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Ashley et al.

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[45] **Dec. 4, 1973**

[54] **ARTICLE HANDLING SYSTEM**

[75] Inventors: **Eugene Ashley**, Burlington; **Francis L. Jarvis**, Troy; **Burton P. Clark**, St. George; **George E. Kontis**, Essex Junction; **Paul A. Spoor**, Jericho, all of Vt.

[73] Assignee: **General Electric Company**

[22] Filed: **Jan. 3, 1973**

[21] Appl. No.: **320,839**

Related U.S. Application Data

[62] Division of Ser. No. 201,357, Nov. 23, 1971.

[52] **U.S. Cl.** **221/21**, 198/40

[51] **Int. Cl.** **B65h 3/00**

[58] **Field of Search** ..... 221/21, 243; 89/12, 89/13, 33 MC, 137; 198/22 B, 40

[56] **References Cited**

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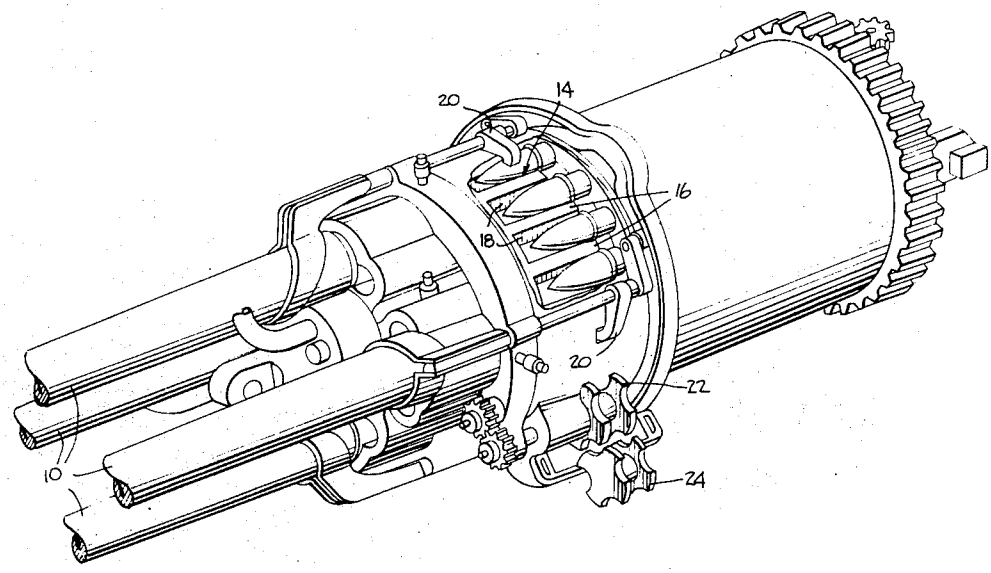
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Primary Examiner—Robert B. Reeves
Assistant Examiner—Joseph J. Rolla
Attorney—Bailin L. Kuch et al.

[57] **ABSTRACT**

A battery gun has a stationary housing; a plurality of barrels disposed in an annular row and stationary with respect to said housing; each of said barrels having a respective chamber; feeding means for receiving a continuous and regular train of projectiles from a supply; intermediate means for receiving the train from said feeding means; and distributor means for receiving the train from said intermediate means for providing projectiles to said chambers; said intermediate means including means for sensing the presence of misfired projectiles in said chambers and for providing lacunae in the train of projectiles corresponding to such misfires, whereby no projectiles are provided to said distributor means for provision to chambers containing misfired projectiles.

