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PHOTOELECTRIC DEVICE FOR ESTABLISHING IDENTICALNESS
OF TEXT AND ILLUSTRATION ORIGINALS, FOR EXAMPLE,
GEOGRAPHICAL MAPS AND REPRODUCTIONS OF THE LATTER

By

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PHOTOELECTRIC DEVICE FOR ESTABLISHING IDENTICALNESS OF TEXT AND ILLUS-
TRATION ORIGINALS, FOR EXAMPLE, GEOGRAPHICAL MAPS AND REPRODUCTIONS OF
THE LATTER

The known photoelectric devices for establishing the identicalness of text and illustration originals, for example, geographic maps, and reproductions of the latter are not very effective and prove to be very time-consuming and tiring.

The proposed device is designed in the form of two photoelectric heads, a modulator of voltage, an electron amplifier of alternating current, a phase-sensitive circuit, an electron unit of comparison, and a system of light and sound signaling. This makes it possible to eliminate the laborious visual process and heightens the precision of the collation.

In Fig. 1 there is a sketch of the principles of the circuit of the electron collating device. In Fig. 2 there is a diagram showing the principles of the electric circuit of the reversing of the carriage of the device described.

Light impulses of different intensity pass onto the photoelectric heads 1, 2 which contain a sensitive element 3 and an optical system 4 with a ring dia-

phragm 5, which serves for focusing the light impulses reflected from the surface under examination and to direct them onto the sensitive element. The photo heads 1, 2 are set on two synchronously shifting carriages, not shown on the drawing. When moving together with the carriage one of the photo heads accomplishes a line-by-line scanning of the original, and the second, reproductions.

The modulator of the voltage developed by the photoelectric heads 1 and 2 designed in the form of a C-shaped magnetic circuit 6 from material with great magnetic penetrability. On the side cores of the magnetic circuit there are wound the excitation coils 7 and 8. The coils are connected up to AC source 9. In an alternating magnetic field produced by the magnetic circuit 6 there is located the sensitive element 3 of the photoelectric heads 1 and 2. The voltage modulated by the AC with a frequency of 50 cps coming from the sensitive element 3 passes to the emitter repeater 10, which serves for matching the loads, and then further onto the amplifier 11. For the electron amplifier 11 there is used an amplifier with direct connection mounted on semiconductor triodes and operating jointly with the emitter repeater 10.

Into the collector circuit of the output triode 12 of the amplifier 11 there is connected the transformer 13. Into the secondary winding of the transformer 13 there is connected the phase-sensitive circuit, consisting of the transformer 14, the windings of which are connected is connected up in accordance with the circuit of the balancing bridge jointly with the semiconductor diodes 15, 16 17, and 18 and the bridging capacitor 19. By feeding onto one input of the phase-sensitive circuit amplified and modulated pulses from the photoelectric heads 1 and 2, and onto the other input alternating current from the source 9, one gets on the output of the phase-sensitive circuit a voltage depending only on the degree of action of the light flux onto the sensitive element 3.

With the aid of the alternating resistances 20, 21, 22, and 23 there is accomplished the initial setup of the given systems. The magnitude of the voltage on the output of the phase-sensitive circuit depends on the degree of action of the light beam reflected from the collated surface, which acts on the sensitive element 3. If under both photoelectric heads 1 and 2 there are placed surfaces, identical as to coefficients of reflection, then on the output of the phase-sensitive circuits the voltages will be equal. In the contrary case, even with slight difference in the coefficients of reflection of the surface, the difference in the voltage on the output of the phase-sensitive circuits will be considerable. The control of the magnitude of the diameter of the aperture with the aid of the ring diaphragm 5, and of the sharpness with the aid of the optical system 4, makes it possible to detect a difference in the thickness of lines with a precision of the order of 0.1 to 0.2 mm. In this way with a synchronous motion of the photoelectric heads 1 and 2 if they simultaneously find themselves on an image with equal coefficients of reflection and simultaneously converge with them, the voltages on their output will be equal. If on one of the photoelectric heads a line (for example, a black one) arrives earlier than the same line on the other, then in the photoelectric head drops sharply and in the second it remains unchanged since under it already has passed the black surface of the line. In this case the voltage from the outputs of the phase-sensitive circuits is fed onto the comparison unit. To serve as comparison unit there are taken electron logical circuits of the type I and NET the trigger cells of which are mounted on the semiconductor triodes 24, 25, 26, and 27.

The voltage from the outputs of the phase-sensitive circuits of the photoelectric heads 1 and 2 is fed onto the inputs of the logical circuits of the type I — I₁. With simultaneous and equal feed of the voltage onto the inputs 28 and 29 of the circuit I, on its output 30 there appears a

voltage, which is fed onto a logical circuit of the type NET. As a circuit NET there is used a trigger in one stable position. When onto the triode 26 there is fed a voltage from the circuit I_1 , on the triode 27 of this trigger the voltage falls away. If under one of the photoelectric heads 1 and 2 there passed, for example, a black line, the voltage on one of the outputs of the circuit I_1 will be absent. There will also be no voltage on the output 30, i. e., it will be taken from the point 31 of the circuit NET.

