Feb. 5, 1963

E. J. SVENSON

3,076,257

AUTOMATIC ASSEMBLING MACHINE

Filed May 28, 1958

9 Sheets-Sheet 1

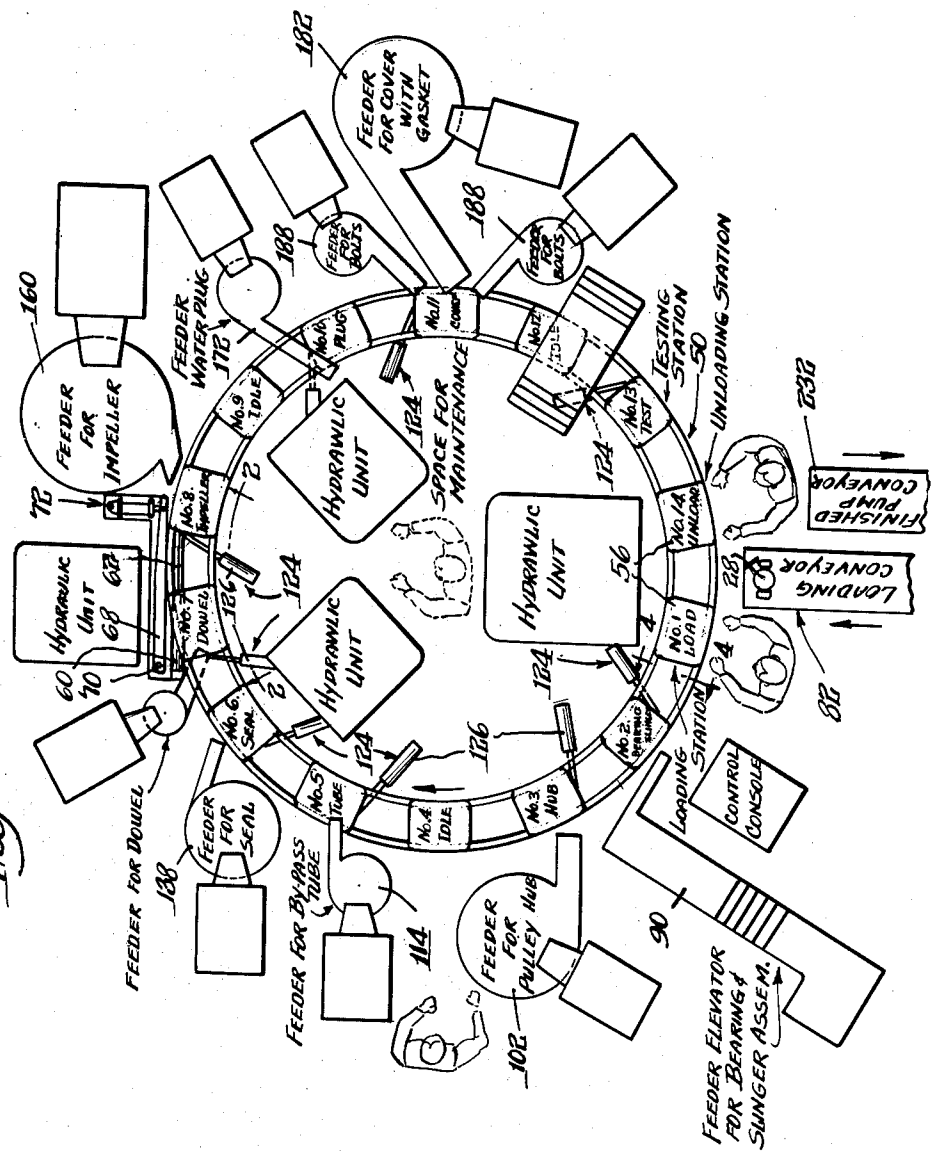


Fig. 1.

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9 Sheets-Sheet 2

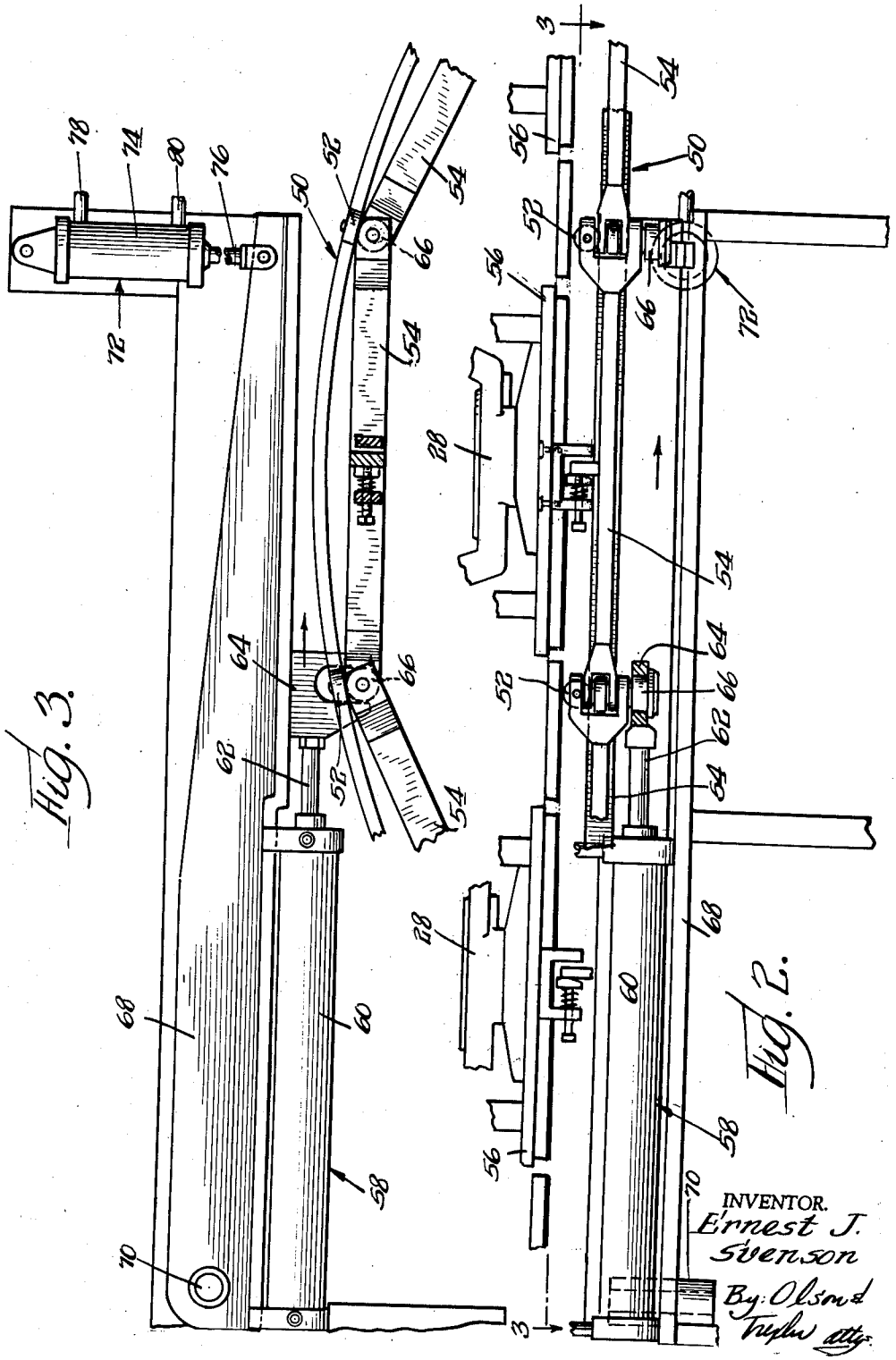


Fig. 3.

Fig. 2.

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AUTOMATIC ASSEMBLING MACHINE

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Fig. 4.

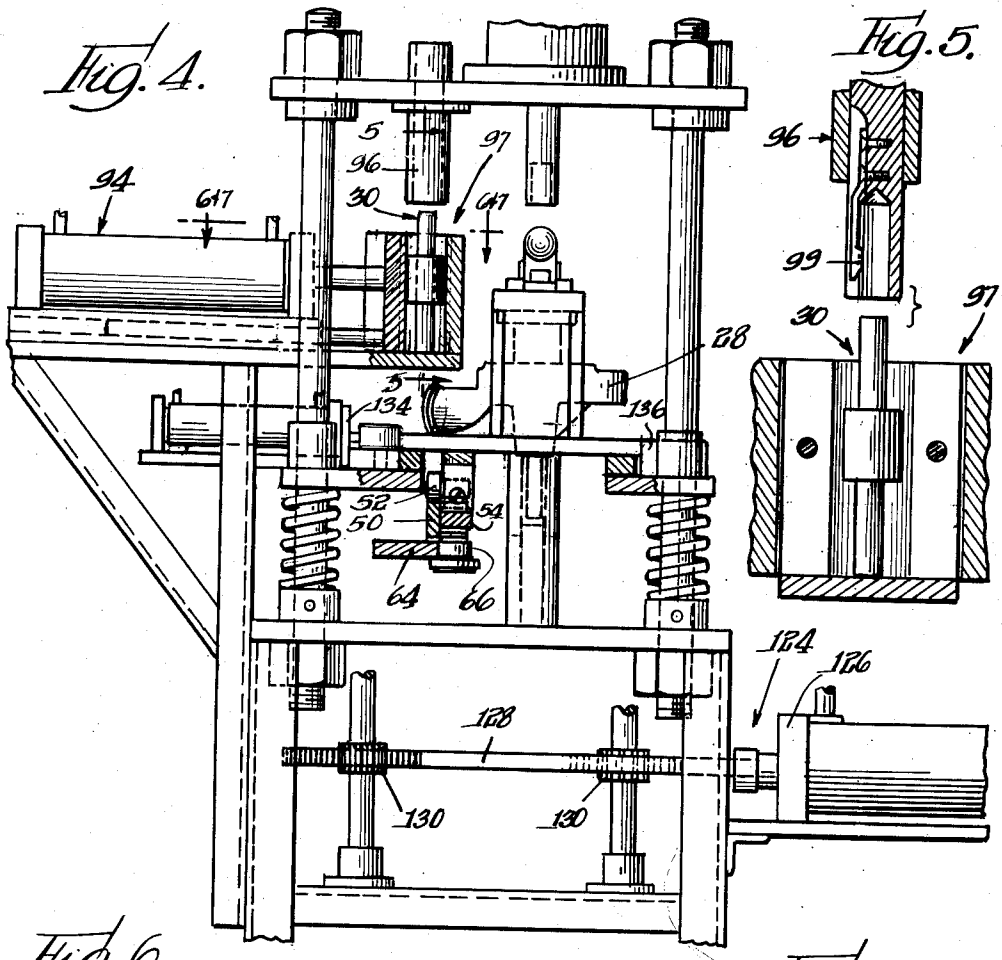


Fig. 5.

