

June 16, 1964

H. L. SHIELDS ET AL

3,137,356

DATA COMPILATION

Filed March 30, 1960

4 Sheets-Sheet 2

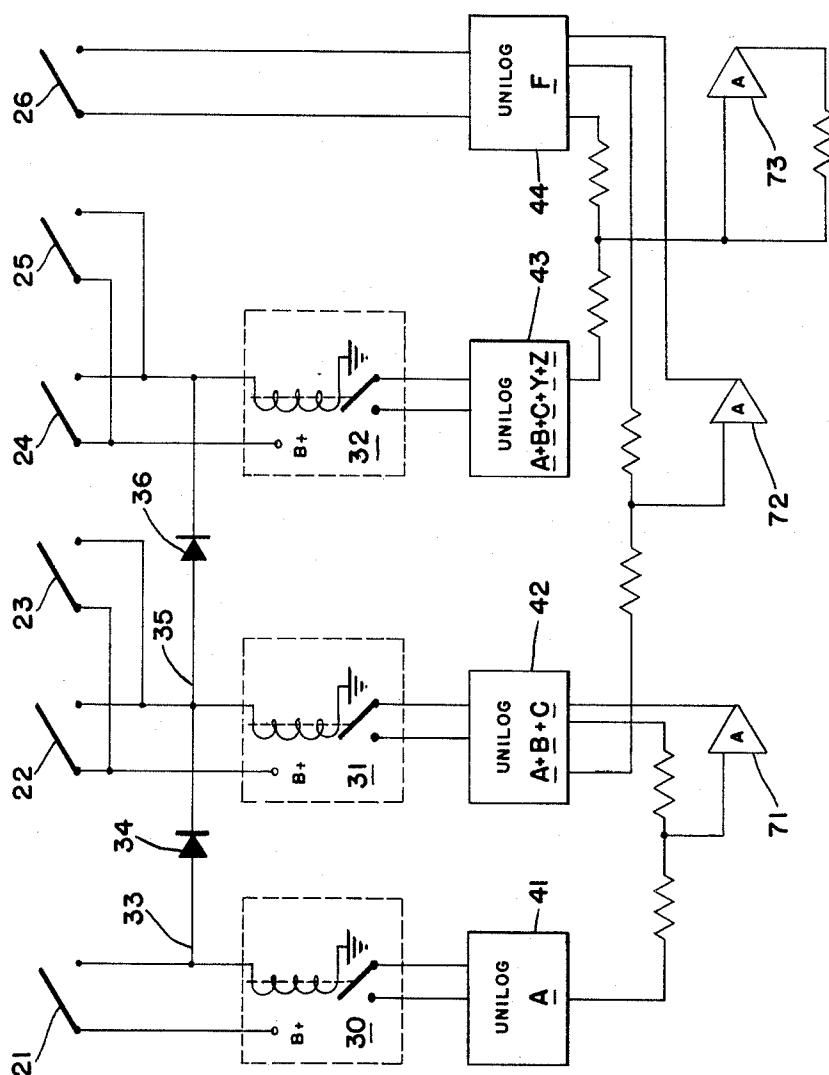


FIG. 2

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4 Sheets-Sheet 3

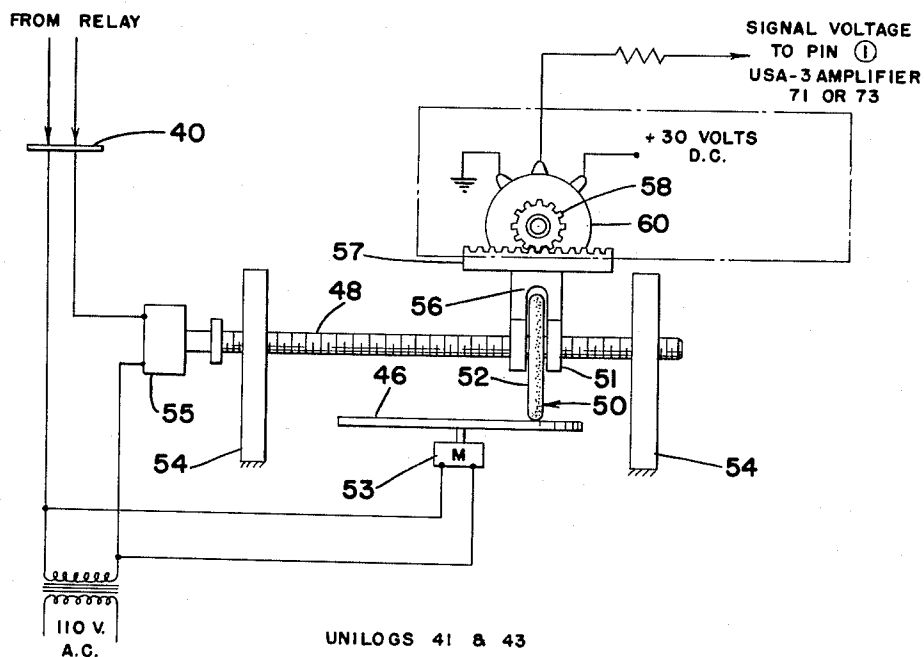
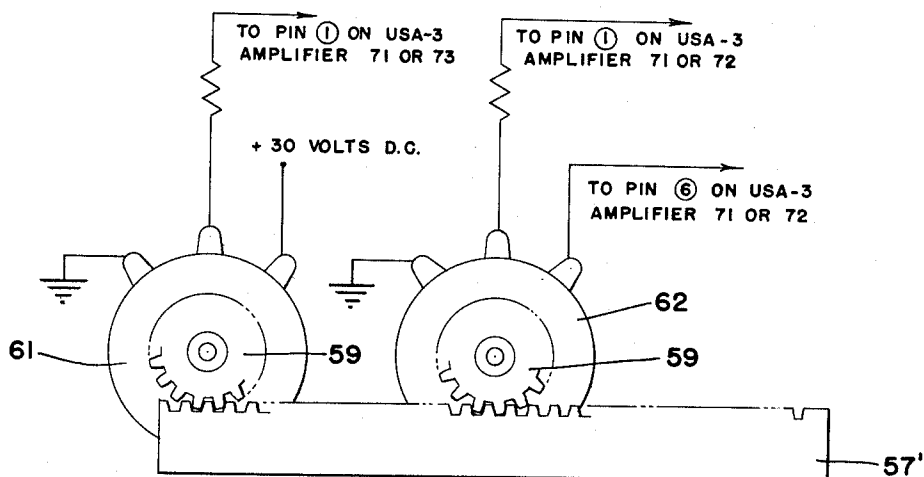


