United States Patent [19]

Maeda

[11] **3,750,122**

[45] **July 31, 1973**

[54] **INDUCTION TYPE TELEMETERING SYSTEM**

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[73] Assignee: **Mitsubishi Denki Kabushiki Kaisha**, Tokyo, Japan

[22] Filed: **Apr. 13, 1972**

[21] Appl. No.: **243,602**

[30] **Foreign Application Priority Data**

Apr. 19, 1971 Japan 46/25132

[52] **U.S. Cl.** **340/196**, 340/151, 340/204

[51] **Int. Cl.** **G08c 19/16**

[58] **Field of Search** 340/196, 204

[56] **References Cited**

UNITED STATES PATENTS

3,176,241	3/1965	Hogan	340/196
3,286,145	11/1966	Silver	340/196
3,471,844	10/1969	Schugt	340/196

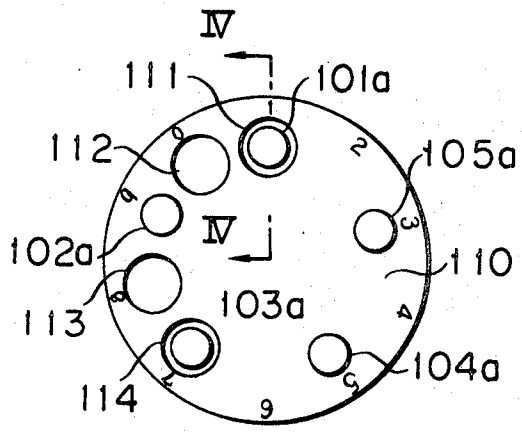
Primary Examiner—Thomas B. Habecker

Attorney—E. F. Wenderoth, V. M. Creedon et al.

[57] **ABSTRACT**

An encoding device includes two circular arrays of five equally spaced windings disposed in opposite relationships to sandwich a rotatable metallic disc provided with four openings. The openings are arranged such that, as the disc is rotated according to the measured decimal measurand, any two of them are always put between selected two pairs of opposite windings. With one of the winding arrays energized the selected two windings of the other array induce voltages indicating the measured measurand in the form of a set of two out of five codes. For the multifigure measurand, output windings one for each figure place can be serially interconnected while driving windings five for each place are sequentially energized through respective switching transistor to serially produce corresponding two-out-of-five codes from the output windings. Alternatively driving windings one for each place may be serially interconnected and successively energized through respective switching transistors while sets of corresponding output windings for all places are scanned for each place through individual transistors one for each set.

17 Claims, 23 Drawing Figures



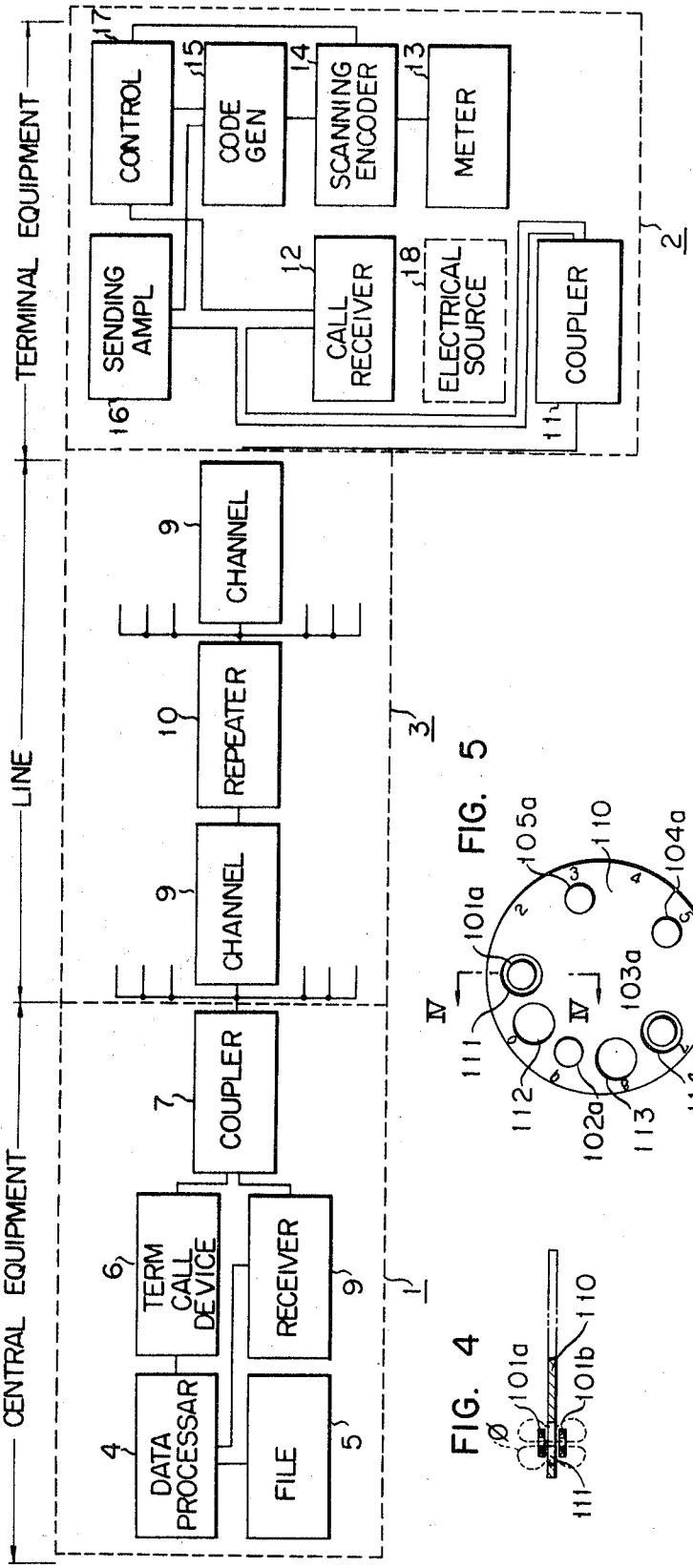


FIG. 1 PRIOR ART

FIG. 4

FIG. 5

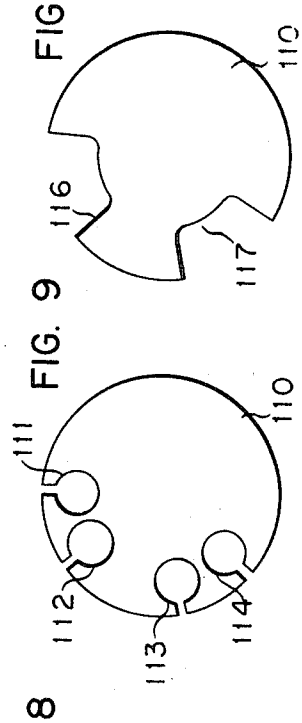


FIG. 9

FIG. 10

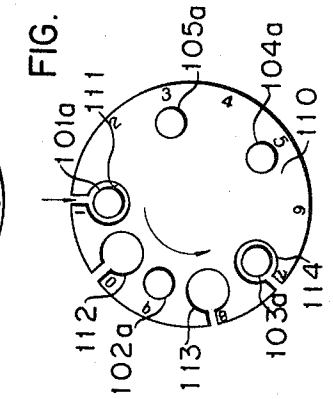


FIG. 8

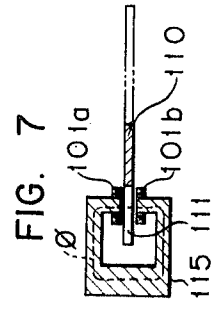


FIG. 7

FIG. 2 PRIOR ART

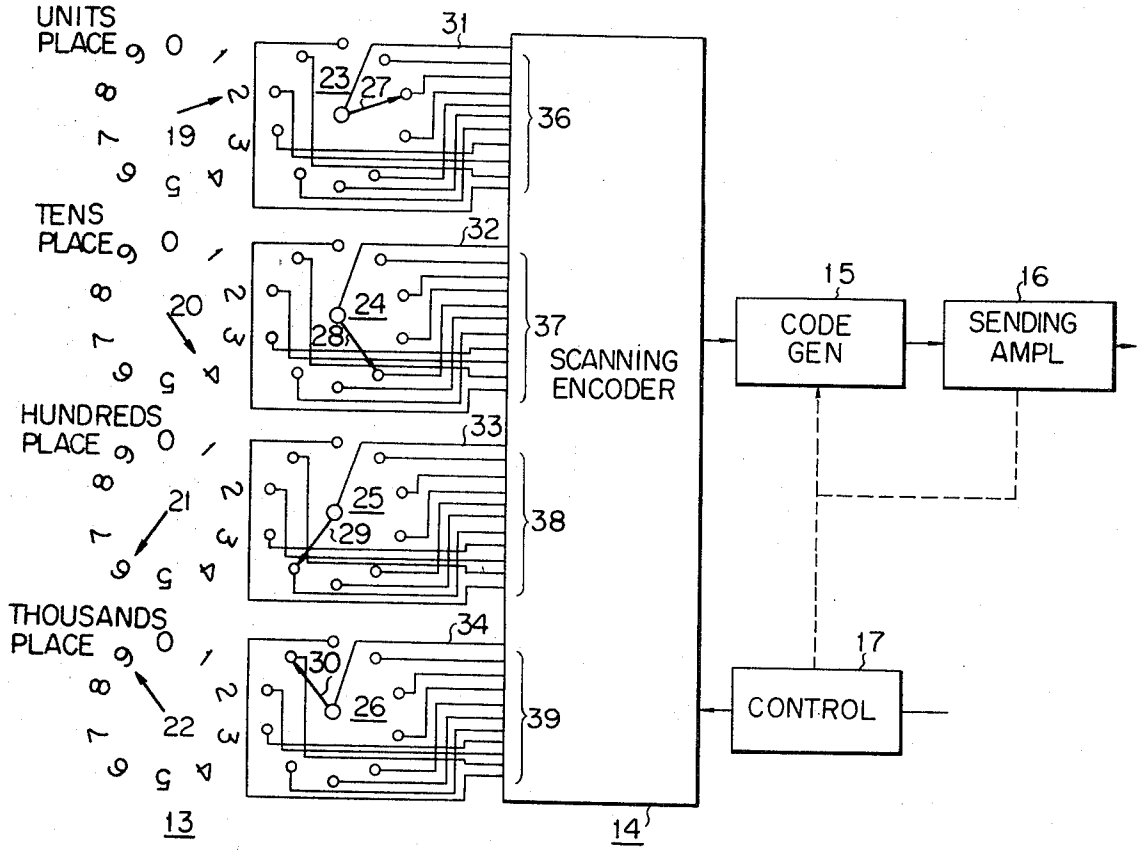


FIG. 6

DEC	WDG 101b	WDG 102b	WDG 103b	WDG 104b	WDG 105b
1	1		1		
2		1	1		
3		1		1	
4			1	1	
5			1		1
6				1	1
7	1			1	
8	1				1
9		1			1
0	1	1			

