Sept. 15, 1959 G. M. TARZIAN 2,903,914

DRIVE MECHANISM FOR AUTOMATIC ASSEMBLY MACHINES

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Fig. 1.

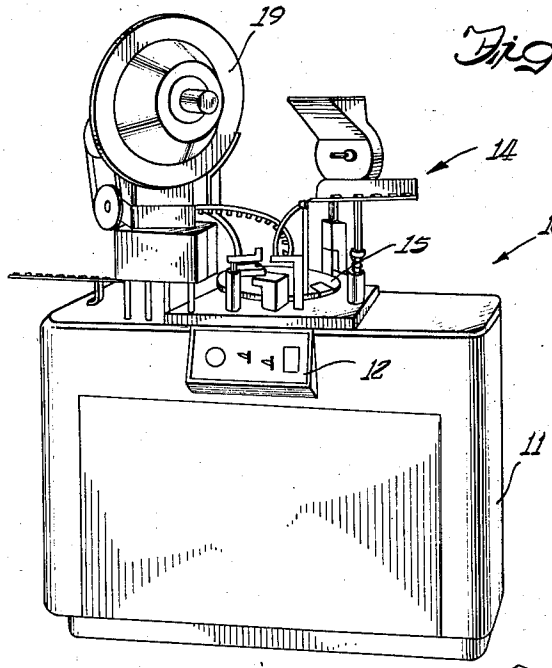
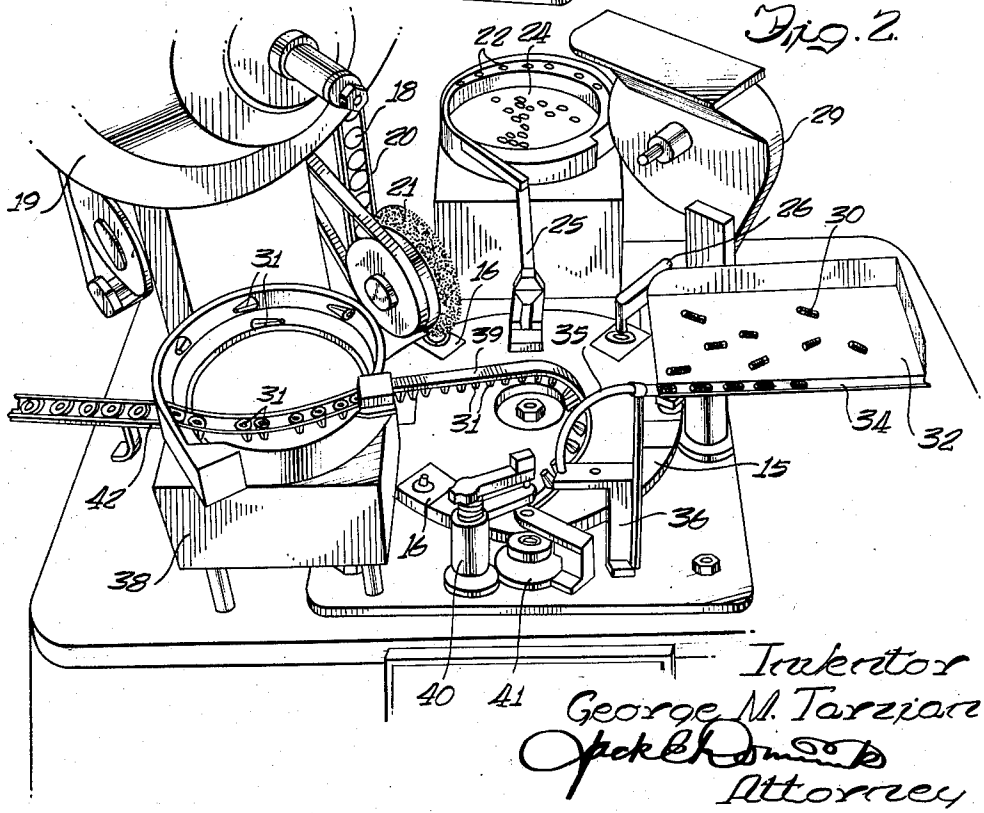


Fig. 2.



