(54) Controlled product feeding device for combination weighing machines

(57) In a combination weighing machine comprising a plurality of weighing units 14, 16 and a plurality of product feeders 6 for feeding product to the respective weighing units, a device (26 Fig. 2) is provided for controlling the amount of product fed to each weighing unit based upon the deviation of the weight data (Wi) from each weighing unit from a predetermined target weight (WTi) given exclusively to each feeder, so that the amounts of product fed to respective weighing units can be controlled independently. A dispersion feeder 2 supplying the product feeders 6 may be controlled on the basis of a comparison between the sums of the product feeder weight data obtained in succeeding weighing cycles.
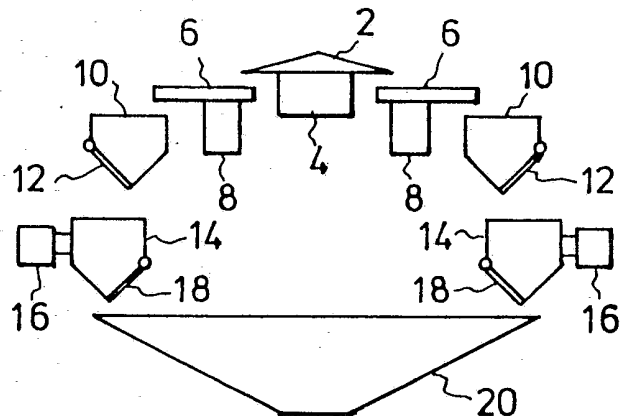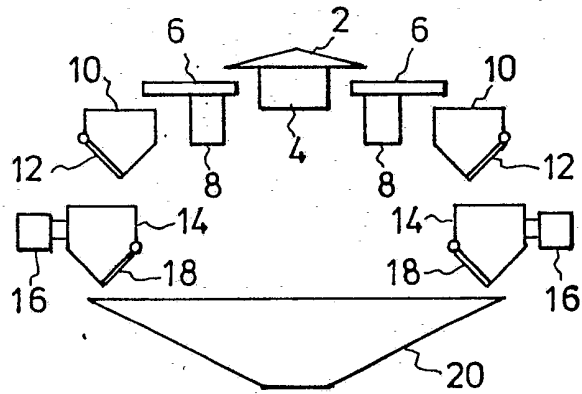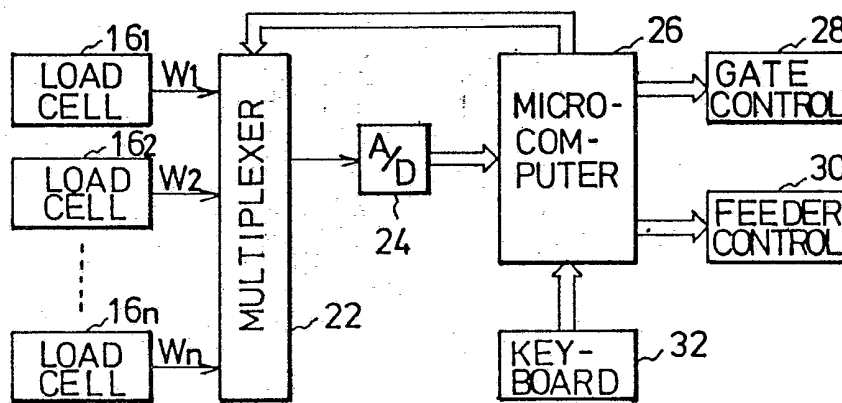
FIG. 1

GB 2 192 728 A

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FIG. 1

LOAD CELL 16₁ → W1
LOAD CELL 16₂ → W2
LOAD CELL 16n → Wn
MULTIPLEXER 22
A/D 24
MICRO-COMPUTER 26
GATE CONTROL 28
FEEDER CONTROL 30
KEY-BOARD 32

FIG. 2

FIG. 3

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START

51 READ WEIGHT DATA Wi

52 EFFECT COMBINATION OPER.

53 SEND DISCHARGE COMMAND

54 C = 0 ? → NO → 75 C ← C − 1

YES

55 ANY P.H. EMPTIED ? → NO

YES

56 i ← 1

57 i-TH P.H. EMPTIED ? → NO

YES

58 $F_i \leftarrow F_i + 1$

59 $F_i \geqq N_2$? → NO → 60 $W_i - WT_i + S_i \rightarrow S_i$

YES

61 $S_i \geqq K_1$? → NO → 63 $S_i \leqq K_2$? → NO

YES → 62 $A_i - \Delta A \rightarrow A_i$

YES → 64 $A_i + \Delta A \rightarrow A_i$

65 $S_i \rightarrow 0$ $F_i \rightarrow 0$

66 $i \leftarrow i + 1$

67 $i > n$? → NO → (loop back to 57)

YES

69 $SA \geqq \overline{SA} + K_3$? → NO → 72 $SA \leqq \overline{SA} - K_3$?

