July 21, 1964 W. BURRI 3,142,054

ROTATABLE SYMBOL CARRIER HAVING PLURAL SYNCHRONIZING POSITIONS

Filed March 26, 1962 3 Sheets-Sheet 1

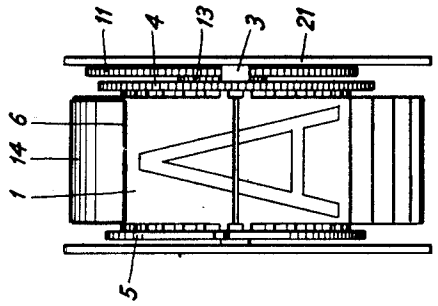


Fig. 2

Fig. 3

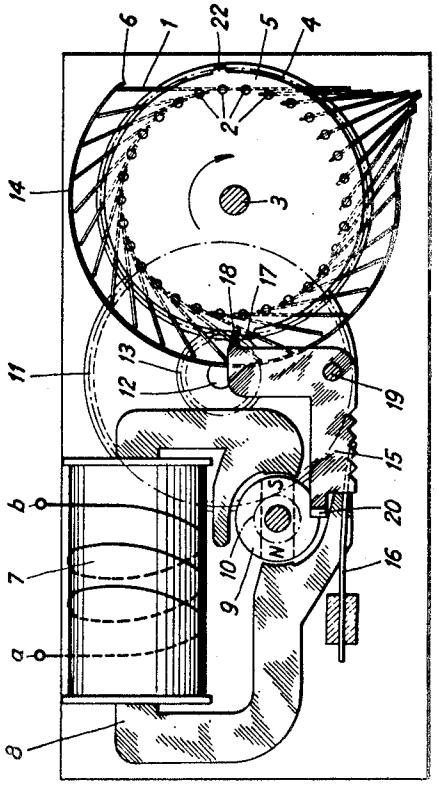
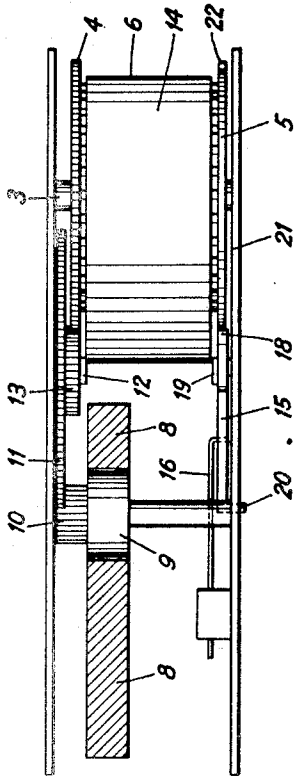


Fig. 1



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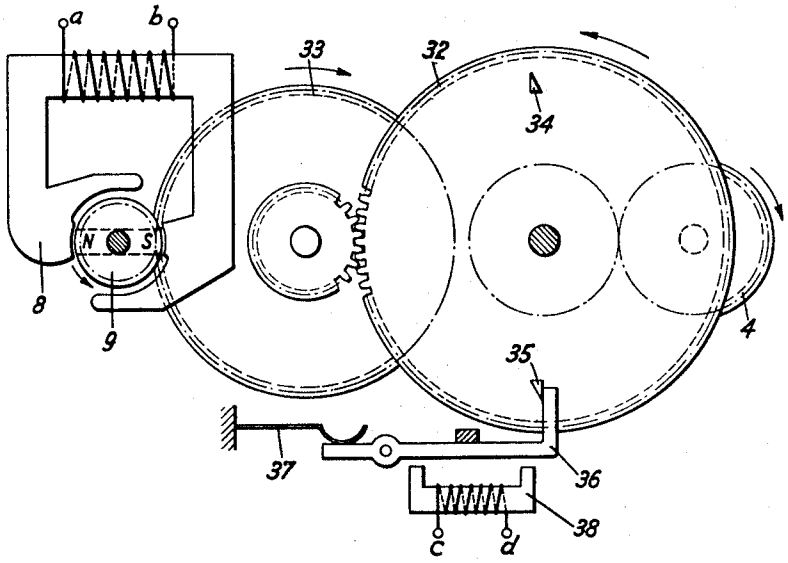