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Fig. 3.

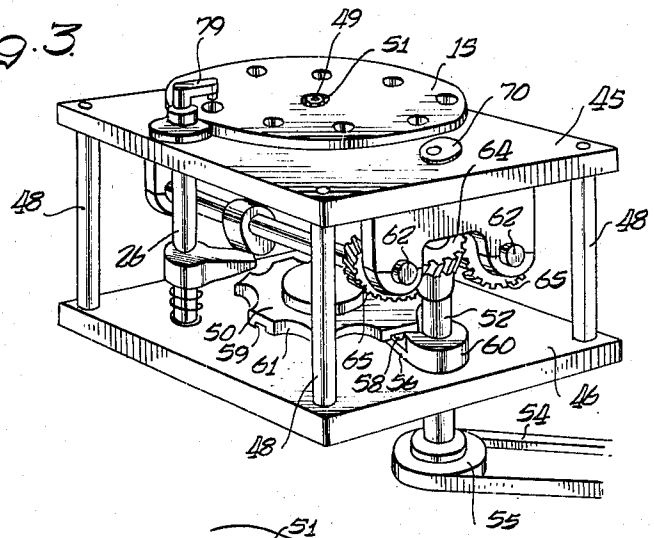
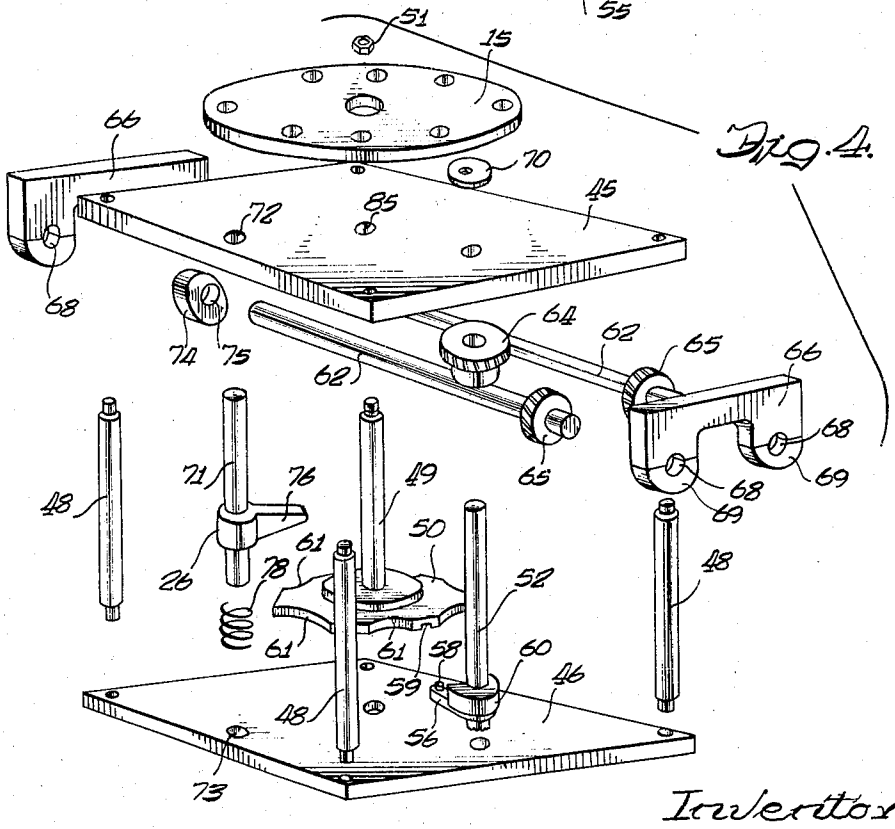


Fig. 4.



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Fig. 5.