YES → 70 $A_0 \leftarrow A_0 + \Delta A_0$

72 → YES → 73 $A_0 \leftarrow A_0 - \Delta A_0$

NO

71 $SA \rightarrow \overline{SA}$; $N_1 \rightarrow C$

74 i ← 1

76 i-TH P.H. EMPTIED ? → NO

YES

77 SEND Ai & Ti

78 $i \leftarrow i + 1$

79 $i > n$? → NO → (loop back to 76)

YES

80 SEND Ao & To

81 OPERATION TO BE ENDED ? → NO

YES

END

68 CALCULATE TOTAL Ai (SA)

START

FIG. 4

FEEDER MEMORY ~110

16

118

DATA SELECTOR ~112

114

LATCH MEMORY ~116

R

IN

BCD COUNTER ~106

R

4 4

COMPARATOR ~108

4 4

4

4

AMPLITUDE MEMORY ~110

$\bar{A}_0 \sim \bar{A}_n$

120

1/16 1/8 1/4 1/2

R

BINARY COUNTER ~102

1 MHz CLOCK

1/4 FREQ. DIVIDER ~104

R

RESET

FIG. 5

FIG. 6

(a)

(b) RESET   RESET

(c)

(d)

(e)

(f)
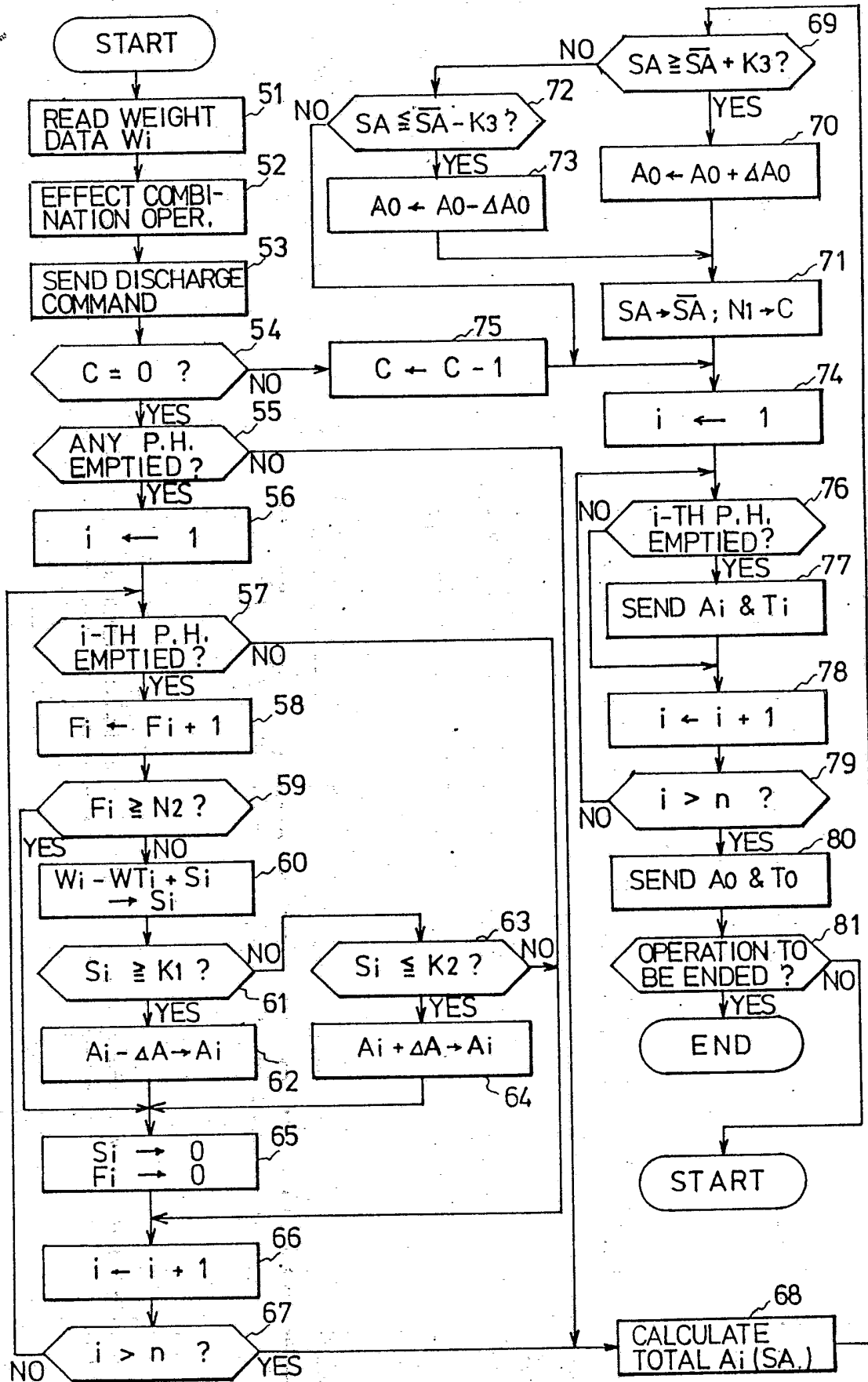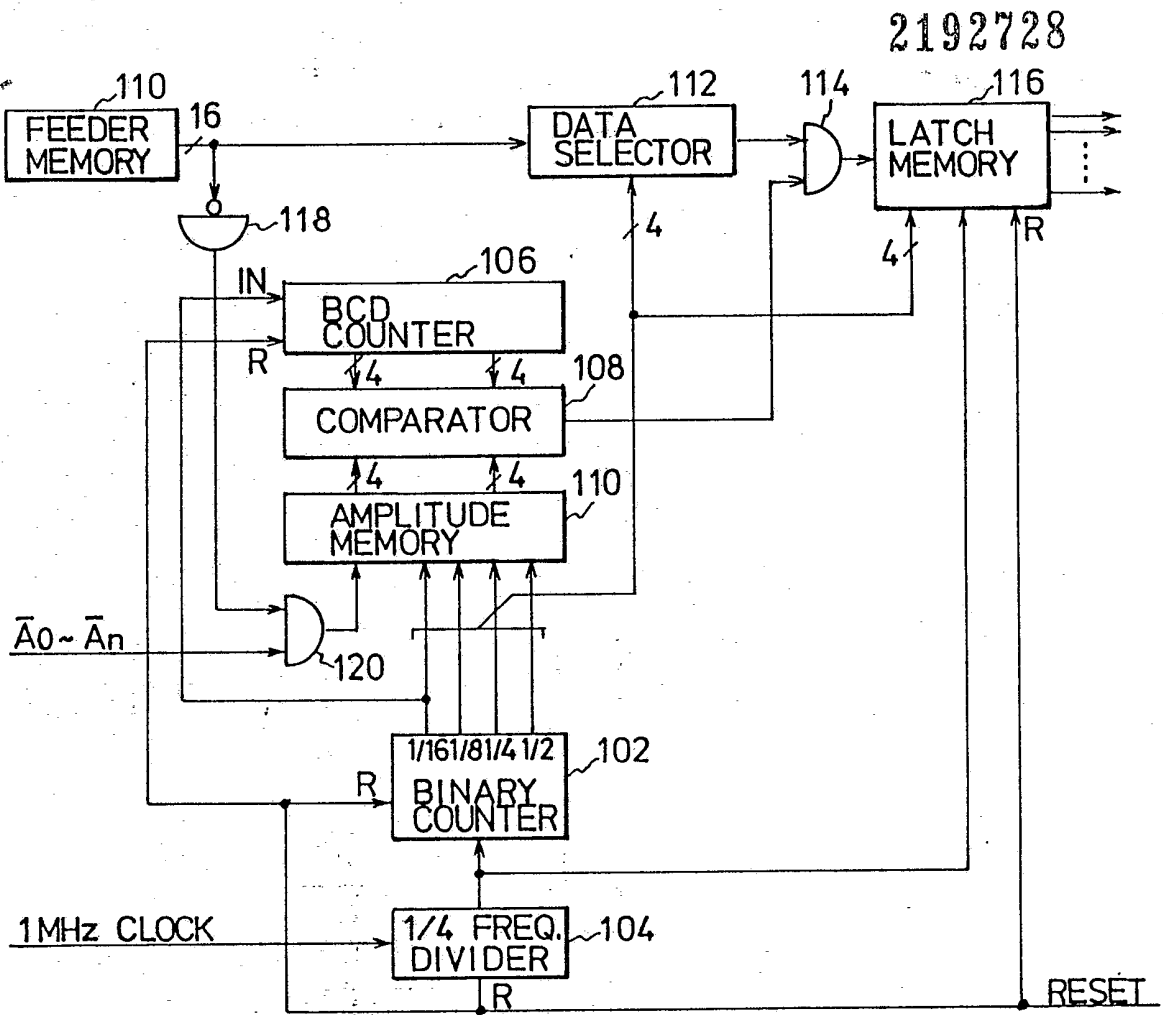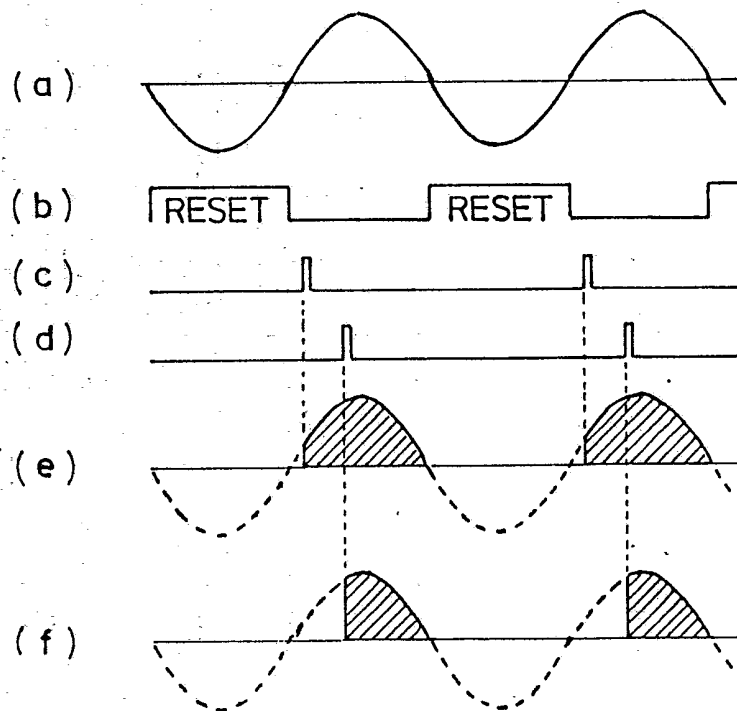
SPECIFICATION

Controlled product feeding device for combination weighing machine

5   This invention relates generally to a combination weighing machine and particularly to automatic control of the amount of product fed to each weigher of such a machine.

