

Jan. 29, 1946.

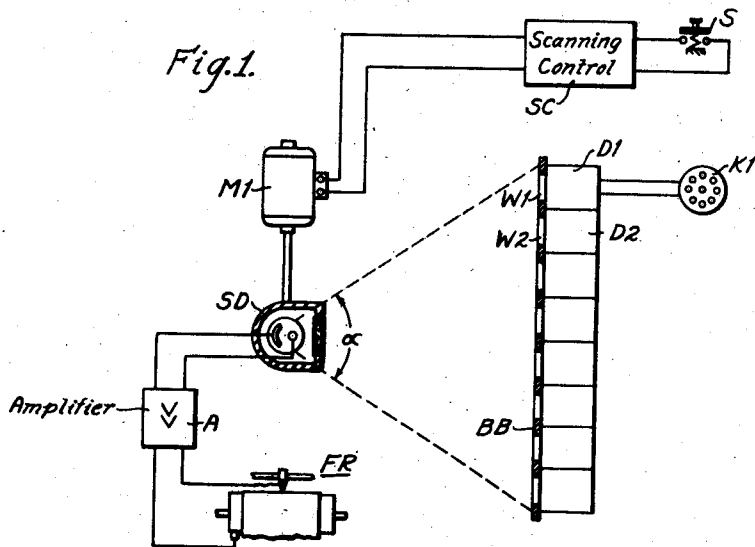
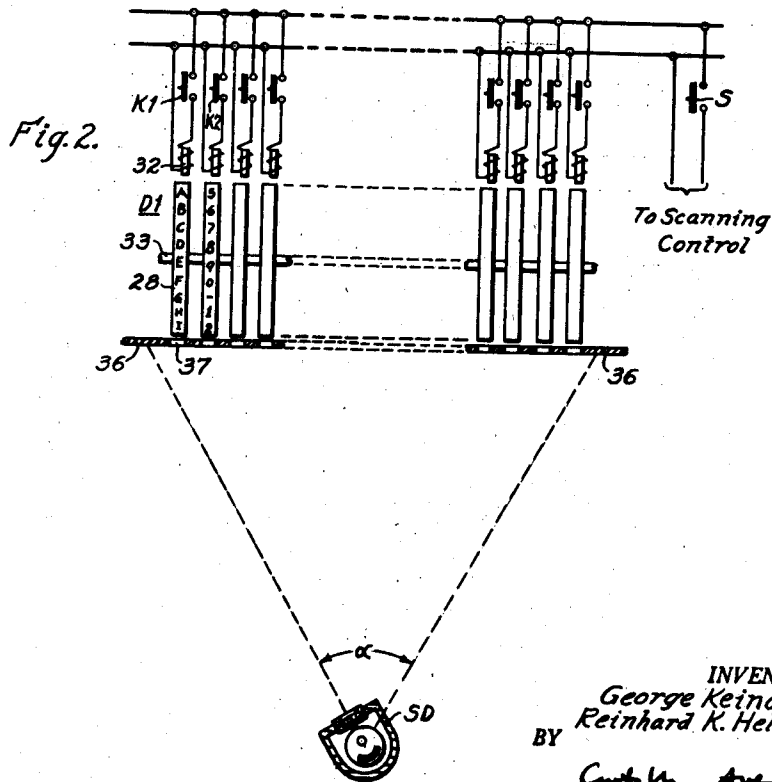
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2,393,638

METHOD AND MEANS FOR RECORDING INDICATIONS

Filed March 23, 1944

2 Sheets-Sheet 1



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Fig. 3.