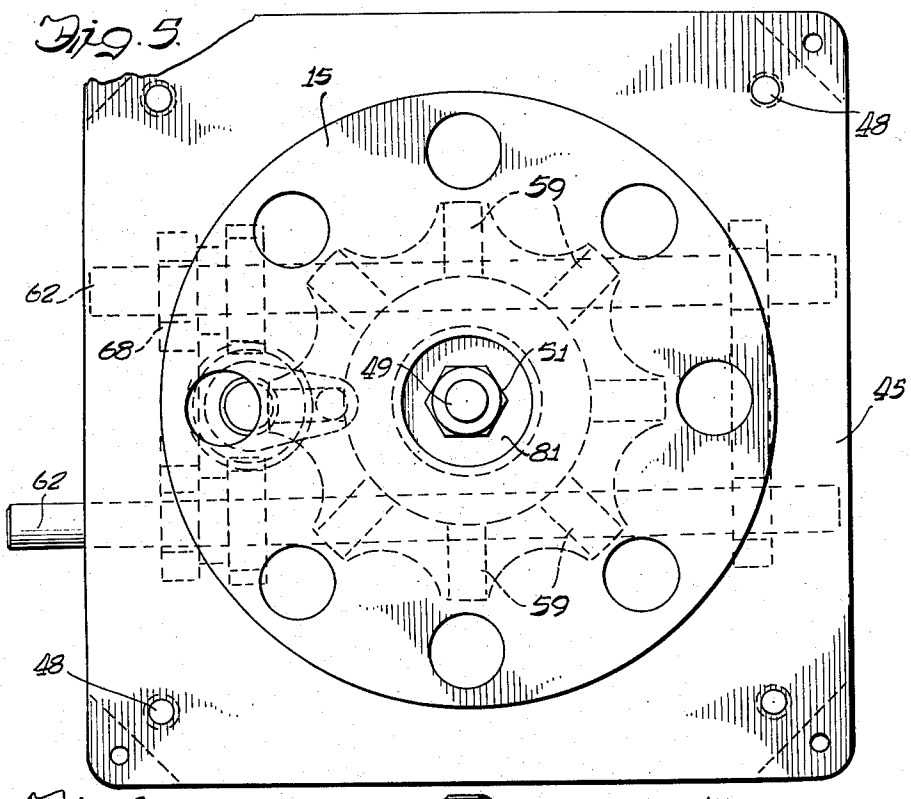
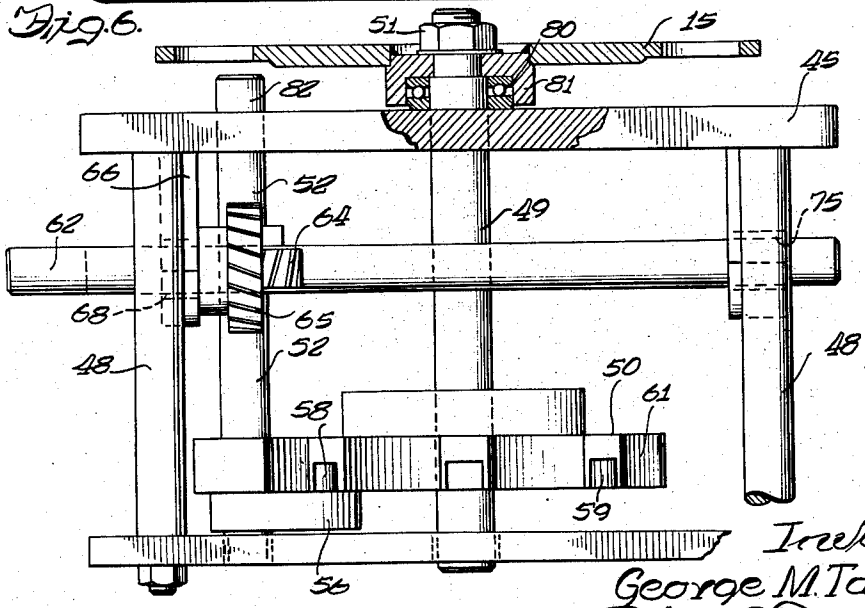


Fig. 6.



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DRIVE MECHANISM FOR AUTOMATIC ASSEMBLY MACHINES

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Fig. 7.

