

Nov. 13, 1962

L. F. STRINGER ETAL

3,063,632

WORKPIECE COUNTER APPARATUS

Original Filed June 28, 1957

6 Sheets-Sheet 1

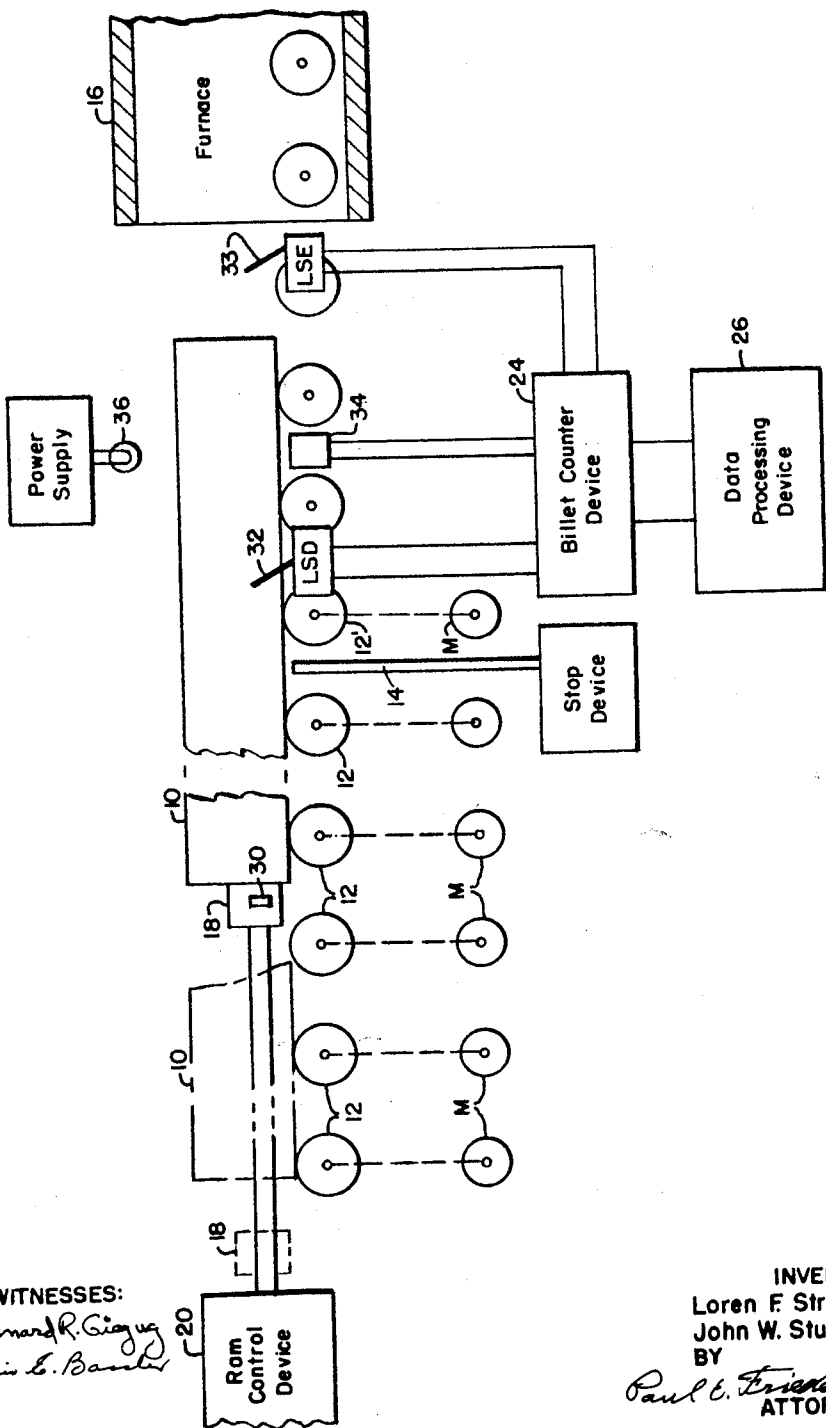


Fig. 1.

