pair of opposed side walls of the carton body immediately below the score lines separating these walls from carton closure flaps, bending a first pair of opposed flaps inwardly while the inside walls of the carton body are being supported, bending a second pair of opposed flaps inwardly simultaneously with the bending of said first pair of flaps, bending a pair of opposed tabs outwardly as said flaps are being bent inwardly, applying of second bending force to said tabs to bend said tabs firmly outwardly against the outer surface of the adjacent pair of flaps, directing hot air in a direction substantially normal to and at only those surfaces of the flaps and tabs which are to be subsequently sealed together, engaging unheated surfaces of said flaps to fold the heated surfaces of the top closure into abutting contact, supporting the unheated surfaces of said tabs, and applying pressure to the flaps against the resistance of said supported tabs with a greater amount of pressure being applied to areas of the top closure which form natural flow passages to partially crush the flaps and block the flow passages.

4. In a method of filling and sealing the top closure of a carton having flaps and tabs separated from each other and from the body of a carton by score lines, the steps of supporting the inner surface of two pair of opposed side walls of the body at one processing station,

preforming the top closure of the carton by folding certain of the flaps inwardly and folding the tabs outwardly while the inner surfaces of the body are being supported, advancing the carton to another processing station, sterilizing the interior of the carton by directing ultraviolet light into the carton having its top closure preformed, advancing the carton to another processing station, filling the carton with a sterile product, advancing the carton to another processing station, engaging and folding the tabs firmly against the outer surfaces of the adjacent pair of flaps, advancing the carton to another processing station, directing hot air in a direction substantially normal to and at only those surfaces of the flaps and tabs which will subsequently be sealed together, engaging unheated surfaces of said flaps to fold the heated surfaces of the top closure into abutting contact, supporting the unheated surfaces of said tabs, and applying pressure to the flaps against the resistance of said supporting tabs to seal the heated surfaces of said flaps and tabs together.

5. In a carton forming and sealing machine, a heating head for heating the flaps which define the bottom closure of a carton of thermoplastic material comprising a main housing defining a plenum chamber, means for directing hot air into said plenum chamber, a pair of spaced exterior housings connected to said main housing and communicating with said plenum chambers, a central housing connected to said main housing and communicating with said plenum chamber, said central housing having perforated walls for directing hot air at the inner surfaces of the flaps of a carton positioned on said head with the flaps of the carton encircling said central housing, and a perforated V-shaped wall on each of said external housings for directing hot air at the outside surfaces of certain of said flaps.

6. In a carton forming and sealing machine, a heating head for heating the flaps which define the bottom closure of cartons of thermoplastic material comprising a main housing defining a plenum chamber, means for directing hot air into said plenum chamber, a pair of spaced exterior housings connected to said main housing and communicating with said plenum chamber, an inwardly facing V-shaped wall on each of said exterior housings, a central housing connected to said main housing and communicating with said plenum chamber and having a pair of perforated V-shaped walls of said central housing spaced from and complementary with said V-shaped walls of said exterior housing, a pair of parallel walls of said central housing having edges disposed closely adjacent edges of said V-shaped walls of said central housing, U-shaped corner members connecting the adjacent edges of the V-shaped walls and parallel walls of the central housing together, and means on said central housing for guiding the bottom of a carton therearound.

7. In a carton forming and sealing machine, a top forming apparatus for preforming the top closure of a carton which top closure includes a body, a pair of end flaps, and a pair of side flaps having oblique score lines therein with a tab hingedly connected to the upper edge of each side flap, said side flaps and end flaps being connected to each other and to the body of the carton along score lines, said apparatus comprising means for supporting the carton in upright position with the top closure flaps projecting upwardly, a vertically movable carrier disposed above said carton support, a pair of trapezoidal-shaped shoes pivotally connected to opposite sides of said carrier, a pair of elongate brake bars pivotally connected to said carrier, each bar being spaced inwardly of one of said shoes and arranged to be moved outwardly toward the shoe, a pair of transverse shoes pivotally connected to opposite sides of said carrier and at right angles to said trapezoidal shoes, means for moving said carrier downwardly, and means operatively connected to said brake bars and shoes and responsive to the downward movement of said carrier for moving the brake bars into supporting contact with opposed inner walls of the body of the carton immediately below the connections of the side flaps to the body of the carton and for moving the trapezoidal shoes against the outer face of said flaps to swing said flaps inwardly, said transverse shoes being movable inwardly during downward movement of said carrier to pivot the end flaps inwardly over the side flaps.