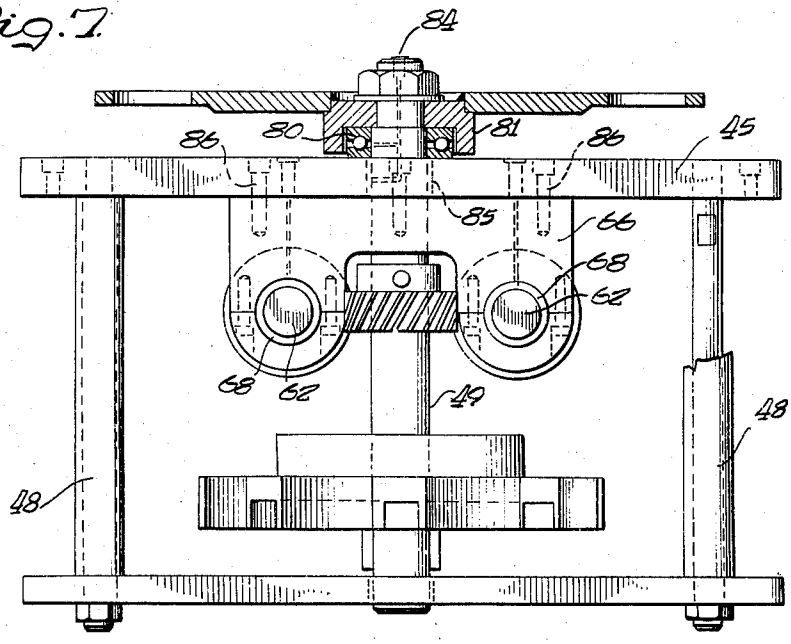


Fig. 8.

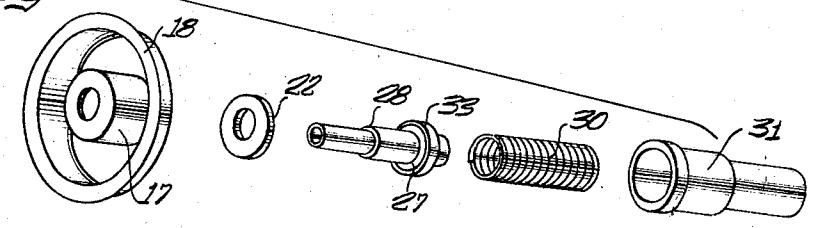


Fig. 9.

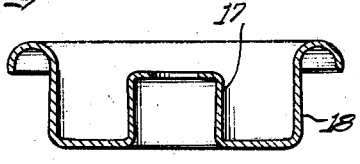
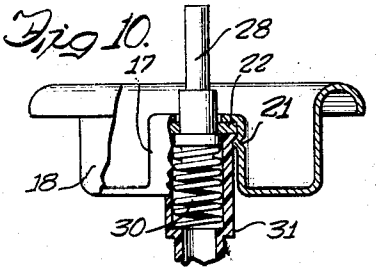


Fig. 10.



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2,903,914

DRIVE MECHANISM FOR AUTOMATIC ASSEMBLY MACHINES

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Application April 5, 1956, Serial No. 576,476

7 Claims. (Cl. 74—820)

The present invention relates generally to machinery for automatic assembly. In particular, the invention deals with a combination gear and work table motion which render the unit flexible for adaptation to a wide variety of assembly setups.

With the increasing costs for hand labor the trend in industry is for automatic assembly. Indeed, it is widely said that industry is approaching the age of automation. But with the advent of automatic machinery new problems are introduced. The automatic machines must be economically feasible, that is, their saving must be high enough to justify their initial cost. If the automatic units are fraught with maintenance problems, their out-of-service time and repair costs can convert the asset to a liability. In addition, a worker can be trained for a new job, but a machine must be rebuilt. Consequently, when automatic assembly units are not susceptible of ready modification their salability is reduced.

With the foregoing in mind, it is the general object of the present invention to provide a motion which permits the construction of a wide variety of automatic assembly machinery. A related object is to furnish such a motion which is readily adaptable to changes in assembly technique or even adaptation to a different product.