WITNESSES:
Bernard R. Giegue
Edwin L. Bandler

INVENTORS
Loren F. Stringer and
John W. Stuart.
BY
Paul E. Friedmann
ATTORNEY

Nov. 13, 1962

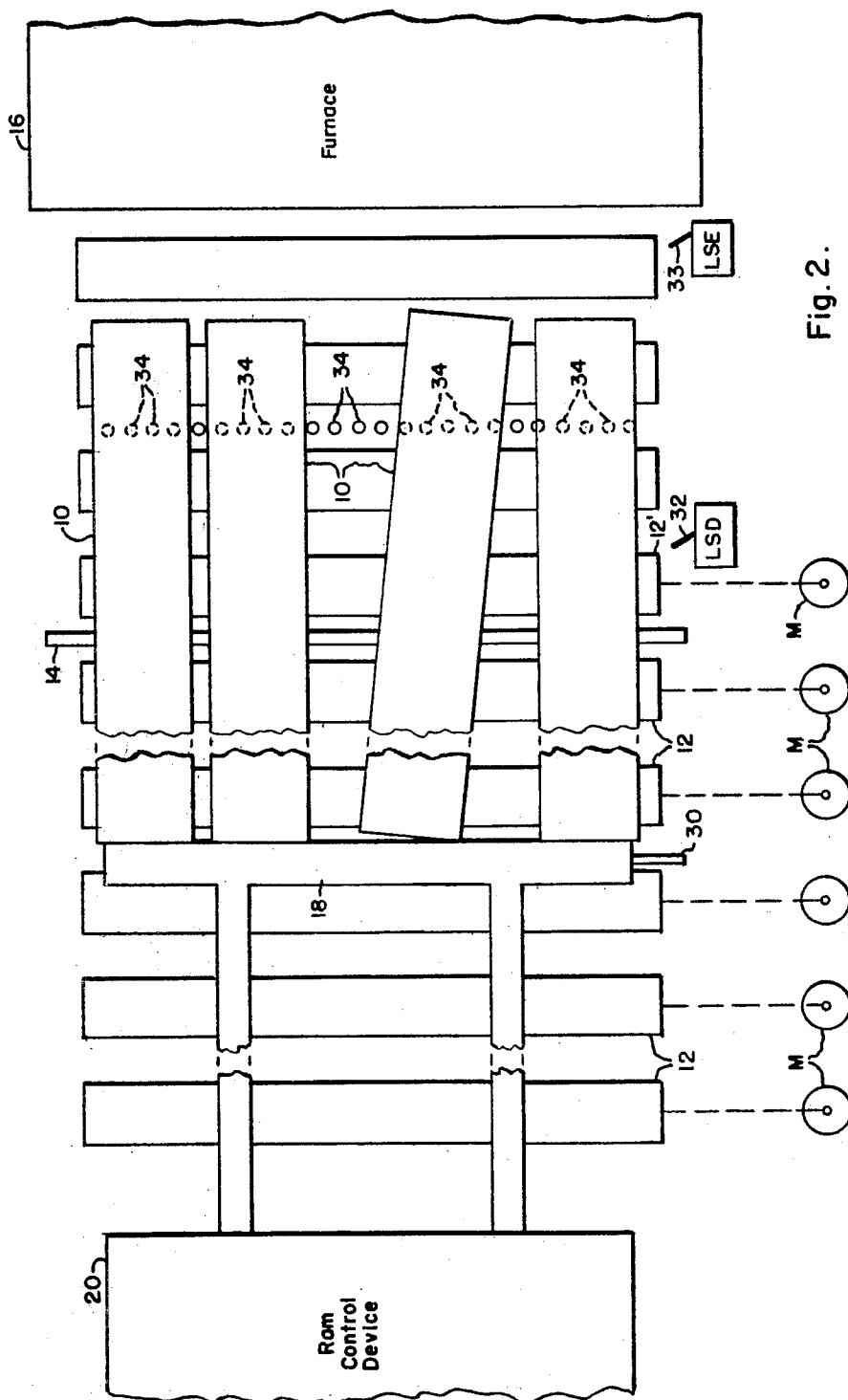
L. F. STRINGER ET AL

3,063,632

WORKPIECE COUNTER APPARATUS

Original Filed June 28, 1957

6 Sheets-Sheet 2



Nov. 13, 1962

