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CODE SELECTIVE SYSTEM

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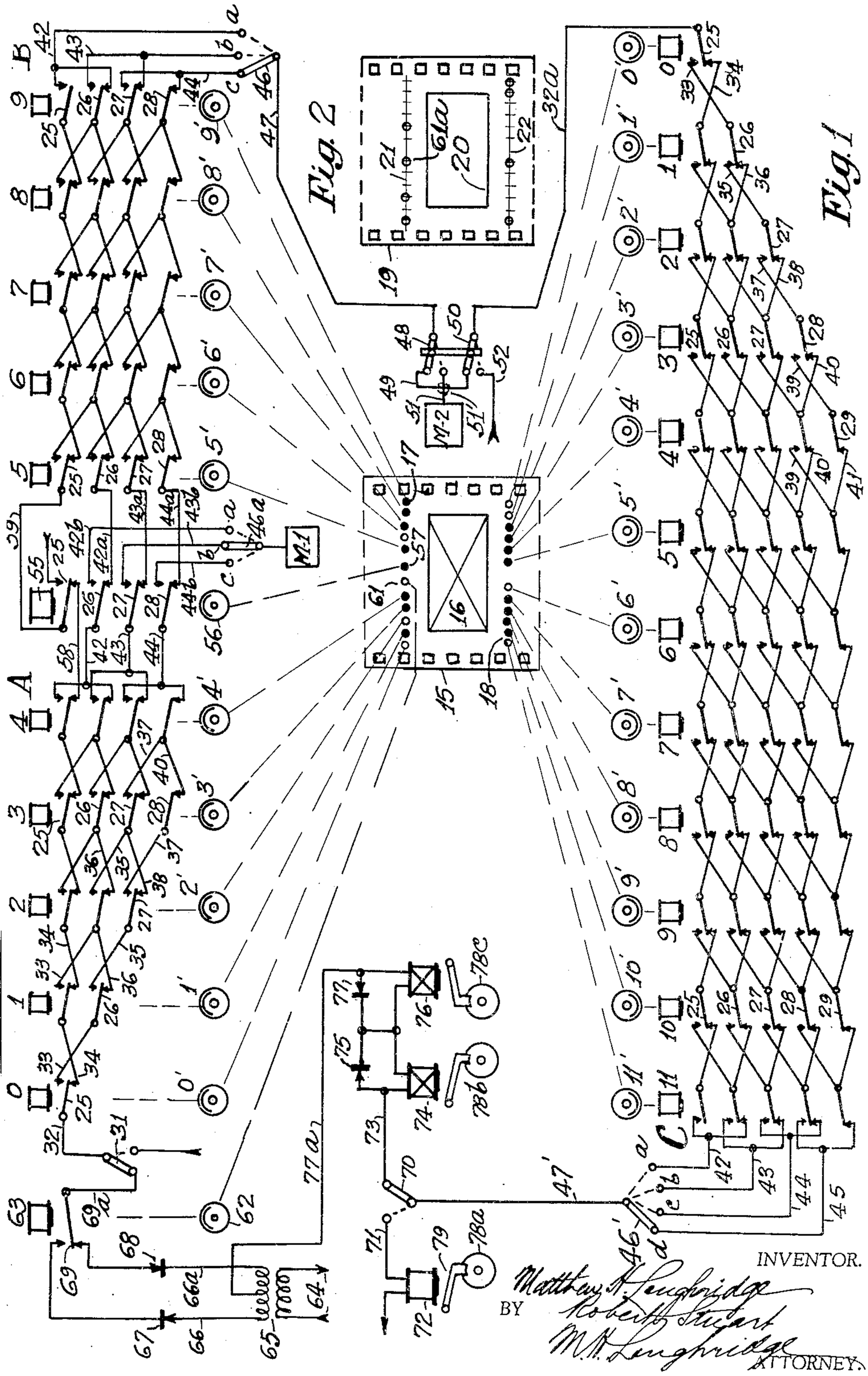

Fig. 2

Fig. 1

INVENTOR.

Matthew H. Loughridge
Robert B. Stuart
M. H. Loughridge

BY

ATTORNEY.