Fig. 6.

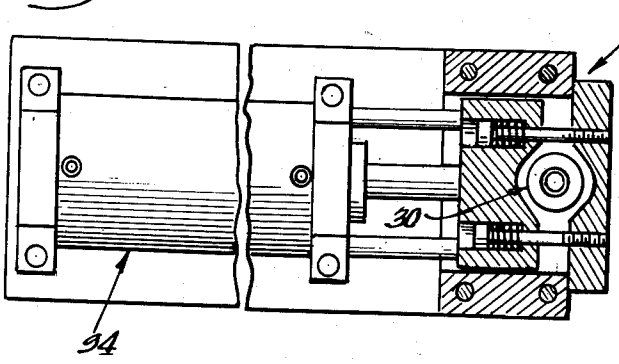
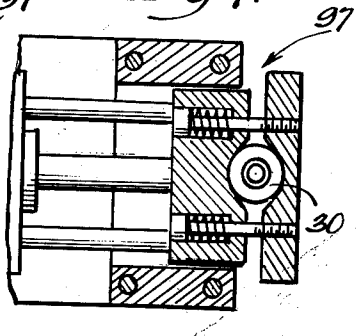


Fig. 7.



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AUTOMATIC ASSEMBLING MACHINE

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Fig. 8.

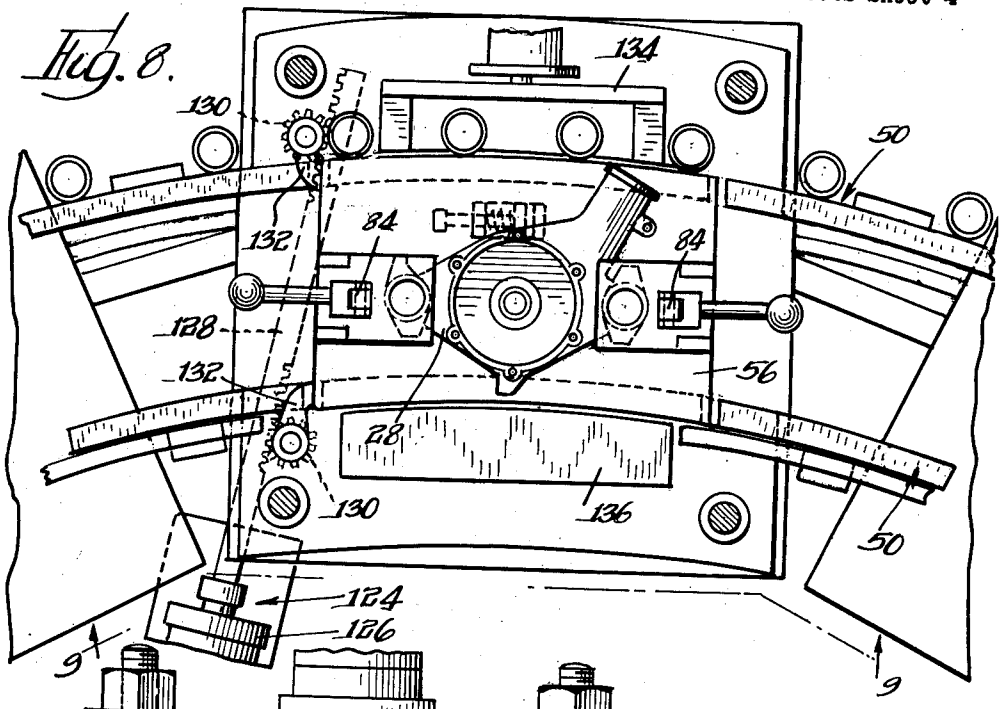
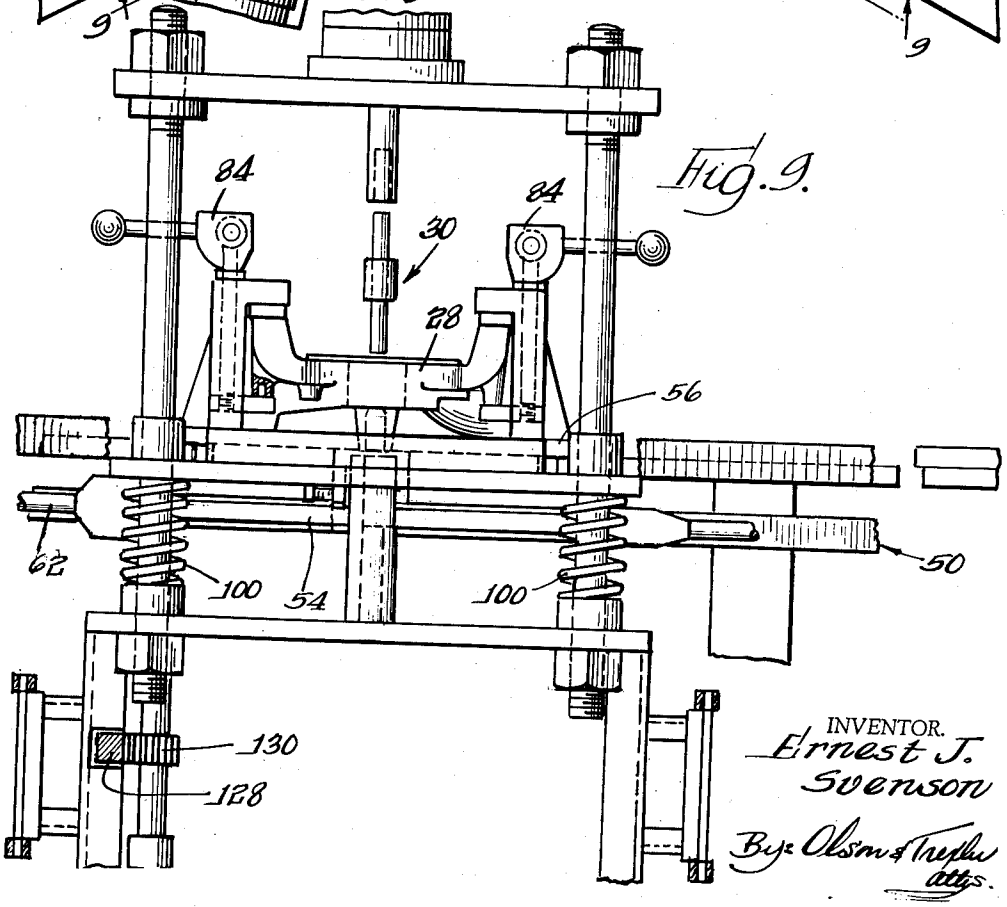


Fig. 9.



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AUTOMATIC ASSEMBLING MACHINE

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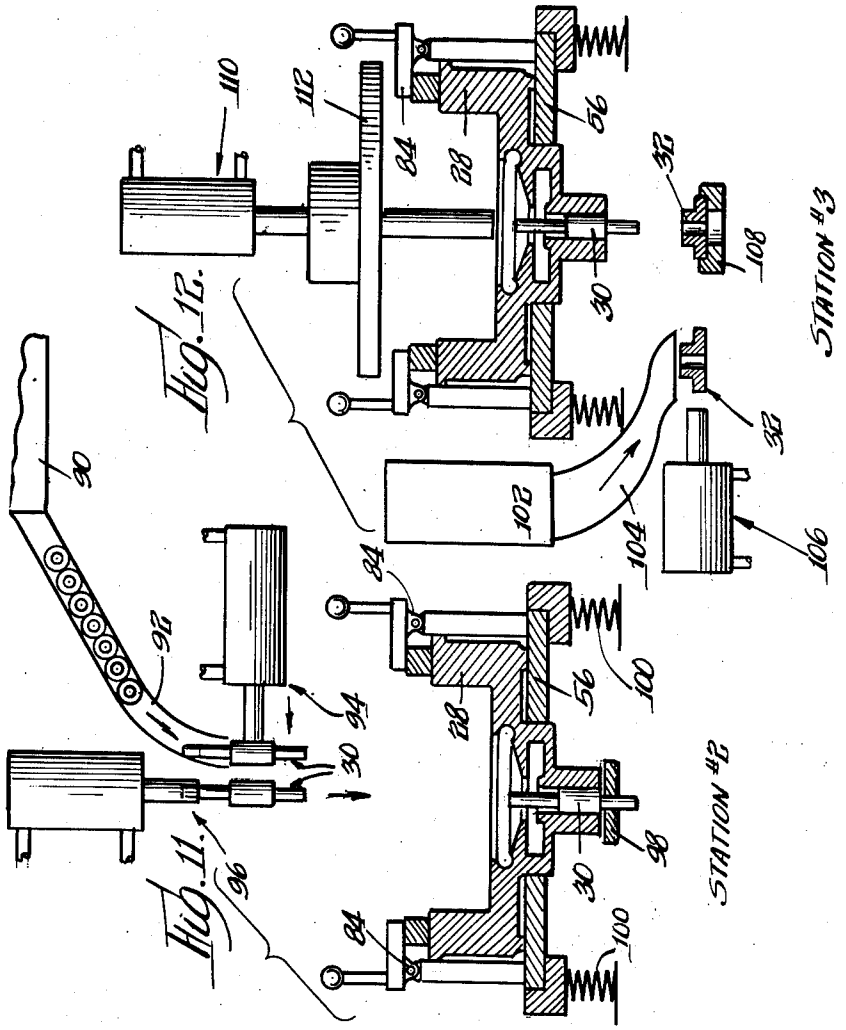


Fig. 12.

