

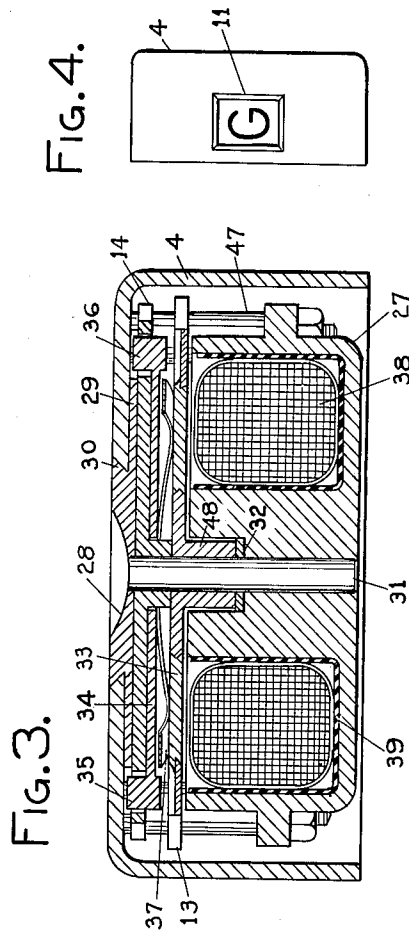
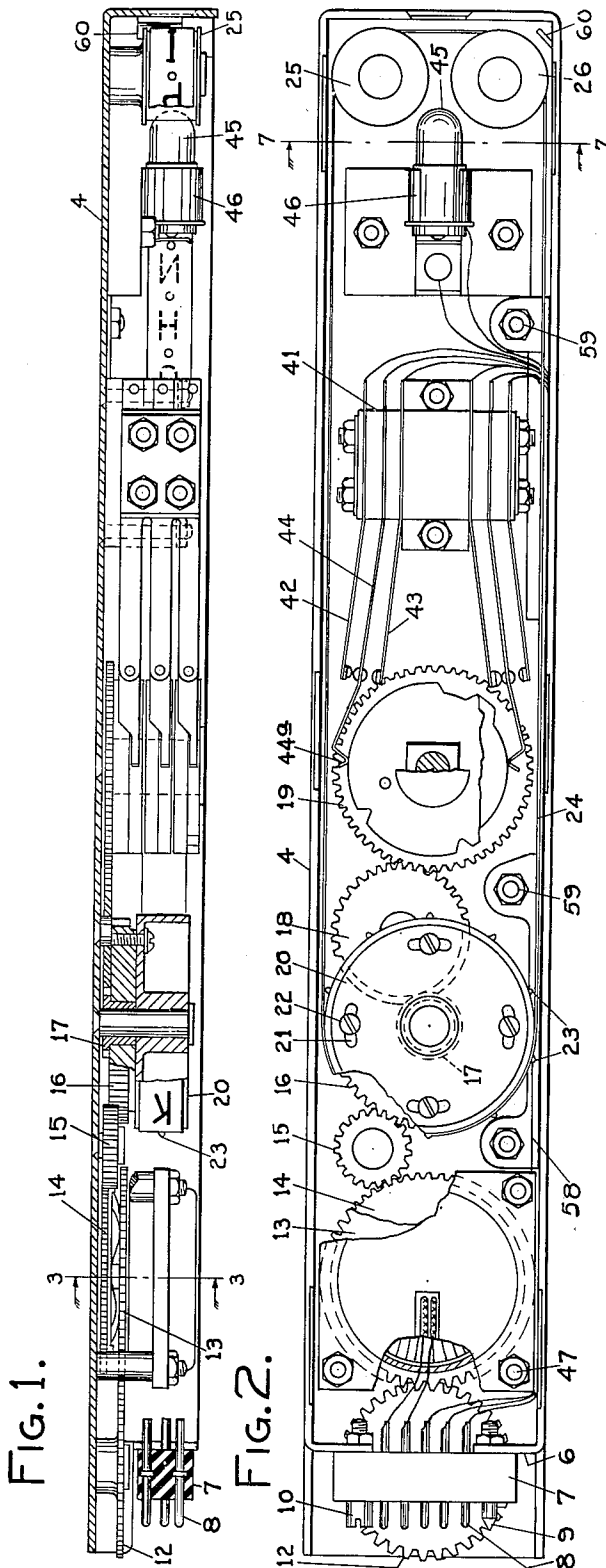
Jan. 17, 1956

O. S. FIELD ET AL
CHANGEABLE INDICATOR

2,731,632

Filed Feb. 13, 1952

4 Sheets-Sheet 1



INVENTORS
O.S. Field and R.W. Hewes

BY *Neil H. Platon*
THEIR ATTORNEY

Jan. 17, 1956

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FIG. 7.

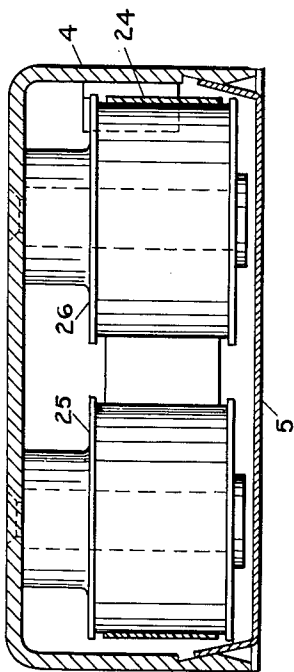


FIG. 5.