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CODE SELECTIVE SYSTEM

Matthew H. Loughridge, Bogota, N. J., and Robert Stuart, Forest Hills, N. Y.

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This invention relates to selective systems and the apparatus used therewith and it has for an object to obtain a variety of selective controls which may be applied to the selection of a particular item from a comparatively few items of the same class and it may be applied to select any particular item from very large groups. The selective apparatus is so arranged that its control may be changed during the operation of the system so that part of the selections may be diverted to one purpose and part to another purpose which are selected at the same time. Another object of the invention is to provide a selective system that is operated mainly by electric control through the medium of photo-electric cells and without an involved and expensive mechanical apparatus. Another object of the invention is to provide selections in groups and to accumulate these selections into a single result representing the product of the group selections, and another object of the invention is to superimpose upon the selective system control by selective current with selectively responsive apparatus which enables the purpose of the selective apparatus to be doubled.

A more particular object of the invention is to provide a selective system operated by and in conjunction with motion picture film whereby particular markings associated with each frame of the film, cooperating with a scanning frame, operates the system for any predetermined frame and the system sets in motion a mechanism to register the frame that has been selected.

This invention includes a comparing system of a film with a scanner translated by a plurality of circuits, each having a relay for actuating various permutations of different numbers of relays, with a plurality of circuits controlled by the relays corresponding to the permutation selected, each circuit being completed only when the number of relays actuated correspond to the permutations and the remaining relays are unoperated and a translating controlled by said relays.

The objects of this invention will be more particularly understood from the following specification and the accompanying drawing showing a preferred form of the invention, in which:

Fig. 1 is a circuit diagram of the system whereby the markings of a film selectively operate a mechanism;

Fig. 2 is a scanning or master film having predetermined markings used to register with the markings of the film in Fig. 1, to secure the selections.

The selective system in the present invention is applied by means of a code which has a plurality of characters and the different selections are established by the location of these characters with reference to the total number of locations that are provided for in one section of the system. For instance, if a section of the code provides in one row ten possible locations for the code characters and each selection of the code is obtained by three characters differently located on the base of the ten possible locations, the total number of different selective combinations obtained by this arrangement is 120. Again, if the base of the code includes twelve possible locations in a row in which four different characters are located, the total possible selective combinations are 495. The limit of the selections can be determined from the formula

$$N=\frac{X\times Y\times Z}{1\times 2\times 3}$$

for a group in which three characters are used. X, Y and Z in this formula representing the three highest numbers in the group. Thus, the capacity of a group having the base 10 with three selective characters is determined by multiplying 8 by 9 by 10 and dividing by 6. The same formula applies when four characters are used in the ciated with each frame of the film for each code used as follows:

$$N=\frac{12\times 11\times 10\times 9}{1\times 2\times 3\times 4}=495$$

It is apparent when one character is to be used in a group of selections that the operation of this character, for instance, by energizing a relay, should control the system and the operation of more than one character should prevent the control; it is also apparent when two characters are used in a group of selections that the selection should be obtained by two characters only, and a greater or less number of characters than two should prevent the system from operating. In the same way, if the system is to be operated by three characters at a time it should operate only by three characters and not by any other number.

The system is applied by a row of marks associated with each frame of the film for each code of the selection and the film, as it passes through a projecting machine, passes over an analyzing or selector plate which may have an aperture registering with the frame of the film to permit the free projection of the subject on the frame, and is provided with rows of marks, which rows correspond in location with the rows that are used to establish the code on the film. The scanning or analyzing plate is provided with marks which correspond to the desired code number only and each row is limited to the number of marks corresponding to the characters of the code. When these marks register with corresponding located marks on the film, the photo-electric cells controlling the system are operated to register as desired.

The simplest way of applying the system is to provide on the film transparent spots in each se-

lective row corresponding to the code and to provide apertures in the opaque scanning plate corresponding with the code characters desired. When the transparent spots of the film register with the apertures in the scanning plate an individual beam of light is projected through these apertures and each beam operates, or energizes a separate, independent photo-electric cell, the other photo-electric cells remaining inactive. A photo-electric cell is provided for each mark of the row of marks making up each code so that a photo-cell is always available to be operated when registration is made with any of the code markings.