FIG. 3



UNILOGS 42 & 44

FIG. 4

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4 Sheets-Sheet 4

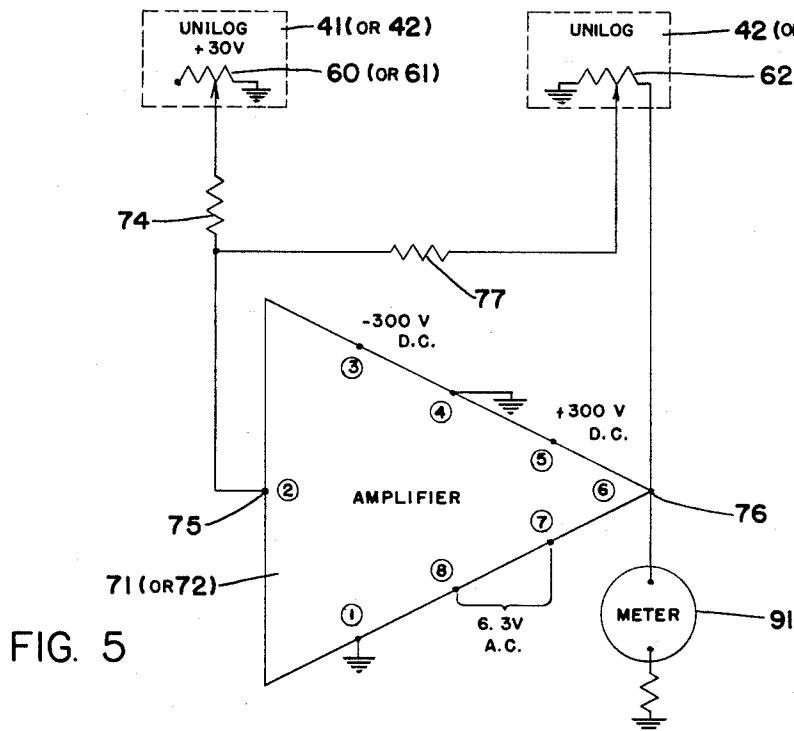


FIG. 5

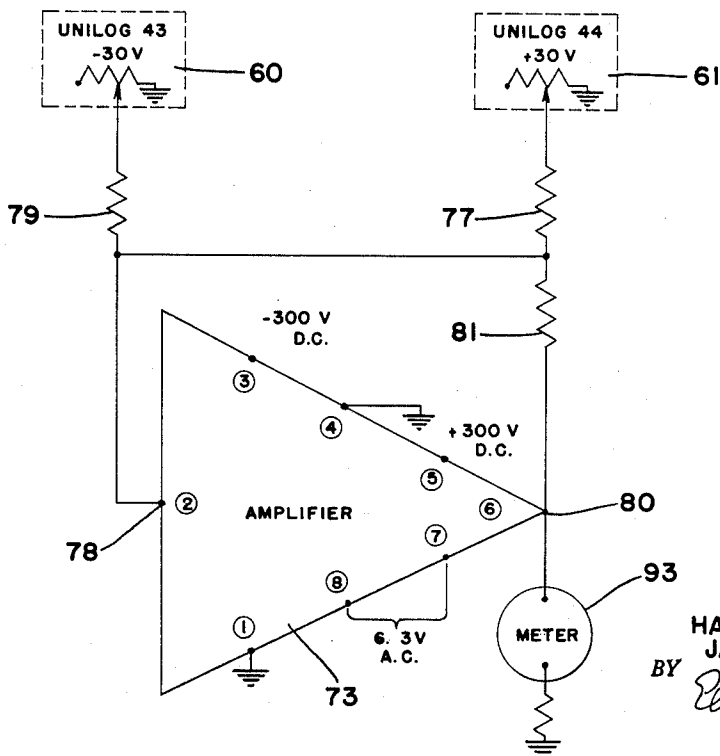


FIG. 6

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DATA COMPILATION

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Filed Mar. 30, 1960, Ser. No. 13,640

11 Claims. (Cl. 177—25)

The present invention relates to data compilation. More particularly, the invention relates to the measurement, computation, indication and recording of operational information from flow type processing systems. Specifically, the preferred form of the invention relates to a dry material process, such as grain milling, operated continuously with measuring, computing, indicating and recording of various kinds of information to determine product yields.

Many dry material milling processes, or similar continuous flow processing systems, comprise or require performance of a series of interrelated and independent operations or procedures designed and intended to produce a number of products, intermediates and by-products from one or more starting materials. Since the products and by-products may differ significantly in economic value, it is important that such processing systems be operated in the most efficient manner to produce the more valuable products in the greatest amounts consistent with quality specifications.

Normally, the operator of such a processing system relies on his skill and experience to control the system in the most efficient manner. The starting materials and various products may be individually weighed or measured and the rates or cumulative totals recorded. At various times the operator may have access to this information and, by arithmetic means, determine any specific data for a single instance or for a given period of time. As often occurs, clerical personnel will determine the processing efficiency for cost accounting purposes and the operator will be informed only at a later time when the value of such data is greatly reduced and the opportunity for immediate control correction has passed.

Accordingly, it is the principal object of the present invention to make continuously available to the process supervisor or operator any and all data pertinent to rates and ratios of the starting materials, products, by-products and losses or shrinkage.

