United States Patent [19]

Cover et al.

[11] **3,776,527**

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

[54] **SIMULATION EVALUATION METHOD**

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[52] **U.S. Cl.** **259/91,** 259/DIG. 38

[51] **Int. Cl.** **B01f 13/00**

[58] **Field of Search** 259/59, 91, 72, 75, 259/92, 54, 76, 80

[56] **References Cited**

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[57] **ABSTRACT**

This disclosure relates to a method of simulating the operation of a commercial can shaker by employing a test shaker and evaluating the results in a repetitious manner until a desired product is observed thereby automatically making a selection of the proper commercial shaker to obtain the desired product commercially, continually and repetitiously. The method includes the steps of selecting from known performance characteristics of existing commercial shakers a predetermined shake time and rate for a particular container size, setting the test shaker to function at the preselected rate, shaking a filled container of the particular size in the test shaker for the predetermined time, observing the results of the shaking on the product, and as necessary repeating these steps using different time and shake rates until the desired result or product effect is observed.

7 Claims, 6 Drawing Figures

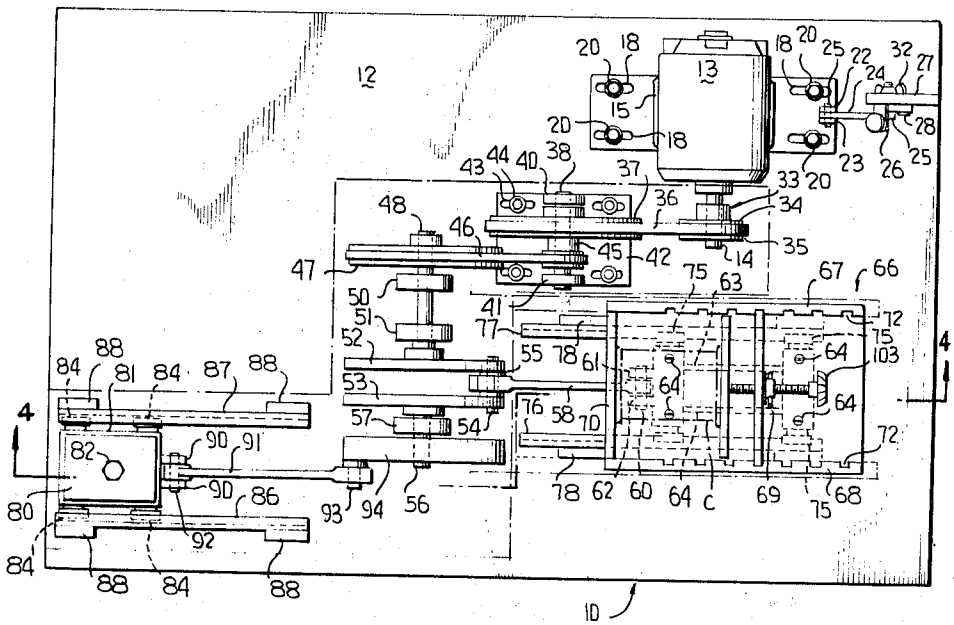


FIG. 1

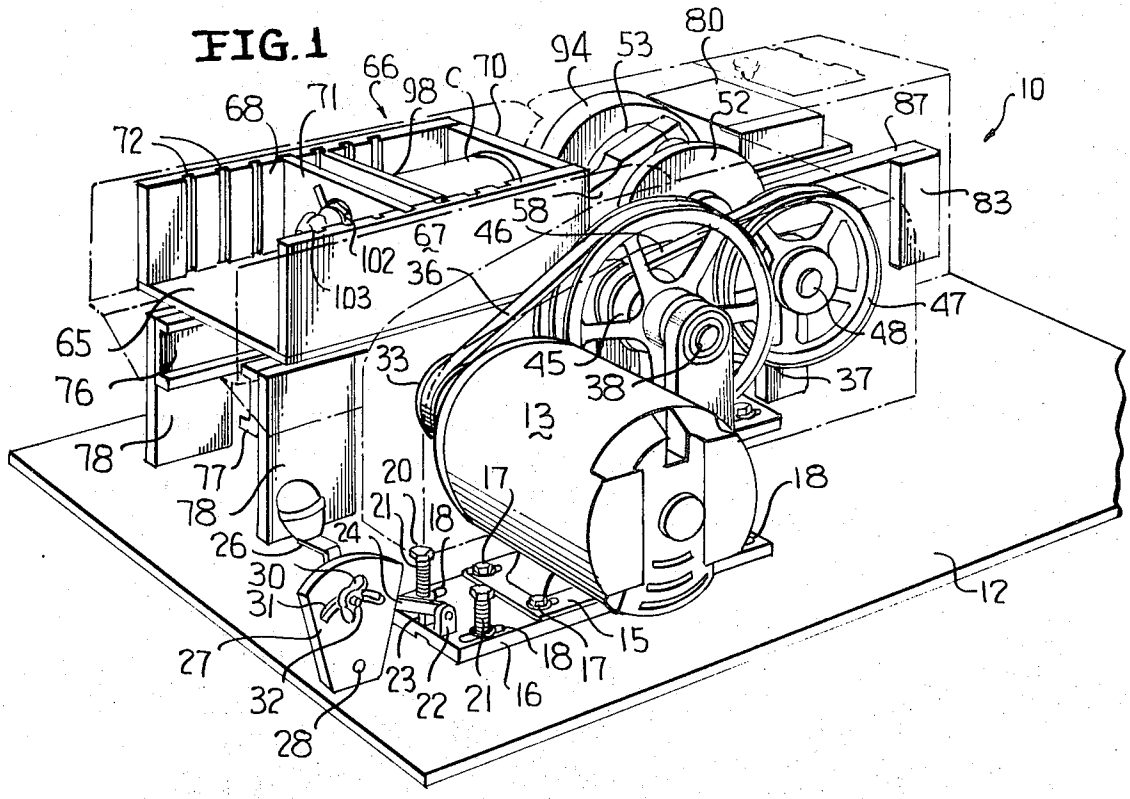
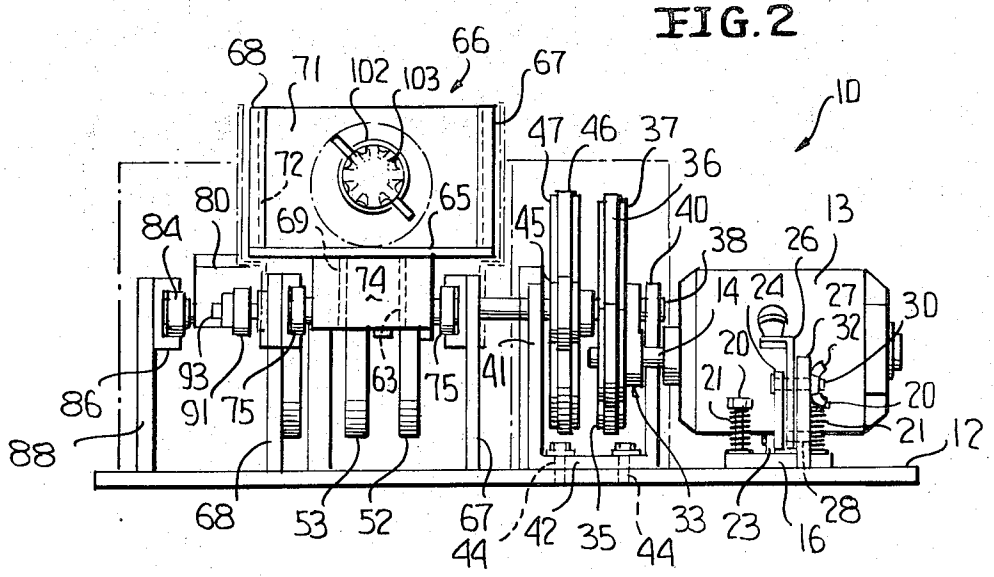


FIG. 2



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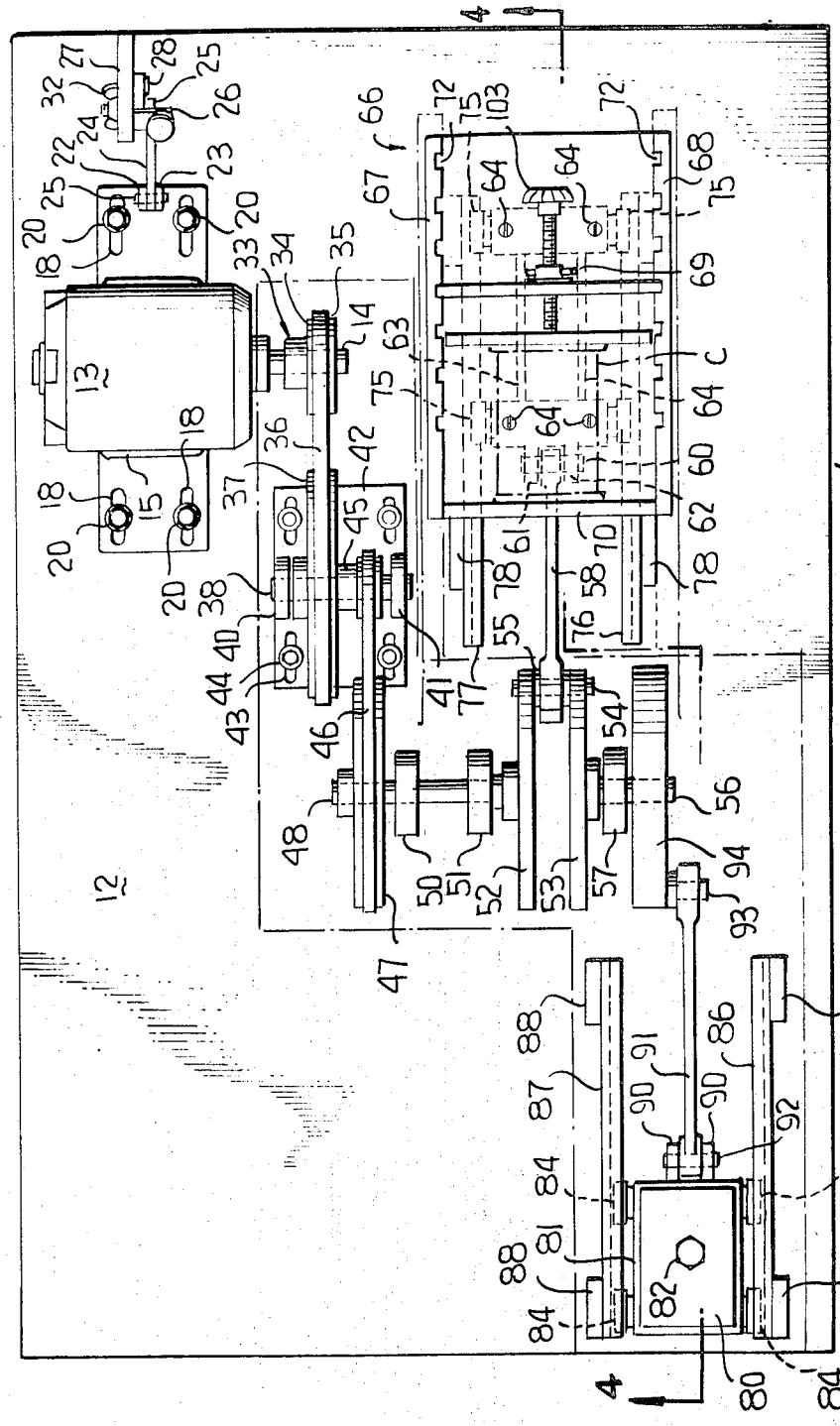