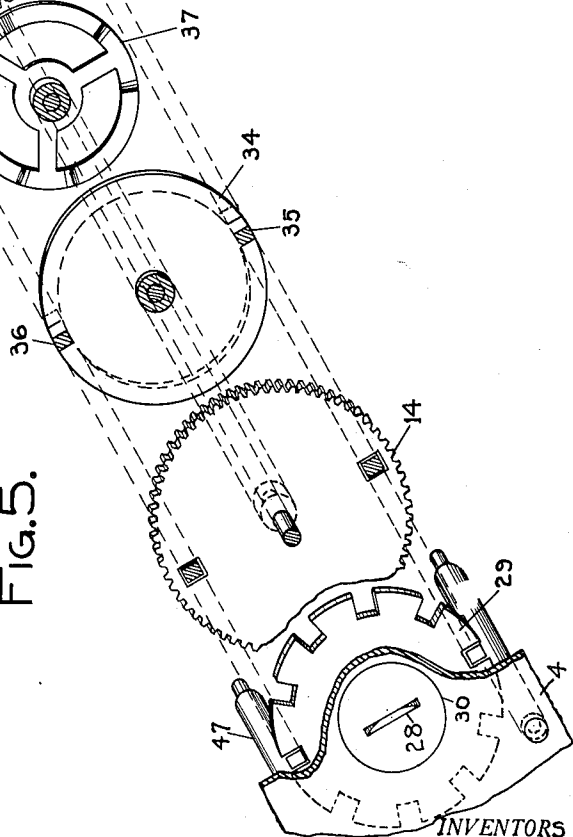
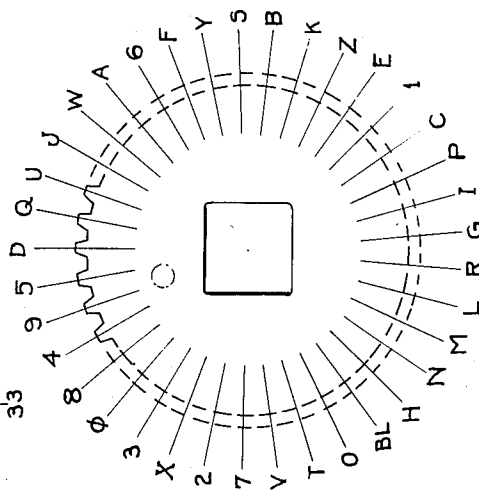


FIG. 8.



INVENTORS
O.S. Field and R.W. Hewes
BY

Neil H. Weston,
THEIR ATTORNEY.

Jan. 17, 1956

O. S. FIELD ET AL

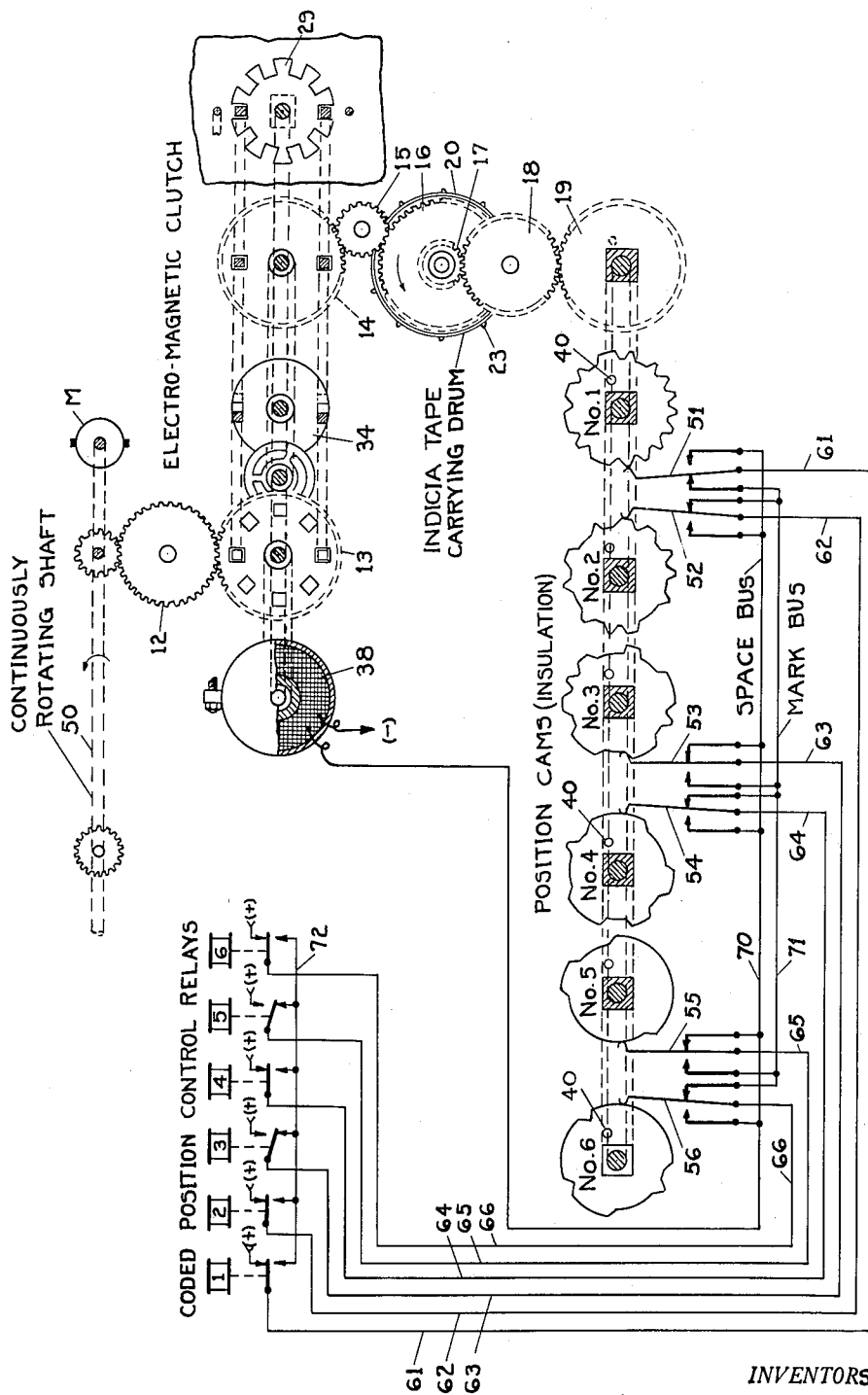
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CHANGEABLE INDICATOR

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4 Sheets-Sheet 3

FIG. 6.



INVENTORS
O.S. Field and R.W. Hewes
BY *Neil H. Preston,*
THEIR ATTORNEY.