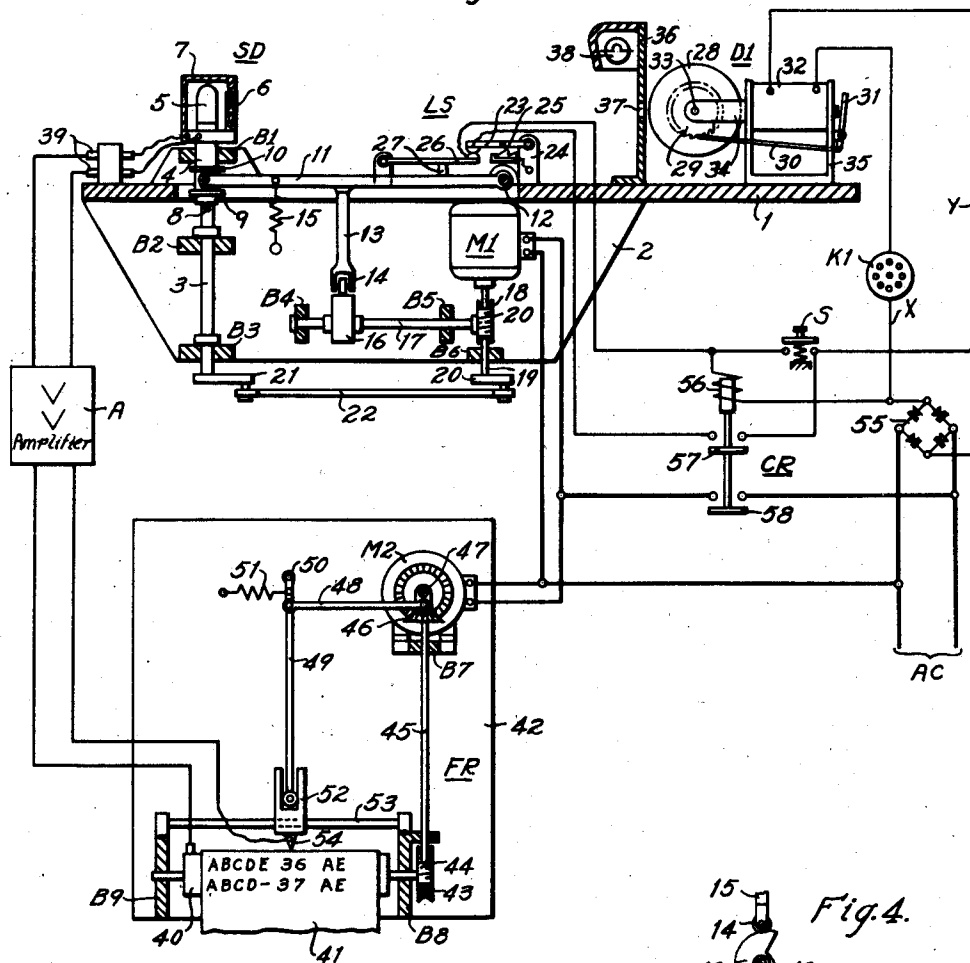


Fig. 4.

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## UNITED STATES PATENT OFFICE

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## METHOD AND MEANS FOR RECORDING INDICATIONS

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14 Claims. (Cl. 178-6.6)

Our invention is related to that of the patent application for Line-for-line recorders by George Keinath, Serial No. 527,773, filed March 23, 1944, and concerns methods and means for recording a group of letters, figures or other symbols indicative of relay positions, operating conditions or other data, for such purposes as transmitting or recording the operative condition of switches in power plants or distribution systems, indicating prices of stocks or commodities, reporting data concerning the operation or output of manufacturing plants, transmitting election returns, supervising the operation of railroads or operating conditions of public carriers in general, or recording the indication of billboards in flight centers, for example.

It is one of the objects of the invention to provide transmitting or recording methods and means of the above-mentioned type which are capable of operation at high operating speeds. More particularly, it is aimed by this invention at decreasing the time required for completing each individual recording of a group of symbols after a change has occurred as regards any of the symbols appertaining to that group. This object will be appreciated by considering the conditions prevailing in a concrete example of application of such a system. As such an example the requirements of a recording apparatus for flight centers are discussed in the following, although it will be understood that the invention is also of advantage for other uses of the kind above mentioned.