8 Claims, 7 Drawing Figures



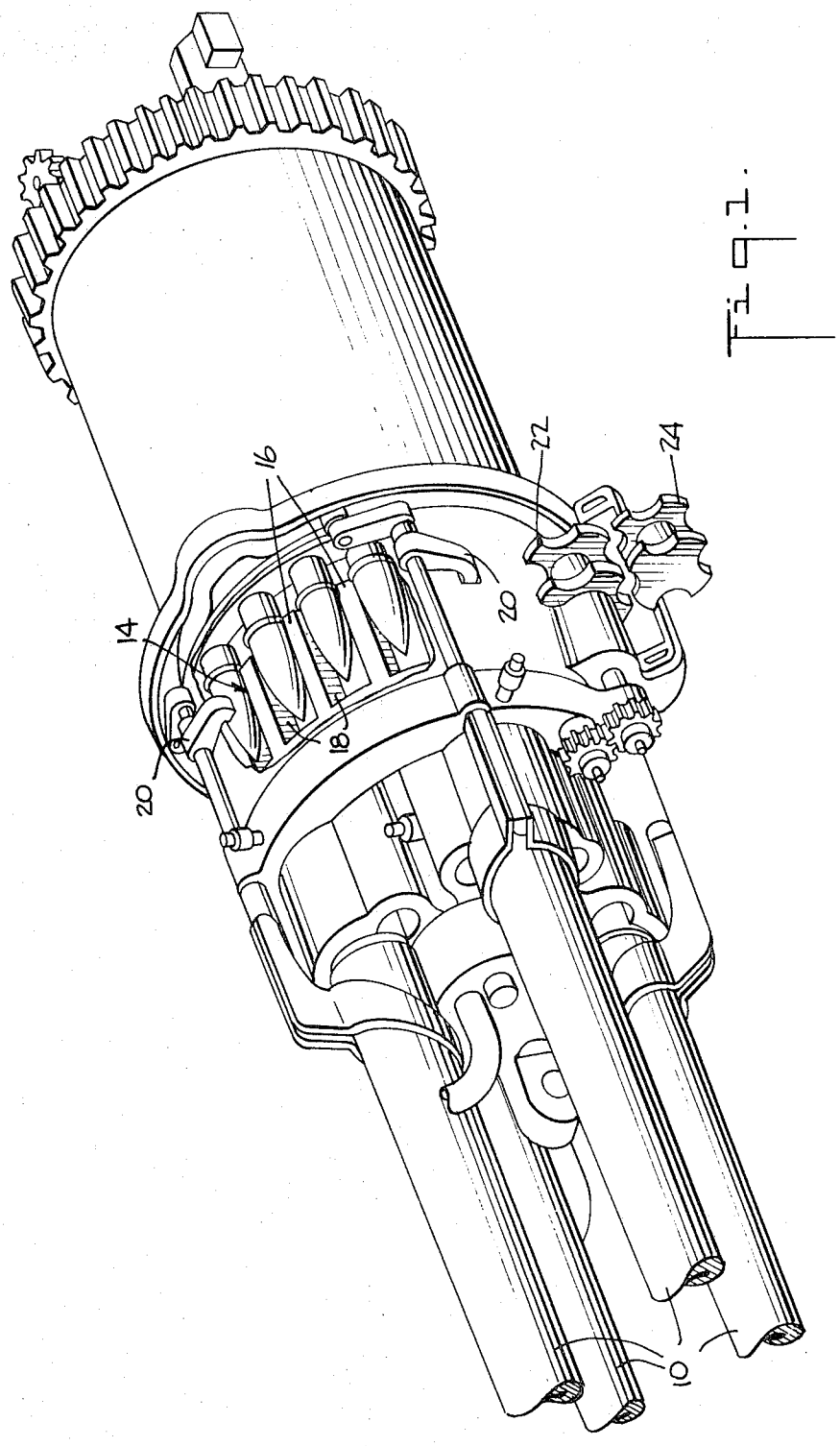


Fig. 1.

Fig. 2.

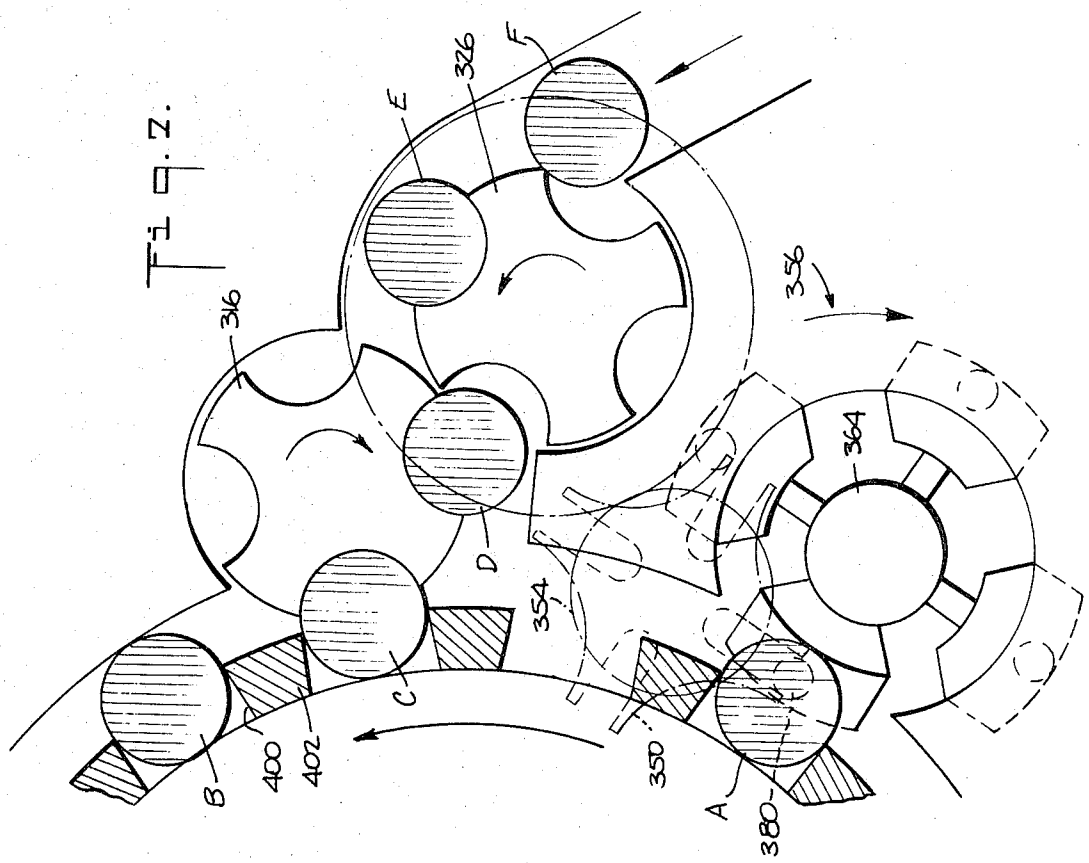

F
326
E
356
316
364
D
354
C
400
402
B
350
A
380

Fig. 2.