Jan. 17, 1956

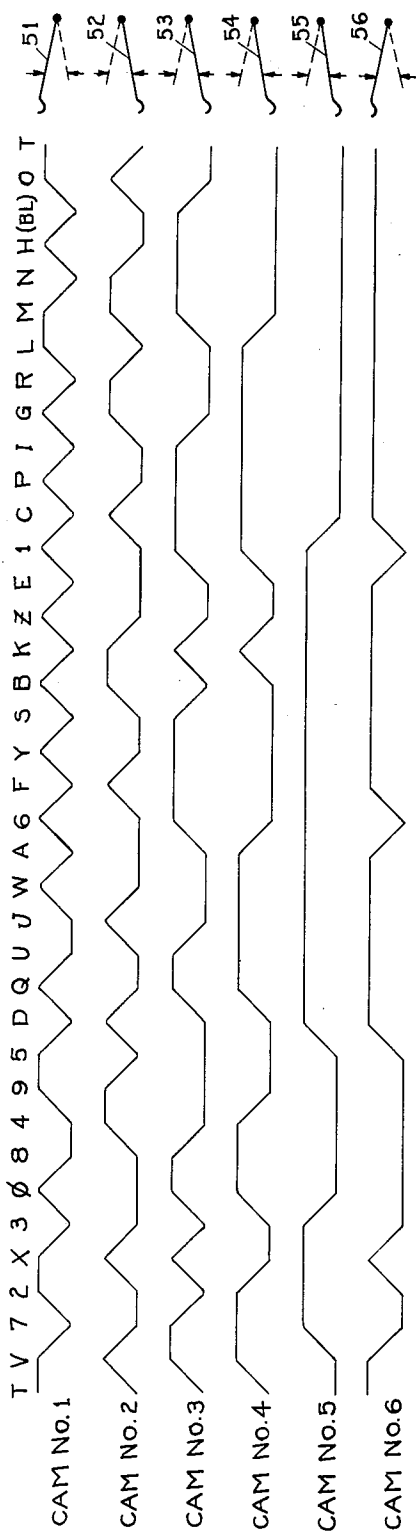
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FIG. 9.



INVENTORS
O.S. Field and R.W. Hewes
BY
Neil H. Preston,
THEIR ATTORNEY

2,731,632

CHANGEABLE INDICATOR

Oscar S. Field and Ralph W. Hewes, Rochester, N. Y.,
assignors to General Railway Signal Company, Rochester, N. Y.

Application February 13, 1952, Serial No. 271,406

9 Claims. (Cl. 340—378)

This invention relates to a changeable indicating device adapted more particularly for use as a posting unit for a flight progress board in an airway traffic control system.

In airway traffic control systems, it is often desirable to provide a display panel upon which the data for the different flights is given; and it has been proposed that this be accomplished by the use of indicators or posting units which are mechanically driven and automatically controlled to display the different indications desired. However, the indicator or posting unit provided by the present invention may be used in other types of systems if desired.

The present invention is more particularly directed to providing a changeable indicator unit having structural characteristics adapting it to be mounted in a panel having a large number of such units, and for this reason the structure is so arranged to require a minimum of space.

Another object of the present invention is to provide an indicator which is self-contained with respect to the inclusion of position contacts, clutch mechanism, visual display means, and the required operating gearing.

A further object of the invention is to provide such an indicator that may be readily inserted or withdrawn from its position in the display panel so that substitute units may be employed when and as required.

A further object is to provide an indicator having a large number of indicating positions with suitable contacts and control means arranged in code fashion, so that a relatively few contacts are required as compared to the number of indicating positions. This feature not only minimizes the space required for such contacts, but also reduces the number of contacts in the plug coupling arrangement which renders the unit quickly detachable from the display panel.

Other objects, purposes and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which like reference characters designate corresponding parts throughout the several views, and in which:

Fig. 1 is a top sectional view of the indicator unit constructed in accordance with the present invention;

Fig. 2 is a side elevational view of the indicator unit with certain parts cut away to more clearly show the structure;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1 to show the structure of the electromagnetic clutch and lock mechanism of the indicator unit;

Fig. 4 is an end front view of the indicator to show how the indicator appears on the face of the display panel;

Fig. 5 is an exploded view of the clutch and lock mechanism shown in Fig. 3 to more readily show the structure of the detailed parts;

Fig. 6 is a diagrammatic exploded view of the struc-

ture with more particular emphasis placed on the form and relation of the cams employed in the contact operating portion of the indicator unit;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 2 to show the structure of the idler wheels and the cover structure for the indicator unit;

Fig. 8 is a diagrammatic view of the cam carrying gear with the different indicia positions indicated relative thereto; and

Fig. 9 is a chart of the different up and down positions of the contacts for various cams.

With more particular reference to Figs. 1, 2 and 3, it will be seen that the indicator unit has an outer shell 4 which has a U-shaped form best seen in Fig. 3. This shell 4 is adapted to fit side by side with other units, and is provided with a cover 5 to enclose the open side as shown in Fig. 7. This cover 5 is provided with inwardly bent projections at three different points along each side, which projections snap into holding recesses in the case 4 in such a way as to hold the cover in position. The detail form of each holding recess can be seen in Fig. 7, while the different recesses have been indicated in Fig. 2.

It can be seen in Fig. 2 that the left-hand end of each shell or casing 4 has inwardly bent projections 6 which support an insulating block 7. This block 5 is formed with fourteen plug coupling contacts 8, a guide plug 9, and the guide socket 10 for receiving a guide plug on the stationary coupling unit. The contacts have suitable wire connections as later explained.

The right-hand end of each indicator unit is enclosed by the shell 4 except for a small opening 11 which permits the display of a symbol or indicium related to the then existing position of the indicator elements (see Fig. 4). This opening 11 may have a glass or plastic window pane if desired.