In a flow processing system, the starting materials, products and by-products may be weighed or measured as to quantity to provide information for operational control; and such information should immediately be transformed into analogous signals proportional to or representing the several rates of flow. However, the starting materials, products and by-products may move into or out of a processing system in continuous streams, or in batches or in lots of constant measured at recurrent intervals of time. Many known systems employ a combination of batch and continuous flow techniques.

Therefore, it is another object of the invention to provide for compilation of operational data on a continuous flow, batch flow or a combination of both techniques in a single processing system.

The starting materials, products, intermediates and by-products moving into and out of a processing system are measured (as to weight, volume, density, etc.) by any of several different types of equipment. Such equipment may be mechanical, electrical, pneumatic or hydraulic units with the desired measurement being expressed in any of several different forms. To provide for immediate utilization of operational data, it is still another object of the invention to provide for compilation of data from a variety of measurement units and in different forms.

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These and other objects of the invention as well as additional advantages of the invention will be apparent in view of the following description of the invention and the attached drawings depicting a preferred form of the invention.

In the drawings:

FIG. 1 is a schematic block and flow diagram of a milling or processing system and the installation of components for the compilation of data therefrom according to the invention;

FIG. 2 is a more detailed schematic showing of various components of the data compiling installation of FIG. 1;

FIG. 3 is a schematic showing of a mechanical component of the data compiling installation of FIG. 1;

FIG. 4 shows another form for the mechanical component of FIG. 3 (a modification within the area indicated by chain lines in FIG. 3);

FIG. 5 is a schematic showing of an electrical component of the data compiling installation of FIG. 1; and

FIG. 6 shows a modified form of the electrical component of FIG. 5.