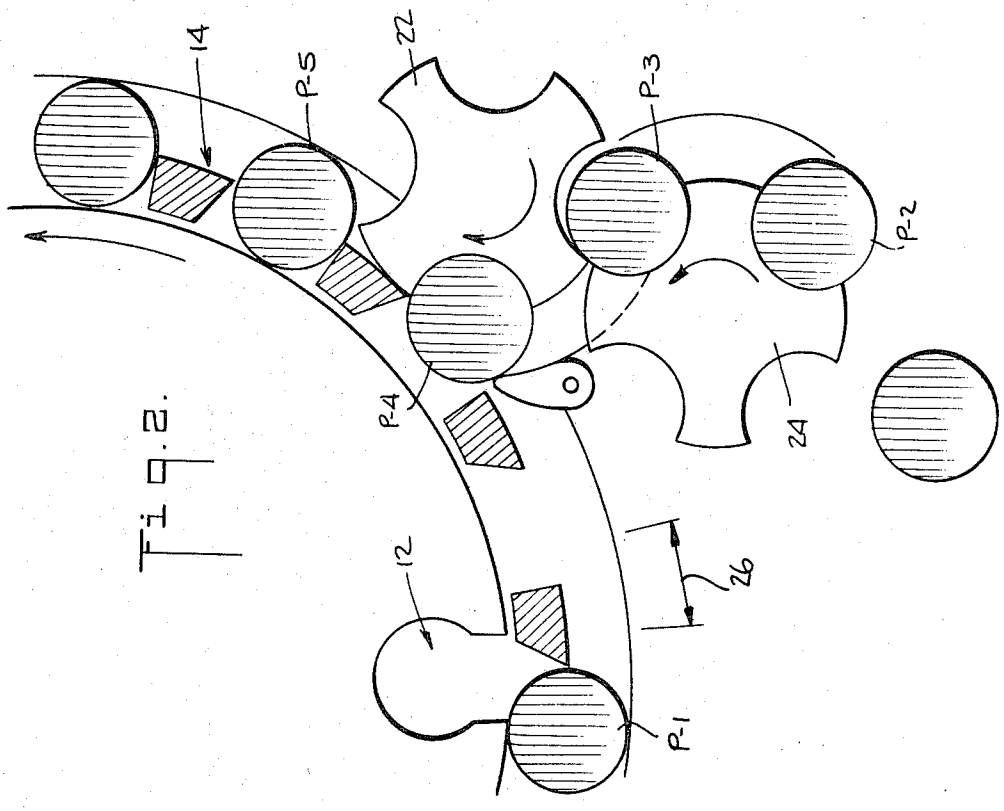
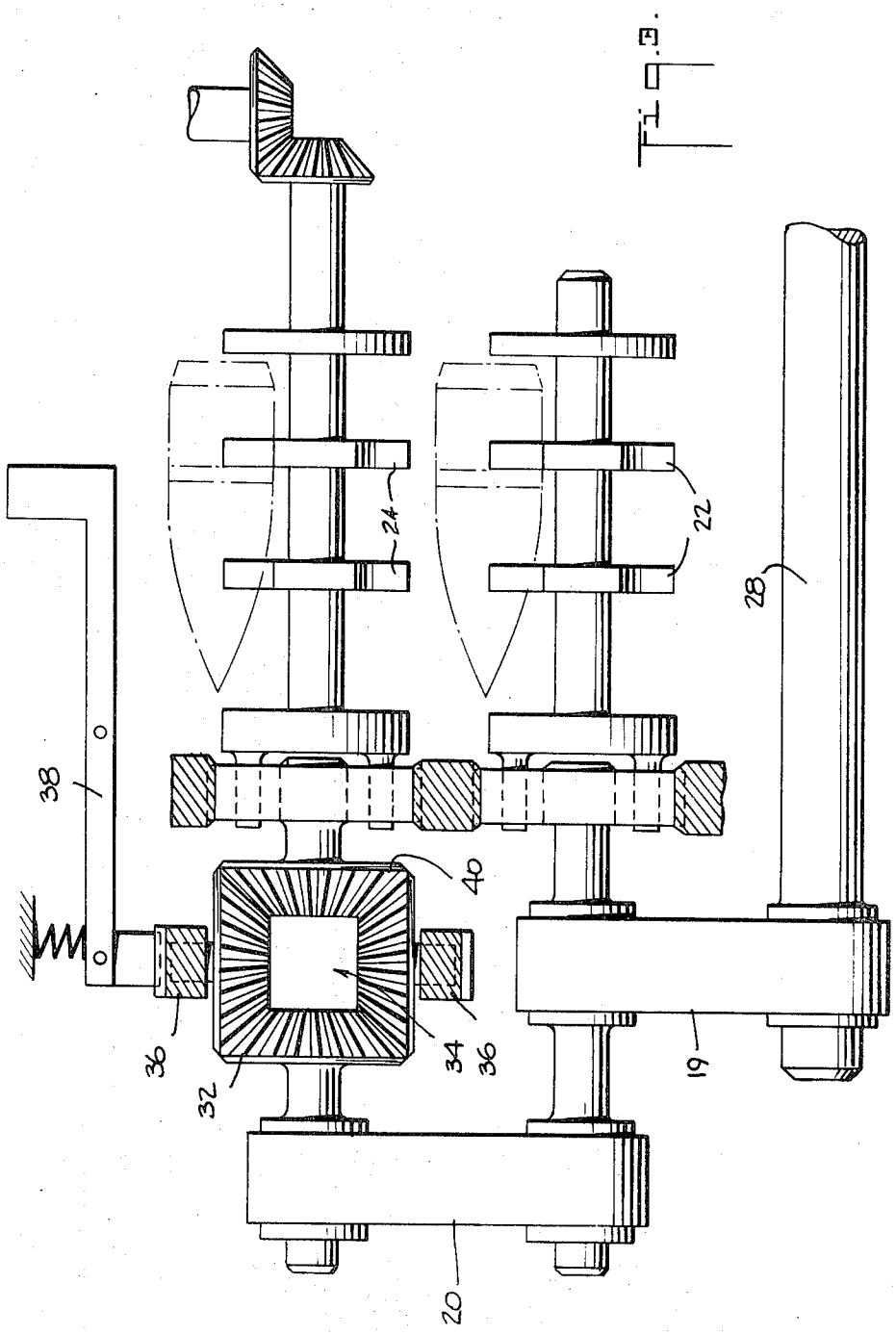