In a flight center, messages from airplanes in flight, concerning flight conditions, are continually received and orders to such planes are continually issued, and these data are manually transferred to a large billboard, each line of the board representing the data for one airplane at a certain time, such as altitude, speed, location or time of arrival. Each line is composed of numerous symbols, for instance, up to 32 letters and figures. Whenever a change occurs in such a line, the whole line is recorded on paper in order to have a permanent record. At present, this is done with tele-typewriters which have a speed of about five letters per second so that about six seconds are needed for recording each changed line. This is rather slow in cases where the indications change in rapid succession. Hence, our invention aims at reducing the operating time, for instance, to as little as about one second.

In order to achieve these ends, and in accordance with our invention, we proceed in the following manner. At first we select the symbols of

the group to be recorded and place them juxtaposed in a given reference position so that they form a single composite notation. As a result, only the selected symbols are simultaneously positioned, exposed, or visible for the subsequent recording operation. The next step is to produce an image of the complete notation formed by the selected symbols. When subsequently one or any number of the selected symbols is changed, the image producing recording step is repeated so that each time the changed complete notation is recorded. One way of producing the complete images of the notations is to scan the composite notation electrically and transmit the scanning impulses to a facsimile recorder, a new scanning and transmitting cycle being performed upon completion of each change within the group of data represented by the notation. Due to the fact that the recording operation proper is either virtually instantaneous or completed within a fraction of a second and that the time needed for making a change in a line or group of symbols is usually limited to a change of only one or a few symbols and hence much shorter than that needed for retyping the entire line or group of symbols, the total operating time is considerably reduced.

These and other objects and features of the invention, as well as the means according to the invention for achieving the above-mentioned advantages and performing the above-described method will be apparent from the following description of the embodiments exemplified by the drawings in which:

Figure 1 represents diagrammatically an annunciator and image recorder system designed and operative in accordance with our invention;

Fig. 2 shows schematically another embodiment of a system based on the principles of the invention, illustrating only the selective adjusting means and an appertaining impulse transmitting scanning device of the system;

Fig. 3 refers to the system of Fig. 2 and illustrates a different view of the same adjusting and scanning means in conjunction with the appertaining image producing recorder and the electric control circuits and devices, while

Fig. 4 is a separate view of a cam gear appertaining to the same system as shown in Fig. 3.

Referring to Fig. 1, letters BB denote a billboard or other indicating panel of the annunciator type. The board has several rows of windows, such as those denoted by W1 and W2 in the single row visible in the illustration. Each row corresponds to a group of individual indicating

devices such as those denoted by D1 and D2. Each indicating device, as will become apparent hereinafter, permits placing one of a group of selective symbols, i. e. letters, figures or other characters, behind the appertaining window. The selection is made by means of selective electric contact means, here diagrammatically represented by a dial switch K1 connected with device D1. Each indicating device has its own selector switch means, and all these means are located at a single control place to be actuated by the operator. Once all symbols of a row have been properly selected, a composite notation formed of the totality of these symbols will appear behind the windows of that row.

Also within reach of the attendant is a control switch S common to the whole row of symbols, or allotted to several rows of the billboard if desired. This switch controls an image-recording apparatus which comprises an impulse transmitting scanning device SD and a recorder FR of the facsimile recorder type. The scanning device is actuated by an electric motor M1 so that its scanning point performs a series of oscillations over a range indicated by the angle  $\alpha$  while moving once in a direction transverse to the oscillatory motion. Scanning control means SC are provided which cause the motor M1 and the scanning device SD to perform a single complete scanning cycle for each actuation of switch S. During each cycle, the area covered by the row or rows of symbols to be recorded in swept over by the scanning point and the electric impulses issuing from device SD are passed through an amplifier A to the recorder. The motion of the stylus of recorder FR relative to the recording surface is synchronized with the scanning motion of the transmitter so that the impulses cause the recorder to produce an image of the scanned row of symbols according to the known principles of electric picture transmission. Preferably, a separate scanning device SD is provided for each row of symbols, although several or all devices SD may cooperate with a single recorder FR. If the scanning angle  $\alpha$  becomes too large with a billboard of straight shape a curved or convex board BB may be provided. While details of apparatus suitable for performing the above-described operations will be referred to hereinafter, the diagram of Fig. 1, as explained, will permit understanding the following method of operation.