FIG. 3 PRIOR ART

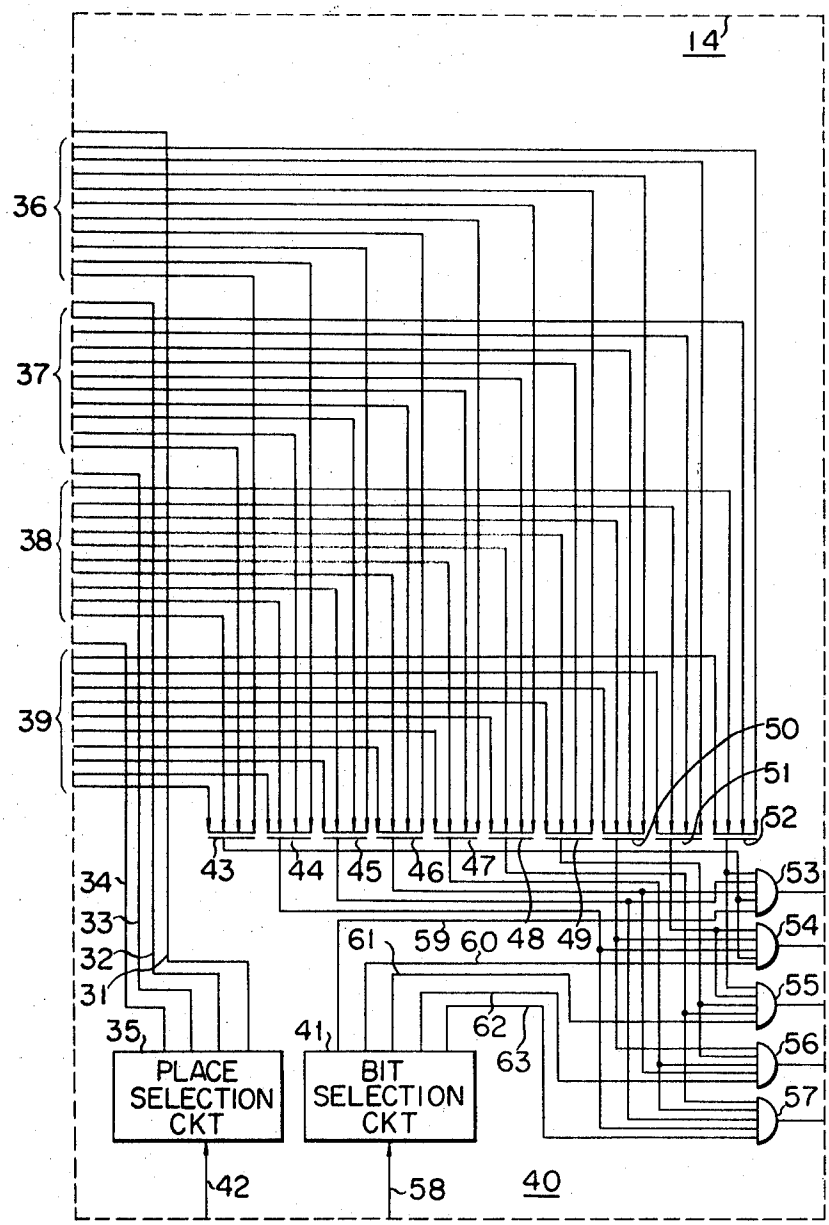


FIG. 11

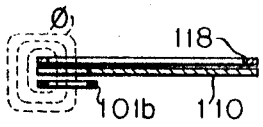


FIG. 12

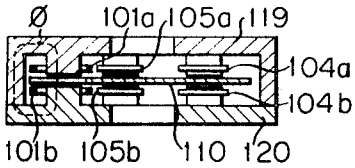


FIG. 13

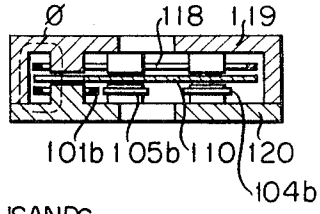


FIG. 22

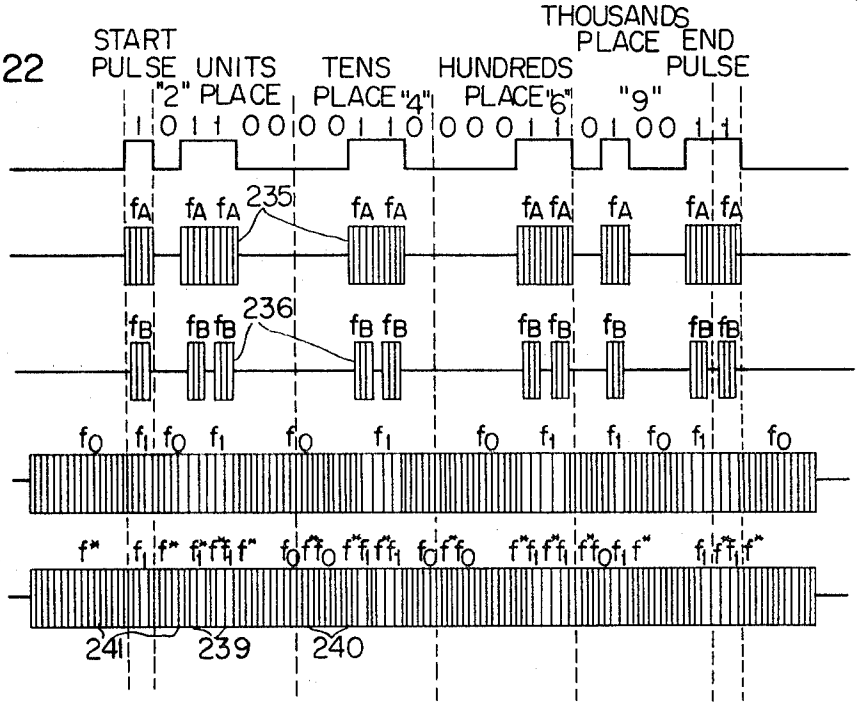
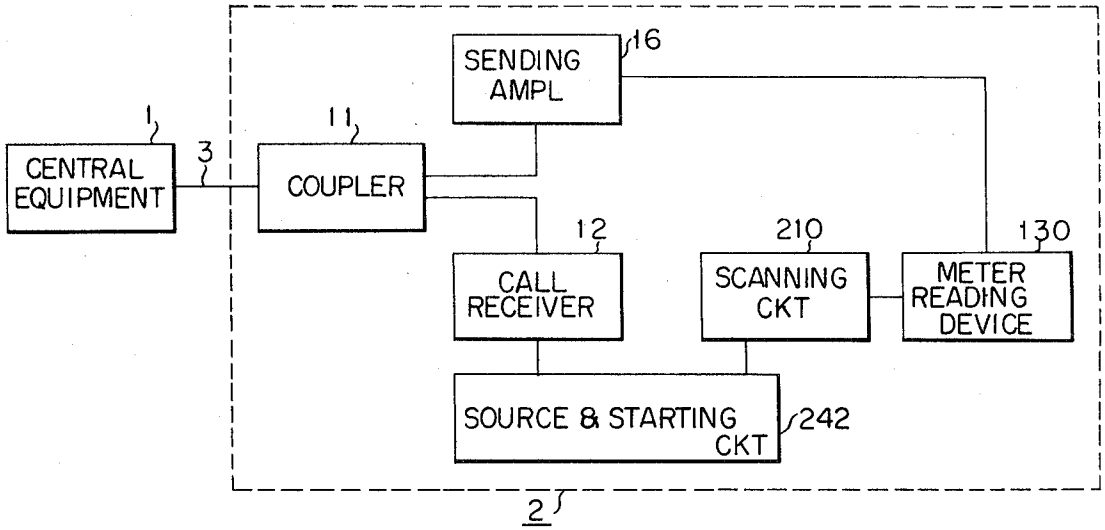