8. In a carton forming machine a top forming apparatus for preforming the top closure of a carton which top closure includes a pair of end flaps, and a pair of side flaps having oblique score lines therein with a tab projecting from the upper end of each side flap, said side flaps and end flaps being connected to each other and to the body of the carton along score lines, said apparatus comprising means for supporting a carton with its end flaps projecting upwardly, a vertically movable carrier disposed above said carton support, a pair of brake bars movable to a position within said carton to engage the body of said carton immediately below the score lines which connect the side flaps to the body, a pair of U-shaped levers pivotally connected to said carrier, one arm of each lever being secured to one of said brake bars and the other arm having a camming surface thereon adapted to engage and bend outwardly one of said tabs during downward movement of said carrier, resilient means connected between said carrier and each lever for normally urging said levers to retracted positions away from said carton, a pair of trapezoidal-shaped shoes pivotally connected to said carrier and movable to a position alongside the outer surface of said side flaps during downward movement of said carrier, resilient means connected between said carrier and said shoes and arranged to urge said shoes away from said side flaps, a pair of transverse shoes disposed at right angles to said trapezoidal shoes and pivotally connected to said carrier and movable into contact with said end flaps during downward movement of said carrier, resilient means connected between said carrier and said transverse shoes and arranged to urge said transverse shoes away from said side flaps, means for moving said carrier downwardly, and means operatively connected to said brake bars and shoes and responsive to the downward movement of said carrier for moving the brake bars into supporting contact with the inner surface of the body of the carton immediately below the connection of each side flap with the carton body, and for moving the trapezoidal shoes and the transverse shoes against the outer surfaces of said side and end flaps to bend the same inwardly.

9. In a machine for forming, filling and closing thermoplastic cartons having sealed bottom closures and having preformed top closures which top closures include side flaps and end flaps, said side flaps having tabs projecting upwardly and outwardly therefrom; the combination of an intermittently driven conveyor for advancing cartons along a predetermined path and indexing one carton at a time at a top sizing station and immediately thereafter indexing the cartons at a top heating station, means at said top sizing sation movable into position to crimp the tabs firmly against the associated side flaps, a top heating head at said top heating station, means for moving said head into engagement with said top closure, and means for directing hot air into said head for discharge therefrom in a direction substantially normal to and upon those surfaces of the top closure which are subsequently sealed together.

10. In a machine for forming, filling and closing thermoplastic cartons having sealed bottom closures and having preformed top closures which top closures include side flaps and end flaps, said side flaps having tabs projecting upwardly and outwardly therefrom; the combination of an intermittently driven conveyor for advancing cartons along a predetermined path and indexing one carton at a time at a top sizing station and immediately thereafter indexing the cartons at a top heating staion, a carrier at said top sizing stations mounted for vertical movement, a pair of sizing fingers pivotally supported by said carrier, cam followers on one end of said fingers, a stationary cam

mounted in position to be engaged by said cam followers, resilient means urging said cam followers against said cam, means for vertically reciprocating said carrier while said conveyor is stationary to cause said cam followers to move downwardly along said cam thereby causing said fingers to engage and bend said tabs outwardly and downwardly against the associated side flaps, a top heating head at said top heating station, means for moving said head into engagement with the top closure flaps of the carton positioned therebelow, and means for supplying hot air to said head for discharge therefrom upon those surfaces of the top closure which are subsequently sealed together.

11. In a machine for forming cartons, a top heating head for heating the preformed top closure of a thermoplastic carton, comprising an L-shaped housing defining a plenum chamber and an end chamber communicating said plenum chamber, each of said side housings having a perforated inner wall, a pair of spaced side housings connected to said L-shaped housing and communicating with said plenum chamber, each of said housings having a perforated inner wall and a downwardly and inwardly inclined perforated wall, a central housing communicating with said plenum chamber and having four perforated walls connected together at their corners by perforated U-shaped corner members, a channel member extending through said central housing and establishing communication between said central housing and said side housings, said channel member having perforated walls extending between the central housing and the associated side housings, and means for directing hot air into said plenum chamber for distribution to said housings and for discharge through said perforated walls against the top closure of the carton.

12. In a machine for forming, filling and closing the top closure of a thermoplastic carton which top closure includes end flaps and side flaps with tabs projecting upwardly and outwardly from said side flaps, a top heating apparatus comprising an L-shaped housing defining a plenum chamber and an end chamber communicating therewith, said end chamber having a perforated inner wall, a pair of spaced side housings connected to said L-shaped housing and communicating with said plenum chamber, each of said side housings having a perforated inner wall and a downwardly and inwardly inclined perforated wall, a central housing communicating with said plenum chamber and having four perforated walls connected together at their corners by perforated U-shaped corner members, a channel member extending through said central housing and establishing communication between said central housing and said side housing, said channel member having perforated walls extending between the central housing and the associated side housings, an angle finger secured to each of said side housings and each angle finger extending over one of said downwardly and inwardly inclined perforated walls, means on said central housing for guiding said central housing within said top closure, means on said side housings for guiding said side flaps therebetween, means for moving said heating head into engagement with said top closure, and means for directing hot air into said plenum chamber for distribution to said housings and for discharge through said perforated walls against the top closure of the carton.