When the operator has completed adjusting a row of symbols so as to indicate on the billboard a full notation, he actuates switch S. This starts the scanning and recording apparatus to produce an image of the complete notation. The motor stops as soon as the image is completed. If a change is made in the notation, the operator again actuates switch S upon completion of the change. As a result, an image of the changed complete notation is recorded. Since such a change is usually limited to one or a few symbols and the image producing recording operation can be performed at high speed, the total time needed for recording a changed notation is considerably shorter than the teletyping method now customary.

In the system shown in detail in Figs. 2, 3 and 4, the images to be recorded are not taken directly from a billboard or the like large size device but are first reproduced in a special indicating device which forms part of the impulse transmitting scanning device. In Figs. 2 and 3, the frame or supporting structure of this indi-

cating and transmitting device has a base plate 1 provided with a rearwardly extending portion 2 and carries several bearings denoted by B1 through B6. A shaft 3, journaled in bearings B2 and B3 serves to drive the base member 4 of the scanning device SD. The photocell 5 of the device SD is focussed by a lens 6 which is mounted on a holder 7 attached to member 4. The base member 4 and all parts mounted thereon are axially displaceable relative to the shaft 3 but prevented by a feather 8 from relative rotation.

Two flanges 9 and 10 of member 4 form abutments for a guide roller carried by a lever 11 which, at 12, is fulcrumed to the base plate 1 and has a downwardly extending arm or follower 13 with another roller 14. A spring 15 fastened between lever 11 and base portion 2 provides an auxiliary biasing force tending to move lever 11 and member 4 in the downward direction. Roller 14 engages a spiral shaped cam 16 whose cam radius changes in proportion to its angular travel. As a result, the lever 11 and the scanning device SD are lifted at uniform speed from a lowermost position to a given upper position during one full rotation of cam 16. Upon completion of each cam rotation the device SD drops quickly back to its starting position and is then ready for a new cycle of lifting motion.

Cam 16 is mounted on a shaft 17, journaled in bearings B4 and B5, and has a worm gear 18 meshing with a corresponding gear portion on the shaft 19 of the drive motor M1. Shaft 19 is also connected with the drive shaft 3 of the scanning device, and this connection is formed by a transmission which causes the device SD to oscillate during continuous revolutions of the motor shaft 19. While it appears preferable to select for this purpose a transmission which, similar to the above-described cam drive, affords a substantially uniform scanning speed throughout the utilized scanning range of device SD, other types of transmission may also be employed; and we have chosen to exemplify a crank type connection for the sake of a simple and readily understandable illustration. The illustrated transmission comprises a crank 20 of relatively small radius fastened to shaft 19, a second crank 21 of larger radius mounted on shaft 3, and a connecting link or pitman 22 between the two cranks. When crank 20 is rotated, crank 21 with shaft 3 and device SD are caused to perform one complete oscillation through angle  $\alpha$  (Fig. 2) for each complete revolution of the motor shaft. During a given number of oscillations, this number being determined by the transmission ratio of shafts 19 and 17, the scanning device SD is simultaneously displaced in the upward direction as described previously and thus performs a resultant scanning motion.

A limit switch LS is mounted on base plate 1. The movable contact 23 of this switch is pivoted on a post 24 and biased by a spring toward a stop 25 so that it tends to engage another movable switch contact 26. Contact 26, in turn, is engaged by a lug 27 of lever 11. The electric engagement between contacts 23 and 26 is open only at the beginning of a cycle of axial motion when the contact 23 rests against the stop 25, but closed immediately after a cycle has been started and until the cycle is completed.