Fig. 11.

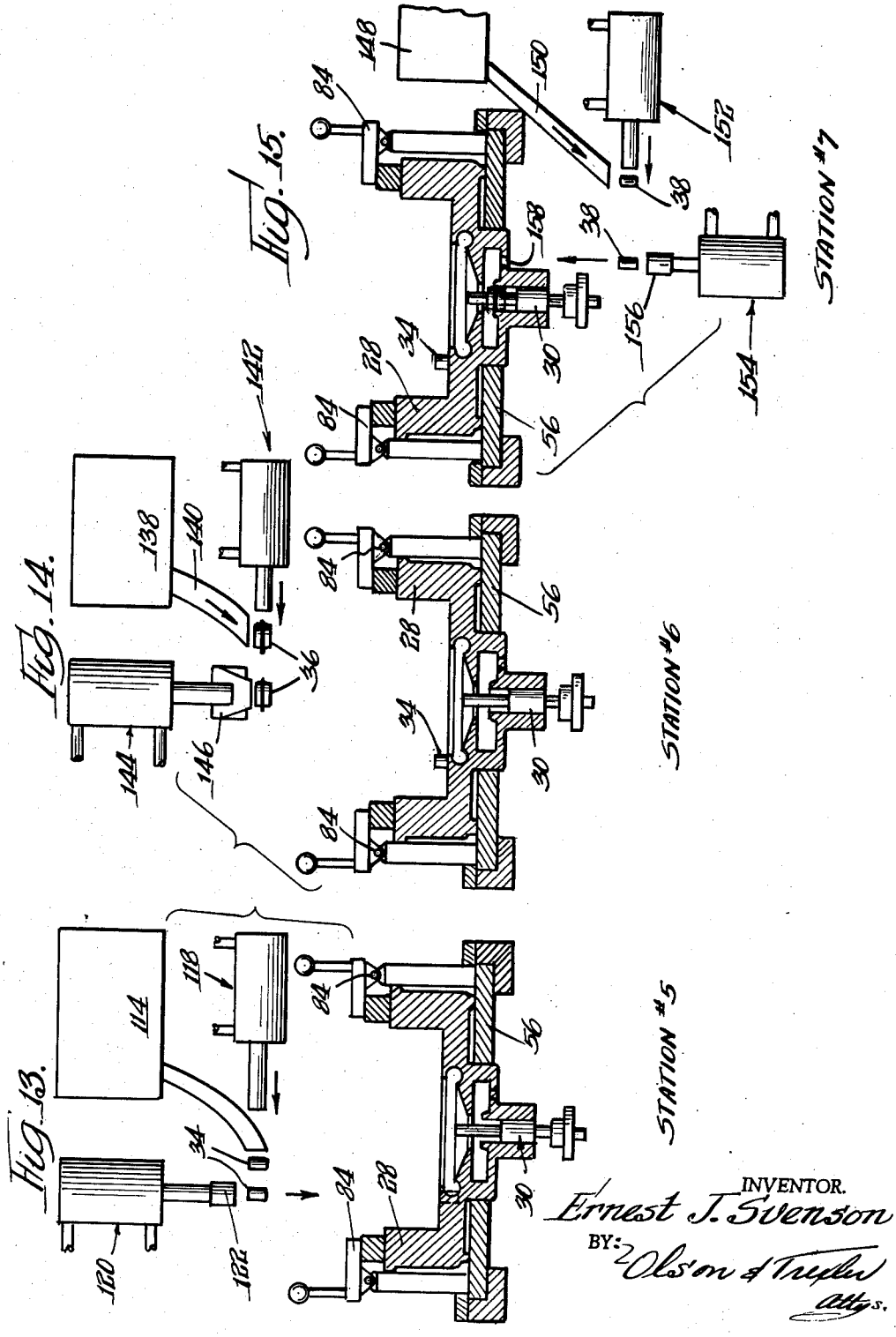
Fig. 10.

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AUTOMATIC ASSEMBLING MACHINE

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AUTOMATIC ASSEMBLING MACHINE

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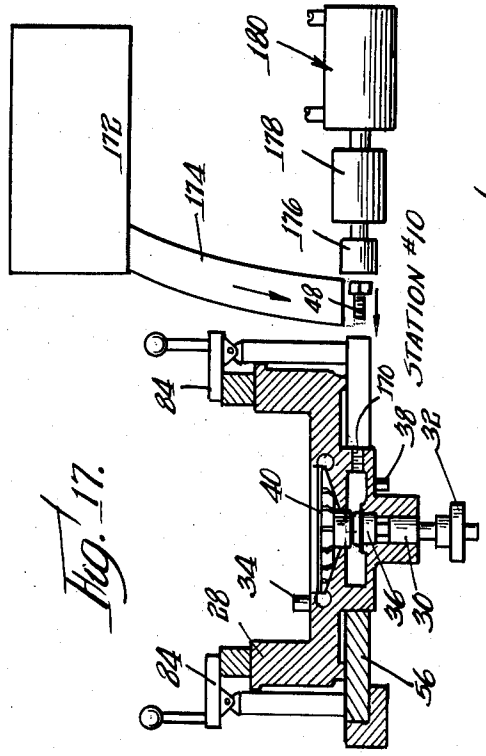


Fig. 17.

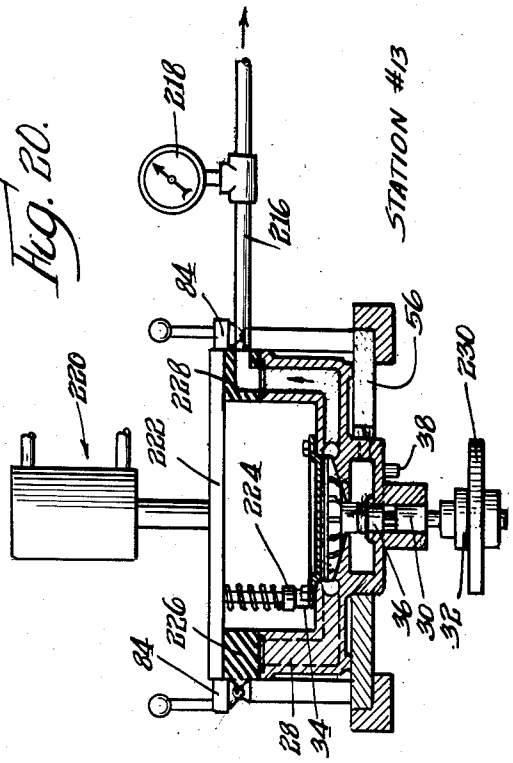


Fig. 20.

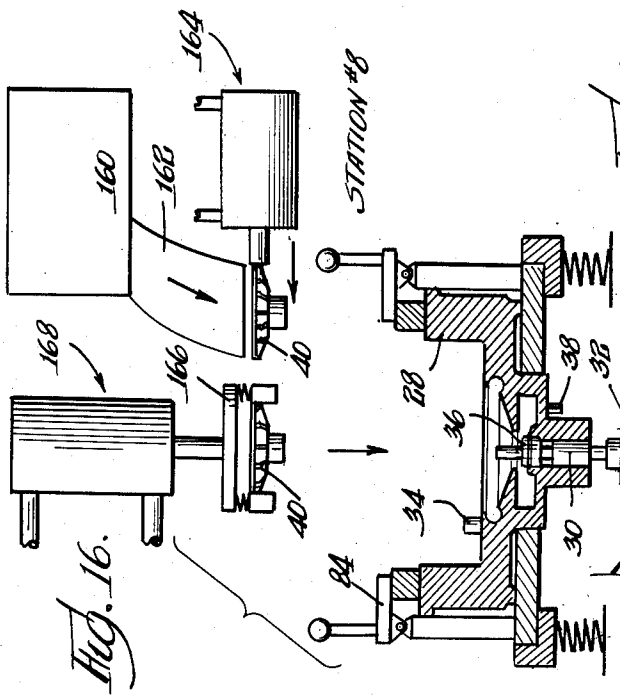


Fig. 16.

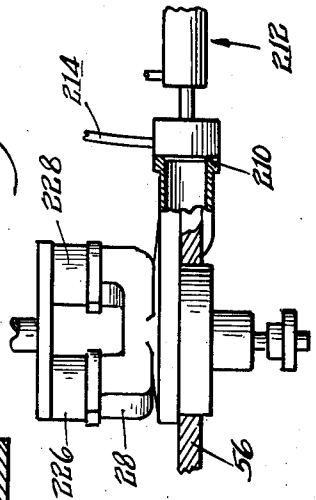


Fig. 21.