FIG. 23



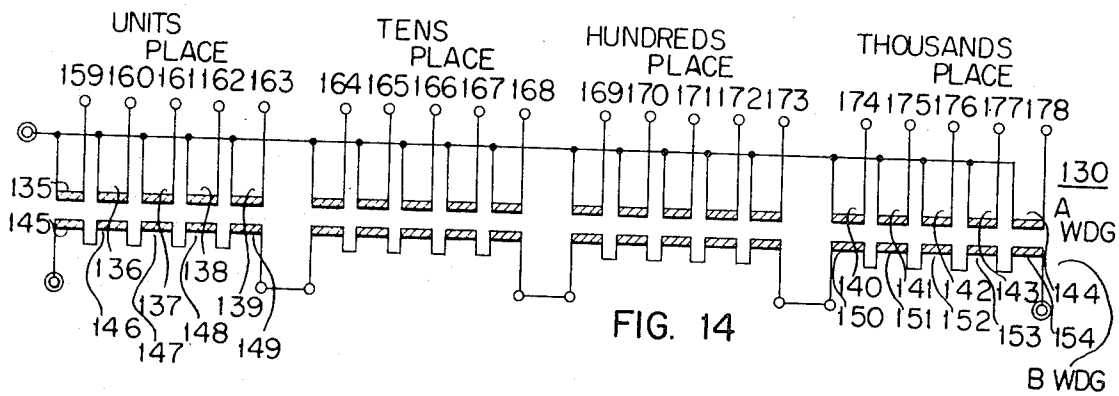


FIG. 14

FIG. 15

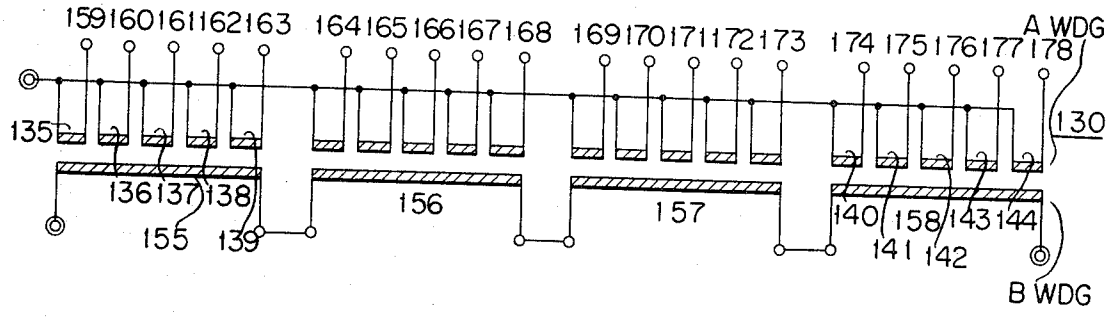


FIG. 16

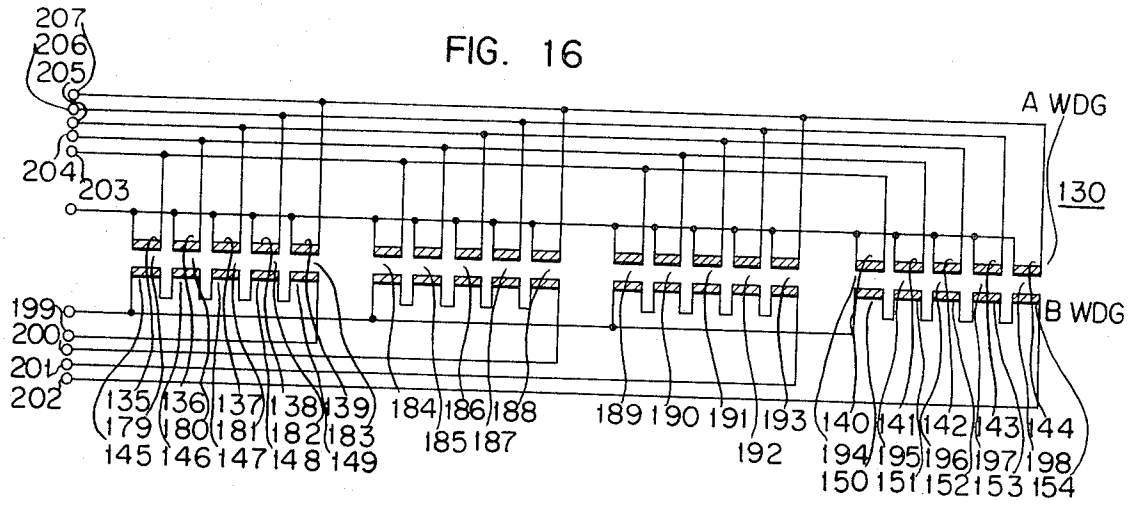


FIG. 17

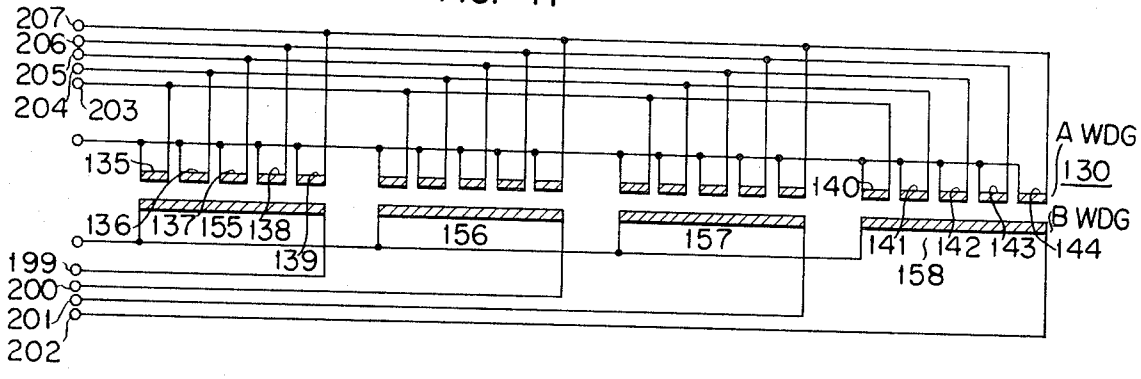


FIG. 18

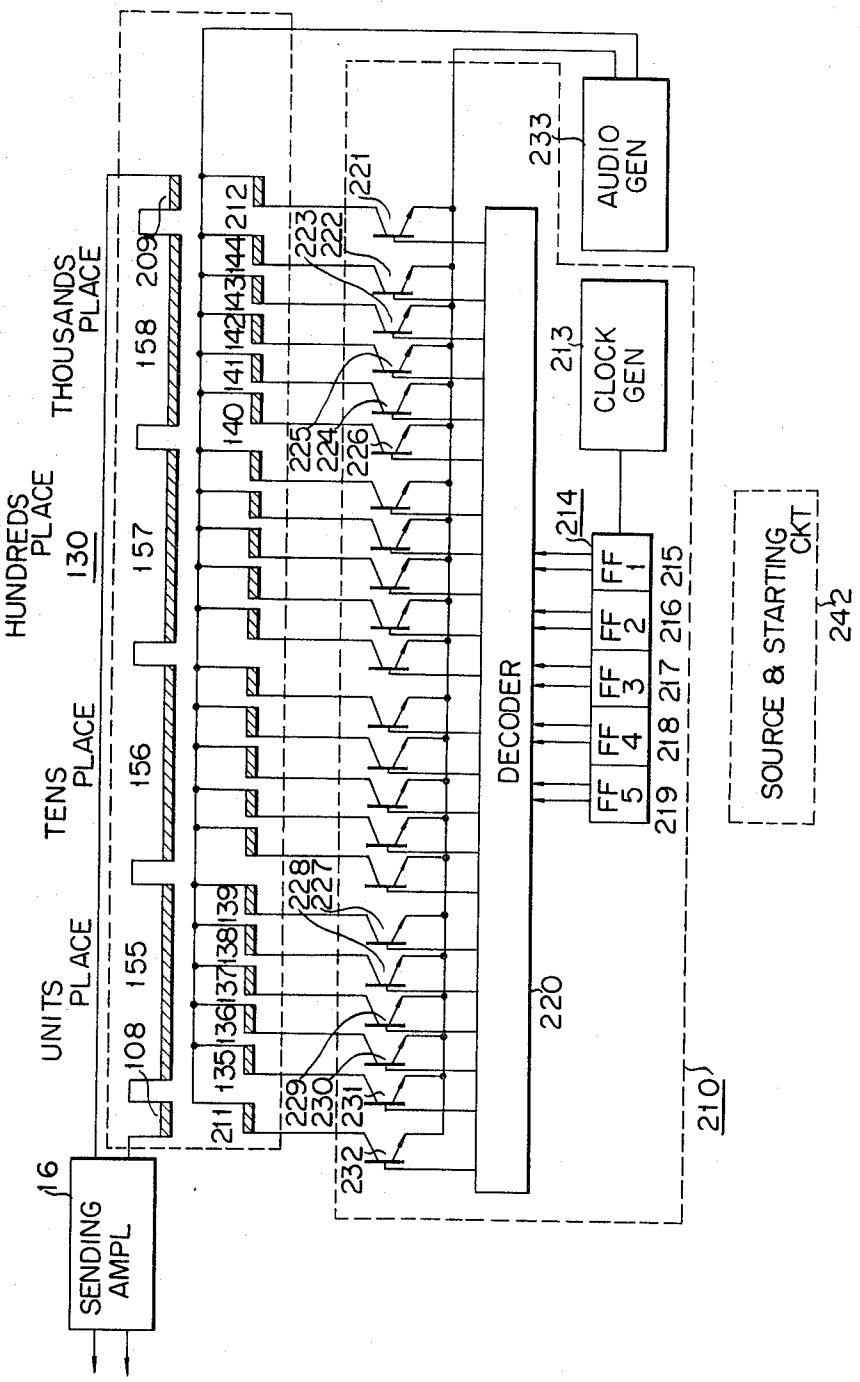

UNITS PLACE
TENS PLACE
HUNDREDS PLACE
THOUSANDS PLACE
SENDING AMPL
16
DECODER
220
CLOCK GEN
213
AUDIO GEN
233
SOURCE & STARTING CKT
242
210
214
FF 1
FF 2
FF 3
FF 4
FF 5
215
216
217
218
219
221
222
223
224
225
226
227
228
229
230
231
232
155
156
157
158
209
212
135
136
137
138
139
140
141
142
143
144
108
211

FIG. 19

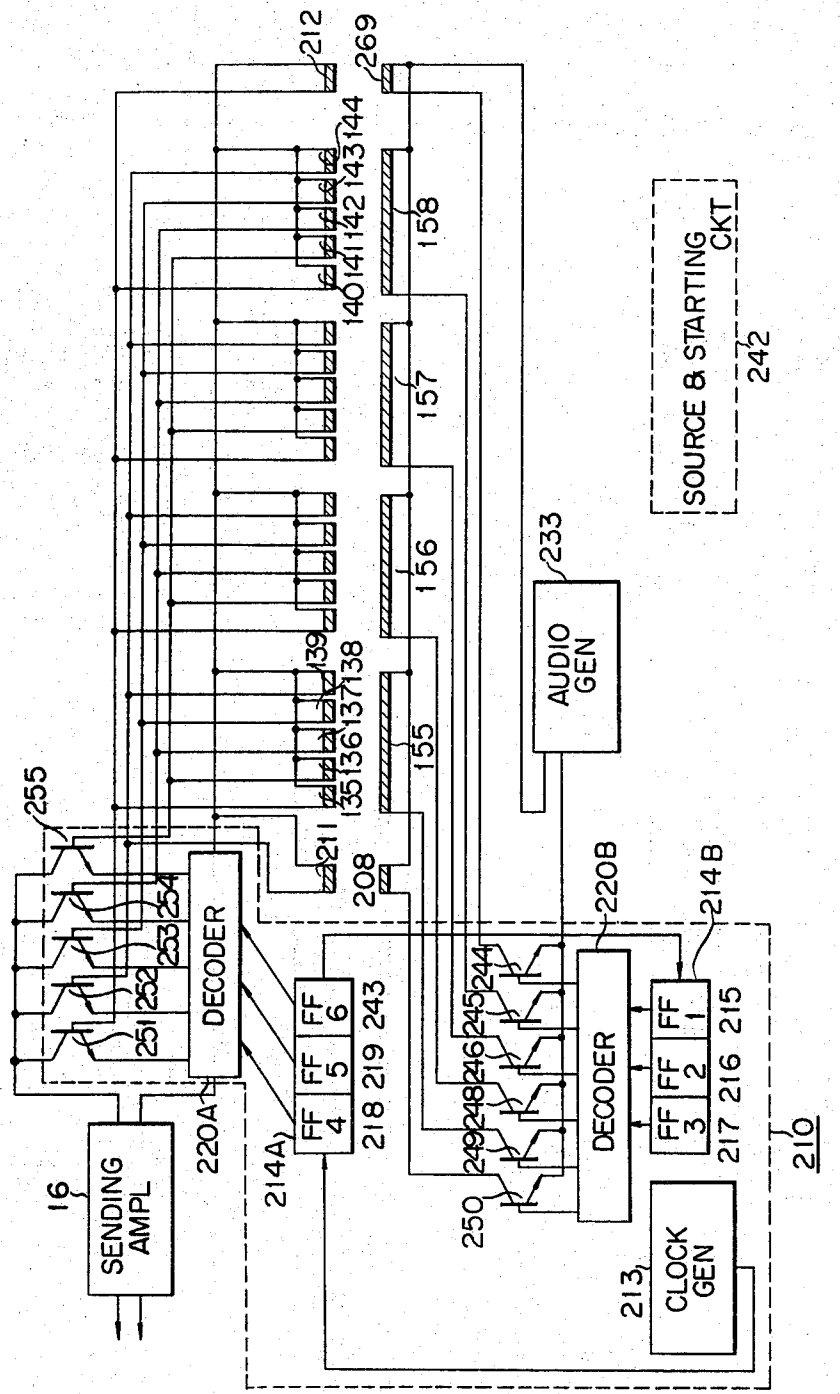

212
269
144
143
142
141
140
158
157
156
155
139
138
137
136
135
211
208
255
254
253
252
251
DECODER
220A
214A
FF 4
FF 5
FF 6
218 219 243
16
SENDING AMPL
AUDIO GEN
233
SOURCE & STARTING CKT
242
220B
214B
244
245
246
248
249
250
DECODER
FF 1
FF 2
FF 3
217 216 215
210
213
CLOCK GEN