14
P-5
22
P-3
P-2
P-4
24
12
26
P-1

FIG. 5



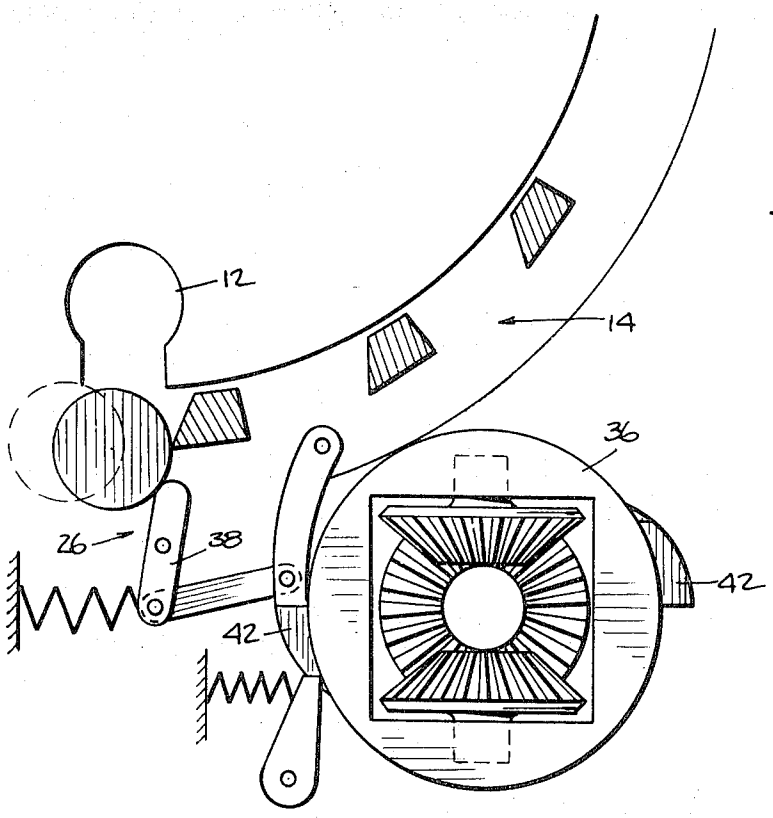


Fig. 4.