Each photo-cell is connected through an operating circuit, including an amplifier, not shown in the drawing, with a relay and these relays in turn control the operating circuit. Relays are normally deenergized but become energized in response to the light beam effecting each photo-cell.

The relays are arranged to control a series of parallel circuits by a repeating circuit arrangement and any of these parallel circuits may be used to control the system. The term "parallel" implies that the circuits are arranged in parallel rows, as shown in the drawings, connecting in series from the back contact of the finger of one relay to the corresponding finger of the next relay. As applied one circuit may be used which is established when one relay is energized and the other relays are deenergized; or another circuit can be used which is established when any two of the relays are energized and the remaining relays are deenergized; or another circuit may be used which is established when any three of the relays are energized and the remaining relays are deenergized or again a circuit may be used which is established when any four of the relays are energized and the remaining relays are deenergized. The number of relays that are energized for an operation correspond with the number of characters that are used in applying the code.

When it is desired to obtain a large number of selections, two or more codes may be operated in series so that the selection is made from a number corresponding to the product of the total selection of each code. This condition is obtained simply by connecting the operating circuits controlled by the code relays for each code in series.

It may sometimes occur that the code provided for certain records is not required on the same frame as the code required for other records and in this case it is possible to provide a change-over relay operated by the film and by the scanning plate whereby the code, or part of the code, may be changed over from the code that is not required and used for a code that is necessary.

Where the record coded contains data that may correspond in all but a single item and this data does not occur for both conditions on the same frame it is then possible to use the same coding apparatus and select the result by the characteristic of current used to operate the system. An example of this kind might arise where data on one frame relates to men and data on another frame relates to women, in each case while the coding is the same for both the results are separated for men and women.

The coding marks are applied to the film from data sheets or cards for each subject that is to be photographed on the film frame.

In the drawing 15 is a portion of motion picture film having the frame 16 with the picture subject and provided with a row 17 of marks for coding purposes and a second row 18 of marks for further coding. 19 is the scanning or analyzing plate that is used with the film 15 and is provided with an aperture 20 through which the picture subject may be projected and with a row 21 of marks registering with the row 17 for coding purposes and a similar row of marks 22 registering with the row 18 for the same purpose. The scanning or selector plates 19 may be placed in a fixed location over which the film 15 passes so that for each frame of the film the markings on the film and on the analyzing plate register in position. If the markings on the row 17 that register with the markings of row 21 are transparent a light beam passes through these markings or such of them as register and the same conditions apply to the markings in row 18 and row 22. The light beam is interrupted except where transparent markings of the film register with the apertures of the analyzing plate. If it is desired to change the selective code during the operation of the projector, then the plate 19 is made in the form of a motion picture film so that its position can be changed after any predetermined operation.

A row of photo-electric cells are provided as indicated from 0' to 9' and each cell is located in the focus of the light beam that is projected through the row of transparent markings indicated at 17 so that each photo-cell responds independently and solely to the light beam from its own transparent mark on the film, as indicated by the chain lines connecting each mark with its photo-cell. In the same way the row of markings at 18 are connected with a row of photo-cells indicated from 0' to 11' to be operated only when a light beam is projected through the transparent mark which is connected with its photo-cell.

Each photo-cell is connected through an amplifier and an operating circuit, not shown in the drawing, with its selective relay which relay bears the same reference numeral as the photo-cell but without the prime mark. When the photo-cell is energized by a light beam the relay is energized and when the photo-cell is deenergized the relay remains in its normal or deenergized position.

The armatures of the selective relays each are provided with a number of independent contact fingers indicated by 25, 26, 27, 28 and 29, so arranged that when the relay is energized the contact fingers are raised to close the front contact of each finger and to open the back contact and when the relay is deenergized the contact fingers are moved to the normal position shown in which the circuit connected with the back contact is established and the circuit connected with the front contact is open. The relays may be of the telephone type with spring fingers which are normally biased to close the back contacts or they may be operated by gravity.