FIG. 20

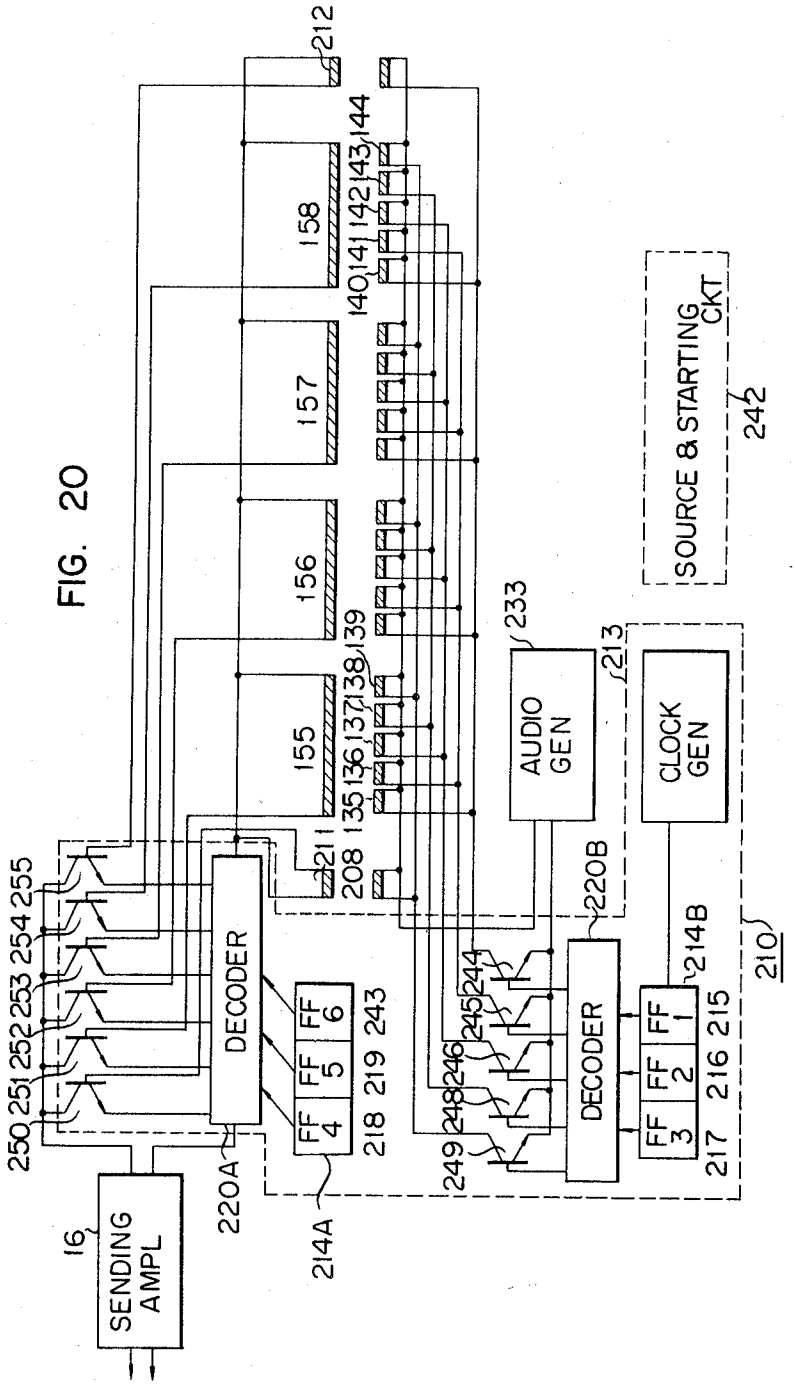
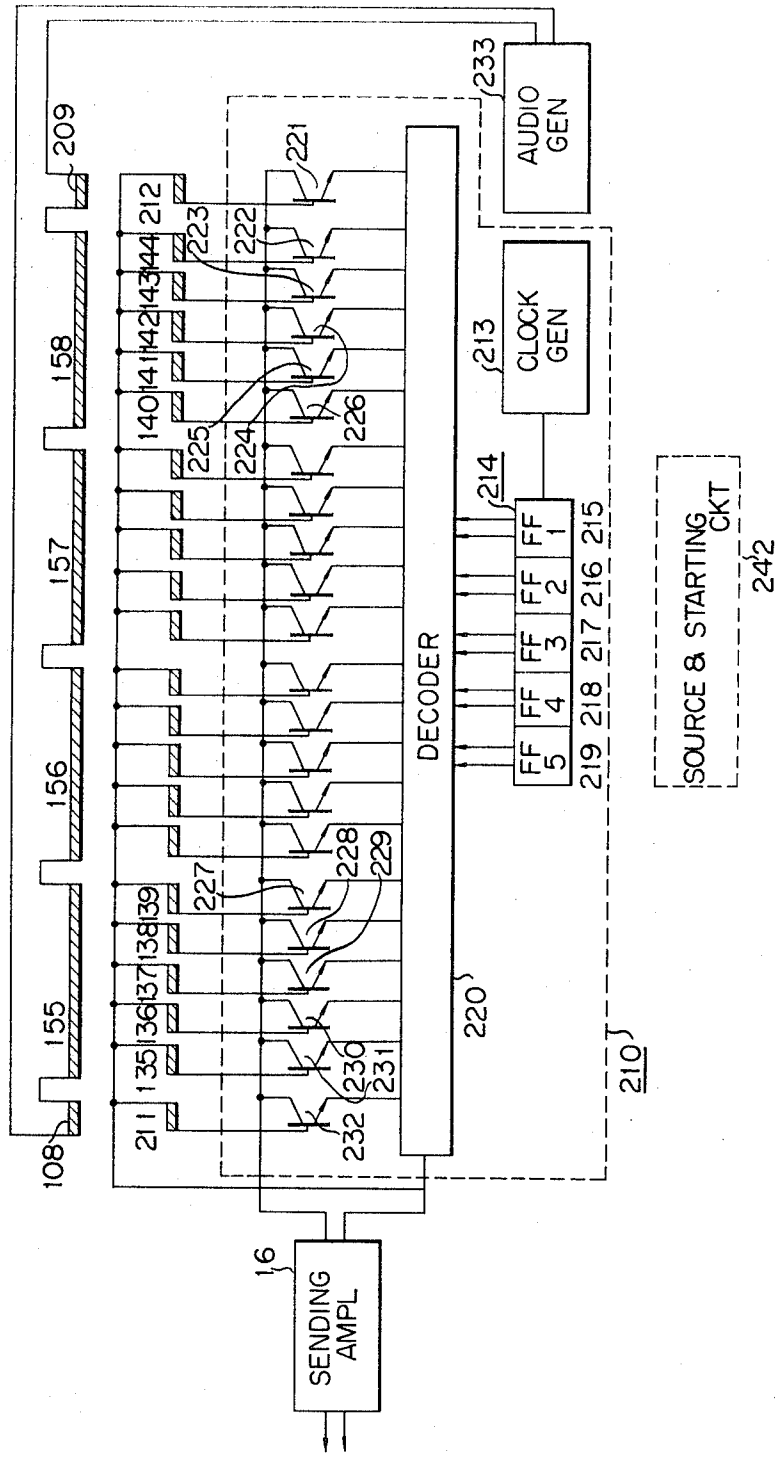

212
158
157
156
155
140 141 142 143 144
139 138 137 136 135
211
208
233
213
AUDIO GEN
CLOCK GEN
SOURCE & STARTING CKT
242
220B
214B
210
DECODER
FF 6
FF 5
FF 4
FF 1
FF 2
FF 3
218 219 243
217 216 215
244 245 246 248 249
250 251 252 253 254 255
220A
214A
16
SENDING AMPL

FIG. 21


209
212
223
222
221
233
AUDIO GEN
213
CLOCK GEN
158
140
141
142
143
144
225
224
226
214
157
FF 1
FF 2
FF 3
FF 4
FF 5
215
216
217
218
219
156
DECODER
227
228
229
139
138
137
136
135
155
220
230
231
232
211
210
108
16
SENDING AMPL
SOURCE & STARTING CKT
242

INDUCTION TYPE TELEMETERING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to an inductive type telemetering system and, more particularly to improvements in an encoding device for use with such a system encoding measured values of the measurand.

In the field of the automatic meter inspection, for example, utilizing the telemetering system, there have been already known various types of translators or encoders for converting the measurand measured and read by meters into a representative quantities of another kind that can be conveniently transmitted through the associated transmission line. The known translators or encoders have been of the contact type wherein the wiper involved may step from that contact engaged thereby to the succeeding contact with no electrical conduction caused therebetween for the reason that the surface of the succeeding contact has been coated with a non-conducting film during long service. This has resulted in a malfunction of the encoder and therefore the impossibility of inspecting the associated meter. In addition, such a meter has been required to be operatively associated with a plurality of rotary suitches to drive them with an additional torque. Furthermore a reading on the meter has been obtained separately from the operation of encoding the reading leading to the disadvantages that the encoder may be incorrectly operated and that it become expensive.

SUMMARY OF THE INVENTION

Accordingly it is an object of the invention to eliminate the objection to and the disadvantages of the prior art devices as above described by utilizing a phenomenon of mutual induction to eliminate the necessity of using electric contacts.

It is another object of the invention to provide a new and improved encoder device for use in the telemetering system encoding the measurand simultaneously with reading thereof while it is minimized in malfunction and high in reliability.

The invention accomplishes these objects by the provision of an induction type telemetering system comprising a central equipment, a terminal equipment, a transmission line for connecting the central equipment to the terminal equipment, and an encoder device disposed in the terminal equipment, characterized in that the encoder device includes encoding plate of electrically conductive material provided with a plurality of holes or slots opening at the edge thereof in a pattern predetermined by a code format into which the measurand is converted, the encoding plate being stepwise rotated in response to a measured value of the measurand, a plurality of first electromagnetic windings on one side of the encoding plate disposed in a pattern predetermined by the code format, at least one second electromagnetic winding disposed on the other side of the encoding disc to oppose to the plurality of windings through the encoding plate scanning means for scanning and sensing the mutual induction caused between each of the first windings and the opposite winding to express the measured measurand by the code format on the basis of the sensed mutual induction between the windings varied in accordance with the rotational movement of the encoding plate, and means for transmitting the measured measurand having the code format to the central equipment through the transmission line.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram typically illustrating the conventional automatic meter inspection system utilizing the telemetering technique;

FIG. 2 is a combined circuit and block diagram of one portion of the terminal equipment shown in FIG. 1;

FIG. 3 is a circuit diagram of anencoder of the prior art type for converting a decimal four figure number to a coded number in the form of a set of two out of five codes;

FIG. 4 is a longitudinal sectional view of one half of a reading encoder constructed in accordance with the principles of the invention with the section taken along the line IV — IV of FIG. 6 and with parts omitted;

FIG. 5 is a plan view of the encoder shown in FIG. 4;

FIG. 6 is a chart useful in explaining binary coded decimal numbers in the form of two out of five codes produced by the encoder shown in FIGS. 4 and 5;

FIGS. 7 and 8 are views similar to FIGS. 4 and 5 respectively but illustrating a modification of the arrangement shown in FIGS. 4 and 5;

FIG. 9 is a plan view of the encoding disc shown in FIGS. 7 and 8;

FIG. 10 is a plan view of a midification of the encoding disc shown in FIGS. 7, 8 and 9;

FIGS. 11 is a longitudinal sectional view of a modification of the arrangement shown in FIGS. 4 and 5 with parts omitted;

FIGS. 12 and 13 are views similar to FIG. 7 but illustrating modifications of the arrangement shown in FIGS. 7, 8 and 9;

FIGS. 14 and 17 are circuit diagrams of meter reading devices including four reading encoders for four decimal places whose windings differently interconnected.

FIGS. 18 through 21 are circuit diagrams of the meter reading devices as shown respectively in FIGS. 15 and 17 connected to the associated peripheral circuitries;

FIG. 22 is a graphical representation of waveforms illustrating a measured four digit value of the measurand in the form of 2 out of 5 codes and various types of modulated signals representative thereof for transmission purpose; and

FIG. 23 is a block diagram of a telemetering system constructed in accordance with the principles of the invention to be applied to the automatic inspection of meters.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the invention is effectively applicable to a wide variety of the fields of digital measurements the same will now be described, by way of example, in conjunction with the automatic meter inspection system.