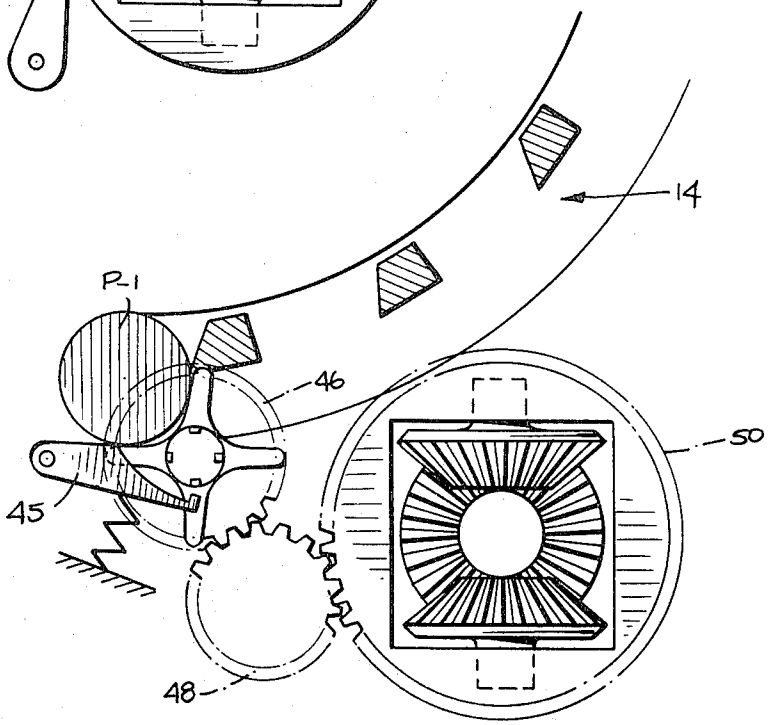


Fig. 5.

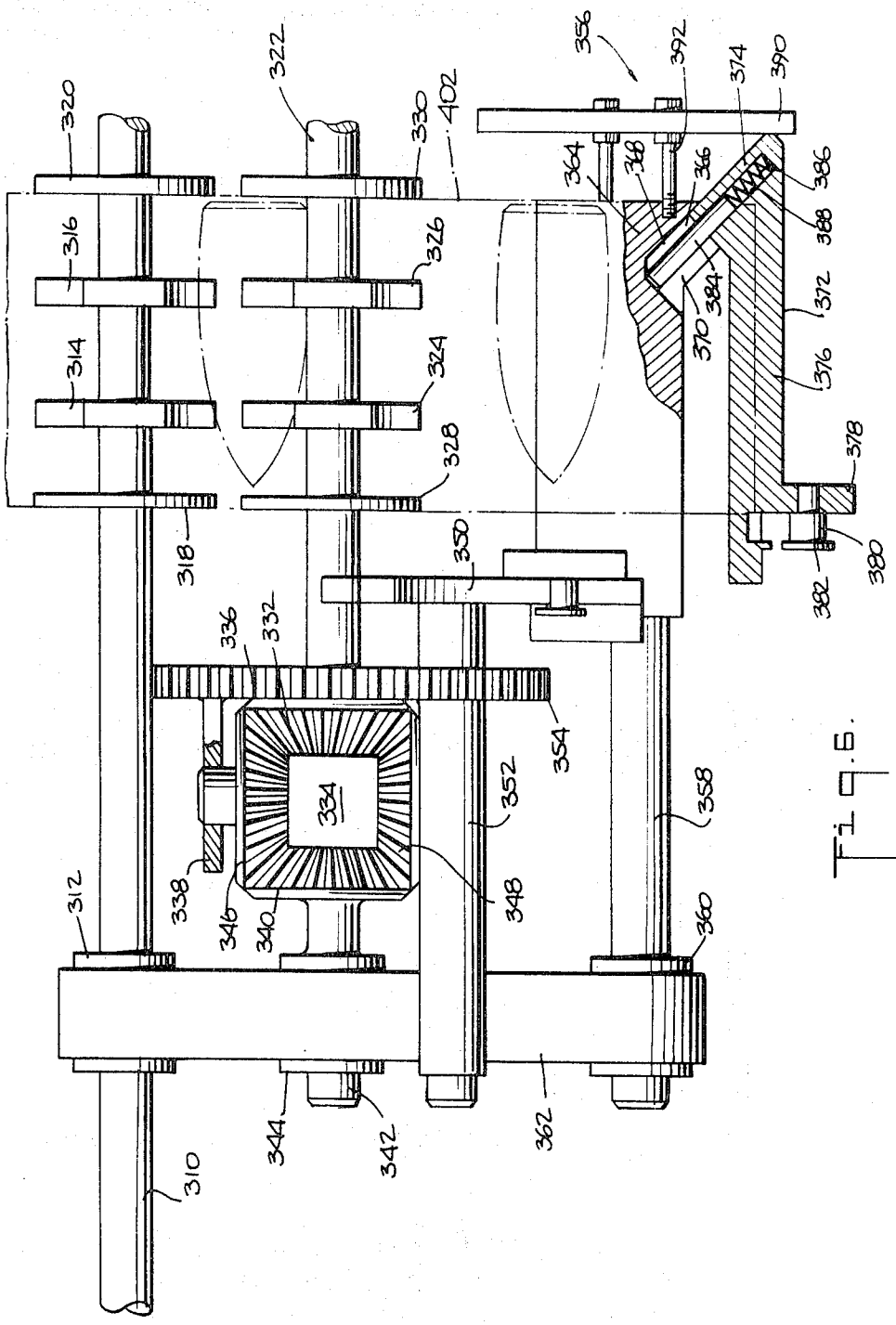

320
322
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402
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392
374
390
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328
378
318
350
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382
336
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334
352
358
338
348
312
346
340
360
344
342
362
310

Fig. 6.