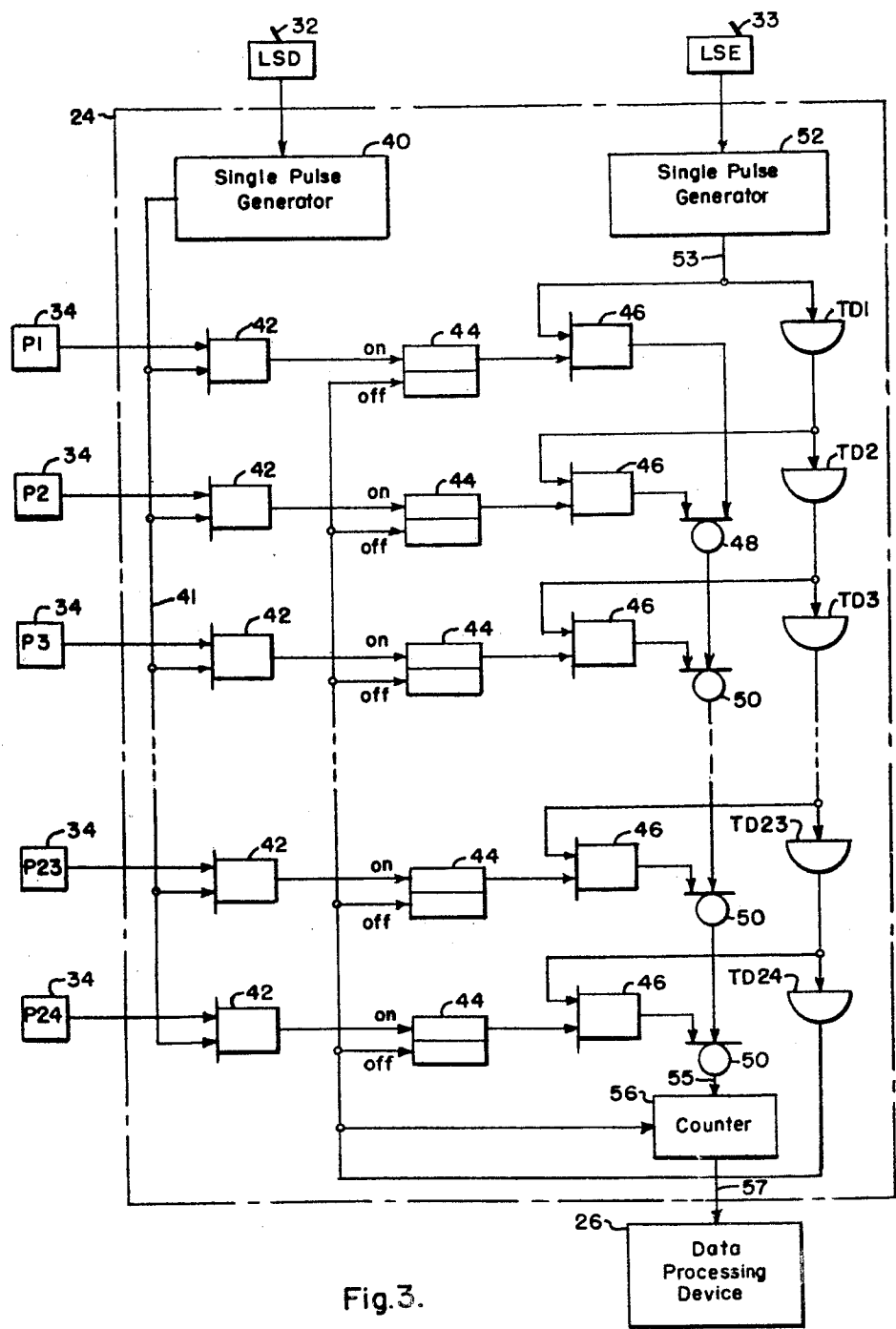
L. F. STRINGER ETAL

3,063,632

WORKPIECE COUNTER APPARATUS

Original Filed June 28, 1957

6 Sheets-Sheet 3



Nov. 13, 1962

L. F. STRINGER ET AL

3,063,632

WORKPIECE COUNTER APPARATUS

Original Filed June 28, 1957

6 Sheets-Sheet 4

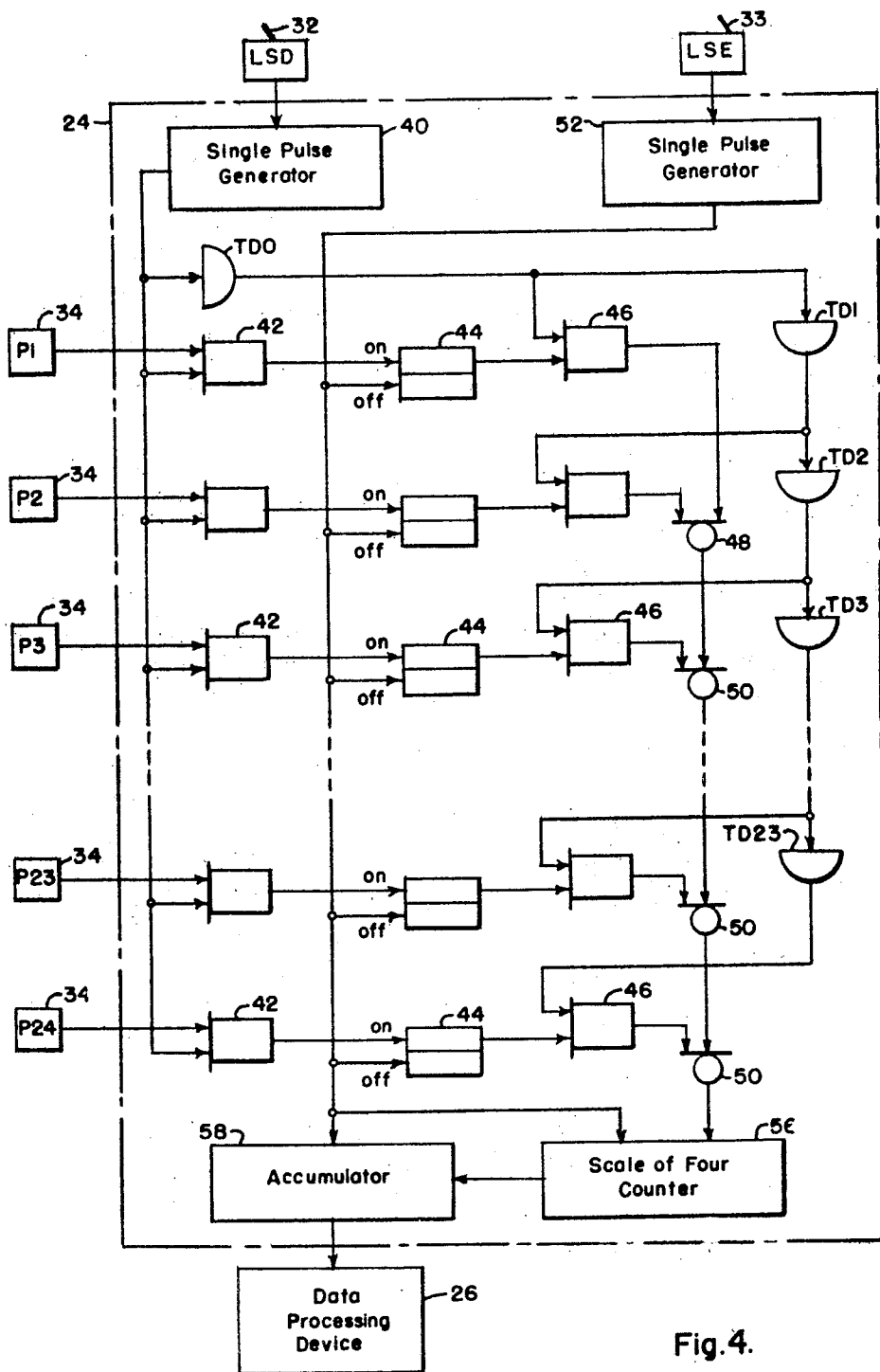


Fig. 4.