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Fig. 18.

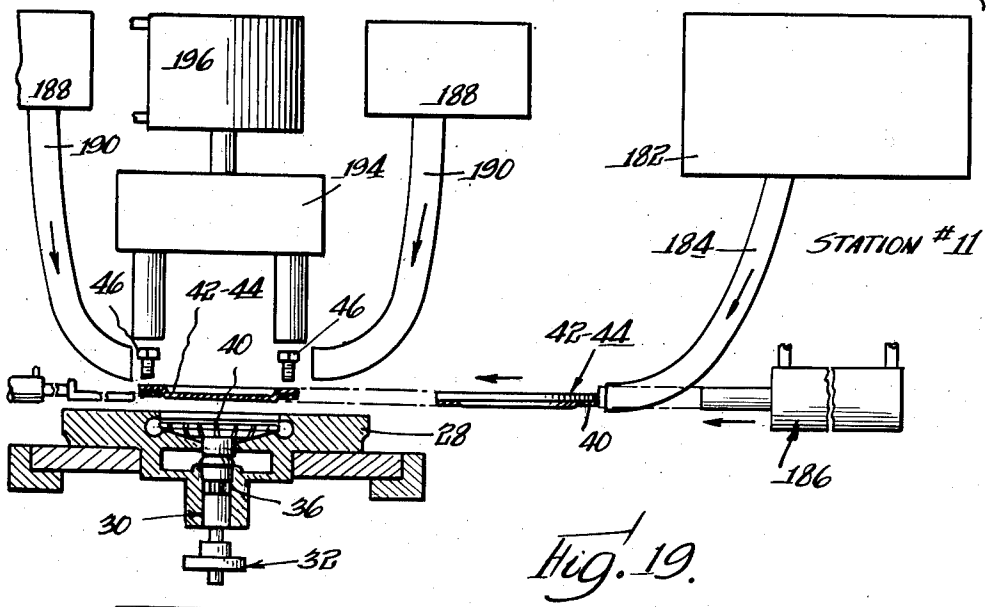
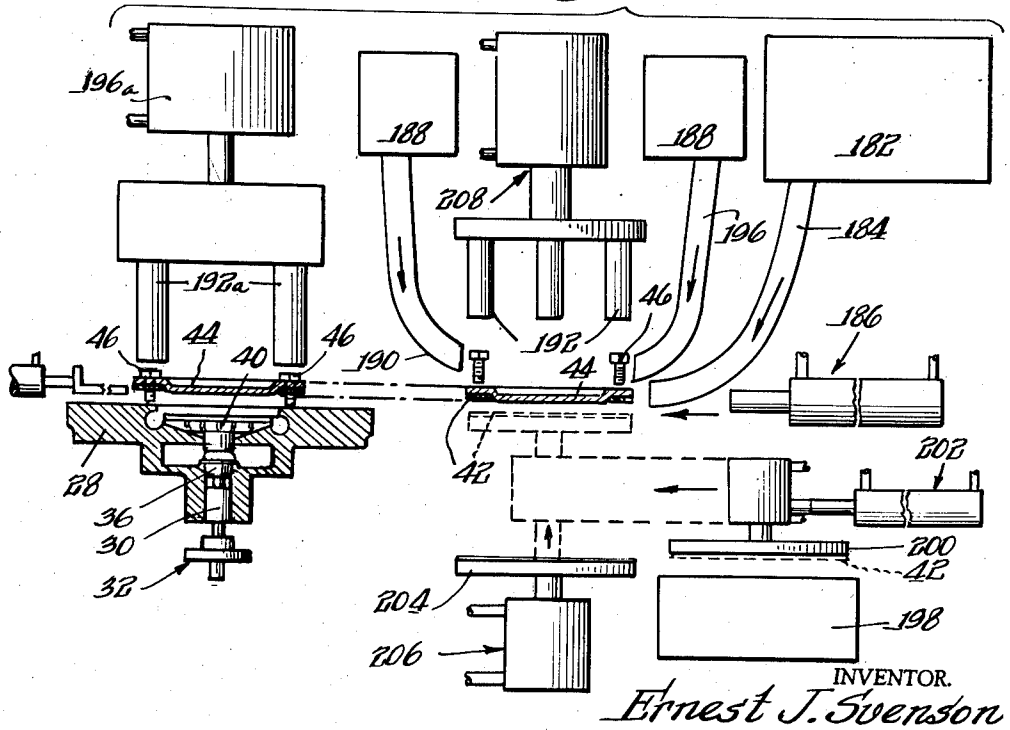


Fig. 19.



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Fig. 22

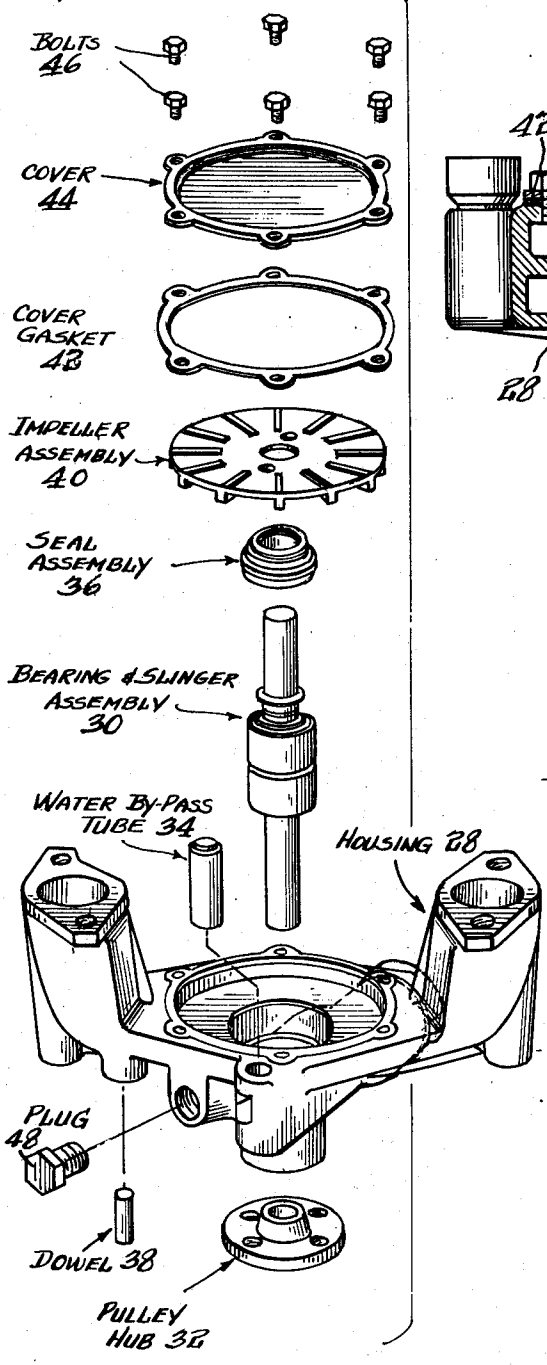


Fig. 24.

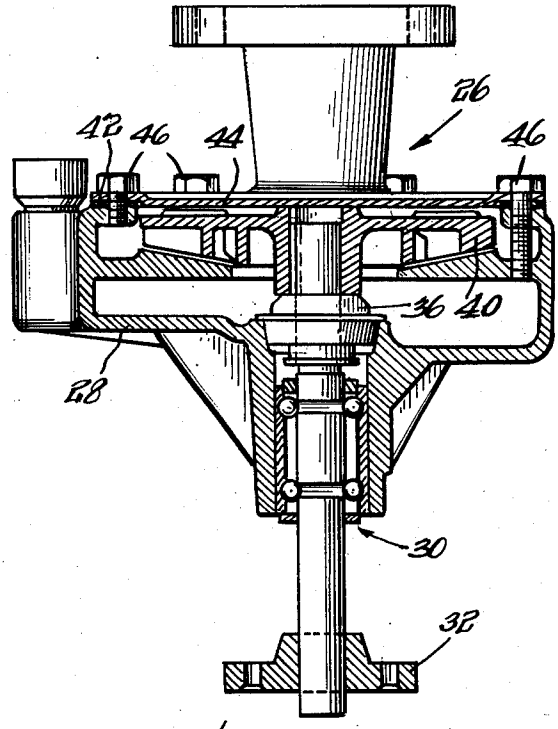
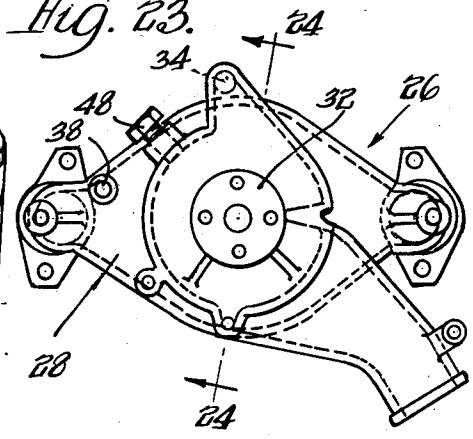


Fig. 23.



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United States Patent Office 3,076,257 Patented Feb. 5, 1963

3,076,257

AUTOMATIC ASSEMBLING MACHINE

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Filed May 28, 1958, Ser. No. 738,500
10 Claims. (Cl. 29—156.4)

This invention relates to improvements in methods and apparatus for assembling and testing parts and more particularly to improved methods of assembling and testing pump structures.