A number of symbol-carrying indicator members, hereinafter called "symbol wheels" are rotatably mounted on base plate 1. The symbol wheels are arranged coaxially. Each of them has

its peripheral cylindric wheel surface provided with a row of different symbols such as letters, figures or other characters. Each wheel, such as the one denoted by 28, has a ratchet gear 29 cooperating with a pawl 30 under control by the armature 31 of an electromagnet 32. The wheel shaft 35 passes through an arm 34 firmly attached to the frame structure 35 of the magnet. Each energizing impulse supplied to magnet 32 causes pawl 30 to advance the symbol wheel 28 one step. Hence, any of the symbols of the wheel can be adjusted to a given position by transmitting a corresponding number of impulses to the magnet.

An opaque partition 36 extends along all symbol wheels of the transmitting apparatus and has a number of openings 37 in alignment with one another in front of the respective symbols along the horizontal axial plane of the group of wheels. When the scanning device SD is actuated by motor M1, the scanning point travels first along the bottom side of the aligned openings 37 (Fig. 2) while being gradually lifted (Fig. 3). Consequently, the entire surface area of the row of openings and the line of symbols appearing behind them are scanned during one complete scanning cycle. A lighting fixture 38 extending along the partition 36 (Fig. 3) provides the necessary illumination.

The photocell 5 is connected by flexible leads with insulated terminals 39, mounted on base plate 1, to which the input circuit of an amplifier A is attached. A facsimile recorder FR has its recording means electrically connected with the output terminals of the amplifier A to be energized in accordance with the impulses issuing from the photocell. Various types of facsimile recorders, known for picture transmission, can be used for the purpose of this invention by adapting it to an intermittent line-for-line or cycle for cycle operation similar to that of the above-described impulse transmitting apparatus. In the illustrated example, such an operation is achieved in the following manner: The member or drum 40 for accommodating a recording strip 41 of electrolytic paper is journaled in bearings B2 and B3 of a support 42 and driven by a gear 43 meshing with a worm 44 which, in turn, is operated through a shaft 45 and a bevel gear 46 by an alternating current motor M2. Motor M2 runs in synchronism with motor M1 and hence in synchronism with the axial displacement of the photoelectric scanning device SD of the transmitter. As a result, the advance of the paper strip 41 is proportional to the axial or lifting motion of the scanning point of device SD.

The shaft 47 of the recorder motor M2 has a crank linked by a pitman 48 to a lever 49. The lever is fulcrumed at 50, to the support 42 and under the bias of a spring 51 serving to prevent dead motion within the crank connection. Lever 49 engages the carrier 52 of a stylus assembly which is guided by a bar 53 for parallel motion of its stylus 54 along the drum 40. The transmission ratio of the crank connection corresponds to that of cranks 20 and 21 of the scanning transmitter. Consequently, when both motors M1 and M2 are in operation, the stylus assembly is caused to oscillate in synchronism with the oscillations of the scanning point while the strip 41 advances slowly in synchronism with the lifting motion of the point. Stylus 54 and drum 40 are connected to the output terminals of the amplifier A. As a result, the amplified impulses coming from the photocell, as it scans the line of selected symbols,

are reproduced on the sheet 41 as an image of the same line of symbols.

Each electromagnet 32 of the indicating device is connected with the leads X and Y of a direct current circuit energized, for instance, from the above-mentioned alternating current line AC through a rectifier 55 (Fig. 3). Selective switch means are provided for each symbol wheel in order to permit passing a selected number of electric control impulses to the magnet 32, thereby adjusting the appertaining wheel 28 so as to place the corresponding symbol behind the opening 37. Since different types of such impulses transmitting control means are well known for telephone and telegraph circuits and not, as such, part of the invention proper, they are represented in Fig. 3 schematically by a single dial switch K1. If desired, reference may be had to the above-mentioned application Serial No. 527,773, containing a more detailed description and diagram of suitable high-speed selector switch means.