Nov. 13, 1962

L. F. STRINGER ET AL

3,063,632

WORKPIECE COUNTER APPARATUS

Original Filed June 28, 1957

6 Sheets-Sheet 5

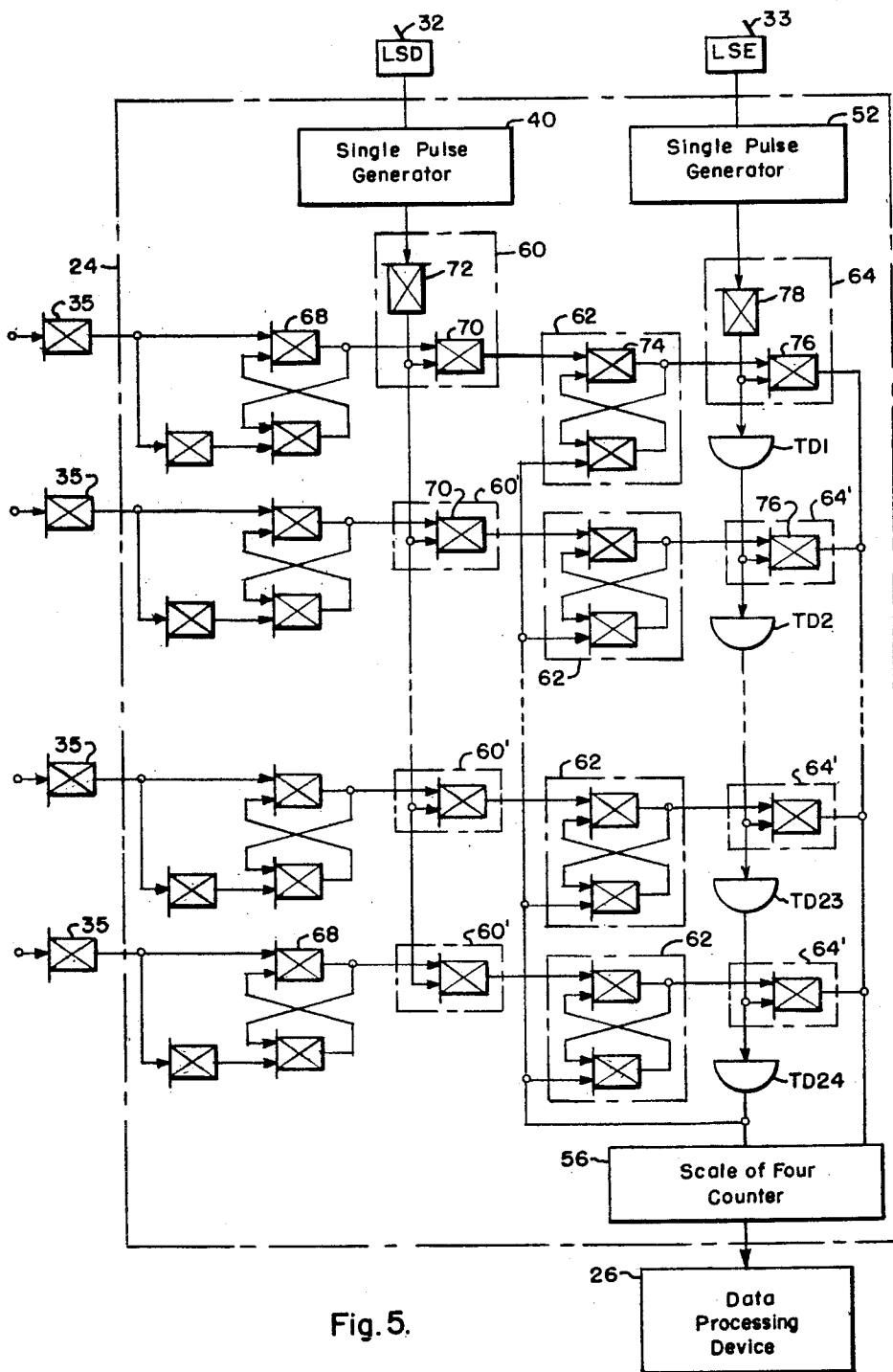


Fig. 5.

Nov. 13, 1962

L. F. STRINGER ETAL
WORKPIECE COUNTER APPARATUS

3,063,632

Original Filed June 28, 1957

6 Sheets-Sheet 6

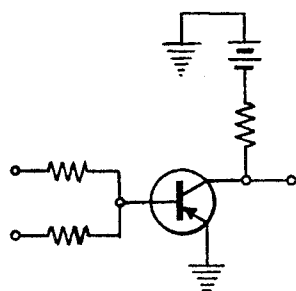


Fig. 6.

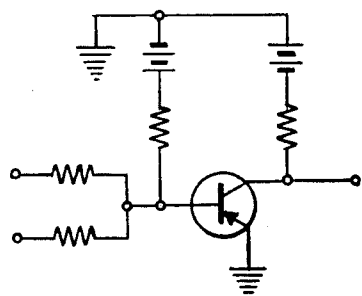


Fig. 7.

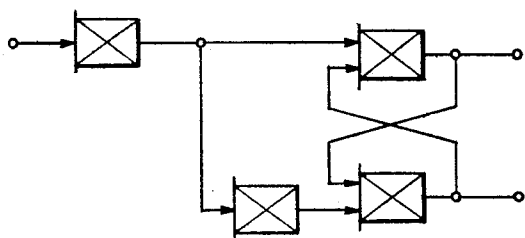


Fig. 8.

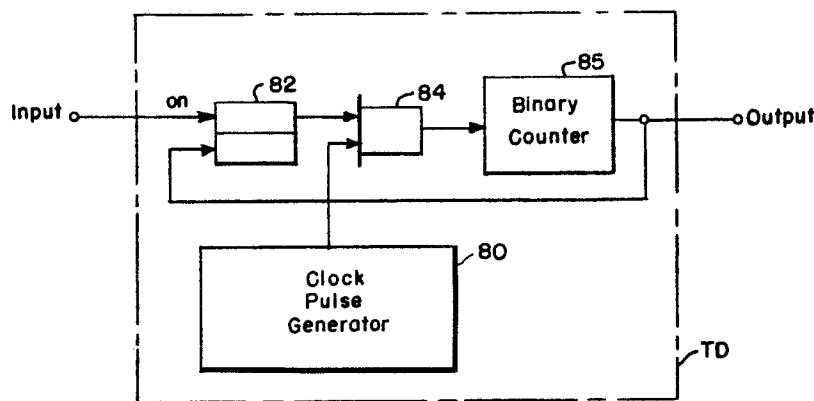


Fig. 9.

1

3,063,632

WORKPIECE COUNTER APPARATUS

Loren F. Stringer, Williamsville, N.Y., and John W. Stuart, Columbus, Ohio, assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Continuation of application Ser. No. 668,733, June 28, 1957. This application Sept. 28, 1961, Ser. No. 142,454 19 Claims. (Cl. 235—98)

The present invention relates, in general, to workpiece counting and handling apparatus, and more particularly to workpiece counting apparatus operative with a workpiece or billet travel path leading to a workpiece treatment device, such as a furnace and operative for counting the number of workpieces or billets relative to the operation of said treatment device.

This is a continuation of an application of Loren F. Stringer and John W. Stuart, Serial No. 668,733, filed June 28, 1957, now abandoned, and entitled "Workpiece Counter Apparatus."

It is an object of the present invention to provide improved workpiece counting apparatus for supplying better data for subsequent utilization relative to the operation of a workpiece treatment device, and more particularly to provide improved workpiece counting apparatus for accomplishing the required workpiece detection and data provision in this regard as necessary to provide the input data to a subsequent data processing computer device.

It is a different object to provide an improved workpiece counting apparatus operative to in effect integrate the total space occupied by said workpieces at a specific location in a predetermined travel path and thusly determine the number of workpieces actually at said location.

It is an additional object of the present invention to provide improved workpiece counting apparatus operative to provide a predetermined number of counting pulses or signals for each workpiece at a specified location in a workpiece travel path, and further being operative to determine from the total number of said signals provided, the total number of workpieces at said location during a given counting or sampling period of time.

It is a still different object of the present invention to provide improved workpiece counting apparatus including at least one counting signal source for each workpiece and a predetermined position responsive device for providing a control signal, with a static device requiring said counting signal and said control signal before an indication of the presence of said workpiece is made.