Mass production or production line methods have done much to make it possible for the average citizen to purchase such products as automobiles, electrical appliances and the like, which only a few years ago, because of the high cost of manufacture, were beyond the economic range of the vast majority of our citizenry. The present invention is also concerned with the problem of manufacturing cost, particularly as applied to the production of devices which form one of the important constituents of vehicles such as automobiles, trucks, tractors and the like, namely water pumps.

Water pumps of the type referred to above comprise a number of parts such as a pump housing or casting, a pulley, water by-pass tube, gasket, seal, impeller, bolts, plugs, etc. Heretofore such parts have been assembled manually and it is an object of the present invention to make it possible to assemble such parts at greatly reduced costs and with a minimum amount of manual effort. To this end, the present invention contemplates the intermittent movement of a pump housing along a predetermined path from one station to another so that the assembly and testing operations may be accomplished expeditiously, accurately, and with minimum space or area requirements.

It is a further object of the present invention to accomplish the assembly and testing of pump structures by directing constituent parts into the above mentioned predetermined path, shifting such parts into their proper assembled relation during periods of intermittent dwell and finally subjecting the assembled parts to operational testing before removing the pump structure from said predetermined path.

It is also an object of the present invention to expedite the assembling and testing operations as referred to above in such a manner as to enable the use of presently available and efficiently operable actuating and control devices to the end that the methods may be practiced with the greatest economy and reliability.

The foregoing and other objects and advantages will be readily appreciated from the description which follows when considered in connection with accompanying drawings wherein:

FIG. 1 is a plan diagrammatic view of apparatus which may be employed in the practice of the methods contemplate by the present invention;

FIG. 2 is a fragmentary vertical sectional view taken substantially along the line **2—2** of FIG. 1, to show the hydraulically actuated mechanism for imparting step by step movement to the work supporting structure;

FIG. 3 is a plan view of the work shifting device illustrated inFIG. 2;

FIG. 4 is a detail vertical sectional view of the bearing and slinger assembly station #2, said section being taken substantially along the line **4—4** of FIG. 1;

FIG. 5 is a detail vertical sectional view of the assembly mechanism at station #2 as viewed along the line **5—5** of FIG. 4;

FIGS. 6 and 7 are fragmentary horizontal sectional views taken respectively along lines **6—6**, and lines **7—7** of FIG. 4;

FIG. 8 is an enlarged detail plan view more clearly to

illustrate the hydraulically actuated work clamping mechanism at various stations;

FIG. 9 is a vertical sectional view of the hydraulically actuated work clamping mechanism at various stations, taken substantially along the line **9—9** of FIG. 8;

FIG. 10 is a semi-diagrammatic vertical sectional view illustrating the loading and locating station #1;

FIG. 11 is a view similar to FIG. 10 taken at station #2 disclosing the manner in which the bearing and slinger is assembled with the pump housing;

FIG. 12 discloses the step of assembling the pump hub with the shaft of the previously applied bearing and slinger at station #3;

FIG. 13 shows the step of assembling the water by-pass tube with the pump housing at station #5;

FIG. 14 illustrates mechanism at station #6 for assembling of the pump seal;

FIG. 15 shows the manner in which the dowel element is inserted within a pump housing aperture at station #7;

FIG. 16 discloses the step of assembling the pump impeller at station #8;

FIG. 17 illustrates the step of applying a threaded plug to the pump housing at station #10;

FIG. 18 shows one form of mechanism at station #11 for assembling the cover, gasket and clamping screws or bolts to the pump housing;

FIG. 19 illustrates a modification of the arrangement shown in FIG. 18;

FIGS. 20 and 21 show the testing step at station #13, FIG. 20 illustrating the clutch mechanism for coupling the pump shaft to a source of power and the gauge for indicating water pressure developed by the pump, and FIG. 21 showing the mechanism for sealing the intake side of the pump during the testing operation;

FIG. 22 is an exploded view showing the constituent parts of the water pump structure which may be assembled and tested by practicing the method of the present invention;

FIG. 23 is a bottom view of the assembled pump; and

FIG. 24 is a central sectional view of the assembled pump structure, taken substantially along the line **24—24** of FIG. 23.

With the view of more clearly setting forth the method and apparatus for assembling and testing pump structures, as contemplated by the present invention, it is believed essential to comprehend the nature of the constituent elements of one form of water pump now in commercial use. Such a pump is best illustrated in FIGS. 22 to 24 inclusive. The assembled pump is indicated generally by the numeral **26**. The pump **26** comprises the parts shown in the exployed view of FIG. 22 and indicated as follows: pump housing **28**, a bearing and slinger assembly **30**, pulley hub **32**, water by-pass tube **34**, seal assembly **36**, dowel **38**, impeller **40**, gasket **42**, cover **44**, bolts **46**, and threaded water plug **48**. The present invention is concerned with the expeditious assembly of the aforesaid parts.

To accomplish the assembly of the parts applicant contemplates the employment of certain controls and actuating mechanisms of conventional design and therefore, in the description which follows, such conventional arrangements are not shown in detail but rather diagrammatically or schematically. Thus, in FIG. 1, a diagrammatic representation of an assembling arrangement is shown including a substantially circular track or guide structure **50**. (FIGS. 1, 2 and 3.) Guide rollers **52** adapted to roll along the top of the tracks **50**, serve to support a series of pivotally connected links **54**. These links **54** carry pallets or work supporting plates **56**. These pallets may be adjustably positioned with respect to their respective link members.

Intermittent movement is imparted to the pallet supporting links **54** by means of a hydraulic actuator mechanism designated generally by the numeral **58** (FIGS. 2 and 3). This actuator mechanism includes a cylinder **60** and a piston rod **62**, which at its outer extremity carries a fork member **64**. This fork **64** is adapted for intermittent engagement with a complementary roller **66**. One of such rollers is located at the point of pivotal connection of each adjacent pair of links **54**. The hydraulic actuator mechanism **58** is carried by a longitudinal and substantially horizontally disposed frame arm **68** which is pivotally supported on one extremity by a suitable pin **70**. The opposite of the free extremity of the frame arm **68** may be moved back and forth through the agency of a hydraulic actuator designated generally by the numeral **72**, which includes a cylinder **74** and piston rod **76**. The lower end of the piston rod **76**, FIG. 3, is pivotally coupled with the free extremity of the frame arm **68**. Conduits **78—80** connect the actuator cylinder **74** to a suitable source of fluid supply and controls (not shown). Likewise similar conduits connect the cylinder **60** to suitable controls and fluid supply source (not shown).

Lowering the frame arm **68** by the actuator **72**, from the position shown in FIG. 3 brings the fork member **64** into engagement with a complementary roller **66**, and subsequent forward movement (to the right of FIG. 3) causes the pallets **56** to advance a distance of one link length. Upon the completion of such movement, the actuator **72** functions to raise the fork member **64** out of engagement with the complementary roller **66**. The actuator **58** functions to return the fork **64** to the position shown in FIG. 3. Thus the linkage mechanism and supported pallets **56** may be intermittently advanced so as to bring said pallets to a series of stations positioned along said predetermined circular path in a manner about to be described.

A suitable conveyor **82**, FIG. 1, may be employed to direct pump housing **28** in proximity to station #1, at which station an operator places a housing **28** in proper position upon a complementary pallet **56**, and clamps **84**, FIG. 10, are operated to clamp the housing firmly in place upon said pallet. The upper end of a piston rod or shaft **86**, controlled by an actuator **88** must register with the corresponding aperture in the housing, as clearly shown in FIG. 10. With the housing **28** thus located and clamped upon its complementary pallet **56**, the rod **86** may be lowered to disengaged position and the clamped workpiece shifted to station #2 through the agency of the hydraulic actuator mechanism **58**, previously described.

At station #2, a bearing and slinger assembly **30** is directed from a suitable hopper **90** and chute **92**, FIG. 11, to a position in the path of a hydraulically reciprocated shifter means **94**. The shifter means **94** moves the assembly **30** to a position of alignment with a hydraulic shifter means **96**. The means **96** serves to advance the assembly **30** to the position within the housing **28** as shown in FIG. 1. A stop member **98** functions to properly locate the lower end of the assembly. In other words it prevents the assembly from being inserted beyond a given point within the housing in cooperation with the cushioning springs **100**. In FIGS. 4 to 7 inclusive a more detailed disclosure of the hydraulic actuator mechanisms **94** and **96** will be found. It will be noted that the mechanism **94** cooperates with a gripping device **97** which serves to hold or grip the bearing and slinger assembly **30** as it is shifted from the position shown in FIGS. 4 and 6, to the position shown in FIGS. 5 and 7. In the latter position it is in alignment with the accommodating opening of the housing. As shown in FIG. 5, a latch device **99** carried by the piston rod of the actuator **96** serves to retain the bearing and slinger assembly **30** for insertion within the housing. When the assembly **30** has been inserted the gripping device **97** is shifted back to the position shown in FIG. 6 where it is opened

sufficiently to receive the next succeeding assembly **30**. When the gripping device occupies the position illustrated in FIG. 7, the actuator **96** need only overcome the resilient clamping force of the springs in the gripping device **97** to force the assembly **30** downwardly into assembled association with the housing **28**. The housing **28**, with the bearing and slinger assembly **30** mounted therein is now in readiness to be advanced to station #3.