In general, the invention relates to a combination of apparatus components which function cooperatively to compile operational information from a flow type processing system. The quantity of "starting materials" entering the processing system, and "product materials" (including products, intermediates and by-products) leaving the system are measured, as by weighing. Each measuring means has a transducer means for converting the respective quantities of materials to a corresponding number of constant or digital electrical impulses. The transducer signals for each material are transmitted to mechanical computer units and are expressed as rates of material flow in the form of variable or analog electrical signals from adjustable potentiometers. The potentiometer signals are selectively directed to stabilized amplifier means and are combined for computation. The signal outputs from the amplifier means are indicated by calibrated meters to give readings of the desired operational information.

The starting material "F" may be a fluent material such as a cereal grain. During milling or passage through the processing system, the material F may be cleaned, dehulled, flaked, ground, screened, aspirated or subjected to other operations and procedures, to secure a desired result. For purposes of illustration, the processing system is considered as producing three products; a most valuable product "A"; an average valuable product "B"; and a least valuable product "C." If material F were corn, A would be hominy grits; B would be corn meal, and C would be flour.

During processing there is also produced a more valuable by-product "Y," and a less valuable by-product "Z." Also, loss or shrinkage of material F, indicated at "S," would have a bearing on efficiency of operation. If material F were corn, Y would be corn germ meal and Z would be hominy feed. S (loss) would be attributable to spillage, reduction in moisture content, removal of dust and fines, etc.

As an example, the percent yield of a processing system for milling corn, when operated in the most efficient manner, should be:

Table a

Material symbol (F=100%)	Percent yield
A -----	35
B -----	22
C -----	15
Y -----	16
Z -----	10
S -----	2

To effectively control the processing system, the operator should have readily available the following information:

$$\text{Product Yield (percent)} = \frac{A+B+C}{F} \times 100;$$

$$\text{Premium Product (Percent)} = \frac{A}{A+B+C} \times 100; \text{ and}$$

$$\text{Process Loss (or gain)} S = F - (A+B+C+Y+Z)$$

Using the values of Table a, a good Product Yield=72%. Assuming that the ratio of the three products is A=48.6%, B=31.6% and C=20.8%, the Premium Product=48.6%.

Referring to FIG. 1, the material F is weighed by an entry scale 10. The scales 11, 12 and 13 are for products A, B and C, respectively. The scales 14 and 15 are for by-products Y and Z, respectively. The scales 10-15, are conventional automatic dumping scales such as manufactured by the Richardson Scale Company. Each scale is equipped with a transducer means whereby the number of pounds of material which collect in the scale hopper and are dumped, that is, each batch or the quantity of material which passes through the scales per unit of time, is converted to a corresponding number of electrical impulses per unit of time. In the exemplary data, it is assumed that scale 10 trips at 100 pounds and scales 11-15 each trip at 50 pounds.

The transducer means associated with scales 10-15 are conventional electrical momentary contact switches such as manufactured by Electro-Snap (#ES4-KM6). The scale switch, the three product switches, and the two by-product switches are indicated at 20, 21, 22, 23, 24 and 25, respectively.

In the exemplary data, if the processing system for milling corn has a capacity of 2,000 cwt. per 24 hours, the scales 10-15 and associated switches 20-25 would dump and actuate as follows:

Table b

	Pounds/ Minute	Scale Trips/ Hour	Time Between Scale Trips	Symbol
Scale 10-Switch 20	200	120	30"	F
Scale 11-Switch 21	70	84	43"	A
Scale 12-Switch 22	44	52.8	1'8"	B
Scale 13-Switch 23	30	36	1'40"	C
Scale 14-Switch 24	32	38.4	1'34"	Y
Scale 15-Switch 25	20	24	2'24"	Z
Loss	4			S

Digital transducer signals derived from actuation of the scale switches 21-25 are directed to a set of relays and combined in a unidirectional manner to provide analogue signals for compilation of data required by the operator. The preferred form of the invention employs three relays indicated at 30, 31 and 32. Relays 30-32 are conventional D.C., such as manufactured by Automatic Electric (#Z-20155-1) and are energized from a suitable power source (not shown).