Referring now to the drawings and FIG. 1 in particular, there is illustrated a typical form of the existing automatic meter inspection system commonly employed. The arrangement illustrated comprises a central equipment generally designated by the reference numeral 1,

a multiplicity of terminal equipments generally designated by the reference numeral 2(only one of which is shown) and signal transmission line generally designated by the reference numeral 3 connecting the central equipment 1 to the terminal equipments 2. The central equipment 1 includes a data processing device 4, a file device 5 connected to the data processing device 4, and a terminal calling device 6 connected at the input to the data processing device 4 and at the output to a coupler 7 which is, in turn, connected to the device 4 through a receiver 8. The receiver 8 is adapted to selectively receive coded signals provided by the terminal equipments 2. The coupler 7 is connected to a multiplicity of channels 9 each connected through its own repeater 10 and the associated channel 9 to a coupler 11 disposed in the terminal equipment.

In the terminal equipment 2, the coupler 11 is connected to a call receiver 12 for receiving a calling signal from the terminal calling device 6 assigned to that terminal equipment 2. The equipment 2 further includes a meter 13 to be measured, for example, a watt-hour meter, a scanning encoder 14 connected to the meter 13 to scan to read out an indication on the meter 13 and encode it, and a code generator 15 connected to the encoder 14 to generate a corresponding coded signal which is, in turn, delivered to a sending amplifier 16. The amplifier 16 is then connected to the coupler 11 to deliver the amplified signal to the central equipment 1 through the associated channels and repeater 9 and 10 respectively. In order to control the operation of the terminal equipment 2, control 17 is provided so as to be connected to the call receiver, encoder and code generator 12, 14 and 15 respectively. The terminal equipment 2 further includes a source of electric power as shown at dotted block in FIG. 1.

It is assumed that a meter disposed a particular terminal equipment, in this case, the equipment 2 as shown in FIG. 1 is to be measured or inspected. Under the assumed condition, the data processing device 4 in the central equipment 1 is operative to extract data concerning that meter to be measured from the file device 5 to apply to the terminal calling device 6 a selection signal for calling that terminal equipment to be measured. Those data may include the information for selecting the channels, repeater devices and terminal equipments 9, 10 and 2 respectively, and for indicating the ranking of the meter to be measured and an amount of consumption in the preceding month measured by that meter and the like. The calling device 5 responds to the selection signal from the data processing device 4 to select and connect a selected one of the terminal 1 equipment 2 to the central equipment 1 through the selected channels and repeater device 9 and 10 respectively. In the called terminal equipment 2, the call receiver 12 is operated through the coupler 11 to determine if that selection is correct. When correct, the receiver 12 delivers a signal to the control 17. With the source 18 being of the normal "OFF" system, the control 17 responds to that signal to cause the scanning encoder 12 to successively read out an indication on the meter 13 by turning the source 18 "ON" whereby the encoder 14 converts the read indication to a corresponding coded signal. Then the coded signal is transmitted through the code generator, amplifier and coupler 15, 16 and 11 respectively and thence to the central equipment 1 through the selected channels and repeater device 9 and 10 respectively.

In the central equipment 1, the data processing device 4 effects a predetermined calculation on the basis of the inspected data received by the receiver 8 and stores the result of the calculation in the file device 5. Then the data processing device 4 selects the succeeding terminal equipment to repeat the process as above described until all the terminal equipments are measured and the processed data are stored in the file device 5.

Heretofore, it has been commonly practiced to employ the scanning encoder having mechanical contacts operatively associated with the meter reading unit thereof to read out a measured value of the measurand in the form of a decimal number after which read value is encoded.

The conventional type of scanning encoders as above described is shown, by way of example, in FIG. 2. The arrangement illustrated comprises the meter 13 including four pointers 19, 20, 21 and 22 each adapted to be rotated about the center of the associated dial bearing ten decimal digits 0, 1, 2, . . . , 9 disposed at equal angular intervals on the peripheral portion. The pointers 19, 20, 21 and 22 display respectively values at units, tens, hundreds and thousands places of the decimal measurand measured by the meter 13. Each of the pointer 19, 20, 21 and 22 cooperates with a separate rotary switch generally designated by the reference numeral 23, 24, 25 or 26 respectively so that a wiper 27, 28, 29 or 30 are rotated simultaneously and synchronously with the rotation of the associated pointer to be successively engaged by ten stationary contacts arranged in a circle to correspond to the ten digits on the associated dial. In FIG. 2, the pointers 19, 20, 21 and 22 are shown as pointing at the digits 2, 4, 6 and 9 for the places to indicate a value of 9, 6, 4 and 2 while the wipers 27, 28, 29 and 30 are engaged by those contacts corresponding to the digits just described.

The scanning encoder 14 is operative to sequentially scan the stationary contacts of the individual contact arrays one after another of the arrays to determine which of the contacts in each of the contact array is in ingagement with the associated wiper. Then the encoder 14 puts the result of the sequential scanning in this case a desimal number of 9, 6, 4 and 2 into a corresponding coded quantity. The coded quantity thus formed is supplied to the code generator 15 where it is converted in a code or signal that is suitable for transmission. The converted code or signal is delivered through the sending amplifier 16 to the central equipment 1 as above described. The process just described proceeds under the control of the control 17.

Any reading in the form of a decimal number on the meter 13 at each place thereof can be converted into a corresponding binary coded decimal number expressed by a set of two out of five codes by an arrangement as shown in FIG. 3. Each of the rotary switches 23, 24, 25, or 26 as shown in FIG. 2 has its wiper 27, 28, 29 or 30 connected through a selection conductor 31, 32, 33 or 34 to a place selection circuit 35 disposed in the encoder 14 and the ten connected through a length of ten conductor cable 36, 37, 38 or 39 to a group of gate circuits generally designated by the reference numeral 40. More specifically the gate group 40 includes ten "OR" gate circuits 43 through 52 each having connected thereto corresponding contacts of the four contact arrays through a selected one of the different lengths of cable respectively. For example the

"OR" circuit 43 has four inputs each connected to that contact corresponding to the decimal digit 0 of each of the rotary switches through the associated cable conductors. The outputs of the ten "OR" gates 43 through 52 are connected to five "AND" gates circuits 53 through 57 so that selected four of those outputs are connected through their own "OR" gate (not shown) to different one of the "AND" gates at the four inputs. For example, the "AND" gate 53 includes four inputs coupled to the outputs of the "OR" gates 43, 45, 46 and 52. Further, the "AND" gates 53 through 57 each include the remaining input connected to a bit selection circuit 41 through a conductor 59, 60, 61, 62 or 63.

The place and bit selection circuits 35 and 41 respectively are initially put in their reset position by the control 17(see FIG. 2). Upon the initiation of the scanning operation, a pulse from the control 17 is applied an input to the place selection circuit 35. As a result, the selection conductor 31 for the units place changes from a binary ZERO to a binary ONE state. Namely, that conductor has a logical value changed from a binary ZERO to a binary ONE. Then that output conductor in the group of output conductors 36 connected to the stationary contact engaged by the wiper 27 changes from a ZERO state to a ONE state. That is, that output conductor has developed thereon a signal having a value of binary ONE which, in turn, passes through any of the "OR" gates 43 through 52, until it is applied to those two "AND" gates connected thereto via the associated "OR" gates(not shown). In the example illustrated in FIGS. 2 and 3, that out put conductor connected to the contact corresponding to the decimal digit 2 has its logical value of binary ONE that passes through the "OR" gate 51 to the two "AND" gates 54 and 55. At that time, a pulse from the control 17(FIG. 2) is applied to an input 58 to the bit selection circuit 41 to change the state of the output conductor 59 from a binar ZERO to a binary ONE. The ONE signal on the conductor 59 is applied to the "AND" gate 53. Thereafter as pulses from the control 17 are successively applied to the input 58 to the bit selection circuit 41, the remaining output conductors 60, 61, 62 and 63 are sequentially brought into the binary ONE state. It is to be noted that for each pulse only one of the output conductors 59 through 63 is put in a ONE state while all the remaining conductors remain in the ZERO state. The ONE signals on the output conductors 59 through 63 are successively applied to those "AND" gates 53 through 57 connected thereto. Under these circumstances, a ONE output is produced by that "AND" gate having two ONE inputs applied thereto from any one of the "OR" gates 43 through 52 and the bit selection circuit 41 respectively.

Thus it will be appreciated that the particular decimal digit or value as pointed by the pointer 19 select a pair of "AND" gates from the group of "AND"gates to produce a pair of ONE outputs from the two selected "AND" gates. In other words, a decimal figure in the units place is converted into a corresponding binary coded decimal figure in the form of a set of two out of five codes. In the example illustrated the decimal figure of 2 is converted into the form of 2 bits expressed by the outputs from the two "AND" gates 54 and 55.

Then a pulse from the control 17 is again applied to the place selection circuit 35 to initiate to scan the rotary switch 24(see FIG. 2) in the tens place in the same manner as above described. Thereafter the process as above described is repeated with the hundreds place and then with the thousands places until the indication on the meter 13 has been read out and encoded in the form of two out of five codes.

In each rotary switch as shown in FIG. 2, it is required to decrease the rotary torque therefor to a small magnitude. This leads to the necessary of decreasing a contact pressure under which the wiper selectively engages the associated stationary contacts. On the other hand, assuming that the measurand is quantity of electric power, theremay be a customer watt-hour meter will have read a quantity of 1000 KWh after a long period of time. In such a watt-hour meter, any stationary contact such as shown in FIG. 2 maintained in disengagement from the associated wiper could have its contact surface covered with a non-conductive film in bad surroundings. Under these circumstances, the movement of the wiper into engagement with such a contact could not cause the electrical conduction of the wiper to that contact. This has resulted in a malfunction of the scanning encoder such as shown in FIGS. 2 and 3, and therefore the impossibility of inspecting the meter.

In addition, the meter is required to drive a plurality of rotary switches involved with an additional torque. Furthermore a reading on the meter is effected separately from the encoding operation. This has results in the disadvantages that the encoder may be incorrectly operated and that the coats become hight.

The invention contemplates to eliminate the disadvantages of the prior art devices as above described by the provision of an encoding plate permitting the reading operation to be performed simultaneously with the encoding operation through the utilization of the phenomenon of mutual induction without any electric contact employed.

While the invention is equally applicable to a variety of code formats provided by the encoding plate, the same will now be described in conjunction with the two out of five code format considered to be most typical.

Referring now to FIGS. 4 and 5, there is illustrated a combined reading and encoding device constructed in accordance with the principles of the invention. Only for purpose of illustration, FIG. 4 shows only one half of the device in section and the other half in phantom with certain parts omitted. The arrangement illustrated comprises an array of driving windings 101*a*, 102*a*, 103*a*, 104*a* and 105*a* disposed at substantially equal angular intervals in a circle, an array of output windings 101*b*, 102*b*, 103*b*, 104*b* and 105*b*(only one of which is illustrated by 101*b* in FIG. 4) directly opposing to the driving windings 101*a* through 105*a* respectively to form a gap therebetween, and an encoding circular plate 110 of any suitable electrically conductive material such as aluminum rotatably disposed in the gap about its center lying in a vertical broken line as shown in FIG. 4 passing through the centers of both circular arrays of driving and output windings.