10   As well known in the art, a combination weighing machine includes a plurality of weighers for respectively weighing quantities of product and combines the weight values from respective weighers in various fashion to
15   select from the resultant combinations a combination having a total weight satisfying a predetermined condition. It has been known in this machine that maximum accuracy of the total weight with respect to the predetermined
20   condition is obtained when the selected combination is composed of the weight values from a half number of the available weighers. In order to keep this number of weighers, means has been proposed for automatically
25   controlling the amount of product fed to each weigher. For example, U.S. Patent No. 4,397,364 discloses a device for controlling the amount of feed based upon the detected number of weighers includes in each selected
30   combination and U.S. Patent No. 4,484,645 discloses a device for controlling this amount based upon the detected mean weight from those weighers not included in the selected combination. In these prior art devices, the
35   amounts of feed to all weighers are controlled in a lump based upon a common control data.

However, it has been found that such lump control can not provide intended accuracy due to unavoidable variance in feeding operations
40   of product feeders belonging to respective weighers. More particularly, a conventional combination weighing machine includes a product feeding system consisting of a central dispersion table and a plurality of linear feed-
45   ing troughs radially arranged around the dispersion table. These feeding troughs are subjected to mechanical vibration to convey product to respective weighers at their distal or outer ends. While the amount of feed is con-
50   trolled by controlling the vibration amplitude, it is different to obtain uniform control of amplitude in all feeding troughs. The variance in feeding rate is also caused by difference in surface friction between respective troughs.
55

[Summary of Invention]
Accordingly, an object of this invention is to provide an improved product feeding device which enables independent control of the
60   amount of product fed to each weigher based upon a control data which is exclusively provided for said weigher, thereby removing the above-mentioned disadvantage caused by the prior art lump control.
65   According to a feature of this invention,

there is provided a product feeding device including a plurality of separate feeders associated with respective weighers and means for individually controlling the amount of product
70   fed from each feeder to the corresponding weigher based upon a control data which is exclusively provided for said weigher. Each weigher is previously provided with an inherent target weight of product to be fed thereto
75   and the control data is prepared based upon the deviation of the selected weight value from said weigher from its target weight.

According to another feature of this invention, the device further includes a common
80   feeder for distributively feeding product to the separate feeders and means for controlling the amount of product fed from the common feeder to the separate feeders based upon a control data which is prepared based upon the
85   total weight of product fed to the respective weighers and the sum of the regulated target weights of the respective weighers.

These and other objects and features of this invention will be described in detail below
90   with reference to the accompanying drawings.

[Brief Description of Drawings]
In the drawings:
Figure 1 is a schematic side view represent-
95   ing a mechanical configuration of a typical combination weighing machine in which this invention is embodied;
Figure 2 is a block diagram representing an electrical configuration of the combination
100 weighing machine of Fig. 1;
Figure 3 is a schematic circuit diagram representing an exemplary configuration of the feeder control device of Fig. 2;
Figure 4 is a flow chart representing a pro-
105 gram executed in the microcomputer of Fig. 2 for realizing the inventive control;
Figure 5 is a block diagram representing another embodiment of the feeder control device; and
110 *Figures 6(a)* to *6(f)* are waveform diagrams used for explaining operation of the feeder control device of Fig. 5.

[Description of Preferred Embodiments]
115 Referring first to Fig. 1, there is shown an exemplary combination weighing machine including a product feeding device consisting of a conical dispersion table 2 provided with an electromagnetic vibrator 4 and a plurality of
120 linear feeding troughs 6 provided with an electromagnetic vibrator 8 each and arranged radially around the table 2. The dispersion table 2 is subjected to helical vibration to disperse product fed to its apex toward its periphery.
125 The feeding troughs 6 are individually subjected to linear slanting vibration to convey the product received from the dispersion table 2 to their distal or outer ends. Under the distal ends of respective troughs 6, the same
130 number of pool hoppers 10 are disposed re-