More detailed objects of the invention are to provide a motion for automatic assembly machinery which saves space in the mechanism, permits accurate timing of related movements, and achieves a maximum of power transmission.

Another object of the invention is to furnish an automatic assembly machine motion which is susceptible of easy repair and maintenance.

Still another object of the invention is to provide an automatic assembly machine motion which may be standardized thereby reducing the costs of the various completed machines especially adapted for custom assembly work.

Further objects and advantages of the present invention will become apparent as the following description of an illustrative embodiment proceeds, taken in conjunction with the accompanying illustrative drawings in which:

Figure 1 is a frontal perspective view of a completed machine embodying the present invention.

Fig. 2 is an enlarged perspective view of the machine shown in Fig. 1 viewed from a level above the assembly table and showing the various auxiliary mechanisms driven by the basic machine.

Fig. 3 is a perspective view of the internal drive mechanism employed in the illustrative machine shown in Figs. 1 and 2.

Fig. 4 is an exploded view of the assembly shown in perspective in Fig. 3.

Fig. 5 is a top view of the mechanism shown in Fig. 3.

Fig. 6 is a front elevation of the mechanism shown in Fig. 5.

Fig. 7 is an end view of the mechanisms shown in Figs. 5 and 6 viewing the mechanism as it would appear from the left edge of the mechanism.

Fig. 8 is an exploded view of a typical product which may be assembled by the machine shown in Figs. 1 and 2.

Fig. 9 is a cross section of the cap shown at the left hand portion of Fig. 8 in perspective.

Fig. 10 is a partial sectional view of the components shown in Fig. 8 illustrating their assembled relationship.

Although the invention has an infinite variety of ultimate usages, they all depend for their utility upon a unique motion. In broad outline the basic motion contemplates a rotating work table which is driven intermittently. The work table drive is directly coupled to a cam shaft which drives the various stations at the work table in accurate timed relation to the movement and dwell of the turntable. In the unit shown, the work table is driven by a Geneva star wheel. The same shaft which powers the Geneva driver also powers the work station cam shafts. Since the cam shafts are located between the Geneva wheel and the work table, the entire unit may be housed in a very compact cage.

The significance of the invention will be more fully understood as an example of a finished machine embodying the unique motion is described. Referring now to Fig. 1, it will be seen that the assembly machine **10** automatically assembles the components for an "aerosol" bomb cap assembly. The machine contemplates a drive housing in a base **11** and a control panel **12** and a multitude of assembly auxiliary units **14** which are controlled by internal mechanism of the machine which embodies the present invention.

Insofar as external appearances are concerned, the heart of the assembly operation is the rotating work table **15**, best illustrated in Fig. 2, which has a plurality of peripheral work stations **16** in which the bomb cap unit is progressively assembled during the course of the intermittent rotation work table **15**.

The steps in sequential operation involve first feeding the caps **18** from the cap assembly and feeder **19** down through a magazine **20** to the associated work station **16** where the cap is then placed in the intermittently rotating work table **15**. A buffing wheel **21** is employed to clean off the working face of the cap **18**. When the cap comes down to the second station, washers **22** are fed by washer feeder mechanism **24** into a washer magazine **25** from which the washers are dropped into the cap **18**. At the next station the washer is seated by means of the washer seating mechanism **26**. Thereafter the stems **28** are fed by the stem feeder **29** into the cap. The cap, washer and stem then move to the next assembly station where the spring **30** and cup **31** are simultaneously positioned on the cap assembly and crimped in place. The spring feeder **32** delivers the springs into its side gutter **34** and thereafter into the spring magazine **35** which leads to the spring feeder **36**. The cups **31** are fed by a vibration feeder assembly **38** to the cup magazine **39** and down into place over the work station where the cup feeder **40** fits the cup in place over the cap assembly in timed relation with the operation of the crimping station **41**. Thereafter the assembled unit moves into position adjacent the ejection track **42** where the assembled caps are ejected and delivered for inspection and boxing.