The encoding plate or disc 110 radially somewhat extends from the circular arrays of windings and is shown in FIG. 5 as including four coupling openings 111, 112, 113 and 114 disposed in a circle concentric with the circle for each winding array so that the two outermost openings, in this case, openings 111 and 114 are spaced away from the adjacent openings 112 and 113 by angular intervals equal to one half the angular intervals for the circular winding arrays while the two intermediate

openings 112 and 113 are spaced away from each other by an angular interval equal to the angular intervals for the winding arrays. The encoding disc 110 also bears ten decimal digits, 0, 1, 2, . . . , 9 at substantially equal angular intervals on the peripheral portion with some of the digits radially aligned with the couplings as shown in FIG. 5 for reading purpose. For example, the decimal digit 1 is radially aligned with the opening 111 on the outside thereof.

All the driving windings 101*a* through 105*a* are adapted to be supplied from a common source of alternating current(not shown) when an alternating current is caused to flow through the driving winding 101*a*, an alternating magnetic flux ϕ is produced in the vicinity thereof as shown at dotted line in FIG. 4. Assuming that the coupling opening 111 on the rotatable disc 110 is located between the driving and output windings 101*a* and 101*b* as shown in FIG. 4, the alternating flux ϕ links the opposite output winding 101*b* through the opening 111 to induce an alternating voltage across the winding 101*b*. In other words, the presence of an output voltage induced across the output winding 101*b* indicates that any one of the coupling openings such as the opening 111 is at its position where it faces the adjacent output winding, in this case, the winding 101*b*.

Alternatively if no openin g is located between the driving and output windings 101*a* and 101*b*, that is to say, if those windings sandwiches the solid portion of the encoding disc 110 then the alternating flux produced by the driving winding 101*a* does not link the opposite output winding 101*b* by virtue of the electromagnetic shield effect. Under these circumstances, no output is produced across the output winding 101*b*.

Thus, the output winding 101*b* can produce an output voltage or no voltage in accordance with whether the coupling opening is interposed between the output winding 101*b* and the opposite driving winding 101*a*. This is true in the case of all the remaining output windings. In FIG. 5, the openings 111 and 114 is positioned below the driving windings 101*a* and 103*a* to permit the associated output windings 101*b* and 103*b*(not shown) to produce respective output voltages.

As the encoding disc 110 is rotated, the driving windings 101*a* through 105*a* are electromegnatically coupled to the associated output windings 101*b* through 105*b* with different degrees of coupling. More specifically, each time the disc 110 has effected the incremental movement equal to the angular interval between the adjacent driving or output windings starting with its position as shown in FIGS. 4 and 5, selected two of output windings are electromagnetically coupled to the associated driving windings through any two of the coupling openings to produce respective voltages thereacross as shown in a chart of FIG. 6.

In FIG. 6, the output windings 101*b* through 105*b* designated in the uppermost row are shown as selectively producing voltages designated by the binary 1(ONE), in accordance with ten decimal numbers 1, 2, . . . , 9, 0 denoted in the leftmost column. For example, the windings 101*b* and 103*b* produce voltages in response to a decimal number of 1. Thus it will be appreciated that as the encoding disc 110 is incrementally rotated, each of decimal numbers 1, 2, . . . , 9, 0 are coded into a corresponding binary coded number expressed by the outputs from selected two of the five output windings 101*b* through 105*b* as shown in FIG. 6. That is each decimal number is expressed by one set of two out five codes.

In practicing the invention, it is to be understood that the patterns in which the coupling openings and winding pairs are arranged are predetermined by the particular code format into which decimal numbers are converted. Also the openings may be of any suitable shape other than the circular shape in accordance with the productivity of the devices the shape of windings and other requirements.

FIG. 7 wherein like reference numerals designate the components identical or similar to those shown in FIGS. 4 and 5 illustrates another embodiment of the reading and encoding device that may be used with the invention. As in FIG. 4, one half of the device is illustrated and the other half is shown in phantom with certain parts omitted. The arrangement is different from that shown in FIGS. 4 and 5 in that in FIG. 7, each pair of the driving and output windings such as the windings 101*a* and 101*b* are inductively disposed around the adjacent leg or end portions of a separate C-shaped magnetic core 115 while the coupling openings 111 through 114 on the encoding disc 110 are opened at the peripheral edge of the disc through respective slots as shown in FIG. 8 and as best shown in FIG. 9. When a magnetic path for one pair of driving and output windings is closed externally of the encoding disc 110 as shown by the C-shaped core 115 in FIG. 7, it is necessary to provide an air gap for a boundary defining each coupling opening which is not necesarily required for the air-core winding pair such as shown in FIGS. 4 and 5. A part from whether or not the openings are closed, the description made for the air core type as shown in FIGS. 4 and 5 is equally applicable to the core type such as shown in FIGS. 7, 8 and 9.

If desired, each pair of a successive openings such as labelled 111 and 112 may be replaced by a single notch 116 or 117 as shown in FIG. 10.

FIGS. 11, 12 and 13 wherein like reference numerals designate the component identical or similar to those shown in FIGS. 4 and 5 illustrate various modifications of the reading and encoding device as above described. More specifically, FIG. 11 shows a single driving winding 118 having an outside diameter substantially equal to the diameter of the encoding disc 110 to be substituted for five driving windings as shown in FIG. 4 through 8. In other respects, the arrangement is identical to that shown in FIGS. 4 and 5. For example, five output windings should be provided only one of which is illustrated by the reference numeral 101*b* in FIG. 11. The measure as above described permits the resulting construction to be simplified.

FIG. 12 shows a modification of the arrangement shown in FIGS. 7, 8 and 9. As shown in FIG. 12, a magnetic core is formed of an apertured, inverted cup-shaped member 119 of circular cross section and an apertured disc 120 closing the mouth of the cup. Five pairs of opposite legs extend at substantially equal angular intervals in a circle from the inner surfaces of the cup-shaped member and disc 119 and 120 respectively to form a gap therebetween in which the encoding disc 110 is rotatably disposed, although only two pairs of protrusions are illustrated. The driving and output windings such as shown by 101*a* and 101*b* are inductively disposed on the leg pairs on the opposite ends respectively. In other respects, the arrangement is identi-

cal to that shown in FIGS. 4 and 5 or in FIGS. 7, 8 and 9.

FIG. 13 shows a modification of the arrangement illustrated in FIG. 12 wherein a single driving winding 118 encircles all the legs on the cup-shaped member 119. The arrangement corresponds to that as shown in FIG. 11 modified to be of the core type.

From the foregoing it will be appreciated that in all the arrangements shown in FIGS. 4 through 13, the electromagnetic coupling or the mutual induction between each of the output windings and the opposite driving winding is utilized to obtain the angular position of the encoding disc whereby a magnitude of the measurand is read out. When one considers merely the arrangement of the windings, it is not required particularly to distinguish one from the other of the driving and output windings. Only for purpose of illustration, either one of the driving and output windings may be called hereinafter an "A" winding while the other winding is called a "B" winding.

Referring now to FIGS. 14 through 17 wherein like reference numerals designate like components, there are illustrated meter reading devices including the "A" windings differently interconnected and the "B" windings also differently interconnected. In those Figures, the meter reading device generally designated by the reference numeral 130 is adapted to read out a measurand in the form of a decimal number having four places and includes windings 135, 136, 137, 138 and 139 forming the "A" windings for the units place, windings 140, 141, 142, 143 and 144 forming the "A" windings for the thousand places and similar windings for the tens and hundreds places as well as windings 145, 146, 147, 148 and 149 forming the "B" windings for the units place, windings 150, 151, 152, 153 and 154 for the thousands place and similar windings for the tens and hundreds places. The encoding disc as above described is rotatably disposed between the "A" and "B" windings for each place of the decimal number although it is not illustrated.

More specifically, FIG. 14 illustrates the "B" windings all serially interconnected and the "A" windings having one end connected together and the other ends connected to separate terminals 159 through 178 respectively. For example, the other end of the winding 135 is connected to the terminal 159. If desired, the "B" windings for each figure place may be replaced by a single winding 155, 156, 157 or 158 as shown in FIG. 15. In the arrangements, shown in FIGS. 14 and 15, the "A" windings can be sequentially scanned by any suitable means to determine which of the "A" windings is electromagnetically coupled to the opposite "B" winding for each bit. That is, the terminals 159 through 178 of the "A" windings can be sequentially scanned. If desired, both sets of the "A" and "B" windings may be scanned in order to decrease the number of circuit elements involved. This measure is shown in FIGS. 16 and 17.

In FIG. 16 wherein like reference numerals designate the components identical to those shown in FIG. 14, the reference numerals 179, 180, 181, 182 and 183 designate couplings between the "A" windings 135, 136, 137, 138 and 139 and the "B" windings 145, 146, 147, 148 and 149 respectively for the units place. For the thousands place, the "A" windings 140, 141, 142, 143 and 144 are coupled to the "B" windings 150, 151, 152, 153 and 154 through couplings 194, 195, 196, 197 and 198 respectively. Similarly the reference numerals 184 through 188 and 189 through 193 designates couplings for the tens and hundreds places respectively. Series combinations of "B" windings for the four figure places have a common terminal connected to one end thereof, and individual terminals 199, 200, 201 and 202 connected to the other ends thereof respectively. On the other hand, the "A" windings have a common terminal connected to one end thereof and individual terminals 203, 204, 205, 206 and 207 connected to the other ends of corresponding "A" windings for four figure places. The status of each coupling(which corresponds to one bit) can be determined by scanning the terminals 199 through 202 of the "B" windings to select the figure place and scanning the terminals 203 through 207 of the "A" windings to select the bit for each figure place. For example, the terminals 199 and 203 can be used to determine the status of the coupling 179 and the terminals 201 and 205 can be used to determine the status of the coupling 191.

FIG. 17 wherein like reference numerals designate the components identical to those shown in FIG. 16 illustrates a modification of the arrangement of FIG. 16. The arrangement is different from that illustrated in FIG. 16 only in that in FIG. 17 a single "B" winding is substituted for the five "B" windings for each figure place as in the arrangement of FIG. 15.

FIGS. 18, 19, 20 and 21 show different manners in which the meter reading device 130 such as shown in any of FIGS. 14 through 17 can be connected to a peripheral circuitry. More specifically, FIG. 18 shows a meter reading device 130 such as shown in FIG. 15 including four output windings 155 through 158 serially connected across a sending amplifier 16 one for each figure place such as shown in FIG. 1 or 2 through a pair of additional output windings 208 and 209 for the purpose as will be apparent subsequently and five driving windings operatively associated with the output winding for each figure place as in FIG. 15. For example five driving windings 135, 136, 137, 138 and 139 are operatively associated with the output winding 155 for the units place. All the driving windings for four figure places as well as a pair of additional driving windings 211 and 212 are connected together at one end and also connected at the other ends to a scanning circuit generally designated by the reference numeral 210. The additional driving windings 211 and 212 are directly coupled to the opposite output windings 208 and 209 respectively with no shielding plate interposed therebetween. The pair of opposite windings 208 and 211 serve to produce a start pulse indicating the initiation of the transmission of a message concerning each inspection of the associated meter and the pair of windings 209 and 212 serve to produce and end pulse indicating the termination thereof in the manner as will be described hereinafter.