At station #3, see FIGS. 1 and 12, the pulley hub **32** is telescopically associated with the lower shaft portion of the bearing and slinger assembly **30**. Hub members **32** are directed from a hopper or feeder **102** through a chute **104** to a position which is in alignment with a hydraulic actuator **106**. The actuator **106** shifts a hub **32** to a hub holding device **108** positioned immediately below and in alignment with the bearing and slinger assembly **30** within the housing **28**. A hydraulic actuator mechanism **110** positioned at station #3 functions to urge the housing **28** and associated parts downwardly so as to bring the bearing and slinger shaft into telescopic assembly with the hub **32**. A flange or collar **112** on the piston rod of the actuator **110** serves to prevent axial displacement of the bearing and slinger assembly with respect to its complemental pump housing. The hub **32** having been properly assembled on the slinger shaft, the assembled parts are now ready to be shifted to the next station #4.

Station #4 is an idle station in that no assembly operations are performed. During the dwell at station #4, the parts thus far assembled may be checked for any defects. If such defects cannot be corrected during the dwell at station #4, the housing may be unclamped and removed from its supporting pallet.

At station #5, FIGS. 1 and 13, the previously mentioned by-pass tube **34** is inserted within a complementary aperture in the pump housing **28**. Tube elements are directed from a hopper or feeder **114** through chute **116** in position to be acted upon by a hydraulic actuator mechanism **118**. The mechanism **118** shifts the tube **34** into a position of alignment with a hydraulic actuator mechanism **120**. The mechanism **120** carries a tube holding device **122** at the outer extremity of the actuator piston rod and as the tube **34** is positioned in alignment with said piston rod, the holding device **122** engages the tube and shifts it axially so as to press the tube into an aperture in the housing **28**. After this step in the method of assembly, the assembled work unit is ready to be moved to station #6.

Before proceeding with the description of further steps in the method of assembling it would be in order at this point to mention that the housing, in addition to being clamped to its pallet **56** at the various stations, is also located and clamped by additional means designated generally by the numeral **124** at stations 2, 3, 5, 6, 7, 8, 10, 11 and 13. This clamping means or device is in the nature of a hydraulic actuator including a cylinder **126** and a piston rod **128** and is shown somewhat in detail in FIGS. 8 and 9. After the intermittently operable work advancing mechanism consisting of the actuators **58—72** and frame arm **68** (FIGS. 2 and 3) has completed an advancing stroke, the clamping and locating means **124**, through its piston rod or rack member **128** causes rotation of pinions **130**. These pinions actuate positioning or clamping fingers **132** (FIG. 8) into engagement with the work supporting pallet **56**, thereby positioning said pallet properly for an assembling operation. It is desirable in some instances to employ additional pallet clamping means as shown in FIG. 8 consisting of a hydraulically actuated clamping shoe **134** which urges the pallet against an abutment or block **136**. This assures positioning of the pallet both longitudinally and transversely with respect to the path of travel of the supported workpiece. After each assembly operation is completed, the above mentioned locating and clamping means are released to permit shifting of the work to the next station.

Having assembled the water tube 34 with the pump housing 28 as previously described the assembled work unit is then shifted along the predetermined path to station #6. (See FIGS. 1 and 14). At this station with the pallet 56 and workpiece supported thereby properly located and clamped in the manner previously described, a pump seal assembly 36 is directed from a suitable feeder or hopper 138 through a chute 140 into alignment with a hydraulic actuator 142. This actuator 142, at the proper time, advances the seal assembly 36 to a position below another hydraulic actuator 144. A seal holder 146 carried at the lower extremity of the piston rod of the actuator 144 advances the seal assembly 36 into telescopic association with the upper shaft portion of the bearing and slinger assembly 30 and into the complementary aperture of the housing 28.

From station #6, the work supporting pallet 56 is shifted to station #7. (See FIGS. 1 and 15). At station #7, a dowel 38 is directed from a feeder or hopper 148 through a chute 150 into a position of alignment with a hydraulic actuator mechanism 152. The actuator 152 shifts a delivered dowel 38 into position of alignment with a vertically movable actuator 154. A holding device 156 carried at the free extremity of the piston rod of the rod of the actuator 154, engages the dowel 38 and pushes said dowel upwardly into a complementary aperture 158 (FIG. 15) in the housing 28. After the work supporting pallet 56 at station #7 has been unclamped and the actuators 152—154 retracted, said pallet is moved to station #8.

At station #8 (FIGS. 1 and 16) after the work supporting pallet has been properly located and clamped, the housing is in readiness to receive the impeller 40. Impellers are supplied from a suitable feeder or hopper 160 and directed through a chute 162 into the path of an actuator 164. This actuator 164 moves the impeller 40 to the left, FIG. 16, to a position beneath a push plate device 166, carried at the free end of the position rod of a hydraulic actuator 168. This actuator 168 delivers the impeller 40 to the aperture or recess provided therefor in the housing 28 and into telescopic association with the upper shaft portion of the bearing and slinger assembly 30, immediately above the previously assembled seal member or assembly 36. The workpiece is now ready to be shifted to station #9. Station #9 is an idle station to permit inspection of the parts thus far assembled.

From station #9, the pallet and workpiece supported thereby are shifted to station #10. (See FIGS. 1 and 17.) At station #10 the water plug 48 is screwed into a threaded opening 170 in the housing. A feeder or hopper 172 carries a supply of threaded water plugs and a chute 174 serves to direct a plug 48 to a position where it may be engaged by a clutch 176 of a torque applying device 178. This device 178 may be shifted axially by a hydraulic actuator mechanism 180. At the proper interval of time the actuator 180 advances the rotatable torque applying device so as to cause the clutch 176 to engage the head of the screw plug 48 and rotatably advance said screw into the complementary threaded opening 170. The workpiece is now in condition for advancement to station #11.

At station #11, the housing is ready for the final assembly operation. At this station the gasket 42, the cover 44 and six bolts 46 are applied. In FIG. 18, the method of handling a combined cover and gasket is shown. If the gasket 42 has been previously assembled with the cover 44, these two workpieces may be handled as a single unit and directed from a feeder or hopper 182 through a chute 184 into the path of an actuator 186. The actuator 186 serves to advance the combined cover and gasket into a position of registration with opening in the housing as shown in FIG. 18. With the cover and gasket in this position the bolts 46 are directed from suitable feeders or hoppers 188 through chutes 190 into positions where they may be acted upon by torque applying

spindles 192 carried by a head 194. The head 194 is coupled with a hydraulic actuator 196 and at the proper time said actuator advances the rotating torque applying spindles into engagement with the six screw heads simultaneously. The combined cover and gasket is thus secured in position upon the housing.

In FIG. 19, a slightly modified method of assembling the cover and gasket is contemplated. In some instances, the cover 44 and gasket 42 are not handled as a unit as previously described. Hence it is necessary to have, in addition to the hopper 182 and chute 184, a separate hopper 198 for the gaskets 42. A lifter device 200 elevates a gasket 42 from the hopper 198 and a hydraulic actuator 202 shifts the gasket into alignment with a second gasket holding plate or disc 204. The gasket is deposited upon the disc 204 and then a hydraulic actuator 206 elevates the gasket supporting disc so as to position the gasket against the underside of the plate 44. A hydraulic actuator 208 then functions to advance the torque applying spindles 192 into rotative engagement with the bolts 46. The bolts 46 are initially screwed into the cover 44 and then the spindles 192 are withdrawn. The actuator 186 shifts the combined cover gasket and bolts into registration with the housing 28 and a second set of torque applying spindles 192*a* are shifted by a hydraulic actuator 196*a* into engagement with the bolts whereby to impart final tightening thereto. The plate or cover 44 and gasket 42 are now clamped firmly in position and the completely assembled pump structure or unit is ready to be shifted or advanced to an idle station #12 for final inspection before pressure testing.

At station #13, the assembled pump parts are subjected to a pressure test, see FIGS. 1, 20 and 21. The intake side of the pump housing 28 is sealed by a ring or cap 210, FIG. 21, which is held in sealing contact with the housing intake by a hydraulic clamping mechanism 212. Water for test purposes is introduced through a conduit 214. The outlet side of the pump housing is coupled with a conduit 216 which is connected with a suitable pressure gauge 218. A hydraulic actuator 220 urges a clamping plate 222 against the housing 28 as shown in FIG. 20 and a tube sealing member 224 is held in sealing engagement with the open extremity of the water tube 34. Rubber members 226 and 228 also sealingly engage the housing 28 under the influence of the clamping member 222.

With the housing thus sealed, a rotating clutch mechanism 230 imparts rotation to the hub 32 and the impeller 40 is subjected to normal operating conditions. If the pump maintains the required water pressure as shown by the indicator or gauge 218, it is then ready for delivery to its ultimate place of use or assembly with the water system of an automobile or truck.

After the step of water pressure testing has been completed and the housing completely unclamped from its pallet it is unloaded at station #14 to which it is advanced from station #13. An operator removes the tested and completely assembled pump structure from station #14 and places it upon a suitable conveyor 232.

As previously stated, suitable control mechanism, hydraulic devices and the like are used to render the apparatus just described completely automatic. However, for a clear understanding of the novel and highly practical method of assembly and testing contemplated by the present invention, the foregoing description will suffice. It will be apparent that the present invention enables the assembly of pump structures by the practice of simple methods and thus makes it possible to reduce to a minimum the cost of such assembly procedures. By advancing the housings of the pumps along a predetermined path intermittently and bringing parts to be assembled from adjacent sources of supply and into juxtaposition with respect to said housing at succeeding stations along said predetermined path, the ease with which the assembly may be accomplished is greatly enhanced. Also, these improved methods assure not only speed of assembly but

also accuracy and uniformity with minimum manual effort.