ARTICLE HANDLING SYSTEM

This is a Division of application, Ser. No. 201,357 filed Nov. 23, 1971.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an improved article handling system, especially adapted to progressively advance a series of articles to a plurality of work stations, such as an ammunition feeding system for a battery gun. The invention herein described was made in the course of or under a contract or subcontract with the Department of the Navy.

2. Prior Art

The classic modern revolving battery gun is shown in U.S. Pat. No. 125,563 issued Apr. 9, 1872 to R. J. Gatling. A stationary main cam is in a housing which encloses and supports a rotating receiver assembly which has a plurality of barrels and a like plurality of chambers and bolts. Rounds of ammunition are serially passed through the housing and handed to each bolt in turn as it passes the feeding station. The functioning of each bolt is controlled by the main cam. D. P. Tassie et al in U.S. Pat. application, Ser. No. 76,077 filed Sept. 28, 1970 disclose a nonconventional gun, for cased ammunition, wherein the receiver assembly, with its barrels, chambers and bolts, does not rotate, and the main cam in the housing rotates together with an ammunition distribution ring assembly. Misfires are extracted in the conventional manner, as each case, after firing, is normally extracted by the bolt.

Battery guns utilizing liquid propellants have recently been proposed with a nonrotating receiver assembly. A problem arises in the treatment of misfires when utilizing a receiver assembly wherein the chambers are always coaxial with the respective barrels. The projectile cannot be pushed forwardly through and out of the chamber because the barrel is in the way. The projectile cannot be extracted by the bolt because the bolt is unable to sieze the projectile. A single barrel liquid propellant gun system is disclosed by D. P. Tassie in U.S. Pat. application Ser. No. 148,833 filed June 1, 1971 which has been incorporated into the multibarrel system shown in Ser. No. 76,077, supra.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an ammunition feeding system for a battery gun which omits feeding a round to any chamber which contains a misfire.

A feature of this invention is the provision of a battery gun comprising a stationary housing; a plurality of barrels disposed in an annular row and stationary with respect to said housing; each of said barrels having a respective chamber; feeding means for receiving a continuous and regular train of projectiles from a supply; intermediate means for receiving the train from said feeding means; and distributor means for receiving the train from said intermediate means for providing projectiles to said chambers; said intermediate means including means for sensing the presence of misfired projectiles in said chambers and for providing lacunae in the train of projectiles corresponding to such misfires, whereby no projectiles are provided to said distributor means for provision to chambers containing misfired projectiles.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the invention will be apparent from the following specification thereof taken in conjunction with the accompanying drawing in which:

FIG. **1** is a rudimentary perspective view of a four-barrel gun system embodying this invention;

FIG. **2** is a rudimentary schematic showing the principle of the inventive system for feeding the gun system and sensing misfires;

FIG. **3** is a rudimentary schematic showing the power train of the system of FIG. **2**;

FIG. **4** is a rudimentary schematic of a first embodiment of the invention showing a latching device for sensing misfires and interrupting feeding;

FIG. **5** is a rudimentary schematic of a second embodiment of the invention showing first escapement device for sensing misfires and interrupting feeding;

FIG. **6** is a rudimentary schematic of a third embodiment of the invention showing the power train of a second escapement device for sensing misfires and interrupting feeding; and

FIG. **7** is an end view of the power train of FIG. **6**.

DESCRIPTION OF THE INVENTION

A liquid propellant gun system having four stationary barrels **10** and chambers, and a rotating feed ring **14** is shown in FIG. **1**. The ring **14** has a plurality of partitions **16** forming a plurality of projectile receiving compartments **18**. Four push arms **20** are cam controlled to sequentially push a selected projectile from its respective compartment through a transport mechanism into alignment with a respective chamber, as shown in Ser. No. 76,077, supra.

The ring is supplied from a feeder which is in turn fed either from a conveyor or directly from a linkless feed drum exit unit. Gun feed ring, and feed system are geared together for positive control of all projectiles fed to the gun. In normal firing, the feeder places projectiles into the feed ring compartments, and these projectiles are removed, chambered and fired at the appropriate station. The feed ring compartments return to the feed position empty.

If one or more barrels misfire, however, the nonfiring barrel or barrels go out of action and no longer accept projectiles. Henceforth, those projectiles not "comsumed" at the misfired stations stay in the feed ring and recirculate through the feed position. The feeder expects each feed ring compartment reaching the feed position to be empty, however, and already contains a projectile destined for such a compartment. A double feed situation will result when the feeder tries to feed an already occupied compartment.

FIG. **2** illustrates the feed arrangement. Feed ring **14** rotates continuously. The feeder assembly, consisting of a handoff sprocket **22** and a feed sprocket **24**, supplies a continuous flow of projectiles to the ring. A projectile P–1 is shown in the feed ring at the position for transfer to the last firing chamber **12**, having almost completed a circuit of the feed ring. This is as far in the ring as a projectile should normally remain. Any projectile which passes this position, still in the ring, must have by-passed a misfired barrel somewhere in the circuit and will remain in the ring as long as the misfired station remains uncleared.

If P–1 does remain in the ring and does circulate back to the feeder, a double feed situation arises. Projectile P–2 is destined for the space already occupied by P–1, and the two will collide unless some accommodation is made.