The scanning circuit 210 includes a clockpulse generator 213 a counter 214 formed of a plurality of cascade FLIP-FLOP's 215, 216, 217, 218 and 219 with the FLIP-FLOP 215 connected to the clock generator 213, and adecoder 220 connected to the FLIP-FLOP's 215 through 219 of the counter 214. The circuit 210 further includes a plurality of switching transistors each having a base electrode connected to the decoder 220, emitter electrode connected to the emitter electrodes of the other transistors and a collector electrode connected to a different one of the driving windings of the meter

reading device **130**. In FIG. **18**, that transistor connected to the additional driving winding **212** is designated by the reference numeral **221**, and those transistors connected to the driving windings **140** through **144** for the thousand places are designated by the reference numerals **222** through **226**. The reference numerals **227** through **231** designate those transistors operatively coupled to the units place and the reference numeral **232** designates the transistor connected to the driving winding **219**. All the transistors are operative to amplify the output from the decoder **222** and to switch an audio current provided by an audio generator **233** connected across all the driving windings at one end and all the transistors at the emitter electrodes.

As clock pulses from the clock generator **213** are successively applied to the counter **214**, the transistors sequentially switch in the order of the transistors **232, 231, . . . 222** and **221** through the decoder **220** to permit the audio current from the audio generator **233** to be successively applied through the switched transistors to the associated driving windings in the order of the windings **211, 135, . . . 144** and **212**. Thus the angular positions of the four encoding discs(not shown) or the particular measured values of the measurand in the four figure places can be serially read out in the form of two out of five codes, and supplied in the sending amplifier **16**.

The sending amplifier **16** may be simply what amplifies a power of an output from the meter reading device **130**. Alternatively the amplifier **16** may be operative to suitably modulate the output from the device **130** in accordance with a transmission involved and then amplify its power. In the latter case, the output applied to the sending applifier **16** from the meter reading device **130** may be of an amplitude modulated (AM) wave having a predetermined frequency and including those portions in the form of two out five codes having a predetermined fixed amplitude representative of the binary ONE and the remaining portion substantially null in amplitude corresponding to the binary ZERO as shown at waveform "*b*" in FIG. **22**.

In FIG. **22** waveform "*a*" describes, by way of example, a measured measurand as supplied by the meter reading device **130** including figures of **2, 4, 6** and **9** in the units, tens, hundreds and thousands units places with the start and end pulses located respectively before and after the measured to be transmitted. The waveform "*b*" designates an AM modulated wave, such as above described, shown as including those portions **235** having a frequency of f_A and representing the binary ONE. The waveform "*b*" includes pairs of wave portions **235** consecutive to each other without a pause therebetween which can not be distinguished from each other. Under these circumstances, the associated receiver side can utilize some separation technique similar to the start and stop system as well known in the art. Waveform "*b*" may be modified to waveform "*c*" as shown in FIG. **22** wherein any pair of consecutive AM wave portions disabled to be distinguished from each other are separated into two wave portions **236** having a frequency of f_B.

Further in FIG. **22** "waveform""a" depicts a frequency shift (FS) modulated wave used in coded transmission in communication and in radio telemetering system and included those portions **237** having a frequency f_1 indicating the binary ONE and those portions **238** having a frequency f_o indicating the binary ZERO with the frequencies f_1 and f_o shifted from the carrier frequency thereof. Waveform "*e*" designates a two value-three frequency FS modulated wave including those portions **239** having a frequency f_1 indicating the binary ONE, those portions **240** having a frequency f_o indicating the binary ZERO and those portions **241** having a frequency f^* effective for purposes of separation and carrier.

In practicing the invention, any of the modulation systems as shown in FIG. **22** and other two group multifrequency coding system may be utilized in accordance with the economy and reliability.

FIG. **18** further shows a source of electric power and a starting circuit in dotted block **242** required for the arrangement of the same Figure to be operated.

FIG. **19** shows a modification of the arrangement as shown in FIG. **18** applied to a meter reading device such as shown in FIG. **17**. In FIG. **19** the scanning circuit **210** is divided into two portions operatively coupled to the driving and output sides of the meter reading device **130**. It is noted that the device **130** shown in FIG. **19** includes five output windings and one single driving winding for each figure place and that the output windings are desiganted by the same reference numerals denoted the driving windings in FIG. **18**. This is true in the case of the driving windings as shown in FIG. **19**. In other respects, the like reference numerals are used in FIGS. **18** and **19**. One of the two divided portions comprises a counter **214B** including a plurality of serially connected FLIP-FLOP's **215, 216** and **217**, a decoder **220B** connected to the FLIP-FLOP's **215, 216** and **217**, and a plurality of switching transistors disposed between the decoder **220B** and the driving windings included in the meter reading device **130**. More specifically, the switching transistors **244, 245, 246, 248, 249** and **250** include base electrodes connected to the decoder **220B**, emitter electrodes connected together to the audio generator **233** at one end and collector electrodes connected to the windings **209, 158, 157, 156, 155** and **208** at one end respectively. Those windings are connected together at the other ends to the audio generator **233**.

The other portion of the scanning circuit **210** comprises the components similar to those of the one divided portion as above described. More specifically a counter **214-A** is formed of a plurality of serially connected FLIP- FLOP's **218, 219** and **243** while a decoder **220A** is connected to the FLIP-FLOP's **218, 219** and **243** and also across the sending amplifier **16** through emitter-to-collector circuits of switching transistors **251, 252, 253, 254** and **254**. The FLIP- FLOP's **218** is connected to the clock pulse generator **213** and the FLIP-FLOP's **243** is connected to the FLIP-FLOP's **215**. The decoder **220A** is further connected to all the output windings disposed in the meter reading device **130** at one end and the base electrodes of the transistors **251** through **254** are connected to the output winding **211**, the corresponding output windings for the four figure places, and the output winding **211** at the other ends respectively.

The division of the decoder into two portions as above described is well known in the field of computers and more particularly of their memories.

FIG. **20** wherein like reference numerals designate the components identical or similar to those shown in FIG. **19** illustrates a modification of the arrangement shown in FIG. **19**. The arrangement illustrated is differ-

ent from that shown in FIG. 19 only in that the scanning circuit 210 includes a pair of divided portions operatively coupled to the meter reading device 130 in the manner reversed from that shown in FIG. 19. That is, those scanning portions operatively coupled to the driving and output sides of the meter roading device as shown in FIG. 19 are operatively coupled to the output and driving sides of the device 130 as shown in FIG. 20 respectively.

FIG. 21 shows an arrangement for scanning only the output side of the meter reading device 130 with its driving windings all serially interconnected. In other words, the arrangement illustrated is different from that shown in FIG. 18 only in that in both Figures the output and driving windings are replaced by each other. In FIGS. 18 and 21 like reference numerals designate the identical or similar components except for the reference numerals for the driving and output windings of the meter reading device being used reversely.

FIG. 23 is a block diagram illustrating the telemetering system of the invention in the entirety. The operation of the invention will now be described with reference to FIGS. 18 and 23.

When the terminal equipment 2 receives an inspection calling signal from the central equipment through the associated transmission line 3, the signal is applied to the call receiver 12 through the coupler 11. When having determined the received signal being correctly assigned to that terminal equipment, the receiver 12 instructs the source and starting circuit 242 to control the operation of the terminal equipment 2. Then the scanning circuit 210 to sequentially is operated to sequentially read out the particular measured values at figure places of the measurand which are, in turn, supplied through the sending amplifier 16 and thence to central equipment 1 via the coupler line 11 and 3 respectively.

Referring back to FIG. 18, the source and starting circuit 242 puts the sending amplifier 16 in its operative state and initiate to oscillate the audio and clock generators 233 and 213 respectively as well as resetting the counter 214. Under these circumstances, no energy of alternating current is applied to any of the driving windings disposed in the meter reading device 130.

Then a first clock pulse from the clock generator 213 is applied to the counter 214 where "1" is counted. This causes the decoder 220 to turn the switching transistor 232 "ON" thereby to permit the audio generator 233 to supply audio current to the driving winding 211 through the now conducting transistor 232. While the switching transistors 221 through 232 are shown in FIG. 18 as being of the NPN type, it is to be understood that such transistors may be replaced by any suitable components required only to perform the switching operation. Due to the absence of any shield plate disposed between the driving winding 211 and the opposite output winding 208, a voltage is induced across the output winding 208. The voltage thus induced is supplied to the sending amplifier 16 and appropriately modulated to be suited to the characteristics of the transmission line 3 after which it is delivered to the line as a start pulses. It is to be understood that that voltage without modulation may be delivered to the line 3. That is, the sending amplifier may be merely a power amplifier.

The clock generator 213 successively provides the clock pulses at time intervals predetermined by a transmission speed involved. It is herein assumed that the transmission speed is of 200 bands. Under the assumed condition after the first clock pulse has appeared, a time interval of 50 milliseconds elapses until a second clock pulse is provided by the clock generator 213. The counter 214 is responsive to the second clock pulse to increase its count to a decimal value of 2 which causes, in turn, the decoder 220 to turn the switching transistor 231 "ON" while the transistor 232 is turned "OFF." Therefore the driving winding 135 has applied thereto an audio current from the audio generator 233. Whether that driving winding 135 is electromagnetically coupled to the mating winding 155 is determined by the particular measured value of the measurand in the associated figure place in this case, the units place. Assuming that a decimal value of 2 has read out in that decimal place for which the single output winding 155 is disposed, the output winding 155 is not coupled to the driving winding 135 and therefore applies no output to the sending amplifier 16.

As a third and a fourth clock pulse are successively produced by the clock generator 213, the counter 214 counts decimal "3" and "4" in succession to successively turn the switching transistors 230 and 229 "ON" while the preceding transistors are turned OFF. Thereby the coupling between the windings 136 and 155 and between the windings 137 and 155 is examined. Under the assumed condition, the output winding 155 induces a voltage thereacross indicating the measured measurand has a decimal value of 2 in that figure place corresponding to that output winding 155. The process as above described is repeated with all the remaining driving windings to indicate the measured values in the remaining figure places of the measurand. Upon the occurence of a 22nd clock pulse, the driving winding 212 is energized by the audio generator 233 to cause the opposite output winding 209 to produce an output through the coupling between both windings. The output from the winding 209 is supplied to the sending amplifier 16 as an end pulse indicating the termination of the particular reading out operation. Then a 23rd clock pulse appears from the clock generator 213 to change a count of the counter 214 to decimal "23" whereupon the terminal equipment 2 is reset to the original state in readiness for the succeeding operation.

When the meter reading device and scanning circuit 130 and 210 respectively are of the arrangement as shown in FIG. 19, one array of output windings is scanned for each figure place. As above described, the source and starting circuit 242 is operated to reset both counters 214A and 214B or all the FLIP-FLOP's 215 through 219 and 243 and also to actuate the clock and audio generators 213 and 233 respectively.

Since each of the counter 214A and 214B is shown in FIG. 19 as including three FLIP-FLOP's Nos. 1, 2 and 3 or Nos. 4, 5 and 6, the counters 214A and 214B counts the clock pulses from the clock generator 213 in the quinary system. A first clock pulse from the clock generator 213 is applied to the FLIP-FLOP's 218 of the counter 214A to render its count equal to a decimal "1." This causes the switching transistor 286 to be turned "ON" through the decoder 220A with no effect. The succeeding four clock pulses causes the transistors 255, 254, 253 and 252 to be sequentially turned "ON" while the preceeding transistor is brought into its "OFF" state. The turning "ON" of the transistor 252 in "OFF" response to the fifth clock pulse from the

clock generator **213** causes the output winding **211** to be connected across the amplifier **16** through the now conducting transistor and decoder **287** and **220A**.