FIG. 3

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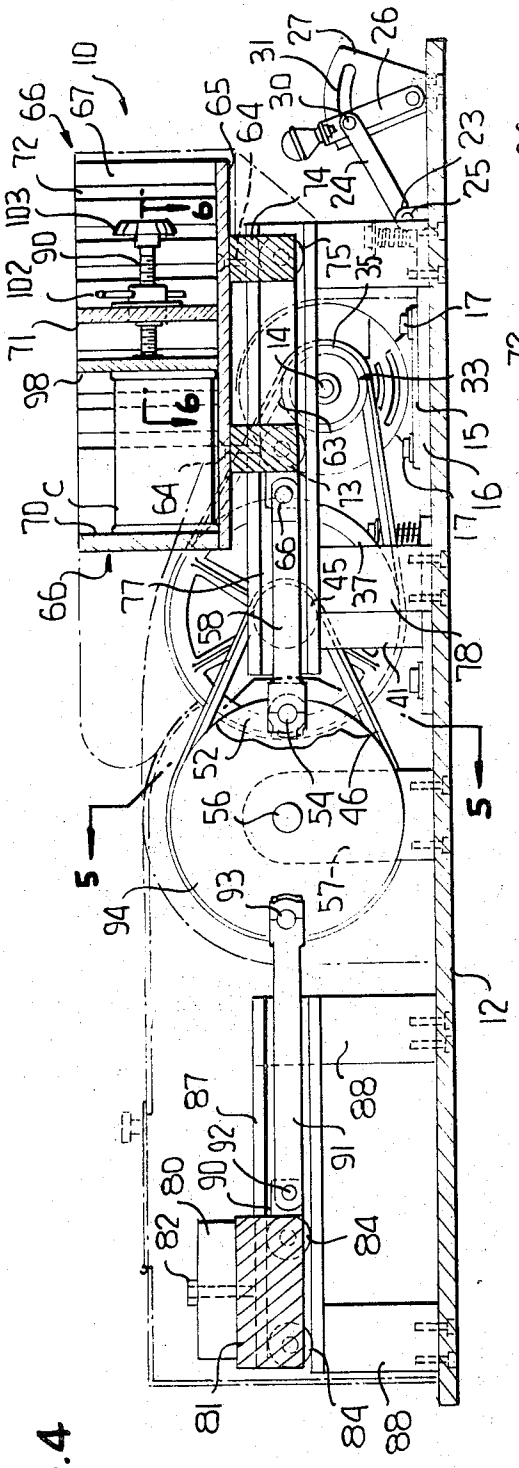


FIG. 4

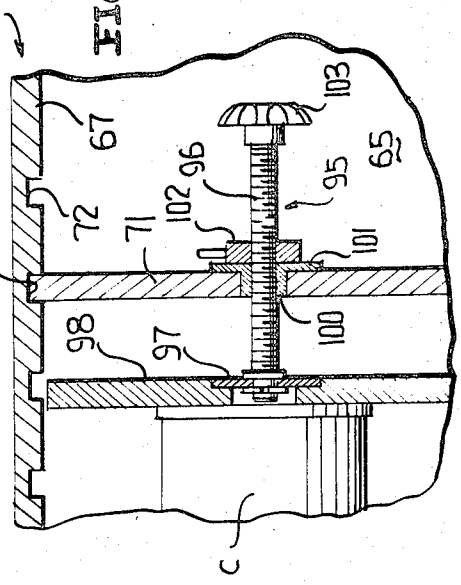


FIG. 6

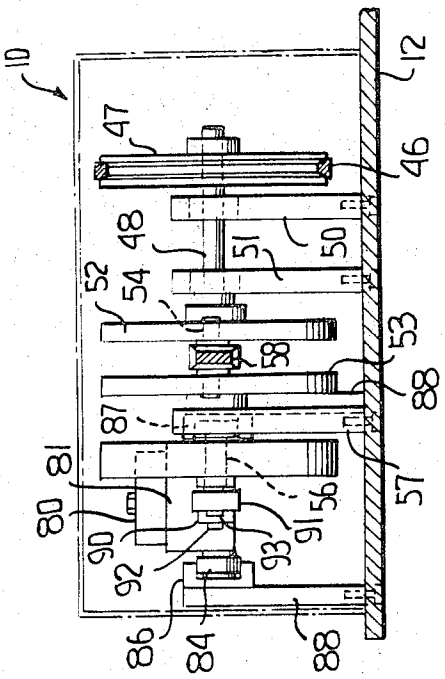


FIG. 5

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SIMULATION EVALUATION METHOD