Generally speaking, the indicator unit comprises a series of gears mounted along one side of the shell 4, the end one of which is adapted to engage a constantly driven gear on a shaft extending horizontally along a row of indicators for the display panel. These constantly driven gears are then rendered effective or not to drive the contact and display parts of the indicator structure depending upon the energized condition of the associated electromagnetic clutch. In other words, the train of gears extending to the contact operating portion of the structure is driven only when rendered active by the energization of the clutch.

More specifically, the gear wheel 12 is adapted to engage the pinion adjacent its space and attached to a horizontal constantly driven shaft, when the indicator unit is plugged into its position. This gear 12 engages the drive gear 13 of the electromagnetic clutch. Assuming that the clutch is energized, then the gear member 14 is also caused to rotate and operating through the idler 15 drives the gear 16. Attached to the gear 16 is a pinion 17 which in turn drives another idler 18 to operate the gear 19 carrying the contact actuating cams.

The gear 16 has attached to it a belt or tape carrying barrel 20 which has slots 21 for receiving lock screws 22 so that this tape carrying barrel may be rotationally adjusted within certain limits with respect to the position of the gear 16. This tape carrying barrel has protruding pegs 23 over which the belt or tape 24 passes since it has correspondingly spaced perforations. The endless tape 24 is supported at the front end of the indicator unit by two idler wheels 25 and 26 which are mounted on suitable supporting shafts attached to the case 4. In this way, the symbols or indicia on the tape 24 are carried up to the window 11 to be viewed for the different positions of the indicator.

With reference to Figs. 3 and 5, it will be seen that the electromagnetic clutch comprises a cup-shaped magnetic

portion 27 which is mounted on four supporting bolt members 47 connected to the frame 4. The cup-shaped magnetic structure has a raised center about which is located a cylindrical winding 38 insulated from the metal by suitable fiber insulation 39. This structure provides the winding 38 with an inner core and an outer shell to collect a maximum amount of its flux for attraction of an associated armature in the form of the disc 34 later to be described in detail. Between the magnetic portion 27 and the inner face of the indicator shell are located the operating parts of the clutch which will now be described.

Adjacent the inner face of the shell 4 is a circular notched disc 29 which has a circular portion which rises from the surface of the disc at its center and passes through a corresponding circular hole in the shell 4, in such a way as to readily permit the peening over of the metal as indicated at 30 in Fig. 3. The raised portion of the disc 29 is provided with a screwdriver slot 28 on the outside of the case so that an adjustment of the disc position may be made during the assembly of the indicator device after which the disc 29 is sealed in position by solder or a deformation in the metal at point 30. This disc 29 has a number of slots around its outer edge, such as ten, for determining the different positions in which the indicator unit may be locked.

A shaft 31 passes through the magnetic member 27 to also be supported by the disc 29. On the shaft 31 are mounted the gears 13 and 14. The gear 13 is adjacent the magnetic core portion 27 and has its hub extending into a hollowed out portion in the magnetic member 27. However, a bushing 32 is located between the hub of the gear 13 and the magnetic member, preferably of a different kind of metal, such as bronze, to serve as a thrust bearing. This gear 13 is made up of an outer ring (see Fig. 5) of silicon steel or other low residual ferrous metal, and has eight grooves located around its circumference for engaging the projections 35 and 36 when the clutch winding 38 is energized. The inner portion or hub 48 of the gear 13 is also made of silicon steel, or the like, and this inner portion is connected to the outer portion of the gear by a nonmagnetic metal (such as bronze) insert 33.

The gear 14 is separated from the gear 13 to an extent provided by the thickness of its hub (i. e., gear 14) surrounding the shaft 31, and mounted on this hub is a disc 34 which has projections 35 and 36 extending both ways away from its surfaces. As viewed in Figs. 3 and 5 it can be seen that these projections 35 and 36 are substantially square and pass through two square holes in the gear 14 so as to engage two notches of the disc 29. This disc 34 is also slightly recessed on its under side as seen in Fig. 3 to receive a wave spring 37, of nonmagnetic material, which bears against the upper surface of the gear 13 and the lower surface of the disc 34 tending to separate them and biasing the projections 35 and 36 to engage the notches in the disc 29.

However, when the winding 38 is energized, the disc 34, which is of magnetic material, is attracted toward the gear 13 so that its projections 35 and 36 disengage the notches in the disc 29 and their opposite ends engage two of the slots in the gear 13. In other words, the gear 14 is locked in a stationary position by the projections 35 and 36 on disc 34 engaging notches in disc 29 under normal conditions, but when the clutch is energized, the disc 34 is moved downwardly (see Fig. 3) and a positive engagement is made between the gear 13 and the gear 14 so that both are rotated in the manner previously described. It is noted that the inner portion 48 of the gear 13 is of magnetic material the same as the outer portion of this gear, and for this reason, the magnetic circuit is readily completed through the disc 34 to effect its attraction. The gear 14 must also be of nonmagnetic material to allow this action to readily take place.

Since the gear 14 is positively locked in any one of ten

different positions, it is necessary that the belt carrying drum 20 be suitably adjusted to have a typical symbol properly displayed through the window 11 for a typical position, and this is accomplished through the adjusting means including lock screws 22.

The gear 19 is mounted on a shaft attached to the case 4 and itself has a square hub upon which six cams are mounted. For convenience in the drawing of Fig. 2, only the shape of the outer cam has been shown, but the details of each of the six cams is shown in Fig. 6 where they have respectively been designated as cams No. 1, No. 2, No. 3, No. 4, No. 5 and No. 6. Each of these cams has a hole 40, and the holes in all six cams must be aligned when placing them on the square hub of gear 19 in order for the cams to be in proper positions with respect to each other.

Referring to Figs. 1 and 2, it will be seen that a suitable insulating block 41 is attached to the case 4 and this block supports six groups of contacts, one for each cam. Each group of contacts has front and back contacts 42 and 43 with a center movable contact 44. Each movable contact 44 extends outwardly with a suitable bent portion 44a at the end adapted to cooperate with the periphery of its respective cam.