Fig. 4

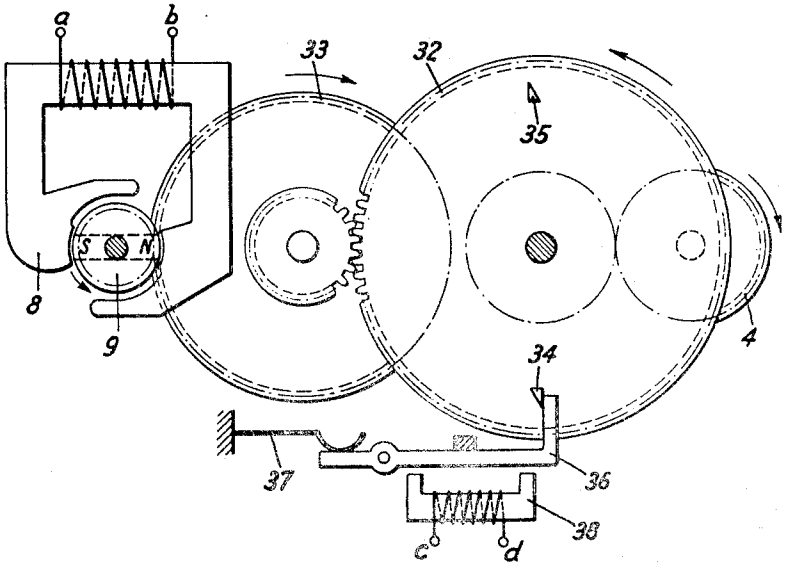


Fig. 5

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ROTATABLE SYMBOL CARRIER HAVING PLURAL SYNCHRONIZING POSITIONS

Filed March 26, 1962 3 Sheets-Sheet 3

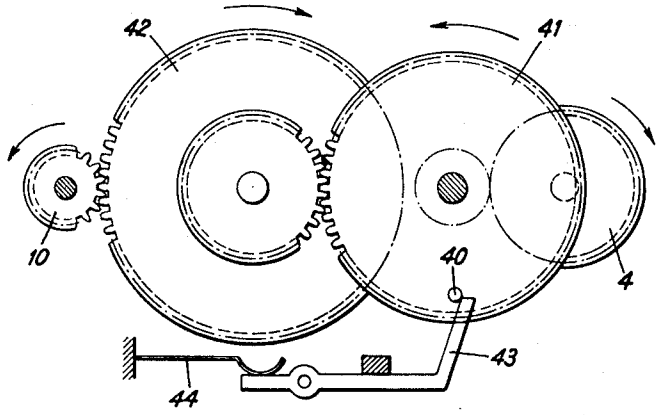


Fig. 6

St.		Imp	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		I = O II = X	−	+	−	+	− F O	+ F X	−	+	−	+	−	+ F	− F	+	−	+
	−																	
SI 1	+												O					
2														O				
3	−														O			
4	+	R																
5	−	⊠																
SII 6	+		⊠	⊠	⊠		X	X	X	X	X	X	X	X				
7	−						O	O	O						X			
8	+									O						X		
9	−										O						X	
10	+											O						
	−																	

Fig. 7

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United States Patent Office 3,142,054 Patented July 21, 1964

3,142,054

ROTATABLE SYMBOL CARRIER HAVING PLURAL SYNCHRONIZING POSITIONS

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4 Claims. (Cl. 340—325)