Can shakers of the type disclosed in commonly assigned U.S. Pat. No. 3,427,004 in the name of Ralph Cover et al., issued Feb. 11, 1969, were developed originally in the furtherance of cream corn processing where layers of cream and kernels had to be thoroughly mixed in large (No. 10) cans after cooking and cooling. Since then, many sectors of the food processing industry have turned to can shakers with new and far-reaching benefits. Some of the most difficult and most exacting problems were solved in all types of metal and glass containers, with such products as soups, spaghetti-type products, potted meats and meats-with-gravy, pie fillings, baby foods, aerosol items, pet foods, and viscous materials. It soon became evident that there are many reasons for shaking products in their sealed containers. Such problems as lack of product uniformity, too heavy product consistency, component separating, curdling, localized discoloration, etc., have been solved by commercial can shakers. Moreover, problems not limited to edible food products have also been solved as, for example, the failure of insoluble salts to disperse in aerosol packages.

Though the problems solved by commercial can shakers are noteworthy, it has been heretofore virtually impossible for small manufacturers to purchase such relatively expensive commercial equipment with the expectation of solving a particular problem through shaking when shaking may appear to be but is not the solution. Commercial can shakers of the type described in the latter-noted patent are produced in lengths up to 22 feet weighing as much as 10,700 pounds. Thus, the size and cost of such commercial equipment for experimentation could prove prohibitive to users unless results were guaranteed and in many cases such guarantees are impossible even though can shakers over the years have reduced labor, speeded filling lines, eliminated raw product waste, broadened production tolerances, lowered rejections, protected or advanced the quality level, salvaged unsaleable material by rectifying areas, saved dollars through reformulation, and simplified processing procedures.

In keeping with the present invention, the operation of conventional can shakers is simulated under laboratory or test conditions by first selecting from known performance characteristics of existing commercial shakers a predetermined shake time and rate for a particular container size. A novel test shaker of this invention is then set to function at the preselected rate and a filled container of the particular size is shaken in the test shaker for the predetermined time. The effect of the shaking on the product is thereafter observed and, as necessary, these steps are repeated using different time and shake rates until the desired result is observed thereby automatically making a selection of the proper commercial shaker to obtain the desired result commercially in a continuous and repetitious fashion.

A further object of this invention is to provide a novel simulation technique or method of the type heretofore set forth wherein the predetermined shake time is determined by the formula $P = D/Is$ where D is the shake length in inches, Is is the inches traveled per second and P is the seconds in the shake area of a commercial shaker with shaking taking place in the range of 200–300 shake cycles per minute on any container ranging in size between No. 200 through No. 603 cans or equivalent containers.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claimed subject matter, and the several views illustrated in the accompanying drawings.

IN THE DRAWINGS

FIG. 1 is a side perspective view of the test shaker for performing the method of this invention, and illustrates a reciprocal carriage in which is clamped a can or similar container having packaged therein a product intended to be improved by being shaken at a predetermined rate for a predetermined period of time.

FIG. 2 is an end view of the shaker of FIG. 1 looking from left-to-right, and illustrates means mounting the carriage for reciprocal movement.

FIG. 3 is a top perspective view of the shaker of FIG. 1, and illustrates the drive mechanism for the carriage and a counterweight likewise mounted for reciprocal motion.

FIG. 4 is a sectional view taken generally along line 4—4 of FIG. 3, and more clearly illustrates the drive mechanism of the shaker along with means for clamping a can in the carriage.

FIG. 5 is a sectional view taken generally along line 5—5 of FIG. 4, and more clearly illustrates portions of the drive mechanism including a pair of crank arms connected to the under side of the carriage and the counterweight.

FIG. 6 is a fragmentary enlarged sectional view taken generally along line 6—6 of FIG. 4, and illustrates the manner in which the volume of the carriage can be adjusted to accommodate cans of different sizes.

Before describing the novel method of this invention, reference is first made to a test shaker illustrated in the drawings which is generally designated by the reference numeral **10**. The test shaker **10** includes a base **12** in the form of a heavy metallic plate which may be provided with suitable openings (not shown) for anchoring the plate **12** to a support. An alternating current, single phase, sixty cycle motor **13** rotates a shaft **14** thereof at **1725** RPM. The motor **13** includes a base **15** (FIG. **1**) which is secured to a plate **16** by bolts **17**. The plate **16** in turn includes four elongated slots **18** which permit the plate **16** and thus the motor **13** mounted thereon to be shifted left and right as viewed in FIG. **3** to vary the output of the shaft **14**, as will be described more fully hereinafter. A plurality of bolts **20** pass through each slot **18** and are threaded into the plate **12** with springs **21** being positioned between each bolt head (unnumbered) and the upper surface (also unnumbered) of the plate **16**. A pair of lugs **22, 23** are welded to the plate **16** and are connected to an arm **24** by a pivot pin **25**. The arm **24** is connected at its opposite end to a handle **26** having its lower end (unnumbered) connected to a vertical plate **27** by a pivot pin **28** with the lower edge of the plate **27** being welded or otherwise secured to the base **12**. A threaded stud **30** projecting normally from the handle **26** passes through an arcuate opening **31** of the plate **27** and has secured thereto a wing nut **32**. With the wing nut **32** loosened the handle **26** can be pivoted to shift the motor **13** with the motor **13** being locked in any desired position by merely once again retightening the wing nut **32**.