A single sensing mechanism serves to adjust both the feeder and the feed system to intermittent gun feed requirements, and positive control of the projectiles is maintained at all times. As seen in FIG. 2, the system operates by sensing a projectile in the feed ring after it has passed the last firing position. The sensing zone **26** in FIG. 2 shows the approximate position in which sensing takes place. When a projectile is detected passing through this zone, an adjustment is made in the drive train between the hand-off sprocket **22** and the feed sprocket **24** which permits the hand-off sprocket to continue rotating while the feed sprocket stops and drops back at least one pitch space. The feed sprocket must rotate sufficiently far to release the projectile ahead of P–2, since that projectile is already under the control of the hand-off sprocket. Immediately thereafter, the feed sprocket can be made to pause and to avoid feeding P–2 into the next space in the hand-off sprocket. Double feed will thus be avoided. If a single misfired round has appeared in P–1 position, the feed sprocket and hand-off sprocket should then be reengaged in proper timing relationship and the feeding action continued.

FIG. 3 shows a mechanism through which the described action is achieved. All power for the feed system is taken from a primary drive shaft **28.** Timing chains **19** and **20** (or gears) transfer power to the hand-off sprocket **22** and to the input gear **32** of a differential gear set **34** which drives the feed sprocket **24.** Gearing is provided to match sprocket speeds to main cam speed. Planetary reductions are shown in the diagram. Under conditions of normal firing, the spider assembly **36** of the differential is held in locked position by a pivoted, spring loaded, sensing linkage **38,** and the differential acts as fixed gear train in transmitting torque to the feed sprocket and on to the feed magazine.

When a misfire has occurred, and a projectile enters the sensing zone **26,** in FIG. **2,** the sensing linkage **38** is moved to release the differential spider assembly. Drive motion at the differential input will now divide between output **40** and the spider assembly **36** in proportion to the respective resisting torques on each. Since the output "sees" drive torque, and the spider is essentially free, the spider will rotate in preference to the output. Thus, the action of the sensing linkage in releasing the spider assembly is simply to introduce a pause in the drive motion to the feed sprocket and the feed magazine, while the main gun and hand-off sprocket motions continue uninterrupted.

As the gun rotates and projectile P–1 leaves the sensing zone, the sensing linkage will be released. It will then re-engage the spider assembly to restore drive torque to the feed sprocket and feed magazine. FIG. **4** shows how timing relationship can be preserved. Stop lugs **42** are located in the periphery of the spider assembly in positions which assure proper timing relationship. For the gear ratios shown in FIG. **3,** for example, a 180° rotation of the spider assembly will correspond to one pitch of the feed sprocket.

FIG. **5** shows an alternative scheme for maintaining a more positive control over the indexing of the spider assembly than is provided by the system of FIG. **4.** A small escapement wheel **44,** normally locked by a spring loaded detent **45,** is rotated by the unfired projectile P–1 moving through the sensing zone. Through appropriate gearing **46, 48** and **50,** the escapement drives the spider through a controlled angle, which is made equivalent to one round pitch on the feed sprocket **24.** The unfired projectile moving through the sensing zone initiates and fully controls the motion of the spider. Proper shaping of the escapement wheel profile makes it possible to control the drive reengagement torque characteristic. In order for a four toothed escapement to correspond to one-fourth turn of the feed sprocket with the 2/1 ratio between the escapement and the spider shown in FIG. **5,** the differential is placed on the other side of the planetary reduction in FIG. **2.** In this location, a one-fourth turn of the escapement wheel will produce one-eighth turn of the spider, which in turn corresponds to one-fourth turn of the feed sprocket.

A third embodiment of the invention is shown in FIGS. **6** and **7.** Feed system power is applied to a shaft **310** to which are fixed a timing sprocket **312,** two hand-off sprockets **314, 316,** a forward stop-disk **318** and an aft stop-disk **320.** Power is delivered out to the feed magazine by a shaft **322** to which are fixed two feed sprockets **324, 326,** a forward stop-disk **328,** an aft stop-disk **330** and the output bevel gear **332** of a differential gear set **334.** A spur gear **336** is journalled on the shaft **322** and is fixed to the spider **338** of the differential. The input bevel gear **340** of the differential is fixed to a shaft **342** to which is fixed a timing sprocket **344.** Two idler gears **346, 348** are respectively journalled to the spider and meshed with the input and output gears of the differential. A geneva drive wheel **350** is fixed to a shaft **352** to which is fixed a spur gear **354** which is meshed with the gear **336.** A spring detent geneva locking surface, or other means, not shown, biases the wheel **350** against undriven movements. A geneva drive wheel assembly **356** is fixed to a shaft **358** to which is also fixed a timing sprocket **360.** A time chain **362** is meshed with the timing sprockets **312, 344** and **360.**