13. In a machine for forming, filling and closing the heated top closure of a thermoplastic carton which top closure includes transverse flaps and side flaps with tabs projecting outwardly from said side flaps, said side flaps and end flaps when folded together defining spaced end portions disposed over said tabs and a central portion disposed between said tabs, a top sealing apparatus comprising means for folding the flaps of the top closure together with the tabs projecting outwardly from the upper edge of said side flaps, means inserted below said tabs for supporting only the tabs and said end portions of said flaps disposed vertically thereabove against compressive forces and for squaring the top closure, and downwardly moving sealing means for applying a downward sealing force to a portion of said top closure against the resistance of said supporting means, said central portion of said flaps being supported against downward movement effected by said downward moving sealing means by transverse tensile forces applied to said central portion by said downward moving sealing means.

14. In a machine for forming, filling and closing the heated top closure of a thermoplastic carton which top closure includes end flaps and side flaps with tabs projecting outwardly from said side flaps, a top sealing apparatus comprising means for folding the flaps of the top closure tabs together with the tabs projecting outwardly of said side flaps, means inserted below said tabs for supporting the tabs and for squaring the top closure, means for applying a sealing force to a portion of said top closure against the resistance of said supporting means, and means for localizing the sealing force at predetermined areas of the top closure where leakage is apt to occur to disrupt natural flow lines in the top closure by physically deforming said predetermined areas relative to the total area of the top closure upon which sealing pressure is applied.

15. In a machine for forming, filling and closing the heated top closure of a thermoplastic carton which top closure includes a front and a rear flap with a wide lip extending from said rear flap, said top closure also including inwardly bent side flaps with tabs projecting outwardly therefrom and a narrow lip extending from said forward flap, the combination of a conveyor for intermittently advancing the carton along a predetermined path into a top sealing station, folding means for engaging the narrow lip of said front flap and for holding said narrow lip down as the carton is moved into the top sealing station, flap supporting means movable into position to engage said front flap as said carton is moved into the top sealing station for holding said front flap in a predetermined position, support means movable under said tabs and lips immediately after the carton has been moved into the top sealing station for supporting said tabs and for squaring said carton, a sealing bar, means for swinging said folding means away from said top closure and for swinging said sealing bar into engagement with said wide lip to fold said wide lip over said narrow lip of the front flap, and means for moving said sealing bar downwardly upon said lip against the resistance of said supporting means to seal said top closure.

16. In a machine for forming, filling and closing the heated top closure of a thermoplastic carton which top closure includes a front and a rear flap with a wide lip extending from said rear flap, said top closure also including inwardly bent side flaps with tabs projecting outwardly therefrom and a narrow lip extending from said forward flap, the combination of a conveyor for intermittently advancing the carton along a predetermined path into a top sealing station, a rigid frame, a shaft journalled on said frame above the carton and having a rectangular central portion, a sealing bar having an enlarged rectangular opening therein for slidably receiving said rectangular central portion and for permitting limited movement of said sealing bar transversely of the axis of said shaft, resilient means urging one edge of said rectangular opening against said central portion, a tab extending outwardly from said sealing bar, a folding shoe journalled on said shaft for limited rotation, adjustable means on said folding shoe disposed in position to engage said tab to limit the amount of movement of said folding shoe relative to said sealing bar, a front support shoe journalled on said shaft and movable into position to engage the front flap of the carton, a pair of anvils slidably received in said frame and movable from a retracted position to an active position under said tabs and lips to prevent downward movement of the same, first power means connected to said front support shoe and timed with

the movement of said conveyor for moving said front support shoe from a raised position retracted above the path of movement of said carton to a lowered position in the path of movement of the carton to engage and bend said front flap rearwardly as said carton is moved into the top sealing station, second power means connected to said shaft and timed with the movement of said conveyor for holding said sealing bar in an inactive position above the path of movement of said cartons and for holding said folding shoe in position to engage and fold said narrow lip downwardly as the carton is moved into the sealing station, said second power means adapted to rotate said shaft 90° after the carton has been moved into the top sealing station for moving the folding shoe to an inactive position above the path of movement of the carton and for moving said sealing bar into position for folding the wide lip over the narrow lip, third power means connected to said anvils and timed with the movement of said conveyor for moving said anvils from the retracted position to the active position under said tabs and lips immediately after the carton has been moved into the top sealing station for squaring said top closure and for preventing downward movement of the same, and fourth power means operatively connected to said sealing bar and timed with the movement of said conveyor for firmly forcing said sealing bar downwardly upon the wide lip to seal the heated surfaces of the top closure which are disposed between said sealing bar and said anvils.

17. In a machine for forming, filling and closing thermoplastic cartons, the combination of means for supporting a carton with end closure flaps projecting outwardly therefrom, a heater head, an air distribution housing in said head for directing hot air at the closure flaps, air

heating means in said head communicating with and disposed immediately adjacent said distribution housing, means for moving said head between a heating position with said housing disposed immediately adjacent the flaps and an inactive position with said housing spaced outwardly of said flaps, and means for directing air into said head past said heating means and through said distribution housing against the closure flaps to heat the flaps to a bonding temperature when said head is in said heating position.

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