It is a further object of the present invention to provide improved workpiece counting apparatus including at least one counting signal source for each workpiece and a predetermined position responsive device for providing a suitable control signal when an initial predetermined position is reached by said workpiece and an additional position responsive device for providing a second control signal when a subsequent predetermined position is reached by said workpiece, with said apparatus being operative to respond to said counting signal only after said first control signal has been received, and being further operative to provide an indication of the total number of said counting signals received and thereby the total number of said workpieces only after said second control signal has been received.

These and other objects and advantages of the present invention will become apparent in view of the following description taken in conjunction with the drawings, wherein:

FIGURE 1 illustrates the operation of the present counter apparatus;

FIG. 2 further illustrates the operation of the present counter apparatus;

2

FIG. 3 is a schematic showing of one form of the present counter apparatus;

FIG. 4 is a schematic showing of another modification of the present counter apparatus;

FIG. 5 is a schematic showing of a third modification of the present counter apparatus;

FIG. 6 is a schematic showing of a NOR element suitable for use with the control apparatus as shown in FIG. 5;

FIG. 7 shows a modification of the NOR element shown in FIG. 6;

FIG. 8 is a showing of a photosensitive NOR element utilizing a phototransistor, with said NOR element having its sensitivity increased by means of the toggle action circuit as shown in FIG. 8; and

FIG. 9 is a schematic circuit arrangement for a NOR element time delay device suitable for use with the counter apparatus as shown in FIG. 5.

In FIG. 1 there is illustrated the operation of the counter apparatus in accordance with the present invention operative to provide discrete electrical counting pulses for counting and recording the number of billets or workpieces charged into a furnace. In one application of the apparatus, each billet is approximately 3½ inches wide and 3½ inches high and 30 feet long, and is carried by a plurality of power rollers 12 to a retractable billet stop 14. From one to four billets may be accumulated transversely along each of the power roller members 12 at the billet stop 14 prior to being charged into the furnace 16. An operator controls a charging ram 18 by means of a ram control device 20 which is operative to push the accumulated billets 10 into the furnace 16. The billet stop 14 is retracted when it is desired to push the billets 10 into the furnace 16 by means of the charging ram 18, also the charging ram 18 may be removed from the billet travel path when desired.

The workpiece or billet counting operation is desired to be done after the charging ram 18 has moved beyond the last driven roll 12' so that only workpieces actually charged into the furnace 16 are counted and recorded by the billet counter device 24 and subsequent data processing device 26. A limit switch LSD operative as a delivery limit switch is positioned adjacent the last driven roll 12' for providing a first control signal to initiate the counting operation when the charging ram 18 moves beyond the last driven roll 12'. In this regard, the charging ram 18 includes an extension arm 30 operative with a control member 32 of the limit switch LSD. The count accumulated within the billet counter device 24 is not read out until the charging ram 18 has reached a forward position as sensed by the limit switch LSE positioned adjacent the entry to the furnace 16 such that it provides a second control signal to the billet counter device 24 for controlling the read-out operation of the billet counter device 24. In this manner, a double count operation is prevented.

After the charging ram 18 has pushed the workpieces 10 into the furnace 16, the charging ram 18 is withdrawn to its initial position as shown by the dot-dash lines in FIG. 1. The billet stop 14 may be now raised into position to stop the movement of workpieces along the travel path, and the billet counter device 24 and data processing device 26 are cleared in preparation for a new counting operation.

A plurality of spaced phototransistor devices 34 are transversely positioned and equally spaced below the workpiece travel path and beyond the last driven roll 12'. A suitable light source 36 is positioned above the work travel path and includes an optical system for each phototransistor for collecting the light from the light source 36. The workpiece or billets in passing along the rollers 12 defining the work path interrupt the light to some of

the phototransistors 34, and the spacing of the phototransistors transverse to the work path is so arranged such that a single workpiece or billet will cut off either four or five phototransistors, two workpieces in the travel path will cut off between eight to ten phototransistors, three workpieces will cut off between twelve to fifteen phototransistors, and four workpieces will cut off between sixteen to twenty phototransistors, with some allowance for shadow effect and the finite resolving power of the optical system. It should be here noted that the above arrangement is merely illustrative. The spacing of the photoelements and the size of the workpieces determine the desired discrimination.

Since the workpieces are in motion along the work path, they may have a component of velocity in a transverse direction relative to the direction of the work path and, therefore, it is necessary to sample the energization of the phototransistors 34 by the light source 36 over a relatively small interval of time. In addition, during the latter counting operation or scanning operation information must be stored until the charging ram 18 has completed its stroke. Thusly, the furnace entrance limit switch LSE having a control arm 33 is provided for furnishing a read-out control signal to the billet counter 24.

In FIG. 2 there is shown a top view of the workpiece counter and handling apparatus shown in FIG. 1 and in accordance with the present invention, wherein the charging ram 18 is operative with four workpieces 10 for moving the workpieces into the furnace 16. A plurality of twenty-four phototransistors 34 are shown, with the equally spaced transverse positioning of the phototransistors 34 illustrated relative to the direction of the workpiece travel path.

In FIG. 3 there is shown a schematic arrangement of the billet counter device 24 as shown in FIG. 1. In FIG. 3 the delivery limit switch LSD is operative to trigger a single pulse generator 40 for providing a first control pulse to a first plurality of AND devices 42, with one of said AND devices 42 being provided for each of the phototransistors 34, which are also designated P1 to P24. The output of each of the AND devices 42 is supplied to the On input of a Flip-Flop or Memory device 44, with one of said Flip-Flop devices 44 being provided for each of the phototransistors 34. The output of the Flip-Flop device is connected to one input of a second AND device 46, with one of said AND devices being provided for each of the phototransistors 34. The output of the AND device 46 for a first phototransistor P1 and the output of an AND device 46 for a second phototransistor P2 are combined in a first OR device 48. The output of said OR device 48 is applied to a successive OR device 50 in conjunction with the output of an AND device 46 provided for a third phototransistor P3. Successive OR devices are provided in a similar manner as needed for the successive counting signals received from the outputs of the subsequent respective AND devices 46, as illustrated in FIG. 3 and well known to persons skilled in this art.