The geneva drive wheel assembly **356** includes a central hub **364** having four slots **366** therein. Each slot is at an angle (e.g., 45°) to the longitudinal axis and includes an inner rounded-dovetail cross-section portion **368** and an outer rectangular cross-section portion **370.** Four sliding sectors **372** are respectively disposed in the slots **366.** Each sector includes a rounded-dovetail cross-section portion **374** riding in the slot portion **368** and a body portion **376** riding in the slot portion **370.** A ledge portion **378** extends centrifugally from the body portion **376** and carries a pin **380** with a head **382.** Each sector is biased outwardly-upwardly by a rod **384** riding against a compression spring **386,** both captured in a blind bore **388** in the sector. The four sectors are captured to the hub by a disk **390** fixed to the hub by a plurality of bolts **392.**

In operation, power is applied to the shaft **310** and by means of the timing chain **362** to the shafts **322** and **358.** The driven geneva wheel **350** is held stationary against undriven rotation by the detent, and via gears **354** and **336** holds the spider **338** against rotation. The feed magazine chuting and the feed sprockets **324, 326** are driven by the locked-up differential transmission **334** to deliver projectiles to the hand-off sprockets **314** and **316** and thence to the compartments **400** of the ro-

tating feed ring **402.** The projectiles are normally carried around by the feed ring and transferred into the chambers of the gun. In the event of a misfire in a particular chamber, the projectile loaded therein remains therein and the respective next projectile for that chamber is blocked from transfer from the feed ring into that chamber. The blocked projectile, indicated as projectile A in FIG. **7,** rides against a sector **372** on the rotating geneva drive wheel assembly and forces it centripetally. The sector rides centripetally downwardly in its slot **366** against the bias of its spring **386,** so that its pin **380** is brought initially to the same longitudinal level as the geneva driven wheel, and then as the geneva drive wheel assembly continues to rotate, the pin rides into a slot of the geneva driven wheel, drives it around an increment, and rides out. As the geneva driven wheel rotates one increment (e.g., 90°) via the gears **354** and **336,** it rotates the spider one increment (e.g., 45°), thereby turning the differential input gear **340** and the differential output gear **332** in opposite directionsrelative to one another, which causes the feed sprockets **324** and **326** to slow down, stop, back up, stop, and finally move forward to their original position and speed. During this sequence the hand off sprockets **314** and **316** and the feed ring **402** have continued to turn one pitch, so the feed sprockets and magazine have lost one pitch with respect to the feed ring. As seen in FIG. **7,** with misfired projectile "A" at the geneva drive wheel assembly, projectile "E" in the feed sprockets will be retained therein for an extra pitch, and no projectile will be handed to the compartment which already contains projectile "A."

While there has been shown and described a preferred embodiment of this invention, it will be appreciated that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. An article handling system comprising:
a plurality of work stations disposed in an annular row;
article distribution means including:
an annular conveyor rotating about said annular row of work stations and passing a feeding station for receiving a continuous series of articles from said feeding station,
means for sequentially transporting each of the articles from said annular conveyor to a respective one of said work stations, each work station in progressive sequence receiving one such article, for halting such article at such respective work station for a given period of time, and for thereafter discharging such article from said work station; and
means for sensing the presence of an undischarged article from a workstation and coupled to said feeding station for providing lacunae in the series of articles corresponding to such undischarged articles, whereby no articles are provided to said conveyor for provision to work stations containing undischarged articles.

2. An article handling system including:
a plurality of work stations disposed in an annular row and each having a respective workpiece receiving chamber;
feeding means for receiving a continuous and regular train of workpieces from a supply;
distributor means for receiving the train of workpieces from said feeding means, for providing workpieces to each of said chambers, for retaining for processing each workpiece in said chamber, and for discharging each processed workpiece from said chamber, and
means for sensing the presence of an undischarged processed article from a chamber and coupled to said feeding means for providing lacunae in the train of articles corresponding to such undischarged workpieces, whereby no workpieces are provided to said distributor means for provision to chambers containing undischarged, processed workpieces.

3. A system according to claim **2** wherein:
said distributor means includes:
a distributor ring having a plurality of compartments disposed in an annular row, each compartment for receiving a respective workpiece from said feeding means; and
intermediate means for transferring a workpiece from a compartment to a respective unoccupied chamber and for not transferring from such compartment if the respective chamber is preoccupied;
said sensing means sensing the presence of an undischarged processed workpiece by sensing the presence of an untransferred workpiece in such compartment.

4. A system according to claim **3** wherein:
said sensing means is coupled to said feeding means for interrupting the passage of workpieces from said feeding means to said distributor means.

5. A system according to claim **3** wherein:
said feeding means includes:
a feed sprocket for passing workpieces as a train to said distributor means,
a differential gear system coupling said feed sprocket to a source of rotary power; and
said sensing means is coupled to said differential gear system for actuating said differential gear system to decouple said feed sprocket from said power source when said sensing means senses the presence of an untransferred workpiece.

6. A system according to claim **5** wherein:
said differential gear system includes:
a spider which is normally locked to provide a fixed gear train function and which is unlocked by said sensing means to decouple said feed sprocket.

7. A system according to claim **5** wherein: said spider is locked by a pawl and detent.

8. A system according to claim **5** wherein:
said spider is locked by a geneva wheel system.

* * * * *