As pointed out above the heart of the invention is in the motion employed to intermittently drive the work table **15** and supply a timed actuation of the multitude of assembly steps in accordance with the rotation of the work table **15**. The motion itself, as illustrated in Figs. 3 and 4, evidences a simplicity not easily detectable from the complexity of a typical assembly machine such

as just described above. As will be seen in Fig. 3, the motion driving the work table **15** is housed in a cage defined generally by the confines of the upper cage plate **45** and lower cage plate **46**, the cage plates being separated at their four corners by means of the cage plate support posts **48**.

The work table drive shaft **49** is driven by a Geneva drive wheel **50**. The Geneva drive wheel **50** is parallel with the work table **15** as a result of the drive shaft **49** being mutually perpendicular with the work table **15** and Geneva drive wheel **50**. The work table drive shaft **49** is secured to the drive table **15** by means of a mounting nut **51**. A main drive shaft **52** supplies the power to the intermittent drive mechanism and also the auxiliary units. In the present instance the main drive shaft is shown as driven by a V-belt **54** which engages a pulley **55** which is keyed or otherwise secured to the main drive shaft **52**. The Geneva wheel **50** is driven by the Genva driving dog **56** which is also secured to the main drive shaft **52**. The Geneva driving dog has a driving tooth **58** at its end portion which engages the radial drive slots **59** at the under portion of the Geneva drive wheel **50**. Similarly, the Geneva wheel **50** is secured in place for a dwell period by means of the semi-circular dwell lock **60** secured to the main drive shaft **52** above the driving dog **56**. The dwell lock **60** cooperates with the semi-circular dwell lock recesses **61** which characterize the external configuration of the Geneva drive wheel **50**.

The auxiliary equipment contemplated for use with an automatic assembly unit such as might be adapted to the motion of the invention is driven by a cam shaft **62**, the cam shaft **62** being driven by main drive shaft **52**. More specifically, it will be seen that a helical type gear **64** is secured to the main drive shaft **52** between the upper cage plate **45** and the Geneva drive dog **56**. The cam shafts **62** have mating helical cam shaft gears **65** located to mesh with the cam shaft drive gear **64**. The cam shafts, it will be seen, are journaled in parallel relation to the upper cage plate by means of the cam shaft pillow blocks **66** which are secured to the upper cage plate **45** against its lower face. The pillow blocks **66** shown each have two bearings **68** which may be split by removing the bearing caps **69** for the purpose by easy assembly and maintenance. Although a pair of parallel cam shafts have been shown as driven by the cam shaft drive gear **64**, it will be appreciated that in some instances a single cam shaft may work effectively, and in other instances additional gearing may be employed to drive more than two cam shafts, the additional gearing being slaved to the main drive shaft **52**.

In further keeping with the utilization of all functional elements an ejection cam **70** is secured to the main drive shaft **52** and serves to eject the piece part being assembled on the work table **15**.

In Figs. 3 and 4 the washer seating mechanism **26** has been shown for illustrative purposes to demonstrate how the various auxiliary stations are actuated by the cam shafts **62** in timed relation to the main drive shaft **52**. The seating mechanism contemplates a main shaft **71** which pierces the upper cage plate **45** and lower cage plate **46** through holes **72**, **73**. A washer seating cam **74** is bored with a hole **75** to be fitted and secured to the cam shaft **62**. The cam follower **76** is secured to the washer seating main shaft **71** and drives the washer seating main shaft in reciprocatory fashion respective to the action of the cam **74**. The return spring **78** moves the washer seating head **79** back to its neutral position after the seating has been accomplished by the cam **74** on the cam follower **76**.

Referring now to Figs. 5 through 7, some of the additional detailed features of the motion cage shown in Figs. 3 and 4 will be seen. A ball type thrust bearing **80** is housed in a thrust bearing retaining ring **81** which in turn is secured to the rotating work table **15**. It will also be seen, particularly in Fig. 6, that the main drive shaft upper end **82** projects above the upper cage plate **45** where it receives the ejection cam **70** (not shown in Fig. 6). In Fig. 7 it will be seen that a number of oil holes have been provided in order to satisfactorily lubricate the main thrust bearing **80** as well as the bearing **68** which support the cam shafts **62**. The oil hole **84** at the top of the work table drive shaft **49** is bored to diverge the oil into the thrust bearing **80** as well as the journal bearing **85**. The cam shaft bearing **68** may be similarly provided with lubrication facilities.