Another contact S, for instance a push button, is located close to the selector controls (K1) of the symbol wheels for actuation by the operator or automatically after the completion of a change in the line of symbols. During the short interval in which the push button S closes its contact, the coil 56 of a control relay CR is energized. It closes a self-sealing contact 57, thus preparing a holding circuit which is interrupted by the above-described limit switch LS when the motor M1 is at rest and the scanning device in its starting position. A second contact 58 of relay CR closes the energizing circuit of the motors M1 and M2 so that the motors start running. This causes the limit switch LS to close its contacts, as explained in the foregoing. Hence, when the push button S is released and reopens its contact, the relay coil 56 remains energized through the holding circuit X, 56, 26, 23, 57, Y so that the motors M1 and M2 continue their operation. After the completion of a given number of turns, for instance ten, the lever 11 and follower 13 drop back toward the starting portion of cam 16 and open the limit switch LS so that both motors are stopped. The motors remain then at rest until the push button S is again depressed.

Once switch S has been actuated, its further actuation has no effect on the control operation as long as the motor M1 has not completed a full cycle of operation. Upon such completion, however, a renewed actuation of contact S will start a new cycle.

It will be understood by those skilled in the art, upon study of this disclosure, that various changes and modifications may be applied in systems of the type above described without departing from the gist and essential features of our invention.

What we claim as our invention:

1. The method of recording indications formed by a group of selected symbols, which comprises the steps of arranging the selected symbols in a given reference position, exposing only the symbols to be recorded, producing an image of the group of simultaneously exposed symbols, and repeating the image production after a change of at least one of the symbols of the group so that each time a complete group is recorded by the image.

2. The method of recording indications formed by a group of selected symbols, which comprises the steps of selecting each symbol of the group from a separate multiplicity of different sym-

bolts and aligning it in juxtaposition with the other selected symbols thereby forming a composite notation, electrically scanning the notation as a whole for facsimile recording an image thereof, and repeating the scanning and recording step upon a change of one or several of the selected symbols so that each time a changed complete notation is recorded by the image.

3. A system for recording indications, comprising enunciator means for placing a group of individually selected symbols in a given reference position, electric impulse transmitting scanning means, drive means for oscillating said scanning means and moving it transverse to its oscillatory path so as to scan said group of symbols during a given cycle of scanning motion, and synchronous recording means connected with said scanning means for producing an image of said line of symbols.

4. A recording system comprising, in combination, a group of coaxial rotary members each having a peripheral row of different symbols, electric drive means associated with each of said members for rotating it so as to adjust a selected symbol along a given reference line, during a given cycle of scanning motion and synchronous recording means connected with said scanning means for producing an image of said line of symbols.

5. A recording system comprising, in combination, a group of indicating devices each having symbol means and selective control means for adjusting said symbol means so as to place a selected symbol into a given reference position, said devices being juxtaposed with said positions adjacent to one another so that the totality of simultaneously selected symbols form a composite notation, recording apparatus having a recording sheet and means for producing thereon an image of said notation and being provided with drive means for advancing said sheet between successive recording operations of said apparatus, and control means connected to said apparatus for causing said image producing means to record a single complete notation for each control actuation of said control means.

6. A recording system comprising, in combination, a group of juxtaposed indicating devices each having symbol means provided with a series of different symbols each having the configuration of a character to be recorded and selective control means for adjusting said symbol means so as to place a selected symbol into a given reference position, said devices being located one aside the other so that said positions are adjacent to one another, recording apparatus having means for accommodating a recording sheet and means for producing thereon an image of the totality of symbols located in said positions at a time, control means for operating said apparatus intermittently in order to produce one complete image at a time, intermittent drive means forming part of said apparatus for advancing said sheet, and means for controlling said drive means in dependence upon the operation of said first control means.