In the circuit diagrams one side of the circuit only is shown which is assumed to start at the line indicated by the tail end of the arrow and to return on the line indicated by the arrow point. The selective relays control in series a row of parallel circuits, each circuit being determined by a contact finger of the relay. The first circuit, *a*, starting at the switch 31, through conductor 32, contact 25 of relay 0 to conductor 34, connecting with the back contact of 25 and similarly to the first contact finger of each of the relays in the series until the last relay is reached where the circuit is open between conductor 42 and

contact finger 25. If any one of the relays from 0 to 9 is energized, while the other relays remain deenergized, circuit *a* will be established. If the last relay is energized the circuit is established through the front contact of finger 25, if however, any other relay is energized the circuit is transferred at the energized relay to the next or second contact finger 26 for the remaining relays of the group.

The circuit on the second row of contact fingers 26 is normally established through its back contact and conductor 36 from relay to relay until at the last relay the back contact established by contact finger 26 completes circuit *a* to conductor 42. It will be seen that if, for instance, relay 0 is energized the circuit to the first row of contact fingers is interrupted at the back point of finger 25 and a new circuit is established through the front contact of this finger and conductor 33 to the second row of contact fingers 26. The same conditions prevail when any one of the group of relays is energized, that is, the control circuit is transferred from the first row of contact fingers to the second row of contact fingers and the last relay, when energized, establishes the circuit through the first row of contact fingers and when deenergized establishes the same circuit for the second row of contact fingers. It will be observed that if two of the relays are energized at the same time then the circuit is transferred from the second to the third row of contact fingers and circuit *a* is not included in this control.

The circuit to the third row of contact fingers 27, at top in Fig. 1, is established by the second energized relay through the conductor 35 and the front contact of finger 26, conductor 33 and the front contact of finger 25, of the first energized relay. The contact finger 27 of the relays in the deenergized position continues the circuit through conductor 38 to the contact finger 27 of the next relay throughout the series, thus bringing the third row of contact fingers into circuit and, when the last relay is deenergized, circuit *b* is established on conductor 43. If any two relays are energized at the same time and the other relays deenergized it will be noted that the circuit is established from conductor 34 to conductor 33 through 25 and the second finger 26, and from this finger to conductor 35 and contact finger 27 in the deenergized position which connects the circuit with conductor 43. For instance, if relay 3 and relay 9 are energized and the other relays deenergized, the circuit is transferred from the front contact of finger 25 at relay 3 to contact finger 26 of the next relay in the deenergized position and the circuit is continued until contact finger 26 of relay 9 is reached in the energized position which establishes the circuit *b* to conductor 43.

The circuit on the fourth row of contact fingers 28 is established through conductor 37 and the front contact 27 of the preceding relay in the energized position. The circuit is continued from the back contact of finger 28, through conductor 40 to each of the contact fingers 28 of the following relays. At the last relay circuit *c* is established on conductor 44 through the back point of contact finger 28 or the front point of contact finger 27. In this arrangement any three of the selective relays energized while the others are deenergized will establish circuit *c*. The first relay energized transfers the circuit from the first row of contact fingers to the second row for the following relays and the second relay energized transfers the circuit from the second contact finger to the third contact finger of the following relays and the third relay energized transfers the circuit from the third row of contact fingers to the fourth row which is connected with conductor 44. It will be noted that if more than three relays are energized at the same time the circuit to conductor 44 is interrupted, if only two relays are energized at the same time the circuit to 43 is established and the circuit to 44 is not established and if only one relay is energized at a time the circuit to 42 is established and the other circuits are interrupted.

The system as shown in Fig. 1 is applied with codes A, B and C, codes A and B may be combined to operate as a single code system or they may be separated to operate as independent codes under the control of the film. When codes A and B are combined a total of ten relays are provided in the group which corresponds to the base 10 while the code indicated by C has twelve relays corresponding to the base 12 and may be arranged to operate with from one to four characters. Code C differs from A and B by two additional selective relays with their control mechanism and by the application of the additional contact finger 29 which controls circuit *d*.

The circuit for the contact 29 is established through conductor 39 and the front point of contact 28 of the preceding relay and is continued through the back point of contact 29 by conductor 41 to the succeeding relays and to conductor 45 connected to circuit *d*. In this arrangement, when four of the relays are energized the first relay transfers the circuit from contact finger 25 to contact finger 26 of the next relay and the second energized relay transfers the circuit from contact finger 26 to contact finger 27 of the next energized relay and the third energized relay transfers the circuit from contact finger 27 to contact finger 28 of the next energized relay and the fourth energized relay transfers the circuit from contact finger 28 to contact finger 29 which connects with conductor 45.