spectively to receive the product from the troughs 6 and temporarily hold the same. In accordance with this invention, the vibration amplitude and/or time of the vibrators 8 are
5 separately controlled to adjust the amount of product fed to the respective pool hoppers 10. Each pool hopper 10 has a discharge gate 12 at the bottom and a weigh hopper 14 is disposed thereunder for receiving the product
10 from the pool hopper 10 when the gate 12 opens. Each weigh hopper 14 is associated with a weight sensor 16 such as a load cell for providing an electric signal indicative of the weight of product in the weigh hopper 14.
15 Each weigh hopper 14 also has a discharge gate 18 for discharging the content when it is opened, and a common collection chute 20 is disposed thereunder for collecting the product discharged from the weigh hoppers 14. While
20 any number "n" of weigh hoppers (and corresponding pool hoppers 10 and feeding troughs 6) may be included in the machine, only two facing ones are shown in the drawing for simplicity.
25 As shown in Fig. 2, the weight sensing load cells 16_1, 16_2, ... 16_n are coupled through a multiplexer 22 and an analog-to-digital (A/D) convertor 24 to a microcomputer 26. The multiplexer 22 is controlled by the microcom-
30 puter 26 to sequentially supply the weight data W_1, W_2, ... W_n in time division fashion to the A/D convertor 24 and the analog weight data are converted there in digital form and stored in a random access memory (RAM)
35 of the microcomputer 26. As well known in the art, the microcomputer 26 combines the stored weight data in various fashion and calculates the total weights of the resultant combinations. The microcomputer 26 then selects
40 from these combinations a combination whose total weight is equal or nearest to a predetermined reference weight and commands a gate control device 28 to open the discharge gates 18 of the weigh hoppers 14 whose weight
45 data are included in the selected combination. The gate control device 28 further opens the discharge gates 12 of the corresponding pool hoppers 10 to refresh the emptied weigh hoppers 14. No further description will be made
50 on this combination selection operation since it constitute no part of this invention.

The microcomputer 26 also calculates feeder control data consisting of amplitude specifying data A_1, A_2, ... A_n and A_0 and
55 time specifying data T_1, T_2, ... T_n and T_0 from the weight data W_1, W_2, ... W_n and corresponding target weight data WT_1, WT_2, ... WT_n as described later and supplies them in digital form to a feeder control device
60 30. The feeder control device 30 responds to these control data to independently control the vibration amplitude and/or time of the vibrators 4 and 8. A keyboard unit 32 is provided for writing initial data such as reference
65 and target weights in the RAM of the micro-

computer 26.

Referring to Fig. 3 which shows an embodiment of the feeder control device 30, the above-mentioned amplitude specifying data A_i
70 (i=0,1,2,...n) are supplied through digital-to-analog (D/A) convertors 34_i to firing circuits 36_i. The time specifying data T_1 are supplied to timing circuit 38_i which provide timing pulses having pulse widths respectively corre-
75 sponding to the input data T_i to the control terminals of normally-open switches 40_i which respectively apply d.c. operation voltage +V to the firing circuits 36_i when closed. The timing circuits 38_i may consist of a programma-
80 ble down-counter set by the digital time specifying data and an OR circuit having inputs connected to respective stages of the down-counter. As the down-counter provides logic "1" output from at least one of its stages
85 until the count reaches decimal zero, the OR circuit provides a continuous output corresponding to the data T_i. It will be easy for those skilled in the art to design other suitable circuits. The firing circuits 36_i have their out-
90 puts connected respectively to the gate electrodes of thyristors 42_i inserted between an a.c. supply 44 and the vibrators 4 and 8_i, and function to change the firing angles of the thyristors. Each of the firing circuits 36_i may be a
95 known phase control circuit including bipolar and uni-junction transistors, a capacitor and resistors, which provides a variable-phase output by controlling the conductivity of the bipolar transistor by the input amplitude specifying
100 data A_i to control the conduction timing of the uni-junction transistor with the RC-circuit. The a.c. driving power applied to each vibrator varies with the firing angle of each thyristor. Accordingly, each vibrator tends to cause vi-
105 bration at an amplitude specified by the data A_i for a time specified by the data T_i.

Now, the operation of the microcomputer 26 will be described below with reference to the flow chart of Fig. 4. It is assumed that
110 the reference total weight R and respective weigher target weights WT_i (i=1,2 ... n) have been stored in the RAM of the microcomputer 26 through the keyboard unit 32 and all weigh hoppers 14_i and corresponding pool hoppers
115 10_i and linear feeders 6_i and the dispersion table 2 have been loaded with product. When the operation starts in this condition, the microcomputer 26 provides a control signal to the multiplexer 22 in step 51 to read the
120 weight data W_i from the load cells 16_i sequentially through the A/D convertor 24 and stores them in digital form in predetermined locations of the RAM. Thereafter, a combination selecting operation is effected in step 52
125 using the stored weight data W_i.

In this embodiment, the prior art operation which has been effected by hardware such as n-bit binary counter, adder and comparator is realized by using a software of the microcom-
130 puter 26. More particularly, the microcomputer

26 initially stores in its read-only memory
(ROM) 2^n-1 operation codes corresponding to
all mathematical combinations of n-number of
weight data W_i. Each operation code is a n-bit
5 binary code in which i-th bit corresponds to
W_i. In step 52, these operation codes are se-
quentially read out from the ROM and the
weight data W_i corresponding to logic "1"
bits of the respective codes are summed indi-
10 vidually to obtain 2_n-1 combined sums. These
combined sums are sequentially compared
with the content of a maximum storage loca-
tion of the RAM (the initial content being a
preset allowable maximum of the combined
15 sum) and the stored reference total weight R
and, if the combined sum is between these
values, the maximum value is updated with
that combined sum and the corresponding
code is stored in a code storage location of
20 the RAM in place of the prior content. This
operation is repeated for all operation codes.
Thus, when the operation completed, the
code storage location will store a code which
provides an optimum combination having a
25 combined sum weight equal or nearest to the
reference total weight R and lower than the
allowable maximum value.