For a long time optical symbol indicators have been known in the art, said indicators being particularly suitable for indicating numerals and having a rotatable symbol carrier which, depending on the position thereof, indicates symbols in any suitable manner. Said symbol carrier is brought into the desired desired position by a control device wherein said symbol carrier is rotated via gearing by a step motor which is driven by alternatingly poled D.C. pulses delivered by a control device. Usually a synchronizing device is employed through which the symbol indicator can be synchronized with the transmitting device during each revolution. In many cases the readjustment of a symbol carrier is undertaken in such a way that the symbol carrier is induced to a set-back movement by being rotated with increased speed by a number of pulses corresponding to a full revolution of the symbol carrier to a synchronizating position, in which said carrier is prevented from further rotation by a mechanical stop. Thereupon said carrier is caused to advance from the synchronizing position and subsequently, to carry out an adjusting movement, the carrier being turned with a reduced speed into a new position by a number of pulses depending on the symbol to be indicated. The replacement may take place with increased speed since in this case a high accuracy is not necessary, namely, the symbol carrier—if the set-back movement lasts long enough—moves also then into the synchronizing position if the movement thereof is not completely commanded by the control device. Conversely, the adjusting movement which has to take place accurately, can only be carried out relatively slowly.

If a great number of symbols has to be indicated, for example, all letters of the alphabet, the adjustment of the symbol carrier may take a relatively long time, undesirable in many cases. The prior art discloses synchronizing device by means of which these disadvantages can be diminished. The devices render possible an acceleration of the adjustment of the symbol carrier by the provision of two synchronizing positions at locations oppositely spaced by about half a revolution, wherein, applying said arrangement, the turning angle which has to be covered, on an average, by the symbol carrier during an adjusting movement can be reduced by half under otherwise identical conditions. This arrangement, however, has the drawback, besides the described advantage, that a releasing magnet is used which has to be operated via a particular wire for each indicator in arrangements having several symbol indicators simultaneously adjusting.

The present invention makes it possible to utilize the advantages of the two synchronizing positions without the above mentioned drawbacks. The present invention relates to an optical symbol indicator having a rotatable symbol carrier which has a number of positions corresponding to the number of the symbols to be indicated. Said symbol indicator comprises a step motor able to be stepped about one step each by means of alternatingly poled pulses, the step motor driving the symbol carrier. It is further equipped with gearing arranged between the step motor and the symbol carrier, the ratio of the gearing being chosen in such a manner that the movement of the step motor through one step corresponds to the movement of the symbol carrier from one position to another. The symbol indicator further comprises a synchronizing device

stopping the further movement of the symbol carrier in at least one predetermined position called the sychronizing position, and allowing the further movement thereof only by reason of a releasing criteria delivered to the symbol indicator. Said optical symbol indicator is characterized by the fact that the symbol carrier has two synchronizing positions which are displaced one from another by approximately half a revolution and, furthermore, are selected so that in both positions the positions of the step motor differ in such a manner that the pulses used for stepping out the motor from both positions have to be poled differently.

The present invention will be now described in three embodiments of which one is shown including all features and both the others merely schematically. Moreover, a detailed description of the procedures regarding the adjustment of symbol indicators in an arrangement comprising several of such indicators will be given.

FIG. 1 is a side elevational view of a symbol indicator in which a side wall is removed.

FIGS. 2 and 3 respectively show a front view and top view, partly in horizontal cross-section, of the symbol indicator shown in FIG. 1.

FIGS. 4 and 5 schematically show the essential features of a modified symbol indicator different in several features, particularly in the manner of the stopping device, with respect to the embodiment shown in FIGS. 1 to 3, said FIGURES 4 and 5 respectively showing the symbol indicator in the two synchronizing positions.

FIG. 6 schematically shows a further embodiment of a symbol indicator having a stopping device as shown in FIGS. 1 to 3.

FIG. 7 shows a movement diagram displaying two examples for the procedure of an adjusting movement of a symbol indicator.

The symbol indicator according to FIGS. 1 to 3 comprises a drum-shaped symbol carrier comprising two discs **4** and **5** rigidly connected by a shaft **3** and a number of plates **1** corresponding to the number of symbols to be indicated, the plates being designated with the symbols to be indicated.