Referring to Fig. 2, it will be noted that a line perpendicular to the casing 4 and passing through the center of the cams and gear wheel 19 does not pass through the point of contact between the follower portions 44a of the movable contacts 44. This is because these follower portions 44a have been moved to the right of this perpendicular center line to the extent of approximately five degrees to compensate for the extent to which the anchor points of the contact fingers 44 are spaced inside a line tangent to the circumference of the cams at the above mentioned perpendicular center line. In other words, if the follower portions 44a were placed at the center line of the cams by making finger 44 longer, they would not remain on the center line as they are moved from their inner to outer positions by their respective cams, and this would, in effect, cause the followers to be in wrong positions with respect to the cams when moved outwardly. By making the movable contact fingers of the proper length with respect to their anchoring block 41, and with the portions 44a displaced from the center line a proper number of degrees, it is possible to cause the cam followers 44a to swing in arcs which substantially follow the radii of the cam positions. In fact, the cam followers are actually on the radii of the cam positions for both of their extreme positions, and this is all that is required to give proper circuit control to effect the accurate positioning of the indicia carrying tape.

With reference to Fig. 8, it will be noted that the cam positions and the positions of the gear 19 number thirty-seven and these different positions have been assigned the letters of the alphabet, the numerals including the symbol θ (phi) for zero, together with a blank position BL. These symbols have been positioned with respect to the cam characteristics so that the combination of energization of the control wires, and the corresponding combination of cam positions correspond to the code characteristics of the well-known teletype system. The first five cams correspond to the different five digit codes; while cam No. 6 represents the control corresponding to the shift code used in the teletype system to shift between letters and figures. The symbol positions indicated in Fig. 8 may be considered the positions for the gear 19 and these positions will also apply to the odd numbered cams, but since the even numbered cams have their followers located on the opposite sides, the symbol positions for such cams is, of course, advanced 180-10 degrees.

As shown in Fig. 6, the various cams are in the position for the letter G, which letter has been shown in the window 11 of the indicator in Fig. 4. Since the cam position combinations are specifically assigned to different codes corresponding to the respective symbols, then the

5

6

endless tape 24 must be properly positioned on the tape carrying drum 20 so as to have the proper symbol displayed in the window 11 for the then existing positions of the cams. As previously mentioned the clutch mechanism locks the gear 14 in any one of ten different positions and the ratio between the drum pinion gear 17 and the cam carrying gear 19 is 3.7 to 1. Thus, it is apparent that the position of the cams relative to the locking positions of the clutch is a fixed and definite relationship and for this reason, the tape carrying drum 20 is made slightly adjustable so as to be able to exactly set the symbol for the then existing position into a proper displaying position. When one symbol has been properly positioned, all of the others will, of course, fall into proper positions since they are equally spaced along the surface of the endless tape 24.

In this connection, it might be noted that the disc 34 is provided with two projections 35 and 36 for locking the indicator, but in practice it may be desirable to have only one such projection and merely counterbalance the other side of the disc 34. This modification may be desirable in practice due to the possible inaccuracies in manufacture which would in effect allow only one projection to perform its locking operation.

A small lamp 45 is mounted in a suitable socket 46 located near the front of the indicator unit and so positioned between idler wheels 25 and 26 that light from the lamp 45 will pass through the translucent tape 24 carrying the different symbols or indicia thereon. In this way, the particular symbol opposite the window 11 of the indicator can be illuminated and made readily visible.

Referring again to Fig. 6, it will be noted that the contacts actuated by the respective cams may be suitably connected as shown so that energy applied to the control wires in combinations by suitable code relays will cause the indicator to operate to the proper position and then stop in that position.

In this Fig. 6 the various parts of the indicator have been shown diagrammatically and without regard to their exact positions in the indicator except to illustrate the different relative positions of the cams with respect to each other and the gear 19 which carries them. The motor M is shown as driving a shaft 50 which is continually rotating and has a suitable pinion for each indicator unit position in a horizontal row of the display panel. The exact control of the motor M is not material to the present invention, and it should be understood that it can be controlled in any suitable way, but for simplicity it has been assumed to be continually operating. If desired, the motor, of course, can be shut off when not in use, and started into operation when the operation of the various indicators is anticipated.

The electromagnetic clutch and the indicia tape carrying drum has been shown together with the gear connections to the cam carrying gear 19. Power is transmitted from the motor to the drum 20 only when the winding 38 of the clutch is energized. The various cams have associated therewith their respective movable contacts 51, 52, 53, 54, 55 and 56 (generally designated 44 in Fig. 2). These movable contacts have associated therewith front and back points, which are constructed to be make-before-break contacts, i. e. both front and back points make contact during the passage of the movable contact from one to the other. Also, the front points alone are closed when the cam follower is on a high point of the cam, while the back points alone are closed when the cam follower is on a low point of the cam. For convenience, these high and low points on the cam represent respectively what has been termed as marks and spaces of a conventional teletype code.

The positions of the various cams (as shown) have been assumed to be for the position G as indicated in the Fig. 4. It will be noted that the various contacts are shown in Fig. 6 as being below the center line of the

cams, and this is to be indicative that the offset position is approximately five degrees for reasons explained above. The different indicia positions on the cams are evenly spaced throughout the 360 degrees of the circle and, for this reason, are approximately 9.7 degrees apart. In the diagram of Fig. 6, the cams have, of course, been set side by side, although in the actual structure they are located one above the other (see Figs. 1 and 2). However, the contacts have been kept on the proper sides of the cams to give the proper operation. As above mentioned, the odd cams have their positions with respect to gear 19 as shown in Fig. 8, but the even cams have their positions rotated 180-10 degrees so that the G position meets with the contact follower which falls on the opposite side. In order to make more readily understandable the characteristics of the cams as they are provided in combinations for the different symbols, a chart has been shown in Fig. 9. In this chart, the contour of the cams has been shown diagrammatically and spread out along a line, so that for any particular character it can be determined whether the contacts are operated to front point (cam "up") or back point (cam "down") positions.