In this regard, the second input of each AND device 46 is energized by a second control signal received from a second single pulse generator 52 as controlled by the furnace entry limit switch LSE, with the output of the second single pulse generator 52 being applied directly to the AND device 46 for the first phototransistor P1, and passing through a first time delay device TD1 before it is applied to an input of the AND device 46 provided for a second phototransistor P2. In this regard, successive time delay devices TD2 through TD24 are provided as illustrated in FIG. 3. The final time delay device TD24 is provided to furnish a Clear signal to a counter 56 and to the Off input of each of the Flip-Flop devices 44 as shown in FIG. 3.

In FIG. 4 there is shown a modification of the billet counter device 24 with the first control signal received from the single pulse generator 40 being operative with

an input of the first AND device 42, and further being operative through a time delay device TD0 for energizing an input of the second AND device 46. The read-out control signal as determined by the furnace entry limit switch LSE is provided by the second single pulse generator 52 directly connected to the counter 56 and to an accumulator device 58 before the processing data is supplied to a data processing computer device 26. Also the Clear signal for the Flip-Flop devices 44 is supplied by the single pulse generator 52.

As shown in FIG. 5 a still additional modification of the billet counter device 24 is shown utilizing NOR circuits as shown in FIG. 6. Photosensitive NOR elements 35 as shown in FIG. 5, it should be understood, are to be substituted for the phototransistor elements 34 shown in FIG. 1 when the billet counter device 24 as shown in FIG. 5 is to be utilized. Further, it should be noted that associated with each photosensitive NOR element 35 is a toggle action circuit, as shown in FIG. 8, an input inhibiting gate circuit 60, a NOR Flip-Flop or Memory circuit 62, an output inhibiting gate circuit 64, and a time delay NOR circuit TD1 in accordance with the schematic showing of FIG. 9. In this regard, it should be noted that the input NOR elements of the inhibiting gates 60 and 64 associated with each of the photosensitive NOR elements 35 may be eliminated, except for the first pair, tentatively assuming that one NOR element 72 can safely drive twenty-four other NOR elements 70.

In the presence of radiant energy from the source 36, each of the photosensitive NOR elements 35 which does not receive radiation, due to the presence of the workpieces in the travel path adjacent the row of photosensitive NOR elements 35, provides an output signal to the NOR element 68, to provide said NOR element 68 from having an output signal, such that the NOR element 70 in the input inhibiting gate 60 does not receive a control signal from the NOR element 68. When the delivery limit switch LSD is operated by the charging ram 18, the single pulse generator 40 provides an output signal to the NOR element 72 in the input inhibiting gate 60 such that the latter NOR element 72 does not have an output signal. Since both inputs of the NOR element 70, for each photosensitive NOR element 35 not receiving radiation are not energized, the latter NOR element 70 does have an output signal which it supplied to the NOR element 74 in the flip-flop 62 to cause said NOR element 74 not to have an output signal, such that the input of the NOR element 76 in the output inhibiting gate 64 is not energized by the NOR element 74. Thusly, when the furnace entry limit switch LSE is operated by the charging ram 18, the second single pulse generator 52 provides an output signal to the NOR element 78 in the output inhibiting gate 64 such that the latter NOR element 78 does not have an output signal. Thusly, the NOR element 76 is then not energized on either of its inputs so it provides an output signal. When the single pulse from the second single pulse generator 52 is no longer present, the NOR element 78 provides an output signal to cut off the output signal from the NOR element 76 in the output inhibiting gate 64, and in this manner a pulse is provided when the associated photosensitive NOR element 35 was not energized.

The counter apparatus as shown in FIG. 5 includes a circuit arrangement operative in a similar manner as above described, for each of the photosensitive NOR elements 35, such that each of the photosensitive NOR elements 35 not energized by radiation from the radiation source 36 due to the presence of the workpieces in the travel path adjacent the photosensitive NOR elements 35 is operative to provide an output pulse to the counter 56 in a sequence as determined by the pulse provided by the second pulse generator 52 passing through the successive time delay devices TD1 to TD24.

In this regard, the time delay device TD schematically shown in FIG. 9 is operative such that the clock pulse

5

generator 80 provides pulses at fixed time intervals, and when a signal is applied to the On input of the flip-flop device 82 an output pulse is applied to AND device 84. The AND device 84 has an output signal only when its other input is energized by the clock pulse generator 80. The binary counter 85 is operative such that it has an output pulse for every two input pulses that it received. Another suitable time delay device would be the well-known passive delay line.

The NOR elements as shown in FIGS. 6 and 7 can be made by providing two or more inputs to a single transistor, as well known to persons skilled in this art. For example, in the May 1957 issue of Control Engineering Magazine, there is an article entitled Static Switching Devices by Mr. R. A. Mathias that describes NOR elements and their operation. The output wire is activated if and only if neither input wire is activated. Further, the relatively low base-emitter impedance of the transistor permits the diodes to be eliminated even with as many as six or seven inputs. This operation of a NOR element is set forth and explained in copending application Serial No. 628,332, filed December 14, 1956, by W. D. Rowe and entitled NOR Elements for Control Systems. The circuit arrangement as shown in FIG. 7 extends the temperature range over which the NOR element can satisfactorily be operated by supplying an additional base drive in order to remove thermally generated carriers in the transistor.

A specially formed transistor, called a phototransistor in which radiant light or energy generates the charge carriers necessary to produce saturation can be used to translate an event characterized by the presence or absence of light or radiant energy into an event characterized by the non-activation or activation of a wire such as the output wire of the NOR device. This principle is used in the operation of the photosensitive NOR elements 35 of FIG. 5.

The billet counting system shown in FIG. 3 is operative to provide discrete electrical pulses for counting and recording the number of billets charged into a furnace. The counting apparatus as shown in FIG. 3 utilizes magnetic logic elements whereas the counting apparatus as shown in FIG. 5 utilizes transistor logic elements. A limit switch LSD at the delivery end of the last driven roll 12' triggers a single pulse generator 40 which activates the record wire 41 for a very small interval of time. The states of the phototransistors 34 are registered on the output wires of the AND devices 42 with said output wires being activated if the associated phototransistors 34 are cut off. A second limit switch LSE at the entrance to the furnace is tripped by the charging ram as the ram completes its stroke in pushing the billets into the furnace. At this time, the limit switch LSE triggers a second single pulse generator 52 which activates the read-out wire 53 for a small interval of time. By means of the provided delay line, including the time delay devices, the latter pulse is placed on each of the input wires to the respective AND devices 46 in a time sequence. Thus a sequence of pulses will appear on the input wire 55 to the counter 56 and the number of pulses will be equal to the number of phototransistors 34 that were cut off during the sampling interval or period due to the presence of workpieces in the travel path. The counter 56 produces one pulse on its output 57 leading to the data processing device 26 for every four pulses which appear on its input 55. By the above described predetermined relationship between the number of phototransistors cut off and the number of billets on the table it follows that the number of pulses appearing on the output wire 57 of the counter 56 is equal to the number of billets charged into the furnace. The counting apparatus is then cleared after the read out of all the flip-flops 44 has been completed in preparation for the next counting interval or period.