Referring to FIG. 2, relay 30 connects to the A product scale switch 21. The direct current signal from switch 21 passes through relay 30 to the terminal block 40 of a mechanical computer unit 41. A signal from switch 21 is also directed as at 33 to the input of a conventional rectifier 34. Relay 31 connects directly to the B and C product scale switches 22 and 23. The direct current signals from switches 22 and 23 and the output of rectifier 34 pass through relay 31 to a second mechanical computer 42. The signals from switches 22 and 23 and rectifier 34 are also directed as at 35 to the input of a second rectifier 36. Relay 32 connects directly to the Y and Z product scale switches, 24 and 25. The direct current signals from switches 24 and 25 and the output of recti-

fier 36 pass through the relay 32 to a third mechanical computer 43.

The signal from the F or starting material scale switch 20 may be relayed or amplified, if required, but as shown in FIG. 2, the signal passes directly to a fourth mechanical computer 44.

In the embodiment of the invention illustrated, the several periodically recurring transducer signals from the six scale switches (20-25) are transmitted as follows: switch 20 (F), to computer unit 44; switch 21 (A), to computer unit 41; switches 22 and 23 (B and C), to computer unit 42; switches 24 and 25 (Y and Z) to computer unit 43. Additionally, the signal from switch 21 has also been transmitted to units 42 and 43; and the signal from switches 22 and 23 has also been transmitted to unit 43.

The mechanical computers 41-44 express the several periodically recurring transducer signals from switches 20-25 as rates of material flow in a form usable for electronic computation. Thus, the signal output of unit 41 is analogous to the exit flow of A; the output of unit 42 is analogous to the exit flow of A+B+C; the output of unit 43 is analogous to the exit flow of A+B+C+Y+Z; and the output of unit 44 is analogous to the entry flow of the starting material F.

In the preferred form of the invention, the mechanical computers 41-44 are as disclosed and claimed in the co-pending application of Charles E. Rogers, Serial No. 638,399, filed February 5, 1957 now abandoned, and replaced by continuation application Serial No. 211,945, filed July 17, 1962; to which reference is made for such further details as may be required to more fully understand the invention. Units of apparatus embodying the concepts of application Serial No. 638,399 are distributed commercially under the trade name "Unilog" by Rogers and Ake Co., Akron, Ohio, who are also assignees of the present invention.

Referring to FIG. 3, each unit 41-44 has an axially mounted relatively large diameter disc 46, a threaded shaft 48 mounted radially of the rotational axis of the disc 46, and, a smaller diameter disc 50 provided with an axial hub 51 having internal threads continuously engaging the threads of shaft 48 and an outer surface 52 in continuous frictional contact with the surface of disc 46.

The disc 46 is driven by a suitable means such as a synchronous motor 53 to provide a mechanical force on the outer surface 52 of disc 50. Both ends of shaft 48 are journaled as in stanchions 54 set 180° apart on opposite sides of the disc 46 so that the longitudinal axis of the shaft intersects the rotational axis of the disc at substantially right angles. The shaft 48 is driven by a suitable intermittently actuated means such as a rotary solenoid 55 so that the angularly displaced shaft threads provide a mechanical force against the hub 51 of the small disc 50. The hub 51 is provided with a bracket 56 having clevis-like lower ends. The upper portion of bracket 56 carries a horizontal rack segment 57 of any desired length.

The synchronous motors 53 of each unit 41-44 are rotated at a constant speed to provide the denominator (y) of a rate calculation. The solenoids 55 of each unit 41-44 are rotated a preselected number of degrees per each transducer signal received through terminal block 40 to provide the numerator (x) of a rate calculation. Rate (x/y) is determined by a force equivalent to x which is applied as power to shaft 48 and tends to move the small disc laterally. This motion is mechanically opposed by a constant force equivalent to y. When these forces are in balance, a rate, that is, the ratio of x to y or x/y has been established.

The rate of product flow as established by the position of the small disc 50 in each unit 41-44 is indicated and expressed as an electrical signal by adjustable potentiometers having a variable output voltage. FIG. 3 depicts the computer units designated as 41 and 43 in FIG. 2.

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These units establish the rate of A/y and

$$(A+B+C+Y+Z)/y$$

respectively. In this form, the teeth of each rack segment 57 mesh with a pinion 58 on the adjusting shaft of a single potentiometer 60.