Though not illustrated, the plate **27** includes along its upper convex edge (unnumbered) a number of shake cycles per minute between **180** to **325.** For the purpose of this description, it will be assumed that only the numbers **220, 225, 250, 275, 280, 285, 290** and **300** are present on the plate **27,** each indicating the number of shake cycles per minute when an arrow (not shown) on the handle **26** is in alignment therewith.

The shaft **14** of the motor **13** is keyed to a conventional variable speed pulley **33** having opposite faces **34, 35** which are normally urged toward each other by a spring (not shown). As the motor **13** is shifted left or right as viewed in FIG. **3** by the movement of the handle **26,** the faces **34, 35** move toward or away from each other thereby varying the drive radius of the pulley **33** to vary the speed of a pulley belt **36** entrained thereabout and through mechanism heretofore described selectively obtain any number of shake cycles per minute in the range of **180** through **325.**

The pulley belt **36** is entrained about another pulley **37** which is keyed to a shaft **38** suitably journalled at its opposite ends in upstanding vertical brackets **40, 41** of a plate **42** which is adjustably secured to the base **12** by slots **43** and bolts **44.**

Another pulley **45** is keyed to the shaft **38** and has entrained thereabout a pulley belt **46** which is also entrained about a pulley **47** keyed to a shaft **48.** The shaft **48** is journalled for rotation in a pair of vertical upstanding plates **50, 51** whose lower ends (unnumbered) are bolted to the base **12.** A pair of circular plates **52, 53** form a crank or eccentric in combination with a pin **54** which carries a bearing **55** between the plates **52, 53,** it being noted that the plate **52** is welded to the shaft **48** while the plate **53** is welded to another shaft **56** in alignment with the shaft **48.** The shaft **56** is journalled for rotation in the upper end portion of a vertical plate **57** whose lower end (unnumbered) is bolted to the base **12.** A crank arm **58** is appropriately journalled at one end to the bearing **55** and its opposite end is connected by a pivot pin **60** to a pair of lugs **61, 62** connected to a bar **73** which is in turn secured to another bar **74** by a pair of tie bars **63, 69** bolted therebetween. Bolts **64** (FIG. **4**) secure the bars **73, 74** to a bottom wall **65** of a carriage **66** which also includes two upstanding side walls **67, 68,** a rigid end wall **70** and a movable end wall **71** which can be selectively positioned in any one of a plurality of opposing pairs of vertical slots **72** formed in the side walls **67, 68.** The adjustable nature of the end wall **71** permits containers or cans C of different sizes to be positioned and clamped in the carriage **66** in a manner which will be more fully described hereinafter.

Guide rollers **75** are journalled for rotation to the opposite ends (unnumbered) of each of the bars **73. 74.** The rollers **75** are received in channel-shaped guides **76, 77** bolted to four vertical plates **78** at upper ends thereof while lower ends of the plates are bolted to the base **12.**

From the foregoing it will be noted that the drive for reciprocating the carriage **66** and thus the container C therein includes the motor **13,** the shaft **14,** the variable speed pulley **33,** the pulley belt **36,** the pulley **37,** the pulley **45,** the pulley belt **46,** the pulley **47,** the crank **52, 53** and its associated bearing **55,** the crank arm **58** and the carriage connected thereto.

In order to counterbalance the machine **10** during the reciprocal motion of the carriage **66,** a counterweight **80** is removably secured to a block **81** by a bolt **82** with the block **81** having conventionally journalled at the sides thereof cam followers or rollers **84.** The rollers **84** ride in channel shaped guides or tracks **86, 87** which are bolted to the upper ends of vertical plates **88** with the lower ends of the plates **88** being bolted to the base **12.** A pair of lugs **90** connected to the block **81** are pivotally connected to a crank arm **91** by a pivot pin **92.** An opposite end of the crank arm **91** is journalled to a pin **93** of another crank or eccentric **94** in the form of a circular disc having the pin **93** fixed thereto with the crank **94** being keyed or otherwise fixed to the shaft **56** and thus rotated thereby. It is to be noted that the bearing **55** of the crank **52, 53** is **180** degrees out of phase relative to the pin **93** of the crank **94** and thus both the carriage **66** and the counterweight **80** are reciprocated simultaneously but in opposite senses at all times, thereby affecting the counterbalancing of the machine **10.** Moreover, since the drive for the counterweight **80** is a take-off of the drive for the carriage **66,** any adjustment in speed or the number of shake cycles per minute by varying the position of the arm or handle **26** simultaneously adjusts the speed of movement or the number of shake cycles per minute of the counterweight **80.** Also, the bolt **82** permits additional or other counterweight to be secured to the block **81** depending upon the particular weight of the product being tested.