As can be seen from FIG. 2, the one side of each plate carries the upper half of a symbol and the other side the lower half. The plates **1** are pivoted in holes **2** of the discs **4** and **5** so that the plates are reversed from up to down like pages of a book during the rotation of the symbol carrier in the direction shown by the arrow. During the rotation of the symbol carrier the plates are guided by the guide member **14** and are first held back by the buffer **6**, whereupon they fall downward after the top edges thereof have passed said buffer. The symbol carrier is driven by a step motor comprising a coil **7** having a winding *a–b*, two yokes **8** and an armature **9** having a permanent magnet. The operation of this step motor is assumed to be generally well-known. It is turned for half a revolution each alternation, in the direction which the arrow indicates, by alternatingly poled D.C. pulses delivered to the coil. Inherently, this motor can only be moved out of a certain position if the D.C. voltage supplied has a certain polarity corresponding to this position. The armature **9** of said motor carries a gear wheel **10** which meshes with the gear wheel **11**. Said gear wheel **11** rotates around the shaft **12** and is rigidly connected to the gear wheel **13**. The gear wheel **13**, on the other hand, is in direct meshing engagement with the disc **4** formed as a gear wheel and being a part of the symbol carrier. Therefore, the symbol carrier can be turned by the step motor wherein the gear ratios of the described gear wheels is chosen in such a way that each half revolution of the armature **9** produces a rotation of the symbol carrier, said rotation being the fractional portion of a full revolution, corresponding to the number of the existing plates. The

result is that, at any half revolution of the armature and thus, at any alternation of the polarity of the voltage supplied to the coil of the step motor, a plate passes the buffer 6 and falls down whereby the indicated symbol is changed. In order to always obtain the same position of the armature in a certain position of the symbol carrier and, thus, to assign unambiguously a certain polarity of the voltage supplied to the coil to advance the symbol carrier to any position of the symbol carrier, the reduction ratio between armature and symbol carrier has to be integral whereby an even number of plates results. Now, for indicating a certain symbol, it is necessary to first move the symbol carrier into a predetermined start position wherefrom the number of steps which is required for the indication of this certain symbol can be counted. The setting of the symbol carrier to the predetermined start position is achieved by the synchronizing device comprising the lever 15, spring 16 and the cams 17 and 22 attached to the disc 5, the operation of the device being described in Swiss Patent No. 295,859. The operation is based on the fact that the nose 18 of the lever 15, formed as a deflectable member, extends into the path of the cams 17 and 22. The lever 15 is pivoted around the shaft 19 and pressed by the spring 16 into a rest position in which the lever with its buffer 20 touches the upper edge of a hole, not shown, in the side wall 21. The lower part of the lever 15 has several serrations so that the torque moment acting upon the lever 15 by the spring 16 can be changed by moving said spring into another serration.

By providing an alternatingly poled voltage below a certain magnitude and supplied to the step motor, the symbol carrier can be moved step by step as long as none of the cams hits the nose 18. At both positions in which one of the cams hits the nose 18 the symbol carrier stops, even if the delivery of pulses to the step motor continues. These two positions are called synchronizing positions. The conditions regarding the force applied by the spring 16 and the character of the torque moment of the step motor as a function of the supplied voltage are chosen in a manner such that the symbol carrier can proceed beyond the synchronizing positions by supplying a voltage exceeding the voltage used for the normal movement, wherein, by the greater force applied by the step motor, the lever 15 is somewhat turned counter-clockwise by the cams 17 or 22 against the force of the spring so that the cam can pass the nose 18. Subsequently, the lever 15 returns to the start position, under the action of spring 16. Since—as already mentioned—the armature is always in the same predetermined position during a certain position of the symbol carrier, a certain position of the armature is assigned to the two synchronizing positons so that a pulse by means of which the symbol carrier shall be moved past a certain synchronizing position must have not only an increased voltage but also a certain polarity. The two cams 17 and 22 are arranged so that a positive pulse of increased voltage is necessary in the first synchronizing position and a negative pulse in the other, in order to move the symbol carrier past the synchronizing position. If the number of the plates 1 can be divided by two, but not by four the cams can be diametrically placed on the disc 5, as the number of steps between the two synchronizing positions is odd and, thus, the number of the revolutions of the armature is an integral number plus a half revolution.