A relay 55, operated by the photo-cell 56 from the mark 57 on the film 15 is interposed between code A and code B. When this relay is in the deenergized position codes A and B are connected together to operate as a single code and when relay 55 is energized these codes are separated to operate independently. When 55 is deenergized the circuit on the first row of contact fingers 25 is continued through conductor 58, contact finger 25 of relay 55 and conductor 59 to contact finger 25 of relay 5. Conductor 42 connects the circuit from contact finger 26 through contact finger 26 of relay 55 and conductor 42*a* to contact finger 26 of relay 5. Conductor 43 continues the circuit from contact finger 27 of relay 4 through contact finger 27 of relay 55 and conductor 43*a* to contact finger 27 of relay 5 and conductor 44 continues the circuit from contact finger 28 of relay 4 through contact finger 28 of relay 55 and conductor 44*a* to contact finger 28 of relay 5.

When relay 55 is energized the circuits on 42*a*, 43*a* and 44*a* are interrupted and a circuit is established from the energy wire through the contact 25 to wire 59 and to contact 25 of relay 5 which is the first relay of code B and corresponds to relay .0 of code A. At the same time circuit A is established through contact 26 and conductor 42*b*; circuit *b* is established through contact 27 and conductor 43*b* and circuit *c* is established through contact 28 and conductor 44*b*.

A relay 63 is controlled by the photo-electric

cell 62 which in turn is controlled by a light beam from mark 61 on the film; this arrangement selectively controls the character of the current used to operate the system. A transformer 65 is supplied from the mains 64 and the secondary circuit on wire 66 connects through a rectifier 67 with the front contact of the contact finger 69 of relay 63 and through conductor 69*a* and switch 31 supplies the operating energy controlled by the selective relays. The opposite wire 66*a* from transformer 65 connects through rectifier 68 with the back contact of finger 69 of relay 63, which through switch 31 supplies the operating energy for the apparatus. Since the rectifiers 67 and 68 are reversed in polarity the character of the current energizing the system is changed by energizing relay 63.

A mechanism M—1 is connected by switch 46*a* to be operated by the code relays A and this mechanism may be set to operate on circuits *a*, *b* or *c* according to the position of switch 46*a*. A second mechanism M—2 is controlled by switch 46 and may be operated by the code B alone or by codes A and B combined when relay 55 is deenergized. This mechanism is controlled by conductor 47 and switch 48 in the reversed position connecting with conductor 51 and mechanism M—2. At the same time switch 50 is also reversed connecting the energy wire 52 to conductor 32*a* leading to contact finger 25 of the first selective relay for the code C and in this case code C operates independently of A or B. When, however, the switches 48 and 50 are in the position shown, the circuit is continued from conductor 47 through jumper 49 to conductor 32*a* which places the codes A, B and C in series. If the conductors 49 and 51 are connected at 51', M—2 works in multiple circuit with code C.

The four circuits controled by code C are determined by switch 46' connecting with conductor 47' which is manually positioned to connect with circuits *a*, *b*, *c* or *d* as desired. Conductor 47' connects with switch 70, which, when thrown to the left energizes the control magnet 72 through conductor 71 and through the latch 73 this magnet releases the mechanism 73*a* for a cycle of operation. When the switch 70 is thrown to the right the circuit is continued on conductor 73 through magnet 74 and magnet 76 to conductor 77*a* connecting to the middle point of the secondary of transformer 65. Magnet 74 is shunted by the rectifier 75 and magnet 77 is shunted by the reversed rectifier 77 so that in practice the magnet 74 is energized by current of one characteristic and the magnet 76 is energized by current of the opposite characteristic as determined by the rectifiers 67 and 68, thus magnet 74 is energized when relay 63 is deenergized and magnet 76 is energized when relay 63 is energized. Magnet 74 controls the mechanism 73*b* and magnet 76 controls mechanism 73*c*. If magnet 72 is made responsive to direct current or an operation is required without the selective relay 63, this can be secured by reversing the position of switch 31.