While certain details in structure have been described herein, it will be understood that changes in such details are contemplated without departing from the spirit and scope of the appended claims.

The invention is hereby claimed as follows:

1. The method of assembling pump structures of the type incorporating a housing, impeller means within said housing, and other cooperating pump parts, said method comprising the delivery of a pump housing to shiftable supporting means, securing said housing in a predetermined position on said supporting means, shifting said supporting means intermittently along a predetermined path, effecting a predetermined dwell thereof at various stations along said path, maintaining a supply of pump parts of a specific kind in the vicinity of each of said stations such as bearing and shaft assemblies, seal devices for said bearing and shaft assemblies, impellers for said shafts, covers and gaskets for said housing, screws for securing the latter to said housing, and screw plugs for said housing, directing a bearing and shaft assembly to said housing, forcing said assembly axially into said housing, directing a shaft and bearing sealing device to said housing and axially forcing said sealing device into said housing and over said shaft, directing an impeller to said housing and axially moving said impeller into assembly with said housing and shaft, directing a cover and gasket to said housing in position to be secured thereto, directing cover securing screws to said cover and gasket and rotatably inserting said screws so as to clamp the cover and gasket in final position against said housing, directing a screw plug to said housing and rotatably inserting said plug within said housing, all of the aforesaid assembling steps taking place during dwelling of the housing supporting means at successive ones of said stations, and removing said housing from said path after the aforesaid parts have been associated properly therewith and thus permitting the housing support to be advanced along said path to receive another pump housing.

2. The method of assembling pump structures of the type incorporating a housing, impeller means within said housing, and other cooperating pump parts, said method comprising the delivery of a pump housing to shiftable supporting means, securing said housing in a predetermined position on said supporting means, shifting said supporting means intermittently along a predetermined path, effecting a predetermined dwell of said supporting means at various stations along said path, maintaining a supply of pump parts of a specific kind in the vicinity of each of said stations such as bearing and shaft assemblies, seal devices for said bearing and shaft assemblies, impellers for said shafts, covers and gaskets for said housing, screws for securing the latter to said housing, and screw plugs for said housing, directing a bearing and shaft assembly to said housing, forcing said assembly axially into said housing, directing a shaft and bearing sealing device to said housing and axially forcing said sealing device into said housing and over said shaft, directing an impeller to said housing and axially moving said impeller into assembly with said housing and shaft, directing a cover and gasket to said housing in position to be secured thereto, directing cover securing screws to said cover and gasket and rotatably inserting said screws so as to clamp the cover and gasket in final position against said housing, directing a screw plug to said housing and rotatably inserting said plug within said housing, all of the aforesaid assembling steps taking place during dwelling of said housing supporting means at successive stations and including the application of hydraulic power for shifting the various pump parts, and removing said housing from said path after the aforesaid parts have been associated properly therewith and thus permitting the housing support to be advanced along said path to receive another pump housing.

3. The method of assembling pump structures of the type incorporating a housing, impeller means within said housing, and other cooperating pump parts, said method comprising the delivery of a pump housing to shiftable supporting means, securing said housing in a predetermined position on said supporting means, shifting said supporting means intermittently along a predetermined path, effecting a predetermined dwell thereof at various stations along said path, maintaining a supply of pump parts in the vicinity of said stations as follows, pump housings, bearing and shaft assemblies, shaft sealing devices, pump pulleys for said shafts, by-pass tubes for the housing, pump impellers, pump dowels, screw plugs for said housing, covers and cover gaskets for the housing, and screw elements for securing said covers and gaskets to said housing, at one of said stations, directing one of the aforesaid pump parts toward and into assembled relation with respect to another of said parts during dwelling of said supporting means in each of a plurality of each stations, subjecting the assembled pump structure to fluid pressure testing by first sealing certain pump openings and then rotating the impeller to develop fluid pressure at the discharge side of the pump, and after said parts have been assembled and fluid pressures tested, removing the pump structure from its support.

4. Integrated pump assembling apparatus comprising, in combination, a plurality of assembly supports, means for intermittently indexing said supports through a closed path to locate the individual supports in a succession of stations along said path, pump assembly clamping means carried by each of said supports, a leading one of said stations constituting a housing mounting station, pump housing supply means extending to said housing mounting station; a pump shaft feeding unit, a pump impeller feeding unit, and a pump cover feeding unit mounted in feeding relation to individual stations following said housing mounting station; power operated pump component transfer means and power operated assembly means mounted in coacting relation with said respective feeding units and in operative association with the corresponding feeding stations to transfer pump components from said feeding units into predetermined assembly positions in the respective corresponding stations, a gasket feeding unit mounted in association with said cover feeding unit, power operated transfer means coacting with said gasket feeding unit to transfer gaskets therefrom into assembled relation to covers supplied from said cover feeding unit, a plurality of threaded fastener feeding units associated with said cover feeding unit to supply threaded fasteners to successive covers supplied by said cover feeding unit, a plurality of power operated threaded fastener driving spindles mounted in association with said gasket transfer means said cover feeding unit and said fastener feeding units to assemble threaded fasteners from said fastener supply units into covers and gaskets assembled from said cover and gasket feeding units, and a second plurality of power operated threaded fastener driving spindles mounted at said station corresponding to said cover feeding unit for driving threaded fasteners into assembled relation to a pump housing in said last mentioned station.

5. Integrated pump assembly apparatus comprising, in combination, an interconnected series of assembly support elements, means supporting said elements for movement in unison along a closed path, indexing means coacting with said support elements to intermittently index the latter along said path to locate each individual support element in a succession of stations along said path, pump housing clamping means carried in association with each of said assembly support elements, a leading one of said stations constituting a housing mounting station, pump housing supply means extending to said housing mounting station, a housing locating element movably supported at said housing mounting station, power means coacting with said locating element to controllably extend and retract

the locating element with reference to a housing locating position thereof, bearing supply means mounted alongside said path, a power operated translatable bearing gripper movable from said bearing supply means into overlying relation to a bearing assembly station following said housing mounting station, a vertically movable power operated bearing applying element mounted in overlying relation to said bearing assembly station to move a bearing from said gripper into assembled relation to an underlying housing, impeller supply means and pump cover supply means mounted respectively in alinement with two stations following said housing mounting station, power operated impeller transfer means mounted for transferring individual impellers from said impeller supply means into assembled relation with pump housings on successive support elements indexed into the adjacent station, power operated transfer means mounted for shifting pump covers from said cover supply means into overlying relation to impeller containing housings supported by successive support elements indexed into the adjacent station, a plurality of power operated threaded fastener driving spindles movably supported at said last mentioned station, power means for advancing said spindles into operative threaded fastener driving positions in relation to said last mentioned station, a trailing one of said stations constituting a test station, fluid supply means movably disposed at said test station, fluid means for advancing said fluid supply means into connected relation to an assembled pump in said test station, pump opening sealing means movably supported at said test station, and power means for advancing said sealing means into closing engagement with an opening in a pump in said test station.

6. Integrated pump assembly apparatus comprising, in combination, a plurality of support elements, indexing means coacting with said support elements to intermittently index the latter along a closed path to locate each individual support element in a succession of stations along said path, pump housing clamping means carried in association with each of said assembly support elements, a leading one of said stations constituting a housing mounting station, pump housing supply means extending to said housing mounting station, power operated shaft supply means mounted alongside said path, shaft gripper means movable from said shaft supply means into alinement with a shaft assembly station following said housing mounting station, a power operated translatable shaft applying element mounted in alinement with said shaft assembly station to move a shaft from said gripper means into assembled relation to an underlying housing in said shaft assembly station, impeller supply means and pump cover supply means mounted respectively in alinement with two stations following said housing mounting station, power operated impeller transfer means mounted for transferring individual impellers from said impeller supply means into assembled relation with pump housings on successive support elements indexed into the adjacent station, power operated transfer means mounted for shifting pump covers from said cover supply means into assembled relation to impeller containing housings supported by successive support elements indexed into the adjacent station, a trailing one of said stations constituting a pressure test station, fluid supply and exhaust connection means movably disposed at said test station, power means for advancing said fluid supply and exhaust connection means into connected relation to a pump in said test station, and fluid pressure detection means connected to respond to fluid pressure from said fluid supply and exhaust connection means.