Referring to FIG. 4, the computer units 42 and 44 establish the rate of $(A+B+C)/y$ and F/y , respectively. Additionally, unit 42 supplies a rate signal for the computation $A/(A+B+C)$ and unit 44 supplies a signal for the computation $(A+B+C)/F$. Accordingly, in units 42 and 44, the teeth of a lengthened gear segment 57 mesh with pinions 59 on the adjusting shafts of two variable output voltage potentiometers 61 and 62.

In the preferred form of the invention, the variable electrical signals from the potentiometers 60-62 are selectively combined in three amplifiers 71, 72 and 73 to perform the desired computations. The amplifiers 71-73 are conventional stabilized amplifiers such as manufactured by Philbrick (#USA-3-M3) or equivalent. The amplifier 71 performs the computation $A/(A+B+C)$. The rate of product A exit flow transmitted from potentiometer 60 in unit 41 is multiplied by the reciprocal of

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through a resistor 77 to the input terminal 78 of the amplifier 73. The negative voltage signal from potentiometer 60 in unit 43 is also transmitted through resistor 79 to the input terminal 78. The opposite polarity signals are combined and the output potential from terminal 80 is $F-(A+B+C+Y+Z)$ and when indicated at a suitably calibrated meter 93 will give a reading of unit loss, or S. A stabilizing resistor 81 is inserted between output terminal 80 and the input terminal 78.

By way of example, the components of apparatus described above may be operated as follows:

Each motor 53 may be adjusted to rotate each large disc 46 at 15 revolutions per hour. Each solenoid 55 of the mechanical unit 41-43 may be adjusted to rotate each threaded shaft 45° for each transducer signal received through a terminal block 40. The solenoid of unit 44 would then rotate its threaded shaft 58, 90° for each transducer signal. Each of the potentiometers 60 and 61 may have a signal output in the range zero to 30 volts. Assuming that one (1) volt signal output from the potentiometers 60 and 61 is equal to 8 lbs. of material per minute, the data of Table b would be expressed as follows at the appropriate meter 91-93.

Table C

	Output Signal	Applied Voltage	Signal Voltage	Meter and Reading
Unit 41-(scale 11, switch 21) Pot. 60----	A-----	+30-----	8.75	[A/(A+B+C)]
Unit 42-(scale 11, switch 21) Pot. 62----	1/(A+B+C)-----	Output, Amplifier 71.	-----	Meter 91, 48.6%.
Unit 42-(scales 11, 12 and 13, switches 21, 22 and 23) Pot. 61.	A+B+C-----	+30-----	18	[A+B+C/F]
Unit 44-(scale 10, switch 10) Pot. 62----	1/F-----	Output Amplifier 72.	-----	Meter 92, 72%.
Unit 44-(scale 10, switch 10) Pot. 61----	F-----	+30-----	25	[F-(A+B+C+Y+Z)]=S
Unit 43-(scales 11, 12, 13, 14 and 15, switches 21, 22, 23, 24 and 25) Pot. 60.	A+B+C+Y+Z--	-30-----	24.51	Meter 93, 2%.

the rate of products $A+B+C$ exit flow transmitted from potentiometer 62 in unit 42. The amplifier 72 performs the computation $(A+B+C)/F$. The rate of product $A+B+C$ exit flow transmitted from potentiometer 61 in unit 42 is multiplied by the reciprocal of the entry flow of the starting material F transmitted from potentiometer 62 in unit 44. The amplifier 72 performs the computation $F-(A+B+C+Y+Z)$. The entry flow of the starting material F from potentiometer 61 in unit 44, expressed as a positive potential, is opposed by the rate of products $A+B+C+Y+Z$ exit flow transmitted from potentiometer 60 in unit 43, expressed as a negative potential.

Referring to FIG. 5, the output from potentiometer 60 in unit 41 is transmitted through a resistor 74 to the input terminal 75 of the amplifier 71. The output potential of the amplifier is applied from terminal 76 to an indicating meter 91. The output potential from terminal 76 is also applied to the potentiometer 62 in unit 42 and the output therefrom is fed back as $1/(A+B+C)$ through a resistor 77, matching resistor 74, to the input terminal 75. Thus, the output indicated at meter 91 when suitably calibrated will indicate or express

$$A/(A+B+C) \times 100$$

to give a reading of premium product percent.

Referring still to FIG. 5, the second amplifier 72 is similar to amplifier 71. The output from potentiometer 61 in unit 42 is multiplied by the output from potentiometer 62 in unit 44. Thus, the output of amplifier 72 is $(A+B+C)/F$ and when transmitted to a suitably calibrated meter 92 will indicate product yield.