In this circuit it will be noted that the control spreads from the entering relay until the number of parallel circuits correspond with the number of relays operated at one time, after this, the circuit is uniform and symmetrical for any number of relays in the group. It will be further noted that the same number of circuits enter and leave each finger of the relay. The fingers have a front and a back contact leading to separate circuits, and the pivot end of the finger connects to a front contact of a finger of the preceding relay and also connects to a back contact of another finger of the same relay. The back contact sets up the parallel circuits in series from relay to relay, while the front contact transfers the circuit from one parallel row to the next when the relay is energized. Selections are made by the control of the relays and not by energizing a specific relay for a specific result. The system is operated by energizing a predetermined number of any of the relays in the group with the remaining relays deenergized. It will not operate under any other condition, either for the intended results or for unintended results. As applied in the drawing, the number of relays in the group correspond with the base of a code and the predetermined number of relays, selected from any of the relays of the group, correspond with the number of changeable characters of the code.

In general, this code circuit represents a base including the total number of code relays that are selectively operated by the scanners and the code is established by energizing a predetermined number of these relays while the remaining relays remain deenergized. The translating device is controlled by repeating circuits beginning at one side of the relays, in series, from relay to relay, the first of which is completed by a back contact that is closed when each relay is deenergized, except the last three relays of the group, (when a three character code is used); the second circuit is completed by a back contact that is closed when each relay of the group is deenergized, except the first relay and the last two relays; the third circuit is completed by a back contact that is closed when each relay of the group is deenergized, except the first two relays and the last relay; and the fourth circuit is completed when all the relays of the group are deenergized, except the first three. Further, the first code relay from the beginning side of the circuit that is energized transfers the series control at this relay from the first to the second circuit; the next code relay in this order that is energized, transfers the series control at this relay from the second to the third circuit, and the next relay that is energized in this order transfers the control at this relay from the third to the fourth circuit. The translating device is controlled by these circuits at the last relay of the group by connecting to a front contact on the third circuit and a back contact on the fourth circuit. This arrangement repeats in a regular order and can be expanded for any number of code relays and by additional contact fingers on the relays controlling similar series circuits it will operate for additional characters in the code.

In operation, when the frame on film 15 registers with 19 so that a light beam is projected to energize relays 0, 2, 63 and 6 in the row 17 and to energize relays 0, 1, 7 and 11 in row 18 with the switches arranged as indicated, relay 63 will be energized and circuit *c* will be energized through codes A and B and circuit *d* will be energized through code C and relay 76 will be operated to produce the desired result. If the scanning plate 19 is retained the magnet 76 will be operated for each succeeding frame of the film that has corresponding marks. If, on the other hand, it were desired to maintain the same coding but to operate magnet 74 instead of 76 the index mark 61 on the film would be opaque and cause relay 63 to be deenergized.

If it is desired to operate code B and code A

separately, then the scanning plate 19 must be provided with an aperture that will register with aperture 57 on the film and energize relay 55 to change over the system when frames of this type are brought into register. In this case the coding must be arranged on a base of five units instead of ten.

It is common practice to provide a group of relays that are energized accumulatively to secure selective control. For instance, a system arranged to operate any or all of a group of four relays at a time, and to be controlled by all the relays, can secure the first result by the first relay energized and all the others deenergized; then the second relay may be energized and all the others deenergized; likewise, the third relay may be energized and the others deenergized, and finally, the fourth relay may be energized and all the others deenergized. This gives four results with the operation of a single, but different, relay each time. Again, if the first and second relays are energized, with the others deenergized, this gives a fifth result; if the first and third relays are energized, this gives a sixth result; and if the first and fourth relays are energized, this gives a seventh result.

The complete capacity of this arrangement in which from one to four relays are operated at a time is 16 selections; the first relay controls two circuits; the second relay controls four circuits; the third relay controls eight circuits and the fourth relay controls sixteen circuits; the number of contact fingers of the relay being half the number of circuits controlled. In this arrangement the circuit is not uniform, instead, it changes as the number of relays that are operated change. It, therefore, does not adapt itself to the operation of a uniform coded circuit.