A group of coded position control relays numbered 1, 2, 3, 4, 5 and 6 have been indicated in block form. These relays are assumed to be either manually controllable in accordance with different code combinations, or to be automatically positioned in accordance with a received teletype code. In any event, the energization of these coded position control relays in the code combination for any particular symbol selectively energizes the control wires 61, 62, 63, 64, 65 and 66 in such a way as to cause the winding 38 of the electromagnetic clutch of the indicator to be energized for every position of the indicator except the particular position for the symbol then selected. The arrangement of contacts is such that all of the back points of the cam contacts are connected together by bus wire 70 which may be named a "space" bus. This space bus 70 also extends to the winding 38 of the clutch which has its other terminal connected to the negative side of the battery (-). All of the front points of the cam contacts are connected by a bus 71 which may be conveniently named a "mark" bus.

It will also be noted that all of the back contacts of the coded position control relays are connected together by a bus 72 which may be conveniently termed a code interconnection bus. When any particular symbol is desired, the coded position control relays are energized (to represent marks) for the code then received over the teletype system, or in accordance with manual control. In any event, each energized relay directly applies positive energy (+) to its corresponding control wire, and if any cam following contact is in a back contacting position (as for a space), then energy is directly applied to the winding 38 of the electromagnetic clutch. This, of course, causes the indicator to be operated so long as the winding 38 is energized. The various cam following contacts assume different positions as they pass through the different code combinations for the various symbols, but when any code following contact is in a front contacting position (as for a mark), then energy is applied to the mark bus 71. If all of the cam following contacts are in front point and back point positions (mark or space positions) corresponding to the code then applied to the control wires 61, 62, 63, 64, 65 and 66, then all of the control wires which have direct energy applied to them are connected to cam following contacts which are in "mark" positions and connect the energy to the "mark" bus 71. Since this bus 71 is not connected to the clutch magnet, then the indicator stops in that position. However, for all other positions of the indicator at least one of the cam following contacts will be in a "space" position when a "mark" is called for and this will cause energy to be applied to the "space" bus 70. This energy will be supplied either by direct

energy over its control wire, or by indirect energy fed from mark bus 71 to the code interconnection bus 72 and thence to the space bus 70 through those cam following contacts which are then in space positions. Thus, the winding 38 of the clutch continues to be energized until all of the cam following contacts have assumed positions for the code combination then called for by the energization of the control wires.

Specifically, as above mentioned, the cams are in the position G. For this position, the relays 1, 2, 4 and 6 of the code position control relays are shown picked up. It is noted that the energy applied to control wire 61 is fed to the mark bus 71 by contact 51. The energy supplied to the control wire 62 is fed to the mark bus 71 by the contact 52. The energy supplied to the control wire 64 is fed to the mark bus 71 through contact 54. The energy supplied to the control wire 66 is connected to the mark bus 71 through contact 56. Thus, all energy is removed from the space bus 70 and the clutch is deenergized causing the indicator to be locked in its position for the symbol G.

On the other hand, if the code position control relays are shifted to any other code combination as, for example, for the symbol 4, then the relays 2 and 4 would be energized and the others would be deenergized. The energy thus applied to control wire 62 is fed to the mark bus 71 but the cam contact 51 is also in a mark position so that energy from this bus 71 is fed through control wire 61 to the code interconnection bus 72 and then through the wire 63 and contact 53 to the space bus 70 for energizing the winding 38 of the clutch. It is believed unnecessary to point out in detail how the indicator is then operated through all of its positions from the position G to the position 4, it being sufficient to refer to Fig. 9 and see that the position for symbol 4 is the only one in which the front contacts for cams 2 and 4 alone are closed. Since the control wires 62 and 64 alone receive energy when the cams take this position, the energy is fed to the mark bus 71 thus causing the clutch winding 38 to be deenergized.

In this way, the indicator may be operated to its different positions by code combinations making up different energizations for a number of control wires considerably smaller than the number of different positions of the indicator. As a matter of fact, the indicator could have as many positions as two raised to the power of the number of control wires employed minus two. Briefly, a code having all marks cannot be used, because the indicator could not be operated away from a position corresponding to such a code. For example, such a code would apply energy to all of the control wires 61-66 and when the indicator assumed a corresponding position all of these control wires would be connected to the mark bus 71 through front point positions of the contacts 51-56. Therefore, there would be no additional control wire to supply energy to the space bus 70 to cause operation of the indicator to another position.

Obviously, a code having all spaces cannot be used, since under that condition all of the control wires 61-66 are deenergized, and there would be no energy supplied to the space bus 70 to cause the indicator to be operated from its then existing position.

In other words, the six control wires and six code position relays can provide sixty-two useable combinations, but the indicator as constructed and disclosed herein is shown as merely employing thirty-seven of these different possible positions. However, it is to be understood that any other number of positions may be employed consistent with the principles involved; also a smaller number of code relays and control wires may be employed, if desired, in those cases where the indicator is not required to display such a large number of symbols.

Referring to Fig. 6 it can be observed that the contacts 51-56 normally set in front or back contacting positions depending upon the then existing setting or position of

their respective cams. In being moved from one position to another, it is apparent that these movable contacts 51-56 must not break the circuit to the clutch winding 38 so long as continued operation of the indicator is required to reach the designated or selected position as determined by the combination of energizations of the control wires 61-66.

For this reason, these movable contacts are so associated with their front and back points as to be of the make-before-break type.

More specifically, contact 51 is shown as making contact with its front point, but as the cam No. 1 moves in a clockwise direction toward the next position, the follower rides down the slope of the cam and at about one third of the distance to the next position allows the back point associated with contact 51 to close although the front point is still closed. As the cam continues rotation and the follower travels down the slope of the cam, both front and back points are thus closed for about another third of the distance to the next position, at the end of which the front point opens and the back point remains closed. If the combination of energizations is such that this opening of the front point associated with contact 51 is the determining condition, then the winding of the clutch magnet is deenergized and the mechanism comes to a stop within a short over-run operation. This over-run is approximately one third of the distance between two cam positions so that when the mechanism comes to rest and the electromagnetic clutch is locked in the new position, the contact 51 is then in its lowest position with its back point closed and its front point fully opened, with the cam No. 1 in its next position (for symbol R).