Referring to FIG. 6, the output from potentiometer 61 in unit 44 (expressed as a positive voltage) is transmitted

Although the concepts of the invention have been described and illustrated in conjunction with a grain milling process, it will be apparent that the invention has other applications. Accordingly, the scope of the invention should be limited only by the claims which are intended to include use of the concepts thereof for data compilation from any flow type processing system in which the amounts of starting materials, products, intermediates or by-products may be determined and converted to a digital transducer signal.

What is claimed is:

1. Apparatus for compilation of operational information from a flow type processing system, comprising, means for measuring unit quantities of starting and product materials entering and leaving said system, transducer means with each of said measuring means for converting said unit quantities of materials to a corresponding number of digital impulses, mechanical means for converting said digital transducer impulses to rates of material flow, potentiometer means with said mechanical means for expressing said rates of flow as variable analog signals, stabilized amplifier means for selectively combining said analog signals, and calibrating means for indicating the output of said amplifier means.

2. Apparatus for compilation of operational information from a flow type processing system, comprising, means for batch weighing the starting and product materials entering and leaving said system, transducer means with each of said weighing means for converting unit weights of material to a corresponding number of digital impulses, mechanical means for converting said digital transducer impulses to rates of material flow, potentiometer means with said mechanical means for expressing said rates of flow as variable analog signals, stabilized am-

plifier means for selectively combining said analog signals, and calibrated means for indicating the output of said amplifier means.

3. Apparatus for compilation of operational information from a flow type processing system, comprising, dump scales to determine the weight of starting and product materials entering and leaving said system, electrical switch means associated with each said scale providing a digital impulse corresponding to the quantity of material passing through each scale per unit of time, mechanical means actuated by said digital switch impulses to express rates of material flow, variable output potentiometer means adjusted by said mechanical means to transmit an electrical signal analogous to a rate of flow, stabilized amplifier means for selectively combining said analogous electrical signals to perform mathematical computations, and calibrated means for indicating the results of said mathematical computations as operational information.

4. Apparatus for compilation of desired information from a flow type processing system, said desired information including the ratio of product material exit flow to starting material entry flow, comprising, batch means for weighing the quantity of starting material entering the system, batch means for weighing the quantity of product material leaving the system, transducer means with each said measuring means transmitting digital impulses corresponding to unit quantities of said materials, a first mechanical means for converting a digital transducer impulse to rate of product material exit flow, a first potentiometer means with said first mechanical means for expressing the rate of product material exit flow as an analog signal, a second mechanical means for converting a digital transducer impulse to rate of starting material entry flow, a second potentiometer means with said second mechanical means for expressing the reciprocal of the rate of starting material entry flow as an analog signal, and, amplifier means for combining the signals from said first and second potentiometer means to compute said desired information ratio.

5. Apparatus for compilation of desired information from a flow type processing system, said desired information including the ratio of product material exit flow to starting material entry flow, comprising, batch means for weighing the starting material entering the system, batch means for weighing the product material leaving the system, an electrical switch means associated with each said weighing means transmitting digital impulses corresponding to unit weights of said materials, a first mechanical means actuated by the digital impulses from one of said switch means to express the rate of product material exit flow, a first potentiometer means with said first mechanical means for expressing the rate of product material exit flow as an analog signal, a second mechanical means actuated by the digital impulses from the other of said switch means to express the rate of starting material entry flow, a second potentiometer means with said second mechanical means for expressing the reciprocal of the rate of starting material entry flow as an analog signal, and, amplifier means for combining the analog signals from said first and second potentiometer means to compute said desired information ratio.

6. Apparatus for compilation of desired information from a flow type processing system, said desired information including the ratio of product material exit flow to starting material entry flow, comprising, batch means for weighing the starting material entering the system, batch means for weighing the product material leaving the system, an electrical switch means associated with each said weighing means transmitting digital impulses corresponding to unit weights of said materials, a first mechanical means actuated by the digital impulses from one of said switch means to express the rate of product material exit flow, a first potentiometer means with said first mechanical means for expressing the rate of product material exit

flow as an analog signal, a second mechanical means actuated by the digital impulses from the other of said switch means to express the rate of starting material entry flow, a second potentiometer means with said second mechanical means for expressing the reciprocal of the rate of starting material entry flow as an analog signal, amplifier means for combining said first and second potentiometer means analog signals to compute said desired information ratio, and, calibrated means for indicating the result of said computation.