7. A recording system comprising, in combination, a group of indicating devices each having a rotatable member provided with indicating symbols and an electromagnetic step drive for placing one of said symbols into a fixed reference position, said members being juxtaposed with said positions substantially in alignment with one another so that the simultaneously selected symbols form a composite single-line indi-

cation, recording apparatus having a recording sheet remote from said symbols and image producing means for recording on said sheet a representation of said indication.

8. A recording system comprising, in combination, a group of indicating devices each having a rotatable member provided with indicating symbols and drive means for selectively adjusting the rotary position of said member independently of said other member, a partition positioned on one side of said members and having aligned openings in front of said members respectively so that, at a time, only one of the symbols of each member is behind the appertaining opening depending upon its selected position, recording apparatus having means for accommodating a recording sheet remote from said members and partition and means disposed near said members at the opposite side of said partition for recording, when actuated, an image on said sheet of the symbols simultaneously located behind said openings, and intermittent control means for actuating said record producing means so as to produce the image of a complete single line of symbols during each actuation.

9. A recording system comprising, in combination, a group of indicating devices each having a rotatable member provided with indicating symbols and an electromagnetic step drive for placing one of said symbols into a fixed reference position, said members being juxtaposed with said reference positions substantially in alignment with one another so that the simultaneously selected symbols form a single-line indication, recording apparatus having a recording sheet and means for recording on said sheet an image of said indication, and control means for actuating said apparatus after the completion of a change in said indication.

10. A recording system comprising, in combination, a group of indicating devices each having symbol means and selective control means for adjusting said symbol means so as to place a selected symbol into a given reference position, said devices being located one aside the other so that said positions are adjacent to one another so that the simultaneously selected symbols form a line, recording apparatus having a recording surface and means for producing thereon an image of said line, control means connected to said apparatus for causing said image producing means to record a complete line upon each actuation of said control means and drive means forming part of said apparatus for advancing said surface so that successively lines are recorded one above the other.

11. A recording system comprising a plurality of indicating apparatus each having an aligned group of selected symbol carrying means for forming a line of selected symbols, a recording apparatus and a plurality of impulse transmitting scanning means associated with said indicating apparatus respectively for causing said recorder to produce images of said lines, and means for controlling said scanning means and said recorder so as to produce an image of one of said lines at a time.

12. A recording system comprising, in combination, an aligned group of symbol wheels each carrying a row of different symbols on its peripheral cylindrical surface, means for adjusting each of said wheels to a selected angular position, an impulse transmitting scanning device for scanning a line of selected symbols of said group, drive means for actuating said device so as to complete the scanning of said line in a given

cycle of scanning movements, and a facsimile recorder synchronised with said drive and controlled by said scanning device for producing a record of said line.

13. A transmitting apparatus for facsimile recorders comprising a group of juxtaposed indicating devices each having a rotary member provided with a row of different symbols and electric means for rotating said member so as to place a selected symbol into a reference position aligned with the respective reference positions of said other member, impulse transmitting means, and drive mechanism for causing said scanning means to scan said line during a given plurality of cyclical motions.

14. Apparatus for recording indications, comprising a group of indicating devices each having a rotatable member provided with a peripheral row of symbols and means for selectively adjusting the rotary position of said member, 20

said members being arranged in a consecutive order, a partition positioned on one side of said members and having aligned openings in front of said members respectively so that, at a time, only one of the symbols of each member is behind the appertaining opening, recording apparatus having means for accommodating a recording sheet remote from said members and partition, and image control means disposed at the side of said partition opposite to said members for causing said apparatus to produce an image on said sheet of the symbols simultaneously located behind said openings, and intermittently operating control means for actuating said image control means and apparatus to produce a single complete image of all selected symbols during each actuation of said image control means.

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