In the next step 53, the microcomputer 26
provides the gate control device 28 with this
30 finally stored optimum code as a discharge
command to cause the gate control device to
drive the gates 18_i of those weigh hoppers
14_i corresponding to the weight data W_i in-
cluded in the optimum combination to dis-
35 charge their contents into the collection chute
20 and, thereafter, to drive the gates 12_i of
the corresponding pool hoppers 10_i to reload
the emptied weigh hoppers 14_i with their con-
tents.

40 Before continuing the description, it should
be noted that the microcomputer 26 further
includes a counter for specifying each weight
data W_i (and corresponding weigh hopper 14_i,
pool hopper 10_i, linear feeder 6_i and the like)
45 by its count "i" (hereinunder referred to as "i-
counter"), a down-counter for counting the
number of combination selecting operations
effected after changing the amount of feed to
the dispersion table 2 (hereinunder referred to
50 as "c-counter"), n-number of counters for
counting the number, F_i, of feeds of product
to each pool hopper 10_i from corresponding
linear feeder 6_i (hereinunder referred to as "F_i-
counter") and n-number of accumulators hav-
55 ing a content given by S_i for accumulating the
deviation of each weight data W_i from the
corresponding target weight WT_i every cycle
of operation (hereinunder referred to as "S_i-
accumulator") which are formed of softwares.

60 In step 54, it is inquired whether the count
"C" of the C-counter is zero or not. As de-
scribed later, the C-counter is set to a predet-
ermined number N_1 in step 71 and decre-
mented by one in step 75 and, when the
65 count "C" reaches zero, the linear feeder con-

trol program consisting of steps 55 to 67
and/or the dispersion table control program
consisting of steps 68 to 73 are executed.

In step 55, it is inquired whether there is
70 any empty pool hopper or not. This judge-
ment may be effected by checking the stored
optimum combination code. More particularly,
each logic "1" bit of the code indicates the
corresponding pool hopper being empty. If the
75 answer is NO, that is, if there is no empty
pool hopper, the program jumps to step 68
and no linear feeder control operation is ef-
fected.

If YES, the count of i-counter is set to one
80 in step 56 and it is inquired in step 57
whether the pool hopper 10_1 is empty or not.
If it is empty the F_i-counter is incremented by
one in step 58 and then compared with a
predetermined number N_2 in step 59 whether
85 it is greater than the latter or not. If not, the
deviation of the current weight data W_1 from
the target weight WT_1 is added to the current
content S_1 of the S_1-accumulator in step 60
and the resultant sum is compared in step 61
90 or 63 with a predetermined upper or lower
threshold K_1 or K_2. If the sum has exceeded
the upper or lower threshold, the current am-
plitude specifying data A_1 is reduced or in-
creased in step 62 or 64 by a predetermined
95 correction value ΔA. Thereafter, the contents
of S_1-accumulator and F_1-counter are reset to
zero in step 65. This is also the case when
the answer in step 59 is YES. This means
that the range between both thresholds K_1
100 and K_2 is specified as an immune range and
the accumulation of deviation is newly recom-
menced when the accumulated sum comes
out of this region before the count F_i reaches
the number N_2. This immune region prevents
105 hunting of the vibration amplitude of the linear
feeders. As an example, $N_2=30$, $K_1=+10$
grams and $K_2=-10$ grams.

If the answer in step 57 or 63 is NO, the i-
counter is incremented by one in step 66 and
110 the result is compared in step 67 with the
number "n". Thereafter, the same operation is
repeated until the count "i" exceeds the num-
ber "n" and, when YES is obtained in step
67, the amplitude specifying data for those
115 linear feeders corresponding to all empty pool
hoppers have been corrected and renewed.
When the answer in step 67 is YES or the
answer in step 55 is NO, the dispersion
feeder control program is commenced at step
120 68.

In step 68, the current amplitude specifying
data A_i are summed to obtain a total value
SA and this value is compared in step 69
with the similar value $\overline{SA}$ used in the preced-
125 ing operation. More particularly, it is inquired
in step 69 whether the total value SA has
increased more than a predetermined amount
K_3 above the preceding value $\overline{SA}$ or not. If
YES, the current dispersion table amplitude
130 specifying data A_0 is increased by a predeter-

mined correction amount ΔA_0 in step 70. If the answer in step 69 is NO, it is inquired in step 72 whether the total value SA has reduced more than K_3 below the preceding value $\overline{SA}$ or not. If YES, the amplitude specifying data A_0 is reduced by ΔA_0 in step 73. After correction of the amplitude specifying data A_0, the current total value SA is stored as $\overline{SA}$ for future use and the C-counter is set to N_1 in step 71. Then, the i-counter is reset to one in step 74 and this is also the case when the answer in step 72 is NO.