It will be noted that the pillow block assemblies **66** are secured to the upper cage plate **45** by means of mounting studs **86**.

An appreciation of the complexity of assembly operations which may be performed by the simple driving mechanism shown and described above will become apparent as the details of the aersol bomb cap assembly shows in Figs. 8 through 10 are highlighted. In Fig. 8, particularly, the sequential assembled relationship between the cap **18**, washer **22**, stem **28**, operating spring **30**, and cup **31**, will be seen.

Although the cap **18**, as shown in Fig. 9, has an uninterrupted boss **17** in its central portion, the boss is crimped as at **21** shown in Fig. 10, to lock the cup in place within the boss **17**. In this assembled relationship, the stem when tilted sideways opens exhaust ports **27** in the exhaust port collar **33** which permits fluid under pressure to escape through the hollow central portion of the stem **28**.

The particular assembly unit shown in Figs. 1 and 2 is driven by a ¾ to 1 H.P. electric motor through a V-belt drive as pointed out above. A 1:1 gear ratio between the main drive shaft **52** and the cam shafts **62** has been employed, although it will be appreciated that different ratios may be utilized. The unit in operation was designed for and has successfully essembled one cap unit per second.

Because the helical type cam shaft type gears **64**, **65** are employed, a maximum amount of power may be transmitted from the main drive shaft **52** to the cam shafts **62** for driving the various auxiliary stations. Also, because the cam shafts, as well as the Geneva drive wheel **50** are positively driven from a single drive shaft **52** working tolerances for orienting the cams on the cam shafts run in the order of plus or minus 1°.

As will be seen particularly from reflection upon Figs. 3 and 4, the unique relationship between the intermittent drive mechanism and rotating work table with the auxiliary stations being driven by cam shafts which are in turn driven by the main drive shaft, provides a very compact driving unit. In addition, the location of the cam shafts in closed relationship to the upper cage plate permits the mounting of the various auxiliary units close to their source of actuation, and readily accessible for servicing. Also, it will be readily appreciated that the basic cage assembly may be adapted for a wide variety of assembly operations, thereby eliminating the expense of engineering a completely new unit each time a new automatic assembly problem is encountered.

Although particular embodiments of the invention have been shown and described in full here, there is no intention to thereby limit the invention to the details of such embodiments. On the contrary, the intention is to cover all modifications, alternative embodiments, usages and equivalents of the drive and control mechanism for intermittent rotating work tables as fall within the spirit and scope of the invention, specification, and appended claims.

I claim as my invention:

1. A caged driving and control mechanism for automatic assembly equipment having an intermittently rotating work table comprising, in combination, upper and lower cage plates, cage support posts proportioned and mounted to the cage plates to space the plates in parallel relation thereby defining a cage, a work table drive shaft

perpendicular to and journaled by the cage plates, means for securing the work table to its drive shaft above the upper cage plate, intermittent drive means secured to the work table drive shaft above the lower cage plate, a main drive shaft perpendicular to and journaled by the cage plates, driving means for actuating the intermittent drive secured to the drive shaft, a second shaft within said cage and journaled in parallel relation to the upper cage plate, and shaft drive means on the second shaft and main drive shaft within said cage for driving the second shaft, a work station control element on said second shaft within said cage, a work station mechanism secured to said cage and operably engaged by said control element, the movement of said element controlling the operation of said work station mechanism in timed relation to the work table.

2. A drive mechanism for an intermittently rotating work table characterized by a rigid frame, means journaling the work table for rotation on the frame, a plurality of operable auxiliary station mechanisms oriented around the work table and secured to the frame, a geneva wheel in spaced parallel driving relation with the work table, a main drive shaft within said frame and perpendicular with the work table, drive means for operating said main drive shaft, a geneva drive dog secured to the main drive shaft spaced to drivingly engage the Geneva wheel, a cam shaft drive gear secured to the main drive shaft between the Geneva drive dog and the plane of the work table within the frame, a pair of cam shafts within the frame and geared to the cam shaft drive gear, the cam shafts being oriented beneath and parallel with the work table, and control cams mounted on the cam shafts within the frame and adjacent the work table which operably engage the auxiliary work station mechanisms to control the operation of the auxiliary station mechanisms in timed relation to the rotational advancement of the work table.