The system of the application is fundamentally different from the accumulative system described. Any system is designed to operate by energizing a predetermined number of relays in a group. In the application the entire group is included for each operation, the operated relays being energized and the remaining relays being deenergized to set up the conditions of control. In this operation the relays are not accumulative throughout the group, but are accumulative only to the extent of the predetermined number that are required to operate the system. If the system, for instance, is set to operate by three relays it will not operate unless three relays, any three, are energized and all the others of the group are deenergized. This is true with any other predetermined number of relays and the remaining group. All the relays are included in the control and the predetermined number must be energized.

The system is applicable with any number of relays in the group while its operation is limited to the predetermined number that are operated. In this way the system may be expanded to any extent desired; for instance, ten relays in a group, any three of which are operated each time and seven deenergized, will produce 120 possible different selections, and a group of ten relays, any four of which are operated each time, will produce a possible 210 selections. The accumulative circuits of the prior art cannot produce the extensive combinations in a selective system that are possible with this arrangement.

The system is symmetrical for any number of relays, increasing the number of relays in the group merely extends the arrangement of the wiring in a repeating circuit. The number of relay contacts are not increased by the addition of other relays, in each arrangement, the number of contacts is just one more than the number of relays operated to control the system; this is a matter of importance for large selections. Operating the predetermined number of relays in any order with the remainder deenergized will operate the system. Operating a greater or smaller number of relays will produce no effect—the system cannot operate for any other purpose by the operation of an improper number of relays. This makes it readily useable in a coded system.

Even for smaller combinations, when a group of five relays are used and three are operated, the total selection is ten; while with an accumulative system the total number of selections, with three relays, is eight. In the same way with five group relays and only two operated, the selection possible is ten, while with the accumulated system the possible combinations is four.

The repeating circuit runs in parallel lines from the back contact on one relay to the pivot finger of the next relay and from the back contact of this finger to the pivot of the finger of the next relay and so on. When any relay is energized the parallel circuit is changed to the parallel circuit below, beginning at the next relay following the one that is energized. From this point on the control is transferred from the first parallel circuit to the next and a switch at the end of the controls determine the final composite circuit and thereby determines the predetermined number of relays that operates the system.

The structure of this circuit differs from others used for selective purposes in that the pivot end of the relay finger for the first row of contacts, or parallel circuit connects only to the back contact of the first finger of the preceding relay, while all the following contact fingers have the pivotal end connected to the front contact of the preceding relay for the parallel circuit above, and to the back contact of the corresponding finger of this preceding relay; thus there are the same number of circuits leading to the contact fingers below the first row, and above the last row, as leads from these contact fingers.

This circuit arrangement is readily changed as, for instance, by adding relays to the group and repeating the circuit; also it is changed by the switches to operate on different predetermined numbers of relays energized and the same arrangement of circuits may be independently applied as single codes or as compound codes.

The code is applied symmetrically from a base having a fixed number of positions and for each position a relay is provided which normally remains deenergized or inactive. The scanner aligns with the base and has a predetermined number of positions that synchronize with the positions of the base. If the number that synchronizes corresponds with the number of relays that must be energized to operate the circuit, this predetermined number of relays will be operated and the translating apparatus will function. If the aligned positions permit a greater or smaller number of relays to be energized than the predetermined number, there will be no effect; this is the purpose of the coded selected system.

It should be noted that all the predetermined relays although separately controlled, are operated together and are energized at the same time. All the relays control the circuit of the translat-

ing device in series. The time of operation is thus reduced to the time necessary for one relay to close the circuit, since they all operate together. This is very important for high speed operation and is a result that cannot be obtained from any accumulative or stepping system.

The system outlined can be applied to motion picture film through very small apertures in the film for the light beam and the beam can be projected through these apertures upon the photo cells without interfering with the general purpose of the film. The system admits of very extensive selection and it enables a group of different selections to be accumulated and made cooperative. Corresponding results can be obtained by a mechanism that is largely mechanical in its operation but the electric control and operation is preferred as it is less expensive, is uniform and is rapid in action.