When the answer in step 54 is NO, the count "C" is decremented by one in step 75 and followed by step 74. This means that neither linear feeder control program nor dispersion table control program is effected until the C-counter returns to zero after correcting the amplitude specifying data A_0 for the dispersion table. The reason is that the weighing operation must be effected suitable times after this correction in order to obtain the effect of correction. The value of N_1 may be five, for example.

In the following steps 76 to 79, the corrected amplitude specifying data A_i and the predetermined time specifying data T_1 for the linear feeders are supplied to the feeder control device 30 as confirming emptiness of the corresponding pool hoppers and incrementing the count "i" by one in step 78 until the count exceeds "n" in step 79. Thereafter, the corrected amplitude specifying data A_0 and the predetermined time specifying data T_0 for the dispersion table is supplied in step 80 and it is inquired in step 81 whether the operation of this combination weighing machine is to be ended or not. If the answer is YES, the program is ended and, if NO, it is returned to "START". Thus, the emptied pool hoppers are fed with product at corrected vibration amplitudes.

Fig. 5 shows an another embodiment of the circuit controlled by the microcomputer 26 of Fig. 2 for driving the thyristors 42_i (i=0,1,2,...n) of Fig. 3. The circuit includes an amplitude data memory 100 having n+1 memory locations in which complements $\bar{A}_1$ of the amplitude specifying data A_1 (i=0,1,2,...n) with respect to 99 are set by the microcomputer 26. These complements are sequentially read out in accordance with the count of a four-bit binary counter 102. The binary counter 102 is adapted to count a 250 KHz clock signals obtained for example by frequency-dividing a 1 MHz clocksignal in a 1/4 frequency divider 104. Accordingly, if n=15 for example, it takes 64 microseconds

$$(= \frac{1}{1,000,000} \times 4 \times 16 \text{ second})$$

to read out all complements from the amplitude data memory 100.

The signal at the 1/16 frequency division terminal of the binary counter 102 is counted by a binary-coded decimal (BCD) counter 106. In the above example, therefore, the count of the BCD counter 106 is incremented by one every 64 microseconds. In other words, the count rises every time all complements in the amplitude data memory 68 are read out. The count of the BCD counter 106 is compared with each complement $\bar{A}_i$ from the amplitude data memory 100 by a comparator 108. In the above example, the count of the BCD counter is delivered every $4 \times 16/1,000,000$ second, while the amplitude data memory 100 is read every $4/1,000,000$ second. Therefore, each count of the BCD counter 106 is compared with all complements $\bar{A}_i$ (i=0,1,2,...15). The comparator 108 provides logic "1" when the applied complement coincides with the count. The binary counter 102, BCD counter 106 and 1/4 frequency divider 104 are reset by a reset signal as shown in Fig. 6(b) obtained by negative half-wave rectification of commercial a.c. voltage as shown in Fig. 6(a). Accordingly, each count of the BCD counter 106 is compared with all complements $\bar{A}_i$ from the amplitude data memory 100 every 64 microseconds after the positive half-wave starts in the commercial a.c. voltage. Accordingly, if the "1" output of comparator 108 is applied to the thyristor 42 corresponding to the applied complement, this thyrister is triggered at a time of $64 \times \bar{A}_i$ microseconds after the positive half-wave starts (strictly speaking, some deviation occurs in this time point in accordance with the memory address of each complement) as shown in Figs. 6(c) and 6(d), thereby enabling control of power supplied to the vibrators 8_i of the dispersion table and linear feeders as shown by shadowed areas in Figs. 6(e) and 6(f) and consequent control of vibration amplitudes thereof.

In this condition, however, the vibrators will continue operation so long as the commercial power is supplied thereto. In order to confine the operation time of each vibrator, a feeder memory 110 having n+1 memory locations corresponding to the dispersion table and n-number of linear feeders is adapted by the microcomputer 26 to produce a logic "1" output from each location for a time duration specified by the corresponding time specifying data T_i. The n+1 (16 in the above example) outputs of the feeder memory 110 are coupled to a data selector 112 which also receives the count output of the binary counter 102 and directs only the output of feeder memory 110 from the memory location specified by the input count to an AND circuit 114. The AND circuit 114 also receives the output of comparator 108 at its second input and, therefore, supplies it to a latch memory 116 for the corresponding specified duration of time. The latch memory 116 having n+1 (16

in this example) memory locations respectively
corresponding to those of the feeder memory
110 and being coupled to the gate electrodes
of the corresponding thyristors 42ᵢ. The latch
5 memory 116 is adapted to latch the current
output of AND circuit 114 in its memory loca-
tion specified by the count from the binary
counter 102. Thus, the latch memory 116 can
provide trigger pulses as shown in Figs. 6(c)
10 and 6(d) to specified thyristors for specified
times. The output clock of the frequency di-
vider 104 is used at a latch signal. The latch
memory is also reset for the negative half-
wave period of the commercial a.c. power by
15 the reset signal of Fig. 6(b). Two AND circuits
118 and 120 are provided for rewriting the
data stored in the amplitude data memory
100 only when no feeder is selected (or there
is no empty pool hopper).
20   It should be noted that the above descrip-
tion has been made only for illustration pur-
pose but not for limitation of the invention
and many modifications and variations can be
made within the scope of this invention as
25 defined in the appended claims. For example,
the vibration time may be controlled with the
amplitude unchanged, while the amplitude is
controlled in the above embodiments. The
control of dispersion table may be omitted if
30 possible. This invention can be applied to any
type of product feeders other than vibration
feeders, such as of belt conveyer type. More-
over, this invention is applicable to any type
of combination weighing machine, even in that
35 having no pool hopper, regardless of its me-
chanical and electrical configuration and mode
of combination selecting operation.