3. A drive mechanism for an intermittently rotating work table surrounded by a plurality of auxiliary work station mechanisms characterized by a Geneva wheel in spaced parallel driving relation with the work table, a main drive shaft perpendicular with the work table, drive means for operating said main drive shaft, Geneva drive-means secured to the main drive shaft, auxiliary work station mechanism shaft operating means secured to the main drive shaft between the Geneva drive means and the plane of the work table within the area beneath the work table, and a pair of auxiliary work station mechanism shafts acauted by the auxiliary work station mechanism shaft operating means, the auxiliary work station mechanism shafts being oriented parallel with and within the area beneath the work table, and means fixed to the auxiliary work station mechanism shafts which operably engage the auxiliary station mechanism to control the auxiliary station mechanism operations in timed relation to the rotational advancement of the work table and consequent rotation of the work station shafts.

4. A drive mechanism for an intermittently rotating work table and associated work station mechanism characterized by a Geneva wheel in spaced parallel driving relation with the work table, a main drive shaft perpendicular with the work table drive means for operating said main drive shaft, a Geneva drive dog secured to the main drive shaft and operably engaging the Geneva wheel, cam shaft drive means secured to the main drive shaft between the Geneva drive dog and the plane of the work table within the area beneath the work table, a cam shaft driven by the cam shaft drive means, the cam shaft being oriented in the area beneath and parallel with the work table, and a control cam mounted on said cam shaft and operably engageable with the work station mechanism to control operation of the work station mechanism in timed relation to the rotation advancement of the work table.

5. A drive mechanism for an intermittently rotating work table and associated auxiliary work station mechanisms characterized by a Geneva wheel in spaced parallel driving relation with the work table, a main drive shaft perpendicular with the work table, drive means for operating said main drive shaft a Geneva drive means secured to the main drive shaft and operably engaging the Geneva wheel, cam shaft drive means secured to the main drive shaft between the Geneva drive means and the work table within the area beneath the work table, cam shafts actuated by the cam shaft drive means, the cam shaft being oriented in the area beneath the work table, and control cams mounted on said cam shafts and operably engageable with the work station mechanisms to control operation of the auxiliary work station mechanisms in timed relation to the rotational advancement of the work table.

6. A drive mechanism for an intermittently rotating work table and associated auxiliary work station mechanisms characterized by intermittent drive means in spaced parallel driving relation with the work table, a main drive shaft perpendicular with and in the area beneath the work table, intermittent drive actuating means secured to the main drive shaft, a cam shaft drive gear secured to the main drive shaft between the intermittent drive means and the plane of the work table within the area beneath the work table, and a pair of cam shafts geared to the cam shaft drive gear, the cam shafts being oriented in the area beneath and parallel with the work table, and cam and follower means coupling the cam shaft with the auxiliary work station mechanisms to control operation of the auxiliary work station mechanisms in timed relation to the rotational advancement of the work table.

7. A driving and control mechanism for automatic assembly equipment having an intermittently rotating work table, comprising, in combination, a circular work table, a plurality of work station mechanisms about the periphery of the work table, a work table drive shaft mounted to the work table and perpendicular therewith, a Geneva drive wheel secured to the work table drive shaft in spaced relation with the work table, a main drive shaft parallel with the work table drive shaft and in the area beneath the work table, a Geneva wheel dog secured to the main drive shaft, a cam shaft drive gear mounted to the main drive shaft between the work table and the Geneva wheel dog and within the area beneath the work table, a cam shaft geared to and driven by the cam shaft drive gear, the cam shaft being oriented perpendicular to the main drive shaft and within the area beneath the work table, and cam and follower means coupling the cam shaft to the auxiliary work station mechanisms to control operation of each work station in timed relation to the indexing of the work table.

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