It should be readily apparent to persons skilled in this art that the information supplied to the data processing device 26 by the counter 56 may be utilized for control

6

purposes other than accounting, such as supplying additional workpieces as needed to completely fill and more efficiently utilize the furnace.

Although the present invention has been described with a certain degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the scope and the spirit of the present invention.

We claim as our invention:

1. In workpiece counting apparatus operative with a workpiece movement device and a workpiece movement path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position along said path, a workpiece scanner device for scanning a predetermined portion of said path and providing at least one counter signal for each workpiece present in said predetermined portion of said path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving each of said counter signals, with said counter device being responsive to said second control signal for providing a total of said counter signals received.

2. In workpiece counting apparatus operative with a workpiece movement device along a workpiece path extending in a predetermined workpiece movement direction, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position along said path, a workpiece scanner device for scanning a predetermined portion of said path and providing at least one counter signal for each workpiece present in said predetermined portion of said path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, with said second position sensing device being spaced away from said first position sensing device a predetermined distance in said workpiece movement direction, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving each of said counter signals, with said counter device being responsive to said second control signal for providing a total of said counter signals received to thereby indicate the number of workpieces in said predetermined portion of said path.

3. In workpiece counter apparatus operative with a workpiece movement device along a workpiece movement path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in an initial first predetermined position along said movement path, a workpiece scanner device for scanning a predetermined portion of said path and providing at least one counter signal for each workpiece present in said predetermined portion of said path, a second position sensing device for providing a second control signal when said workpiece movement device is in a subsequent second predetermined position along said path, and a counter device responsive to said first control signal and operative with said workpiece scanner device for receiving each of said counter signals after responding to said first control signal, with said counter device being responsive to said second control signal and being operative to provide an indication of the total number of said workpieces in said predetermined portion of said movement path after responding to said second control signal.

4. In workpiece counter apparatus operative with a workpiece movement path, the combination of a workpiece movement device operative to move at least one

workpiece along said movement path in a predetermined direction, a first position sensing device operative with said movement device for providing a first control signal when said movement device passes a predetermined first position along said movement path, a workpiece scanner device for scanning a predetermined portion of said movement path and providing at least one counter signal for each workpiece present in said predetermined portion of said path, a second position sensing device operative with said movement device for providing a second control signal when said movement device passes a second predetermined position along said path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving each of said counter signals, with said counter device being responsive to said second control signal for providing an indication of the total number of workpieces in said predetermined portion of said path.

5. In workpiece counter apparatus operative with a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position along said path, a workpiece scanner device operative to scan a predetermined portion of said travel path, with said workpiece scanner device including a plurality of radiation responsive position sensing elements at one side of said travel path and a source of radiant energy at the opposite side of said path, with each of said position sensing elements being operative to provide a counting signal when a workpiece is positioned between the latter said element and said source in said predetermined portion of said workpiece travel path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving all of said counting signals, with said counter device being responsive to said second control signal for providing a total indication of the number of said workpieces in said predetermined portion of said workpiece travel path.

6. In workpiece counter apparatus operative with a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position along said path, a workpiece scanner device for scanning a predetermined portion of said path, with said scanner device including a plurality of photoresponsive position sensing elements, with each of said position sensing elements being positioned on one side of said workpiece travel path and being adapted to be energized by a source of light energy positioned on the opposite side of said workpiece travel path such that each of said elements is operative to provide a counting signal when a workpiece is positioned between the latter said element and said light energy source, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, and a counter device operative with each of said photo-responsive position sensing elements and responsive to said first control signal for receiving each of said counting signals, with said counter device being responsive to said second control signal for providing a total indication of the number of workpieces in accordance with a predetermined relationship between the total number of said workpieces relative to the total number of said counting signals received in said predetermined portion of the travel path.

7. In workpiece counter apparatus operative with a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position

along said path, a workpiece scanner device operative to scan a predetermined portion of said travel path, with said workpiece scanner device including a plurality of position sensing elements, with each of said position sensing elements being operative to provide a counting signal when a workpiece is present in a predetermined relationship relative to said sensing element, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, and a signal counter device operative with said workpiece scanner device and including a sequence control device and being responsive to said first control signal for successively receiving each of said counter signals, with said signal counter device being responsive to said control signal for providing a total indication of the number of said workpieces in said predetermined portion of said workpiece travel path.

8. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device operative with said travel path for providing a predetermined number of counting pulses for each workpiece located in a predetermined portion of the travel path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in said travel path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving all of said counting signals, with said counter device being responsive to said second control signal for providing an indication of the total number of said workpieces in said predetermined portion of the travel path in accordance with the number of said counting signals received.

9. In workpiece counting apparatus operative to count the number of workpieces and moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device including a predetermined plurality of workpiece position sensing elements, with each of said elements being operative to provide a counting signal when a workpiece is located in a predetermined portion of the travel path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in said travel path, and a signal counter device operative with said workpiece scanner device and responsive to said first control signal for receiving successively said predetermined number of counting signals, with said signal counter device being subsequently responsive to said second control signal for providing an indication of the total number of said workpieces in said predetermined portion of the travel path.

10. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device including a predetermined plurality of position sensing elements, with each of said elements being operative to provide a counting signal when a workpiece is located in a predetermined portion of the travel path, and sequencing control apparatus operative with said plurality of elements for sequentially operating said elements to provide their respective counting signals such that each of said elements is successively operative to provide a counting signal if a workpiece is located in a predetermined position in said predetermined

portion of the travel path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in a second predetermined position in said travel path, and a signal counter device operative with said workpiece scanner device and responsive to said first control signal for receiving said counting signals, with said signal counter device being subsequently responsive to said second control signal for providing an indication of the total number of said workpieces in said predetermined portion of the travel path.

11. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device operative with a predetermined portion of said travel path, with said workpiece scanner device including a plurality of position sensing elements positioned such that each workpiece is operative with a predetermined number of said elements for providing a predetermined number of counting signals for each workpiece located in said predetermined portion of said path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in said travel path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving said predetermined number of counting signals, with said counter device being responsive to said second control signal for providing an indication of the total number of said workpieces in said predetermined portion of the travel path.

12. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a position sensing device for providing a control signal when said workpiece movement device is in a predetermined position in said travel path, a workpiece scanner device operative with a predetermined transverse portion of said travel path for providing a predetermined number of counting signals for each workpiece respectively located in a plurality of transverse positions in said predetermined transverse portion of the travel path, and a counter device operative with said workpiece scanner device and responsive to said control signal for receiving said predetermined number of counting signals for providing an indication of the total number of workpieces in said predetermined transverse portion of the travel path.

13. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device operative with a predetermined portion of said travel path and including a predetermined number of position sensing elements in accordance with the maximum number of workpieces to be positioned in said predetermined portion of the travel path at any one time for providing a predetermined number of counting pulses for each workpiece located in said predetermined portion of the travel path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in said travel path, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving said predetermined number of counting signals, with said counter device being responsive to said second control signal for providing an indication of the total number of said workpieces in said predetermined portion of the travel path.

14. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, with said travel path being capable of handling a maximum of four transversely positioned workpieces at any one time, the combination of a position sensing device for providing a control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device operative with a predetermined portion of said travel path and including twenty-four position sensing elements positioned transversely to said workpiece movement direction along said travel path and operative such that when one workpiece is located in said predetermined portion of said travel path between four and five counting signals are provided, when two workpieces are located in said predetermined portion of the travel path between eight and ten counting signals are provided, when three workpieces are provided in said predetermined portion of said travel path between twelve and fifteen counting signals are provided, and when four workpieces are provided in said predetermined portion of said travel path between sixteen and twenty counting signals are provided, and a counter device operative with said workpiece scanner device and responsive to said first control signal for receiving said counting signals for providing an indication of the total number of said workpieces in said predetermined portion of the travel path in accordance with the number of said counting signals received.

15. In a workpiece counting apparatus operative with a workpiece movement device along a workpiece movement path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position along said path, a workpiece scanner device for scanning a predetermined portion of said path and providing a counter signal for each workpiece present in said predetermined portion of the path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position along said path, and a counter device operative with said workpiece scanner device and including a plurality of first AND devices, with each of said first AND devices being responsive to said first control signal and one of said counter signals such that said counter device will receive said counter signals, with said counter device including a plurality of second AND devices, with each of said second AND devices being responsive to one of said counter signals and said second control signal such that said counter device will respond to the total of said counter signals received as an indication of the total number of workpieces in said predetermined portion of the movement path.

16. In workpiece counting apparatus operative to count the number of workpieces moved by a workpiece movement device along a workpiece travel path, the combination of a first position sensing device for providing a first control signal when said workpiece movement device is in a first predetermined position in said travel path, a workpiece scanner device operative with a predetermined portion of said travel path for providing a predetermined number of counting signals for each workpiece located in said predetermined portion of said path, a second position sensing device for providing a second control signal when said workpiece movement device is in a second predetermined position in said travel path, and a counter device operative with said workpiece scanner device and including a plurality of first control devices responsive to said first control signal and at least one of said counting signals such that said counter device is operative to receive said predetermined number of counting signals, with said counter device including a plurality of second control devices responsive to said second control signal and at least one of said counting signals for providing an indication of the total

number of said workpieces in said predetermined portion of the travel path.

17. In a system for counting billets fed along a billet conveyor, the combination of positioning means for positioning billets in transverse groups on said conveyor, a billet scanner device for scanning a predetermined transverse portion of said conveyor and providing indication signals in accordance with the number of billets in each of said groups respectively present in said predetermined portion of said conveyor, a counter device operative with said billet scanner device for receiving each of said indication signals to totalize the number of billets which have been fed in groups through said predetermined transverse portion of said conveyor, and reset control means operative after the number of billets in each group has been indicated by said scanner device to readout the resulting indication signals into said counter device and reset said scanner device before receiving a succeeding group of billets.

18. In a system for counting billets fed along a billet travel path, the combination of positioning means for positioning billets in transverse groups on said travel path, a billet scanner device for scanning a predetermined transverse portion of said travel path and providing indication signals in accordance with the number of billets in each of said groups present in said predetermined portion of said travel path, a counter device operative with said billet scanner device for receiving each of said indication signals to totalize the number of billets which have been fed in groups through said predetermined transverse portion of said travel path, first control means operative after said billets have been positioned to prepare said scanner device for operation, and reset control means operative after the number of billets in each group has been indicated by said scanner device to readout the resulting indication signals into said counter device and

reset said scanner device before receiving a succeeding group of billets.

19. In a system for counting billets fed along a billet conveyor, the combination of positioning means for positioning billets in a transverse group up to a maximum number of billets on said conveyor, a billet scanner device including at least as many light paths transverse and perpendicular to said conveyor as there are billets for scanning a predetermined transverse portion of said conveyor and providing at least one indication signal for every billet in said group present in said predetermined portions of said conveyor due to the interruption of said light paths, a counter device operative with said billet scanner device for receiving each indication signal to totalize the number of billets which have passed in groups by said predetermined transverse portion of said conveyor, and reset control means operative after the number of billets in each group has been indicated by said scanner device to readout any resulting indication signal into said counter device and reset said scanner device before receiving a succeeding group of billets.

References Cited in the file of this patent

UNITED STATES PATENTS

2,523,516	Potter	Sept. 26, 1950
2,624,786	Potter	Jan. 6, 1953
2,828,917	Wheeler et al.	Apr. 1, 1958
2,869,788	Turner	Jan. 20, 1959
2,975,969	Stoeckel	Mar. 21, 1961

OTHER REFERENCES

"High Speed Computing Devices" by Engineering Research Associates Inc., McGraw-Hill Book Co., Inc., New York, 1950. FIGS. 13-26, and page 267 relied on.