The same operation occurs as the follower of contact 51 rides up the slope of the cam to the next position (L), i. e. the front contact closes at about one third of the distance to the next position; both contacts remain closed for the next one third of the distance; while the back point opens at the beginning of the last third of the cam movement to the next position (L).

In brief, the front point and the back point associated with a movable contact are closed in their front point or back point positions for approximately two thirds of the distance on each side of that cam position to the next cam position. Thus, both front and back points are closed for approximately the intermediate one third distance between any two different cam positions when a change in cam contour is taking place.

Considering the large number of positions which the indicator must assume, it is thus evident that any one of the six contacts 51-56 might be the one to determine the breaking of the circuit for the clutch winding 38 for the position then selected. These cams are of course, made of suitable insulating material so that the contacts 51-56 are electrically isolated from each other, and are preferably formed with cam surfaces which are very accurate (i. e. within a thousandth of an inch accuracy), and have slopes which together with the shape of the contact followers cause the movable contacts 51-56 to move with harmonic action. This is desired so that the contact followers will readily follow the cams even though they are moved very rapidly between their different positions during the operation of the indicator.

Even though such a construction of the cams is provided and the contacts are adjusted accurately, it is evident that continued use might well cause slight variations in the contacts so that one contact might not shift its position as soon as another. This might cause the stopping of the indicator in a wrong position even though that contact would not be the one critically determining the position of the indicator at that time.

For this reason, the codes have been assigned with respect to each other for the various cam positions so that there is a change in either the movable contact 51 or the movable contact 52 or both for each of the different symbols. This can best be observed by considera-

tion of Fig. 9. For example, the letter C calls for: cam No. 1 and its follower to be in a down position, cam Nos. 2, 3 and 4 with their followers in upper positions, cam No. 5 with its follower in a lower position, and cam No. 6 with its follower in an upper position. By considering cams Nos. 3, 4, 5 and 6 and their respective followers, it will be seen that no change occurs in them for the symbols P and I, but in each case either the cam No. 1 or cam No. 2 or both operates its follower to a different position.

With this arrangement, the follower contacts 51 and 52 for cams No. 1 and No. 2 can be adjusted to have the longest make-before-break condition between each of the different cam positions, while all of the other contact followers are adjusted to shift their positions in such a way that their make-before-break periods will be slightly shorter. In this way, the shifting of the contact 51 or 52 becomes the critical contact for all positions of the indicator. It should be understood that these differences in adjustment are rather small so that all contact changes take place near the one third positions above described. For this reason, no attempt has been made to illustrate this feature in the drawings beyond showing the selection of the codes for the different cam positions.

Such an organization provides that the adjustment of the cam following contacts is made more simple and this adjustment may be maintained over periods of time because the contacts 53, 54, 55 and 56 may have slight variations and still have their movements masked by the make-before-break period of the contacts 51 and 52. This organization of the codes with respect to the cams resulting in the particular structure shown provides a practical and commercially produceable structure which has many advantages over indicators of the prior art.

Another feature of the structure can be noted from Fig. 2 which resides in the provision of a wire chase. This is a thin metal strip 58 which runs along the inside of the casing 4 to hold the wires from the contacts and lamp against the side of the casing as they extend to the plugs 8 at the left of the indicator mechanism. This metal strip 58 has extending ears at right angles along the lower edge which are fastened to the bottom of the casing 4 by suitable bolts 59. This arrangement protects the movable tape 24 from any possible chance that the wires might become displaced and lay against it.

Also, at the lower edge of the casing 4 a small opening is produced by inwardly shearing a portion of the casing as at 60. This leaves a small opening in which a hooked tool may be inserted to withdraw the indicator unit from its place in a bank of similar units.

Having described a changeable indicator as one specific embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and it is also to be further understood that various modifications, adaptations, and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What we claim is:

1. A changeable indicator unit comprising in combination, a continuously driven gear wheel, a rotatable drum carrying the different indicia to be displayed and operable to corresponding positions, spring biased locking means having a plurality of different positions for positively locking said drum in each of said different operated positions, an electromagnetic clutch effective when energized to actuate said spring biased locking means to unlock said drum, said electromagnetic clutch also being effective when energized to operably connect said drum to said continuously driven gear wheel, and circuit controlling means governing energization of said electromagnet including contacts cooperating with cams driven in accordance with the rotation of said drum.

2. In a display panel having changeable indicator units of the quick detachable type, a continuously driven shaft extending along a row of spaces for receiving indicator units, a pinion on said shaft for each said indicator unit spaces, an indicator unit for each space comprising a gear adapted to engage said pinion on said shaft, an indication carrying drum, a lock having detents for normally holding said drum in any one of a plurality of positions, an electromagnetic clutch for at times releasing said lock and actuating a drive disc for causing said drum to be operatively connected to said gear, and means including a plurality of set screws for adjusting said drum with respect to said locking positions.

3. In a changeable indicator device, a lock and clutch mechanism comprising a shaft disposed transverse of the indicator device, a stopping disc attached to said indicator device at one end of said shaft and having a plurality of locking positions, a driven gear on said shaft being continuously caused to rotate and having a number of driving positions, an operating gear on said shaft, a magnetic disc on said shaft between said driven and operating gears and having a projection passing through said operating gear to engage said stopping disc in one of its locking positions, said disc being normally spring biased to such locking position, an electromagnet at the other end of said shaft effective when energized to attract said magnetic disc by setting up a magnetic circuit extending through said driven gear and through said magnetic disc to cause said magnetic disc to disengage said stopping disc and then engage said driven gear in one of its driving positions, said driven gear being constructed partly of magnetic material and partly of nonmagnetic material in a manner to substantially conform to the magnetic structure of the electromagnet so as not to interfere with the magnetic attraction of said magnetic disc, and an indication carrying drum operatively connected to said operating gear.