The procedures for setting the symbol indicator will be described in detail at the end of this description.

Besides a synchronizing device having a mechanical detent which must be overcome by an increased force of the step motor, there is known in the art another synchronizing device in which the mechanical detent element is removed by a separate magnet. FIGS. 4 and 5 show merely schematic views of a symbol indicator employing a synchronizing device of the embodiment described. According to this embodiment the synchronizing device does not directly act upon a disc 4 of the symbol carrier, but upon a pair of gear wheels 32 connected with the symbol carrier via gearing of the ratio 1:1. Said pair of wheels 32 is driven by the pair of gear wheels 33 via gearing of the ratio 1:3.75. The armature 9 encircled by the yoke 8 drives the pair of wheels 33 via a gear reduction having the ratio 1:4. The entire reduction between armature 9 and symbol carrier, or pair of gear wheels 32 respectively, is of the ratio 1:15 so that thirty symbols can be indicated by the symbol carrier. The pair of gear wheels 32 carries two pins 34 and 35. A pivoted deflectable member 36 which is pressed into the rest position thereof by a spring 37 and the front end of which extends into the path of the two pins 34 and 35 stops the gearing and, thus the symbol carrier if it is in the positions shown in the FIGURES 4 and 5. The lever 36 can be swung out from the path of the pins by means of a release magnet 38 which acts against the force of the spring 37. The pins 34 and 35 are exactly diametrically placed, Due to the chosen odd gear reduction 1:15 the step motor occupies different positions in both synchronizing positions shown in FIGS. 4 and 5. In the position shown in FIG. 4, wherein pin 35 touches the deflectable member 36, a further movement of the symbol carrier is only possible if the lever 36 is attracted by the magnet 38 and, simultaneously, the terminal *a* of the step motor is supplied with minus polarity and the terminal *b* with plus polarity. The result is a north pole opposite the north pole of the armature and a south pole opposite the south pole so that the armature 9 is turned counter-clockwise. In the position shown in FIG. 5 the result is vice versa. Therefore, the symbol carrier can be advanced from the synchronizing position only if, simultaneously, the release magnet 38 is operated and a certain polarity is supplied to the step motor, the polarity being different for the two synchronizing positions.

The embodiment schematically shown in FIG. 6 has a stopping device analogous to the first example, wherein the stoppage must be overcome by applying increased voltage. This example shows the obtaining of two synchronizing positions by a single pin 40 which acts against the force of the spring 44 while passing the lever 43. The symbol carrier is driven by means of its gear disc 4 by the pair of wheels 41 with a reduction ratio of 1:2. The reduction between the armature 9 and the pair of wheels 42 is 1:4 and between the pair of wheels 42 and 41 is 1:1.875, thus, as the second embodiment shows, obtaining an entire reduction ratio of 1:15 which corresponds again to a symbol carrier having thirty symbols. By the fact that the pair of wheels 41 performs two revolutions per revolution of the symbol carrier, two synchronizing positions per revolution of the symbol carrier are achieved in which the lever 43 stops the further movement of the pin 40. In order to obtain two different positions of the armature in both synchronizing positions, the armature positions differing by half a revolution, the reduction ratio between motor armature and pair of wheels 41 must necessarily be half of an odd number for this embodiment, so that an integral number of revolutions plus half a revolution of the armature is required between both the synchronizing positions. The number of the positions of the symbol carrier and, thus, the number of the symbols to be indicated is consequently a number divisible by two but not by four, as required for the given reduction ratio of 1:15. The distance between the two synchronizing positions is then 7½ revolutions of the armature.