The subjects to be coded are usually assigned a number for each item and if the code is to have three characters there will always be three numbers in the code; if it has four characters then there will be four numbers in the code and in order to avoid repetition the numbers should be arranged in ascending order, for instance, number 276 should not be followed by the number 267.

The apparatus in Figs. 1 and 2 show the application of an electric coding system in which relays constitute the principal part of the mechanism. The relays are connected by interlocking circuits to prevent improper operation and by the operation of a switch the system can be changed from one code to another. The system is useable for translating a code as illustrated in the application in the drawing or for applying a code and the selective control by the character of the current is useable in either case. The mechanism indicated at 78*a*, 78*b*, 78*c* and M—1 and M—2 may be any type of translating means which the code is intended to control.

We claim:

1. In a comparing system a plurality of relays, adjustable comparing means including circuit controlling means actuated thereby for energizing selectively said relays in the various permutations of different predetermined numbers of relays and different individual relays for each number permutation depending upon the adjustment of the comparing means, a plurality of circuits controlled by said relays, each circuit corresponding to a permutation of a predetermined number of relays energized simultaneously but common to permutations of individual relays for the number permutation, means whereby the relays complete each circuit only when the number of relays operated correspond to the number permutation and the remaining relays are unoperated, a device common to all of said circuits and means for selectively interposing said device in said circuits in accordance with the adjustment employed in the comparing means.

2. In a comparing system a plurality of relays, adjustable comparing means including circuit controlling means actuated thereby for energizing selectively said relays in the various permutations of the system including different individual relays for each permutation according to the adjustment of the comparing means, a plurality of circuits controlled by said relays, each circuit corresponding to a permutation of a predetermined number of relays energized simultaneously, means whereby the relays complete each circuit only when the number of relays operated correspond to permutation of the adjusting means and the remaining relays are unoperated, a device common to all of said relay controlled circuits and selectively responsive to the character of the current energizing said circuits and means including the circuit controlling means actuated by the adjustable comparing means for controlling the character of the current energizing the relay controlled circuits.

3. In a comparing system, a plurality of relays in a group, comparing means including a scanner controlling the circuit of said relays for energizing selectively said relays in various permutations of different predetermined numbers of relays in the group, and different individual relays for each number permutation as determined by said scanner, a plurality of circuits controlled by said relays each circuit corresponding to a permutation of a predetermined number of relays energized simultaneously, but common to permutations of individual relays for the number permutation, means whereby the relays complete each circuit only when the number of relays operated correspond to the number permutation of the scanner and the remaining relays are unoperated, a device common to all of said circuits and means for selectively interposing said device in said circuits in accordance with the comparing means.

4. In a comparing system, a group of at least ten relays, comparing means including circuit controlling means actuated thereby for energizing selectively said relays in the various permutations of three of said relays and different individual relays for said three depending upon the adjustment of the comparing means and means for varying the number of relays in said group by the comparing means, a plurality of circuits controlled by said relays, each circuit corresponding to a permutation of three of said relays energized simultaneously, means whereby the relays complete each circuit only when three of the relays corresponding to the permutation are operated and the remaining relays are unoperated, a device common to all of said circuits and means for selectively interposing said device in said circuits in accordance with the comparing means.

5. In a comparing means, a plurality of relays, adjustable comparing means including circuit controlling means actuated thereby for energizing selectively said relays in the various permutations of different predetermined numbers of relays and different individual relays for each permutation according to the adjustment of the comparing means, means for varying the predetermined numbers of relays, a plurality of circuits controlled by said relays, each circuit corresponding to a permutation of said predetermined number of relays energized simultaneously but common to permutations of individual relays for the number permutation, means whereby the relays complete each circuit only when the number of relays operated correspond to the number permutation of the adjusting means and the remaining relays are unoperated, a device common to all of said circuits and means for selectively interposing said device in said circuits in accordance with the comparing means.

MATTHEW H. LOUGHRIDGE.
ROBERT STUART.

CERTIFICATE OF CORRECTION.

Patent No. 2,266,779. December 23, 1941.

MATTHEW H. LOUGHRIDGE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 23, for "ciated with each frame of the film for each code" read --base 12 in which the four highest numbers are--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of February, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)