Reference is now made particularly to FIG. **6** which illustrates clamp means generally designated by the reference numeral **95** in the form of a threaded bolt **96** having one end keyed to but freely rotatable in an aperture (unnumbered) of a plate **97** which is secured to a plate or wall **98.** The threaded stud **96** is threaded in a threaded bore **100** of an element **101** fixed to the removable wall **71.** A lock nut **102** is also threaded upon the threaded stud **96** which at its end remote from the plate **97** includes a knob **103.**

The can C of FIG. **6** is removed from its clamped position between the walls **70, 98** by unthreading the lock nut **102** and then unthreading the threaded stud **96** by rotating the knob **103** to move the wall **98** to the right as viewed in FIG. **6.** If a larger or smaller can C is to be inserted in the carriage **66,** the entire clamping means **95** is removed from the carriage by sliding the wall **70** upwardly and outwardly of the slots **72** and repositioning the wall **71** in another pair of slots which are closer to or more remote from the wall **70,** as dicated by the size and/or length of the next container to be clamped into the carriage **66.** When thus repositioned the knob **103** is rotated to relock the mechanism.

In order to perform the novel method of this invention in conjunction with the shaker **10** heretofore described, one must first select from Tables I, II or III a desired shaking speed and time made available by existing commercial shakers which vary in overall size and length of their respective concentrated shake areas. For example, experience might suggest that if the product being tested is canned meats a 17 foot commercial can shaker having a 138 inch length of concentrated shake area might be desired if run between 250–300 shake cycles per minute. Table I discloses performance characteristics of an 11 foot commercial can shaker having a 66 inch length concentrated shake area with appropriate parameters being given for No. 200 and No. 202 cans. Like performance characteristics (not disclosed) are provided for the same machine in can diameters of Nos. 208, 211, 300, 301, 303, 307, etc., up to and including No. 603.

Table II likewise indicates the performance charac-

teristics of existing 14 foot long commercial shaker having a 102 inch length of concentrated shake area, and likewise presents parameters for No. 200 and No. 202 cans with like performance characteristics (not shown) being provided for all cans up to No. 603.

Table III discloses performance characteristics for an existing 17 foot long can shaker having a 138 inch long concentrated shake area, and discloses parameters for a No. 307 can.

Assuming that past experience indicates a 17 foot

TABLE I.—11'-LONG CAN SHAKER (66" CONCENTRATED SHAKE AREA)

Can diameter 200 and 202				Flight spacing 2.750" centers							
	Flight belt speed		Sec. can in shake area	Number of shakes each can receives (shake freq.)							
				200 [a]	225 [a]	250 [a]	275 [a]	280 [a]	285 [a]	290 [a]	300 [a]
Cans per min.	Feet/min.	Inches/sec.		3.33 [b]	3.75 [b]	4.16 [b]	4.58 [b]	4.66 [b]	4.75 [b]	4.83 [b]	5.00 [b]
5	1.145	.229	288	959	1,080	1,198	1,319	1,342	1,368	1,390	1,440
10	2.29	.458	144	479	540	599	659.5	671	684	695.5	720
20	4.58	.91	72.5	241	271	301.6	332	337.8	341.3	350	362.5
30	7.8	1.375	48	159.8	180	199.6	219.8	223.9	228	231.8	240
40	9.2	1.83	36	119.8	135	149.7	164.8	167.8	171	173.8	180
50	11.4	2.24	28.8	95.9	108	119.8	131.9	134.2	136.8	139	144
60	13.7	2.75	24	79.9	80	99.8	109	111.8	114.7	115.9	120
70	16	3.2	20.6	68.5	77.2	85.7	94.3	95.9	98.4	99.4	103
80	18.3	3.66	18	60	67.5	74.9	82	83.9	86	86.9	90
90	20.3	4.12	16	53	60	66.5	73.3	74.6	76	77.3	80
100	22.5	4.58	14.4	48	54	60	66	67.1	68.4	69.5	72
110	25.2	5	13.2	43.9	49.5	54.9	60.4	61.5	62.7	64	66
120	27.5	5.5	12	39.9	45	49.9	54.9	55.9	57	58	60
140	32	6.4	10.3	34.3	38.6	42.8	47	47.9	48.9	49.7	51.5
160	36.6	7.3	9.0	29.9	33.8	37.4	41.2	41.9	42.8	43.4	45
180	39.6	8.25	8.0	26.6	30	33.3	36.6	37.3	38	38.6	40
200	45.8	9.1	7.2	24	27	30	32.9	33.5	34	34.7	36
225	51.6	10.3	6.4	21.3	24	26.6	29.3	29.8	30.4	30.9	32
250	57.3	11.5	5.7	18.9	21.3	23.7	26	26.5	27	27.5	28.5
300	67.8	13.8	4.7	15.6	17.6	19.5	21.5	21.9	22.3	22.7	23.5
400	91.7	18.3	3.5	11.6	13	14.5	16	16.3	16.6	16.9	17.5
500	114.5	22.9	2.8	9.3	10.5	11.6	12.8	13	13.3	13.5	14

[a] Per minute. [b] Per second.