Now the adjusting procedure of the symbol carrier for one of the embodiments will be described. Assume that the symbol carrier is in any position and is connected to a control device which is not aware of this position. First, the symbol carrier has to be turned to one of the synchronizing positions in order to obtain a start position as above defined, from which position the symbol carrier can be moved by a series of counted pulses supplied to the step motor into the desired position indicating a certain symbol. In order to decrease as much as possible the number of the required setting pulses by which the symbol carrier is stepped from the synchronizing position into the de-

sired position, the setting must proceed from the synchronizing position which directly precedes the desired position to be indicated.

To move the symbol carrier from any position into the desired synchronizing position a number of pulses at least corresponding to a full revolution of the symbol carrier must be delivered to the step motor, thus causing the step motor to pass the undesired synchronizing position and, on the other hand, to stop at the desired synchronizing position to start the adjusting movement. There are several possibilities by which to achieve this goal.

A first possibility is to first supply to the step motor a number of pulses at least corresponding to half a revolution of the symbol carrier, whereupon the symbol carrier advances to the next synchronizing position, where it stops due to the mechanical stoppage. Subsequent superfluous pulses are without any effect. If the symbol carrier has already reached the desired synchronizing position after the first series of pulses is supplied, it maintains this position even while feeding a second series of pulses to the step motor. If, however, it is to be moved into the other synchronizing position, the second series of pulses, likewise corresponding to half a revolution, effects the moving of the symbol carrier into the other synchronizing position. This operation is carried out by a releasing criterium individually supplied to the symbol carrier to be adjusted at the beginning of the second series of pulses, the kind of the releasing criteria depending on desired synchronizing position. According to prior embodiments, this releasing criteria is formed, depending on the design of the symbol indicator, either by a pulse having an increased voltage supplied to the step motor or by operating the release magnet in phase with the corresponding pulse. As already described in detail, strengthened pulses of different polarity are used in order to pass the two synchronizing positions so that the passing can be controlled at will. Therefore, to adjust simultaneously several symbol indicators, a control device, not shown, must produce two different releasing criteria of which—corresponding to the synchronizing position to be adjusted on a certain symbol indicator—only one thereof is fed into the symbol indicator, the other one being kept away therefrom. For symbol indicators having a release magnet this magnet is operated during both the pulses, however, only one of the pulses being supplied with operative polarity to each symbol indicator. In such a manner all the release magnets of the symbol indicators to be adjusted can be commonly operated while a substantial saving on switch means and wiring is possible.

Another kind of set-back suitable only for symbol indicators having a release by a pulse of increased voltage and practicable by a procedure working uninterruptedly will be described as follows: A reduction of time, however, compared with the above-described kind of set-back, cannot be achieved, because in all cases a number of pulses corresponding to a full revolution of the symbol carrier has to be delivered to the step motor. A further possibility to provide a set-back is carried out by pulses of alternating polarity providing the entire set-back movement, the pulses of the one polarity having a higher voltage than the pulses of the other polarity. As a function of the polarity of the pulses which the high voltage is selected for, the symbol carrier stops at the one or the other synchronizing position, while the other one is easily passed, as can be readily understood.

After reaching the synchronizing position which precedes the desired position of indication the symbol carrier has to be moved into said position of indication. The delivering of the releasing criteria is necessary once more. Since the symbol carriers of all symbol indicators to be simultaneously adjusted have to pass the synchronizing position occupied by them all, the releasing criteria can be transmitted to all the symbol indicators to be adjusted. During the following stepping of the symbol carriers the setting pulses delivered by the control device to each single symbol indicator are counted and limited to a number necessary for reaching the desired position. Then, the setting procedure is finished.