7. Apparatus for compilation of desired information from flow type processing systems producing at least two products, A and B, said desired information including the ratio of the quantity of A to the quantity of A plus B, comprising, batch means for weighing the quantity of A leaving the system, batch means for weighing the quantity of B leaving the system, transducer means with each said measuring means transmitting digital impulses corresponding to said unit quantities of A and B, a first mechanical means for converting a digital transducer impulse to rate of material A flow, relay means for unidirectionally combining the digital transducer impulses, a second mechanical means for converting the combined impulses from said relay means to rate of material A and material B flow, a first potentiometer means with said first mechanical means for expressing the rate of material A flow as an analog signal, a second potentiometer means with said second mechanical means for expressing the reciprocal of the rate of material A and material B flow as an analog signal, and, amplifier means for combining the analog signals from said first and second potentiometer means to compute said desired information ratio.

8. Apparatus for compilation of desired information from flow type processing systems producing at least two products, A and B, said desired information including the ratio of the quantity of A to the quantity of A plus B, comprising, batch means for weighing the material A leaving the system, batch means for weighing the material B leaving the system, an electrical switch means associated with each said weighing means transmitting a digital impulse corresponding to said weights of A and B, a first mechanical means for converting a digital switch impulse to rate of material A flow, relay means for unidirectionally combining the digital impulses, a second mechanical means for converting the combined impulses from said relay means to rate of material A and material B flow, a first potentiometer means with said first mechanical means for expressing the rate of material A flow as an analog signal, a second potentiometer means with said second mechanical means for expressing the reciprocal of the rate of material A and material B flow as an analog signal, amplifier means for combining said first and second potentiometer means analog signals to compute said desired information ratio, and, calibrated means for indicating the result of said computation.

9. Apparatus for compilation of desired information from flow type processing systems, said desired information including the quantity of starting material minus the quantity of product material to determine loss of material during processing, comprising, means for measuring the unit quantity of starting material entering the system, means for measuring the unit quantity of product material leaving the system, transducer means with each measuring means transmitting digital impulses corresponding to the unit quantities of said material, a first mechanical means for converting a digital impulse to rate of starting material entry flow, a first potentiometer means with said first mechanical means for expressing the rate of starting material entry flow as an analog signal of one polarity, a second mechanical means for converting a digital impulse to rate of product material exit flow, a second potentiometer means with said second mechanical means for expressing the rate of product material exit flow as an analog signal of opposite polarity, and a means for combining said first and second potentiometer signals to compute said loss of material.

10. Apparatus for compilation of desired information from flow type processing systems, said desired information including the quantity of starting material minus the quantity of product material to determine loss of material during processing, comprising, batch means for weighing the starting material entering the system, batch means for weighing the product material leaving the system, an electrical switch means associated with each said weighing means transmitting digital impulses corresponding to unit weights of said materials, a first mechanical means for converting a digital switch impulse to rate of starting material entry flow, a first potentiometer means with said first mechanical means for expressing the rate of starting material entry flow as an analog signal of one polarity, a second mechanical means for converting a digital switch impulse to rate of product material exit flow, a second potentiometer means with said second mechanical means for expressing the rate of product material exit flow as an analog signal of opposite polarity, and, means for combining said first and second analog signals to compute said loss of material.

11. Apparatus for compilation of desired information from flow type processing systems, said desired information including the quantity of starting material minus the quantity of product material to determine loss of material during processing, comprising, batch means for weighing the starting material entering the system, batch means

for weighing the product material leaving the system, an electrical switch means associated with each said weighing means transmitting digital impulses corresponding to unit weights of said materials, a first mechanical means for converting a digital switch impulse to rate of starting material entry flow, a first potentiometer means with said first mechanical means for expressing the rate of starting material entry flow as an analog signal of one polarity, a second mechanical means for converting a digital switch impulse to rate of product material exit flow, a second potentiometer means with said second mechanical means for expressing the rate of product material exit flow as an analog signal of opposite polarity, means for combining said first and second analog signals to compute said loss of material, and, calibrated means for indicating the result of said computation.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,137,356

June 16, 1964

Harold L. Shields et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 20, for "independent" read -- interdependent --; line 37, for "clearical" read -- clerical--; columns 5 and 6, Table C, under the heading "Applied Voltage", item 4, after "Output" insert a comma; column 6, line 64, for "calibrating" read -- calibrated --.

Signed and sealed this 3rd day of November 1964.

(SEAL)

Attest:

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Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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