TABLE II.—14'-LONG CAN SHAKER (102" CONCENTRATED SHAKE AREA)

Can diameter 200 and 202				Flight spacing 2.750" centers							
	Flight belt speed		Sec. can in shake area	Number of shakes each can receives (shake freq.)							
				200 [a]	225 [a]	250 [a]	275 [a]	280 [a]	285 [a]	290 [a]	300 [a]
Cans per min.	Feet/min.	Inches/sec.		3.33 [b]	3.75 [b]	4.16 [b]	4.58 [b]	4.66 [b]	4.75 [b]	4.83 [b]	5.00 [q]
5	1.145	.229	445	1,482	1,668	1,851	2,038	2,073	2,127	2,149	2,225
10	2.29	.458	222	739	832	923	1,016	1,034	1,061	1,072	1,110
20	4.58	.91	112	372	420	465	513	522	536	541	520
30	7.8	1.375	74.1	246	287	318	339	347	354	358	370
40	9.2	1.83	55.7	185	208	231	255	259	266	264	278
50	11.4	2.29	44.5	148	166	185	203	207	212	214	222
60	13.7	2.75	37	123	138	153	169	172	176	178	185
70	16	3.2	31	103	116	128.9	141.9	144	148	149	155
80	18.3	3.66	27	90	101	112	123	125	128	130	135
90	20.3	4.12	24.7	82	92.6	102	113	115	117	119	123
100	22.5	4.58	22.2	73.9	83	92	101	103	105	107	111
110	25.2	5	20.4	67.9	76.5	84.8	93	95	96.9	98.5	102
120	27.5	5.5	18.5	61.6	69	76.9	84.7	86.2	87.8	89	92.5
140	32	6.4	15.9	52.9	59.6	66	72.8	74	75.5	76.7	79.5
160	36.6	7.3	13.9	46	52	57.8	63.8	64.7	66	67	69.5
180	39.6	8.25	12.3	41	46	51	56.3	57.3	58.4	59	61.5
200	45.8	9.1	11.2	37	42	46.5	51	52	53.2	54	56
225	51.6	10.3	9.9	32.9	37	41	45	46	47	47.8	49.5
250	57.3	11.5	8.9	29.6	33.4	37	40.7	41.5	42.2	42.9	44.5
300	67.8	13.8	7.5	16.6	18.7	20.8	22.9	23.3	23.7	24	25
400	91.7	18.3	5.5	18.3	20.6	22.8	25	25.6	26	26.5	27.5
500	114.5	22.9	4.4	14.6	16.5	18.3	20	20.5	20.9	21	22

[a] Per minute. [b] Per second.

TABLE III.—17'-LONG CAN SHAKER (138" CONCENTRATED SHAKE AREA)

Can diameter 307				Flight spacing 4.125" centers							
	Flight belt speed		Sec. can in shake area	Number of shakes each can receives (shake freq.)							
				200 [a]	225 [a]	250 [a]	275 [a]	280 [a]	285 [a]	290 [a]	300 [a]
Cans per min.	Feet/min.	Inches/sec.		3.33 [b]	3.75 [b]	4.16 [b]	4.58 [b]	4.66 [b]	4.75 [b]	4.83 [b]	5.00 [b]
5	1.7	.34	405	1,341	1,518	1,684	1,854	1,887	1,923	1,956	2,025
10	3.4	.68	202	672	757.5	840	925	941	959	975	1,010
20	6.8	1.37	100	333	375	416	458	466	475	483	500
30	10	2	69	229	258	287	316	321	327	333	345
40	13.7	2.7	51	169	191	212	233	237	242	246	255
50	17	3.4	40.5	134	151	168	185	188.7	192	195.6	202.5
60	20.6	4.1	33.6	111.8	126	139.7	153.8	156.5	159.6	162	168
70	24	4.8	28.7	95.5	107.6	119	131	133.7	136.3	138.6	143.5
80	27.5	5.5	25	83.2	93.7	102	114	116.5	118	120	125
90	30	6.1	22.6	75.2	84.8	94	103	105.3	107.3	109	113
100	34.3	6.8	20.3	67.5	76	84	92.9	94.5	96.4	98	101.5
110	37.8	7.5	18.4	61	69	76	84	85.7	87.4	88.8	92
120	41	8.2	16.8	55.9	63	69.8	76.9	78.2	79.8	81	84
140	48	9.6	14.4	47.9	54	59.9	65.9	67	68.4	69.5	72
160	55	11	12.5	41.6	46.8	52	57.2	58.2	59.3	60.3	62.5
180	61	12	11.3	37.6	42.4	46	51.7	52.6	53.6	54.5	55
200	68	13.7	10	33.3	37.5	41.6	45.8	46.6	47.5	48.3	50
225	77.3	15.5	8.8	29.3	33	36.6	40.3	41	41.8	42.5	44
250	85.9	17.2	8	26.6	30	33	36.6	37	38	38.6	40
300	103	20.6	6.6	21.9	24.7	27.4	30.2	30.8	31.4	31.8	33
400	137.5	27.5	5	16.6	18.8	20.8	23	23.4	23.7	24	25
500	171.8	34.3	4	13.3	15	16.6	18.3	18.6	19	19.4	20