7. The method of assembling and testing rotary pumps individually comprising a pump housing, a shaft, a shaft seal, a shaft pulley, a pump impeller, a bypass tube, a housing screw plug, a housing cover and gasket, and housing cover screws; said method comprising intermittently indexing an endless series of assembly supports in unison through a closed path to locate the individual supports in a succession of stations including a housing mounting station, a shaft assembly station, a pulley assembly station, a bypass tube assembly station, a shaft seal assembly station, an impeller assembly station, a housing plug assembly station, a cover assembly station, a testing station, and an unloading station; placing a pump housing in each successive support indexed into said housing mounting station, clamping each housing in the support in which it is placed, power operating a shaft transfer device in timed relation to the indexing of said assembly supports to transfer a shaft laterally into alinement with each successive pump housing indexed into said shaft assembly station and into alinement with a shaft inserting element, power operating a shaft inserting element in synchronism with said trasfer device to move a shaft from said transfer device axially into a pump housing in said shaft assembly station, feeding a succession of shafts to said transfer device as an incident to operation of the latter, power operating a pulley transfer device in timed relation to indexing of said assembly supports to transfer a pulley laterally into alinement with each succeeding housing indexed into said pulley assembly station and into alinement with a pulley placement device, power operating the pulley placement device in synchronism with said pulley transfer device to move a pulley axially into assembled relation to a pump shaft in said pulley assembly station, feeding a succession of pulleys to said pulley transfer device as an incident to operation of the latter, power operating a bypass tube transfer device in timed relation to the indexing of said assembly supports to transfer a bypass tube into alinement with each successive pump housing indexed into said bypass tube assembly station and into alinement with a bypass tube inserting device, power operating said bypass tube inserting device in synchronism with said bypass tube transfer device to insert a bypass tube into each pump housing moved into said bypass tube assembly station, feeding a succession of bypass tubes to said bypass tube transfer device as an incident to operation of the latter, power operating a shaft seal transfer device in timed relation to the indexing of said assembly supports to transfer a seal laterally into alinement with the shaft of each successive pump housing indexed into said shaft seal assembly station and into alinement with a seal inserting element, power operating said seal inserting element in synchronism with said seal transfer device to insert a seal into assembled relation to each assembled shaft and housing indexed into said seal assembly station, feeding a succession of seals to said seal transfer device as an incident to operation of the latter, power operating an impeller transfer device in timed relation to the indexing of said assembly supports to transfer an impeller laterally into alinement with each successive pump housing and shaft indexed into said impeller assembly station and into alinement with an impeller pushing device, power operating said impeller pushing device in synchronism with said impeller transfer device to move an impeller from said impeller transfer device axially into assembled relation to a shaft and housing in said impeller assembly station, feeding a succession of impellers to said impeller transfer device as an incident to operation of the latter, power operating a housing plug transfer device in timed relation to the indexing of said assembly supports to transfer a housing plug into alinement with each of said pump housings indexed into said housing plug assembly station and into alinement with a housing plug rotary driving device, power operating said housing plug driving device in synchronism with said housing plug transfer device to thread a housing plug into a pump housing in said housing plug assembly station, feeding a succession of housing plugs into said housing plug transfer device as an incident to operation of the latter, power operating a cover transfer device in timed relation to the indexing of said assembly supports to transfer a housing cover into

alinement with each successive pump housing indexed into said cover assembly station, power operating a multiple spindle threaded fastener driving unit in said cover assembly station and in synchronism with said cover transfer device to secure a cover to a housing in said cover assembly station by means of a plurality of threaded fasteners, supplying a succession of housing covers to said housing cover transfer device as an incident to operation of the latter, supplying a plurality of threaded fasteners to said multiple spindle driving unit as an incident to operation of the latter through successive operating cycles thereof, power advancing fluid supply and exhaust connections into connected relation to each successive housing indexed into said testing station, rotating the shaft in each successive pump housing indexed into said testing station to effect a test of each pump assembly indexed into said testing station, retracting said fluid supply and exhaust connection from each pump assembly tested in said testing station, and removing tested pump assemblies from said unloading station.

8. The method of assembling and testing rotary pumps individually comprising a pump housing, a shaft, a shaft pulley, a pump impeller, a housing cover, and housing cover screws; said method comprising intermittently indexing an endless series of assembly supports in unison through a closed path to locate the individual supports in a succession of stations including a housing mounting station, a shaft assembly station, a pulley assembly station, an impeller assembly station, a cover assembly station, a testing station, and an unloading station; placing a pump housing in each successive support indexed into said housing mounting station, clamping each housing in the support in which it is placed, power operating a shaft transfer device in timed relation to the indexing of said assembly supports to transfer a shaft from a shaft feeder into alinement with each successive pump housing indexed into said shaft assembly station and into alinement with a shaft inserting element, power operating a shaft inserting element in synchronism with said transfer device to move a shaft from the transfer device axially into a pump housing in said shaft assembly station, power operating a pulley transfer device in timed relation to indexing of said assembly supports to transfer a pulley from a pulley feeder into alinement with each succeeding housing indexed into said pulley assembly station and into alinement with a pulley placement device, power operating the pulley placement device in synchronism with said pulley transfer device to move a pulley axially into assembled relation to a pump shaft in said pulley assembly station, power operating an impeller transfer device in timed relation to the indexing of said assembly support to transfer an impeller laterally from an impeller feeder into alinement with each successive pump housing and shaft indexed into said impeller assembly station and into alinement with an impeller pushing device, power operating said impeller pushing device in synchronism with said impeller transfer device to move an impeller axially into assembled relation to a shaft and housing in said impeller assembly station, power operating a cover transfer device in timed relation to the indexing of said assembly supports to transfer a housing cover into alinement with each successive pump housing indexed into said pump housing assembly station, power operating a multiple spindle threaded fastener driving unit in said housing cover assembly station and in synchronism with said housing cover transfer device to secure a cover to a housing in said cover assembly station by means of a plurality of threaded fasteners, supplying a succession of housing covers to said housing cover transfer device as an incident to operation of the latter, feeding a plurality of threaded fasteners to said multiple spindle fastening device as an incident to operation of the latter, power advancing fluid supply and exhaust connections into connected relation to each successive housing indexed into said testing station, rotating the shaft in each successive pump housing indexed into said testing station to effect a pump test, retracting said fluid supply and exhaust connection from each pump assembly tested in each of said testing stations, and removing tested pump assemblies from said unloading station.

9. Apparatus for assembling and testing rotary pumps which individually comprise a pump housing, a shaft, a shaft pulley, a pump cover, a housing cover, and threaded housing cover attaching elements; said apparatus comprising a plurality of assembly support elements interconnected in an endless series, means supporting said elements for movement in unison along a closed path; indexing means coacting with said support elements to intermittently index the latter along said path to locate each individual support element in a succession of stations along said path including, a housing mounting station, a shaft assembly station, a pulley assembly station, an impeller assembly station, a cover assembly station, a pump testing station, and an unloading station; means for supplying pump housings to said housing loading station for moving in each successive support element indexed into said housing loading station, a shaft feeder mounted at said shaft assembly station, a translatable shaft transfer device including a shaft gripping element and hydraulic means for extending and retracting said gripping element to travel between said feeder and an extended position alined with a pump housing in a support element in said shaft assembly station, means for opening said gripping element to receive a shaft as an incident to retraction of the gripping element, a hydraulically operated shaft inserting element positioned at said shaft assembly station to force a shaft from said gripping element into a housing supported in said shaft assembly station, a pulley feeder mounted at said pulley assembly station, a hydraulically powered pulley transfer element coacting with said pulley feeder to move individual pulleys from said pulley feeder into alinement with shafts in successive housings indexed into said pulley assembly station, a hydraulically powered pulley placement device coacting with said pulley transfer device to move a pulley from the latter into assembled relation to a shaft in said pulley assembly station, an impeller feeder mounted at said impeller assembly station, a hydraulically powered impeller transfer device coacting with said impeller feeder to transfer individual impellers from the latter into alined relation to pump shafts in successive pump housing indexed into said impeller assembly station, a hydraulically powered impeller pushing device mounted in said impeller assembly station to move an impeller from said impeller transfer device axially into assembled relation to a shaft in a housing in said impeller assembly station, a cover feeder mounted at said cover assembly station, a hydraulically powered cover transfer device coacting with said cover feeder to transfer individual covers from the latter into alined relation to successive housings indexed into said cover assembly station, a plural spindle threaded fastener assembly unit positioned at said cover assembly station, means for feeding threaded fasteners to said fastener assembly unit, means for operating said fastener assembly unit to secure covers to successive housings in said cover assembly station, a power driving clutch in said testing station engageable with pump shafts in successive housings indexed to said testing station to drive assembled pumps therein, a fluid supply and exhaust connection unit mounted at said testing station, hydraulic actuating means coacting with said connection unit to move the latter into coacting relation to successive pump assemblies indexed into said testing station, and a fluid pressure responsive element connected to respond to pump output pressure applied to said connection unit.

10. Apparatus for assembling and testing rotary pumps which individually comprise a pump housing, a shaft, a shaft pulley, a pump cover, a housing cover, and threaded housing cover attaching elements; said apparatus comprising a plurality of assembly support elements interconnected in an endless series; indexing means coacting

with said support elements to intermittently index the latter along a closed path to locate each individual support element in a succession of stations along said path including, a housing mounting station, a shaft assembly station, a pulley assembly station, an impeller assembly station, a cover assembly station, a pump testing station, and an unloading station; means for supplying pump housings to said housing loading station for mounting in each successive support element indexed into said loading station, a shaft feeder mounted at said shaft assembly station, power operated shaft assembly means mounted at said shaft assembly station for power assembling shafts from said feeder into successive housings indexed into said shaft assembly station, a pulley feeder mounted at said pulley assembly station, hydraulically powered pulley assembly means coacting with said pulley feeder to move individual pulleys from said feeder into assembled relation to shafts in successive housings indexed into said pulley assembly station, an impeller feeder mounted at said impeller assembly station, hydraulically powered impeller assembly means coacting with said impeller feeder to move individual impellers from the latter into assembled relation to pump shafts in successive pump housings indexed into said impeller assembly station, a cover feeder mounted at said cover assembly station, hydraulically powered cover assembly means coacting with said cover feeder to move individual covers from the latter into alined relation to successive housings indexed into said cover assembly station, a plural spindle threaded fastener driving unit positioned at said cover assembly station,

means for feeding threaded fasteners to said fastener driving device, means for operating said fastener driving unit to secure covers to successive housings indexed into said cover assembly station, a power driving element in said testing station engageable with pump shafts and housings in said testing station to drive assembled pumps therein, a fluid supply and exhaust connection means mounted at said testing station, power means coacting with said connection means to move the latter into coacting relation to successive pump assemblies indexed into said testing station, and a fluid presure responsive element connected to respond to pump pressure applied to said connection means.

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