FIG. 7 shows a table disclosing the conditions in setting a symbol indicator by two examples. The table relates to a symbol indicator having only ten positions as a larger number of positions would hamper an easy inspection and understanding. As seen in FIG. 7 the ten positions numbered from **1** to **10** are plotted on the first vertical column. The positions **1** and **6** are the synchronizing positions in which the symbol carrier is stopped from further movement by stop means. These two positions are additionally indicated as SI and SII. The second column shows, between two positions each, the polarity delivered to the step motor in order to step from one position to another. For example, a positive pulse has to be fed to the step motor to move from the third into the fourth position.

The top horizontal row plots the ordinal numbers of the pulses supplied to the step motor by the control device not shown. In setting a symbol indicator having ten positions, at most, sixteen pulses are necessary. The second row plots the polarities of said pulses. The fifth and sixth as well as the twelfth and thirteenth pulses show a mark F which points out that at said positions the releasing criteria are transmitted or can be transmitted by the control device. The symbols O and X indicate the positions of the symbol carrier as a function of the pulses and releasing criteria delivered to the symbol indicator.

The setting of the symbol carrier on to the positions **1** to **5** has to proceed from the synchronizing position SI, and on to the positions **6** to **10** from the synchronizing position SII. The symbols O mark the movements of a symbol carrier first to be stepped into the synchronizing position SI, the symbols X the movements of a symbol carrier to be stepped into the synchronizing position SII. Each one of the two symbols is marked together with each one of the releasing criteria on the third row of FIG. 7, pointing out that the respective releasing criteria is fed into that symbol indicator of which symbol carrier is to be moved into the synchronizing position indicated by the respective symbol. In the example marked by the symbols O the symbol carrier is first to be moved, in accordance with its condition, into the synchronizing position SI and, therefrom, into the position **3**.

In the example marked by the symbols X, however, the symbol carrier is first to be moved into the synchronizing position SII and, subsequently, into the position **9**. As assumed in both examples, the symbol carrier is first at the position **4** indicated by an R.

Referring to the first example marked by the symbols O, a first series of set-back pulses is first fed—as has been described in detail—into the step motor. As can be seen from FIG. 7, the symbol carrier reaches the synchronizing position by the second pulse and stops there, due to the effect of the mechanical stoppage, till the fourth pulse. The fifth pulse is of negative polarity. In order to pass the synchronizing position SII, a releasing criteria is transmitted to the symbol indicator at this moment so that the symbol carrier steps into the position **7** as a negative pulse is necessary in moving from position **6** to **7**. The sixth pulse is suppressed by the control device so that the symbol carrier stops at position **7**. The seventh pulse is delivered once again to the symbol indicator. However, this pulse being of negative polarity while a positive pulse is required to move the symbol carrier from the seventh to the eighth position, the symbol carrier stops once more. By the eighth to eleventh pulse the symbol carrier is stepped forward and reaches the desired synchronizing position SI. The further pulses are setting pulses of which the number depends on the position of the symbol carrier to

be adjusted. With the twelfth and thirteenth pulses releasing criteria are delivered for passing the synchronizing positions. After the thirteenth pulse no further pulses are delivered since the symbol carrier has reached the desired position.

Now referring to the second example marked by the symbols X, set-back pulses are first fed again into the symbol indicator so that the synchronizing position is reached with the second pulse. As described in the first example, the pulses 3 and 4 are without effect because of the mechanical stoppage. Now the fifth pulse is not fed into the symbol indicator as in the case of the first example. Therefore, the symbol carrier maintains the synchronizing position SII. A releasing criteria, however, is delivered with the sixth pulse referring to this example. Since the sixth pulse is of positive polarity, and a negative pulse is necessary to move the symbol carrier out from the synchronizing position SII, the symbol carrier still maintains its position. The releasing criteria would be effective only in the case of a symbol carrier being in the synchronizing position SI. Without an acting releasing criteria during the pulses 7 to 11, the symbol carrier still is in the synchronizing position SII.

With the twelfth and thirteenth pulse the releasing criteria is delivered as the movement of adjustment begins. Since the twelfth pulse is a positive one, and a negative pulse is necessary for stepping out the symbol carrier from the synchronizing position SII, the releasing criteria acts with the thirteenth pulse, whereupon the symbol carrier passes the synchronizing position SII. After two further pulses 14 and 15, counted due to the adjustment, the delivering of pulses to the symbol indicator is broken off because the desired position 9 is reached.