On the other hand, the counter **214B** remains clear and it is assumed that the switching transistor **250** is in its "ON" state to cause the audio generator **233** to energize the driving winding **208.** Therefore it will be seen that the output winding **211** responds to the fifth clock pulse to induce a voltage thereacross providing a start pulse. That start pulse is supplied to the sending amplifier **16.** The fifth clock pulse effects a carry out of the count on the counter **214A** whereby the counter **214B** counts a decimal "1." This causes the audio generator **233** to energize the driving winding **233** to energize the driving winding **155** for the units place rather than the driving winding **208.**

The succeeding five clock pulses sequentially put the transistors **251, 255, 254, 253** and **252** in their "ON" state in the manner as above described to determine which pair of the output windings **135,** through **139** are electromagnetically coupled to the energized driving winding **155** with the result that a measured value in the units place of the measurand is read out and coded in the form of a set of two out of five codes. The coded value of the measurand is then supplied to the amplifier **16.**

As the clock pulses from the clock generator **213** are successively applied to the counter **214A**, the process as above described is repeated to serially read out and encode the measured values in the remaining figure places of the measurand.

The end pulse is produced in response to a **26**th clock pulse and a **30**th clock pulse causes the last output winding **144** for the thousands place to be connected across the amplifier **16** with no effect. The terminal equipment **2** responds to a **31**st clock pulse from the clock generator **213** to be reset whereupon its operation is completed.

The operation of the arrangements as shown in FIGS. **20** and **21** will readily be understood from the foregoing description made in conjunction with FIG. **23** combined with FIGS. **18** and **19.**

The audio generator **233** is designed and constructed such that it produces an AC power of an audio frequency sufficient to determine whether any pair of driving and output windings such as windings **101***a* and **101***b*(see FIG. **4**) are coupled to each other through the encoding disc **110,** with a sufficiently small ratio of signal to noise. If it is attempted to render the audio generator small-sized, then a frequency band higher than the audio band, such as in the order of 50 or 100 KHz is preferably used inorder to obtain a sufficiently small ratio of signal to noise. If the encoding plate will be possible to be precisely machined at low costs, then the same can more decrease in dimension. In the latter case, it is proper to use a frequency band above 1 MHz.

The higher the frequency involved the thiner the encoding disc **110** may be. Thus the associated windings such as the windings **101***a* and **101***b* can become smaller. As a result, it becomes possible to render the device small-sized. Further the encoding disc is formed of any suitable sheet metal high in electric conductivity. Since the higher the frequency used the higher the electromagnetic shield effect will be the encoding disc is capable of further decreasing in thickness.

The invention gives the following advantageous results:

1. The reliability is maintained high for long period time because the electromagnetic coupling is utilized with no contact;

2. The conversion of a decimal number into a coded signal is correctly accomplished with a simple construction because the reading out and encoding operations are simultaneously performed in a single step;

3. The reliability can be additionally improved through the use of code formats having the redundancy such as the format of two out of five codes or, 4 × 4 type code; and

4. The visible reading becomes possible by designating decimal digits 0, 1, 2, . . . , **9** on the encoding disc such as shown in FIG. **5** wherein the arrow indicates the reading position.

The invention has been illustrated and described in conjunction with several preferred embodiments thereof it is to be understood that numerous changes and modifications may be resorted to without departing from the spirit and scope of the invention. For example, only either one of the audio and clock generators **233** and **213** respectively may be provided. In that case, the other of the two may be a counter supplied by the generator to produce a fraction of the frequency of the generator. While counters have been previously expense the existing counters can be manufactured at low costs by virtue of the progress of the semiconductor techniques, for example, the development of the large-scaled intergrate circuit technique. Therefore it is necessary to minimize the number of the generators employed.

The driving and output windings with or without the magnetic core and the encoding disc may be formed into any desired shapes other than those shown in FIGS. **5** through **13.** Since the invention utilizes the fact that the driving windings is either permitted to be electromagnetically coupled to the mating output winding through the encoding disc rotatably disposed therebetween or prevented from doing so, the invention may be carried out to be suitably modified to meet the other requirements. The coupling hole with or without a slit on the encoding plate is not required to be of a circular shape and may be of any desired shape such as a square shape. The magnetic core operatively associated with the windings may be of stacked metallic laminations or of a ferrite as long as it is magnetic.

It is to be noted that the term "opening" used in the appended claims is intended to include either of the hole and slit such as shown in FIGS. **5** and **9** respectively.

While the invention has described in conjunction with the two out of five codes it is to be understood that it is equally applicable to various decimal code formats such as the pure decimal code format, 4 × 4 type decimal code format etc. with the pure decimal code format used, ten windings are theoretically required for each of driving and reading purposes. Of course, it is possible to employ a common winding such as the winding **118** shown in FIG. **11** or **13.**

The 4 × 4 type decimal code format includes codes similar to the 4 × 4 type-two group multi-frequency codes employed in the telephone exchange. A part from the particular transmission line and central equipment suitable for being operative with the 4 × 4 code format or its application in view of the stand point of exchangeability for other, the use of such a code format results in a somewhat complicated construction as

compared with the two out of five code format. Therefore it is desirable avoid the use of the 4 × 4 code format provided that a principal purpose is to provide a cheap system. For this reason, the invention has not be described in term of the 4 × 4 code format by referring to the drawings.

If desired, the encoding plate may be in the form of a cylinder or a curved surface of rotation rather than of a flat disc. Also the start and end pulses may produced by any suitable electronic circuit but not through the coupling of the windings **208** and **209** to the windings **211** and **219** respectively.

If a plurality of meters are disposed adjacent one another, the same may be operatively associated with a common peripheral circuit in the economical point of view.

While the invention has been described in conjunction with the automatic inspection of meters, it is to be understood that it is equally applicable to the whole field of measurements requiring the reading and conversion into codes at low costs with high reliability and a long useful life.

What is claimed is:

1. In an induction type telemetering system comprising a central equipment, a terminal equipment including means for measuring the measurand, and a transmission line for interconnecting the central and terminal equipments, the conbination of encoding means for encoding a measured value of the measurand into a predetermined code format said encoding means comprising an encoding plate of electrically conductive material having a plurality of openings disposed thereon in a pattern predetermined by the code format and stepwise rotatable in response to the measured value of the measurand, a plurality of first electromagnetic windings on one side of said encoding plate in a pattern predetermined by the code format, and at least one second electromagnetic winding disposed on the other side of said encoding plate to oppose to said plurality of first electromagnetic windings through the encoding plate; scanning circuit means for scanning and sensing the mutual induction caused between each of said first windings and said at least one second winding through one of said openings on said encoding plate to cause said first windings to selectively produce an output providing the measured measurand encoded in the code form, said mutual induction between the windings being variable in accordance with the stepwise rotation of said encoding plate; and means for transmitting the ecoded measurand to said central equipment through said transmission line.

2. An induction type telemetering system as claimed in claim **1**, wherein said first windings serve as driving windings capable of being applied with an alternating current.

3. An induction type telemetering system as claimed in claim **1**, wherein said second winding serves as a driving winding capable of being applied with an alternating current.

4. An induction type telemetering system as claimed in claim **1**, wherein in order to convert the measured measurand into a representative quantity in the form of a set of two out of five codes, said encoding plate includes four of said openings and has five driving windings disposed at substantially equal angular intervals on the one side thereof.

5. An induction type telemetering system as claimed in claim **4**, wherein said four openings are positioned on said encoding plate such that each of the outermost openings is spaced away from the adjacent opening by an angular interval equal to one half said equal angular intervals for said driving windings while an angular interval between the two intermediate openings is equal to said equal angular intervals for said driving windings.

6. An induction type telemetering system as claimed in claim **1**, wherein said plurality of first windings serving as driving windings are arranged in a circle and wherein in the array of said first windings and the array of said openings are disposed such that when at least one of said first wings faces any of said openings, both said arrays are concentric with each other.

7. An induction type telemetering system as claimed in claim **1**, wherein a substantially C shaped magnetic member is disposed to form a closed magnetic path outside of said encoding plate along which a magnetic flux produced by the winding flows and each of said openings is formed of a hole opening at the periphery edge of said encoding plate through an individual slit.

8. An induction type telemetering system as calimed in claim **4**, wherein each pair of the outermost opening and the adjacent opening on said encoding plate are continuous to form a notch spaced away from a similar notch formed of the other pair of openings.

9. An induction type telemetering system as claimed in claim **1**, wherein a single electromagnetic winding serving as a driving winding is operatively associated with said encoding plate and has an outside diameter substantially equal to the diameter of said encoding plate.

10. An induction type telemetering system as claimed in claim **1**, wherein said first and second windings are encircled in place with an enclosed magnetic core consisting of at least two part.

11. An induction type telemetering system as claimed in claim **10**, wherein said magnetic core includes a plurality of pairs of leg portions projecting in opposite relationship from a pair of opposite interval surfaces thereof respectively one pair for each of the first windings to form gaps therebetween in which said encoding plate is rotatably disposed, each pair of said opposite leg portions having said first and second windings inductively disposed thereon respectively.

12. An induction type telemetering system as claimed in claim **10**, wherein said magnetic core includes a plurality of pairs of leg portions projecting in opposite relationship from a pair of opposite internal surfaces thereof respectively one pair for each of the first windings to form gaps therebetween in which said encoding plate is rotatably disposed, that set of said leg portions projecting from one of said opposite internal surfaces of said magnetic core having said first windings inductively disposed thereon respectively while all said leg portions of the other set are encircled with a single second winding.

13. an induction type telemetering system as claimed in claim **1**, wherein said encoding means is disposed for each of plural figure places of the measurand to serially transmit the encoded values in the figure places of the measurand to the central equipment through transmitting means.

14. An induction type telemetering system as claimed in claim **13**, wherein said windings for the figure places

of the measurand disposed on the driving side are interconnected in series circuit relationship.

15. An induction type telemetering system as claimed in claim 13, wherein said windings for each of the figure places of the measurand on the driving side has applied thereto an independent driving signal.

16. An induction type telemetering system as claimed in claim 1, wherein for each of plural figure places of the measurand there is provided said encoding means including said encoding plate, said plurality of first windings and said second winding, and said scanning circuit means includes a decoder, and one semiconductor switching element capable of connecting each of said first windings to said decoder and is operative to transmit through transmitting means to the central equipment, a measured value of the measurand as determined by the sensed mutual induction between each of said first winding and said second winding one after another of the figure places.

17. An induction type telemetering system as claimed in claim 1, wherein for each of plural figure places of the measurand there is provided said encoding means including said encoding plate, said plurality of first winding and said second winding, and said scanning circuit means includes a pair of decoders one semiconductor switching element capable of connecting each set of the corresponding semiconductor switching elements for the plural figure places of the measurand to one of said decoder, and one semiconductor switching element capable of connecting each of said second winding to the other decoder, said scanning circuit means being operative to transmit through transmitting means to the central equipment a measured value of the measurand as determined by the sensed mutual induction between each of the first windings and the second winding one after another of the figure places.

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