CLAIMS
40   1. A product feeding device for a combina-
tion weighing machine comprising a plurality
of weighers for weighing product respectively
to provide corresponding weight data, and
means for selecting an optimum combination
45 of said weight data which satisfies a predeter-
mined condition and unloading those weighers
corresponding to said optimum combination
for delivery; the product feeding device com-
prising a plurality of product feeders for feed-
50 ing product respectively to said weighers, feed
control means for individually controlling the
amounts of product fed to said weighers
based upon feed control data respectively pro-
vided for said product feeders, and means for
55 providing said feed control means with said
feed conrol data to control the amounts of
feed of those feeders corresponding to the
unloaded weighers based upon the deviations
of said weight data of said unloaded weighers
60 from respective target weight data.
    2. A product feeding device as set forth in
Claim 1, characterized in that said means for
providing said control means with said feed
control data comprises means for accumulat-
65 ing every delivery the deviation of the weight

data of the same weighers from said corre-
sponding target weight data, means for
changing said feed control data to reduce the
amount of feed when the accumulated value
70 exceeds a first predetermined value, and
means for changing said feed control data to
increase the amount of feed when said accu-
mulated value is less than a second predeter-
mined value.
75   3. A product feeding device as set forth in
Claim 1 or 2, characterized in that said feed
control means is adapted to control the
amount of feed per unit time of each feeder.
    4. A product feeding device as set forth in
80 Claim 1 or 2, characterized in that said feed
control means is adapted to control the oper-
ation time of each feeder.
    5. A product feeding device for a combina-
tion weighing machine comprising a plurality
85 of weighers for weighing product respectively
to provide corresponding weight data, and
means for selecting an optimum combination
of said weight data which satisfies a predeter-
mined condition and unloading those weighers
90 corresponding to said optimum combination
for delivery; the product feeding device com-
prising a plurality of separate product feeders
for feeding product respectively to said weigh-
ers, a common product feeder for feeding pro-
95 duct to said separate product for feeders,
feed control means for individually controlling
the amounts of product fed to said weighers
based upon feed control data respectively pro-
vided for said separate feeders and controlling
100 the amount of product fed from said common
feeder based upon a feed control data pro-
vided for said common feeder, means for pro-
viding said feed control means with said feed
control data to control the amounts of feed of
105 those separate feeders corresponding to the
unloaded weighers based upon the deviations
of said weight data of said unloaded weighers
from respective target weight data, and means
for comparing the sum of said feed control
110 data for the separate feeders with first and
second values functionally related to said feed
control data as a result of the preceding ad-
justment of said common feeder and providing
said feed control means with said feed control
115 data for the common feeder modified based
upon the result of comparison.
    6. A product feeding device as set forth in
Claim 5, characterized in that said means for
providing said control means with said feed
120 control data comprises means for accumulat-
ing every delivery the deviation of the weight
data of the same weighers from said corre-
sponding target weight data, means for
changing said feed control data to reduce the
125 amount of feed when the accumulated value
exceeds a first predetermined value, and
means for changing said feed control data to
increase the amount of feed when said accu-
mulated value is less than a second predeter-
130 mined value.

7. A product feeding device as set forth in Claim 5 or 6, characterized in that said means for providing said feed control means with the feed control data for the common feeder comprises means for increasing said feed control data for the common feeder when the sum of said feed control data for the separate feeders is greater than said sum of feed control data for separate feeders as the result of preceding adjustment of said common feeder plus a third predetermined value, and means for reducing said feed control data for the common feeder when the sum of said feed control data for separate feeders is less than said sum of feed control data for separate feeders as the result of preceding adjustment of the common feeder minus said third predetermined value.

8. A product feeding device as set forth in Claim 5, 6 or 7, characterized in that said feed control means is adapted to control the amount of feed per unit time of each separate feeder.

9. A product feeding device as set forth in Claim 5, 6 or 7, characterized in that said feed control means is adapted to control the operation time of each separate feeder.

10. A product feeding device as set forth in Claim 5, 6, 7, 8 or 9, characterized in that said feed control means is adapted to control the amount of feed per unit time of said common feeder.

11. A product feeding device as set forth in Claim 5, 6, 7, 8 or 9, characterized in that said feed control means is adapted to control the operation time of said common feeder.

12. A product feeding device substantially as hereinbefore described with reference to the accompanying drawings.