4. In a changeable indicator unit, a rotatable drum, two separated idler wheels spaced from said drum, a translucent endless tape passing over said drum and said idler wheels and having indicia located thereon at uniformly spaced intervals, a plurality of cams each having a number of characteristic positions corresponding to the number of indicia on said tape, a clutch and lock mechanism having a predetermined number of locking positions and having an electromagnet effective when energized to release said lock and operatively connect said drum to a constantly driven shaft, gearing connecting said drum with said cams, said gearing having a ratio corresponding to the relation of said number of locking positions to the number of characteristic positions of said cams, and contacts operated by said cams to a number of different combinations of positions corresponding to the number of indicia on said tape.

5. In a changeable indicator unit having a display opening at one end, two separated idler wheels at said one end of the unit and spaced on opposite sides of the display opening, a rotatable drum located at an intermediate position in said unit and spaced from said idler wheels, a translucent endless tape passing over said drum and said idler wheels and having a predetermined number of indicia positions at uniformly spaced intervals along its surface, an incandescent lamp located between said idler wheels and effective when illuminated to cause the indicia on said translucent tape to be clearly displayed, a plurality of cams each having a number of characteristic positions corresponding to the number of indicia positions on said tape, a lock mechanism having a predetermined number of locking positions for holding said drum in such positions, an electromagnetic clutch having a winding effective when energized to release said lock mechanism and operatively connect said drum to a power driven shaft, gear connections between said drum and said cams with a ratio corresponding to the relation of said number of locking positions to the number of indicia positions on said tape, a plurality of contacts correspond-

ing to the number of cams but less in number than the number of indicia positions, said contacts being operated to a number of distinctive combinations of positions corresponding to the number of indicia on said tape, and circuit means for interconnecting said contacts with said winding of said clutch so that the operation of said contacts to their different combinations will cause the energization of said clutch for all positions except that one corresponding to that particular combination then having energy applied thereto.

6. In a changeable indicator unit having a display opening at one end, two separated idler wheels at said one end of the unit and spaced on opposite sides of the display opening, a rotatable drum located at an intermediate position in said unit and spaced from said idler wheels, a translucent endless tape passing over said drum and said idler wheels and having a predetermined number of indicia positions at uniformly spaced intervals along its surface, an incandescent lamp located between said idler wheels and effective when illuminated to cause the indicia on said translucent tape to be clearly displayed, a plurality of cams each having a number of characteristic positions corresponding to the number of indicia positions on said tape, a lock mechanism having a predetermined number of locking positions for holding said drum in such positions, an electromagnetic clutch having a winding effective when energized to release said lock mechanism and operatively connect said drum to a power driven shaft, gear connections between said drum and said cams with a ratio corresponding to the relation of said number of locking positions to the number of indicia positions on said tape, and a plurality of contacts corresponding to the number of cams but less in number than the number of indicia positions, said contacts being operated to a number of distinctive combinations of positions corresponding to a number of indicia on said tape.

7. In a changeable indicator unit, a rotatable drum, two separated idler wheels spaced from said drum, and endless tape passing over said drum and said idler wheels and having indicia located thereon at uniformly spaced intervals, a plurality of cams each having a number of characteristic positions corresponding to the number of indicia on said tape, gearing connecting said drum with said cams, said gearing having a ratio such as to cause said drum to be repeatedly rotated to bring all of said indicia into an indicating position for one complete revolution of said cams, contacts operated by said cams, there being one contact for each different cam, and said contacts being operated to different combinations of positions, said different combinations corresponding in number to the number of indicia on said tape, and an operating mechanism including a shaft located transverse of the indicator unit, a stopping disc positively connected to said indicator unit and located at one end of said shaft, said stopping disc having a plurality of locking positions, a power driven gear located on said shaft and having a number of different driving positions, said power driven gear also being constructed in part of nonmagnetic material, an operating gear on said shaft operatively connected to said rotatable drum, a magnetic disc on said shaft between said driven and operating gears and having a projection passing through said operating gear to engage said stopping disc in any one of its locking positions, said disc being normally spring biased to such locking position, an electromagnet at the other end of said shaft effective when energized to attract said magnetic disc to cause said projection to disengage said stopping disc and then engage said power driven gear in one of its driving positions.

8. In a changeable indicator unit being relatively nar-

row and long, a gear train along the length of said unit including an input gear and an output gear with an intervening electromagnetic clutch having one gear meshing with said input gear and having another gear concentric with said one gear but independent thereof and operatively connected with said output gear, an armature disc located between said one and said another gear and spring biased toward said another gear, projections on one side of said disc for positively engaging said another gear and also a stationary notched locking member when said armature disc is in its spring biased position, projections on the other side of said disc for positively engaging said one gear when said disc is electromagnetically actuated, an electromagnet structure including a winding and core members effective to actuate said disc when said winding is energized for disengaging said disc from said locking member and engaging said one gear, an indicator gear meshing with said output gear, and an indicator drum adjustably attached to said indicator gear.

9. In a changeable indicator unit, a rotatable drum, two separated idler wheels spaced from said drum, an endless tape passing over said drum and said idler wheels and having indicia located thereon at uniformly spaced intervals, a plurality of cams each having a number of characteristic positions corresponding to the number of indicia on said tape, a gear train connecting said drum with said cams, said gear train having a ratio such as to cause said drum to be repeatedly rotated to bring all of said indicia into an indicating position for one complete revolution of said cams, a plurality of contacts, at least one for each different cam and each being operated by the lobes on the periphery of said cams, and the first and second of said cams having their arrangement of lobes such as to cause at least one of their contacts to be shifted each time the cams are moved to the next successive position, and all of said cams having lobes arranged so that said contacts are operated to different combinations of positions distinctive for each different cam position and corresponding in number to the number of indicia on said tape, a lock mechanism for locking said drum in its different positions corresponding to the different indicia positions, an operating mechanism including an energizing winding effective when energized to release said locking mechanism and cause rotation of said drum until said contacts assume a combination of positions to cause the deenergization of said winding, and circuit means for controlling the energization of said winding including said cam operated contacts in such a way that the changes in contact positions are masked by the contacts for said first and second cams to thereby render the positioning of said drum more accurate by making the breaking of the energizing circuit dependent upon said first and second cam operated contacts.

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