[a] Per minute. [b] Per second.

commercial can shaker operating at a speed of from 250 to 300 shake cycles per minute might be desirable for, for example a No. 307 can, reference will be made to Table III from which would be selected a desired production speed of, for example, 160 cans per minute. A shake frequency of, for example, 280 cycles is then selected and from column four it is determined that No. 307 cans moving through the 17 foot commercial can shaker at a speed of 160 cans per minute would pass through the 138 inch concentrated shake area in 12.5 seconds. With this time in mind the handle **26** of the test shaker **10** is moved to set the speed of the machine at 280 cycles per minute, a No. 307 can is clamped in the carriage **66** and the machine **10** is run for 12.5 seconds with the accuracy of the running time being solved by the simple expedient of a stop watch. The can is then removed, opened, and the product observed and/or tested. If the results achieved are those desired, the tester can conclude that like results can be obtained commercially in a continuous and repetitive fashion on the 17 foot, 138 inch concentrated shake area commercial can shaker, and no further testing is necessary. However, if the product result is not that expected further tests may be performed by selecting different shake frequencies (of the same or different commercial can shakers) of any of Tables I through III and repeating the test heretofore described until the desired result is observed.

In the foregoing manner, the relatively low cost machine **10** can be sold, leased or loaned to a person desiring to obtain a particular product characteristic as a result of a shaking operation but who is disinterested in expending a great deal of capital to purchase a particular commercial can shaker which in the final analysis may prove to be the wrong commercial shaker for a particular end product shake characteristic. Thus, irrespective of a particular problem which may be solved by shaking packaged contents a person at little or no investment can determine whether or not the particular problem can be solved continuously on a commercial basis by the novel method of this invention.

Though only three exemplary tables (Tables I through III) have been set forth heretofore to present known performance characteristics of existing commercial shakers, it is to be understood that any number of such tables can be formulated, as was heretofore noted, and the following formulas are applicable thereto:

FORMULA I

To Find Linear Feet Per Minute Flight Belt Travel for Any Can Size and Number of Cans Per Minute.

Formula: $A \times C/12 = L_f$, where

A = Flight Spacing In Inches

C = Cans Per Minute

L_f = Linear Feet Per Minute Flight Belt Travel

Example: 3.125 inches Flight Spacing × 96 cans per minute ÷ 12 = 25 Linear Feet Per Minute

FORMULA II

To Find Linear Inches Per Second Flight Belt Travels.

Formula: $L_f/5 = I_s$, where

L_f = Linear Feet Per Minute

I_s = Inches Per Second

Example: 25 Feet Per Min./5 = 5 Inches Per Second

FORMULA III

To Find Seconds Can Is In Shake Area At X Cans Per Minute.

Formula: $D/I_s = P$, where

D = Concentrated Shake Length In Inches

I_s = Inches Traveled Per Second

P = Seconds in Shake Area

Example: 198 ÷ 5.2 = 38 Seconds

(198 inches Concentrated Shake Length on 22 feet Can Shaker ÷ 5.2 Inches Per Second Travel = 38 Seconds in Shake Area)

FORMULA IV

To Find Shakes Each Can Receives During Length of Time in Concentrated Shake Area.

Formula: $P \times S_s = R$, where

P = Seconds Can Is In Concentrated Shake Area

S_s = Shake Cycles Per Second

R = Shakes Can Receives

Example: 38 Seconds In Shake Area × 5 Shakes Per Second = 190 Shakes Per Can.

While preferred forms and arrangements of parts have been shown in illustrating the invention, it is to be clearly understood that various changes in details and arrangement of parts may be made without departing from the spirit and scope of this disclosure.

We claim:

1. A shaker comprising carriage means for holding an article to be shaken, means mounting said carriage for reciprocal motion along a linear path, a counterweight, means mounting said counterweight for reciprocal motion along another linear path parallel to that of said carriage, and means for simultaneously reciprocating said carriage and counterweight along their respective paths and at all times in opposite directions.

2. The shaker as defined in claim **1** including means for simultaneously identically adjusting the speed of movement of said carriage and counterweight.

3. The shaker as defined in claim **2** wherein said carriage includes a body having a pair of opposite sides in part defining an article-receiving chamber, and means for selectively adjusting the distance between said walls for accommodating articles of different sizes in said chamber.

4. The shaker as defined in claim **2** wherein said carriage includes a body having a pair of opposite sides in part defining an article-receiving chamber, means for selectively adjusting the distance between said walls for accommodating articles of different sizes in said chamber, clamping means between said walls, and means for adjustably moving said clamping means in a direction normal to said walls to clamp an article in said chamber between one of said walls and said clamping means.

5. The shaker as defined in claim **1** including means for clamping an article in said carriage.

6. The shaker as defined in claim **1** wherein said carriage includes a body having a pair of opposite sides in part defining an article-receiving chamber, and means for selectively adjusting the distance between said walls for accommodating articles of different sizes in said chamber.

7. The shaker as defined in claim **1** wherein said carriage includes a body having a pair of opposite sides in part defining an article-receiving chamber, means for selectively adjusting the distance between said walls for accommodating articles of different sizes in said chamber, clamping means between said walls, and means for adjustably moving said walls to clamp an article in said chamber between one of said walls and said clamping means.

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