Therefore, the moving of the symbol carrier into the synchronizing position SI or SII is dependent upon the single fact of whether the releasing criteria is suppressed at the fifth or the sixth pulse.

The further two possibilities of adjustment, namely, the possibilities of starting from a rest position of the symbol carrier between the synchronizing positions SII and SI, will not be described since the procedure of both these cases is easily understandable in view of the descriptions given in detail.

As already mentioned, the advantages of using two synchronizing positions are based on a time-cutting during the adjustment, since the maximum and, therefore, likewise the average number of required setting pulses is halved compared with a device having one synchronizing position only, while, however, the number of the set-back pulses is equal in all cases. Due to the fact that the set-back pulses can be delivered somewhat faster to the symbol indicator than the adjusting pulses—since there has to be no safeguard against fault-causing action—the cutting of time is somewhat greater than it seems initially. There is no additional complexity compared with a symbol indicator having one synchronizing position only, which fact is considered particularly advantageous. Likewise, in view of the installation, no additional expenditure is necessary.

While certain specific embodiments of improved optical symbol indicators have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. An optical symbol indicator comprising a rotatable symbol carrier having a plurality of symbols mounted thereon to be displayed at respective indicating positions of the carrier, said indicating positions being at different successive steps of rotation of the carrier, a step motor of a type adapted to be step-driven responsive to alternately poled pulses applied thereto, means gearingly coupling said motor to the carrier and having a driving ratio such that the step of movement of the motor drives the carrier through one indicating step, for every indicating step only a stepping pulse of a determined polarity being able to drive the symbol carrier to the next indicating step, releasable stop means holding the carrier against movement at two different synchronizing positions, said synchronizing positions displaced from each other by approximately one half a revolution of the carrier and means to release said stop means responsive to a release criteria signal permitting the signal carrier to pass over a synchronizing position when a stepping pulse with the proper polarity to drive said motor is applied to same concurrently with said release criteria, said two carrier synchronizing positions being such that the polarity of said stepping pulse delivered concurrently with a release criteria being able to drive the motor to pass over one of said synchronizing positions is different from the polarity of said stepping pulse delivered concurrently with a release criteria being able to drive the motor to pass over the other synchronizing position.

2. The structure of claim 1, and wherein said stop means comprises a pair of diametrically opposite projections on said symbol carrier and a yieldable detent member mounted to be engaged by said projections at said synchronizing positions, said release criteria signal constituting sufficiently increased strength of the stepping pulses to overcome the restraint of said detent member, said projections being arranged in a manner that in the two different positions of the symbol carrier when the detent member is engaged with one of the two projections the motor being in two different positions so that the polarity of a following pulse able to drive the motor is different in said two different positions.

3. The structure of claim 1, and wherein said coupling means includes a gear rotating simultaneously with said symbol carrier and provided with projections, and wherein said stop means comprises a yieldable detent member mounted to be engaged by said projections at said synchronizing positions, said release criteria signal constituting sufficiently increased strength of the stepping pulses to overcome the restraint of said detent member, said projections being arranged in a manner that in the two different positions of the symbol carrier when the detent member is engaged with one of the two projections the motor being in two different positions so that the polarity of a delivering pulse able to drive the motor is different in said two different positions.

4. The structure of claim 1, and wherein said stop means comprises a member rotating with said symbol carrier at the same rate therewith and having a pair of diametrically opposite projections, a pivoted detent member mounted to be normally engaged by said projections at said synchronizing positions, and electromagnetic means to disengage said detent member from said projections, said projections being arranged in a manner that in the two different positions of the symbol carrier when the detent member is engaged with one of the two projections the motor being in two different positions so that the polarity of a following pulse able to drive the motor is different in said two different positions.

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