Since the trigger of the circuit NET has one stable position it returns to this position, having given out in so doing from the collector circuit of the triode 27 a voltage onto the input 32 of the trigger 33 onto the input 32 of the trigger 33 on two stable states. Trigger 33 made up on the triodes 34 and 35 passes over from one stable state to the other. At the same time the voltage is taken from the collector circuit of the triode 34, circuit 36 is connected in and lamp 37 which signalled the absence of error goes out. At the same time with this there appears a voltage and lamp 38 lights up, circuit 39 operates—signal of error. When under the photoelectric heads there are surfaces with equal coefficients of reflection errors are absent, the trigger 33 from the triode 34 gives out a voltage, not only onto circuit 36, but also onto the input of the logic circuit I_X . With the aid of this circuit line after line according to a determined system of movement the whole surface to be collated is scanned. When an error is detected the signal lamp 38 lights up or a sound signal is connected in (circuit 39), and the carriage with the photoelectric heads 1 and 2 fastened on it stops.

For reversing the motion of the carriage there is an electron device controlled with the aid of magnetic pickup-limiters 40 and 41 the pulses of which are fixed by the tracking electromagnetic element 42 fastened on the carriage, this element being designed in the form of a ferrite ring, the

winding of which is connected up to the electron amplifier and the control circuit 43, which contains the semiconductor triodes 44, 45, and 46.

The magnetic pickup-limiters 40 and 41 are constituted by rectangular small-dimensioned permanent magnets set up on the parallels 47 along which the carriage moves. It is possible to shift them and fasten them at the proper places as depends on the required shift along the vertical and horizontal. In the passing of the tracking element 42 under the pickup in the winding of the element a voltage is excited, which is fed onto the amplifier 43, where it is amplified and from the collector of the input triode 46 it passes onto one of the inputs of the logic circuit III_1 made up on the triodes 48 and 49. Onto the other input of the circuit III_1 there is fed the voltage "start" when the start button 50 is pushed. From the output of the logic circuit III_1 the voltage from the signal of the tracking element 42 passes across the emitter repeater 51 made up on a triode, onto the retardation line 52 and the base of the triode 53 of the trigger 54, made up on the triodes 55 and 53 for one stable state. From the output of the emitter repeater 51 this same signal voltage passes to the base of the triode 56 of the trigger 57, which holds the triodes 56 and 58 with one stable state.

If the carriages together with the photoelectric heads fastened on them move along the horizontal from the left edge to the right, then the trigger 57 finds itself in the first stable situation, as well as the trigger 54. The output of the trigger 57 through the capacitor 59 and the divider diode 60 is connected with the base of the triode 61 of the trigger 62. The trigger 62 finds itself in such a stable situation when its triode 63 is open, and negative voltage does not pass from its collector onto the base of the triode 64. Into the collector circuit of the triode 64 there is connected the triode 65, which works in the system of the key. With triode 64 closed

triode 56 is open and gives out a voltage onto the pulse generator 66 set up on the triodes 67 and 68 and constituted by a symmetrical multivibrator with capacitative connections. The pulse voltage passes from the output of the triode 68 through the diode 69 onto the base of the triode 70 of the logic circuit 71, but onto the base of the triode 72 there is fed a control voltage from the output of the triode 34. Since onto the two inputs of the circuit 71 there are fed simultaneously voltages, on the output of the triode 70 there appears a pulse voltage, which passes across the circuit III_x onto the input of the ring closed counter 73. The direction of the turning of the step electric motors 74 depends on the direction of the motion of the pulses on the ring country 73

Such a reversing of the pulses is accomplished with the aid of the trigger 75 of the reverse and four double rectifiers 76, 77, 78, and 79. From the output of the reverse counter 73 pulses from the generator 66 pass onto the amplifiers of the power 80, 81, and 82, and further to the electric motor 74, which shifts the carriage horizontally with the aid of a ball screw. This motion will continue as long as the generator 66 develops voltage pulses. When the carriage is moving horizontally only the generator 66 is working, but the generator 83, made up on the triodes 84 and 85, is cut out.

If one of the photoelectric heads detects an error on the collated material the trigger 33 switches over to the other stable situation, the voltage is taken off of the output of the triode 34, and it does not pass onto the input of the circuit 71. The logic circuit 71 closes and does not let through pulses onto the input of the counter 73, the step electric motor stops, and it stops the carriage at the place of detecting the error. Having removed the error, the operator by pressing the button 86 feeds the voltage to the base of the triode 34 of the trigger 33. The latter changes over to the

other stable situation, on the output of the triode 34 a voltage appears, and passes to the input of the circuit 71, which opening up lets through pulses to the counter 73, and the movement of the carriage along the horizontal continues. If keeping on an error is not detected in the collated material, and the carriage with the magnetic head has gone to the magnetic pickup 41, then in the winding of the tracking element 42 a voltage pulse is excited, which on being amplified by the amplifier 43, through the circuit ILI_1 , passes onto the input of the emitter-repeater 51, and from the output of the latter onto the base of the triode 56 of the trigger 57. Simultaneously this same voltage pulse from the output of the emitter repeater 51 passes through the retardation line 52 onto the base of the triode 56 of the trigger 54. A pulse from the tracking element 42 after passing onto the trigger 57 connects it over into the second unstable situation. Meanwhile from the collector of the triode 58 a pulse passes onto the base of the triode 61 of the trigger 62.

On the termination of the pulse the trigger 57 returns to the first stable situation. The pulse having passed to the input of the trigger 62 switches it over and from the collector of the triode 63 a negative voltage through the divider diode opens up the triode 64 and the latter closes the triode 65. The voltage of the feed to the generator 66 is switched off and the feed of the pulse onto the input of the counter 73 is cut off. The horizontal motion of the carriage is stopped also. The pulse having passed from the output of the emitter repeater 51 onto the base of the trigger 54 is retarded by the line of retardation 52 for the time necessary for the full stopping of the carriage moving horizontally, and only after complete stopping of the carriage the trigger 54 switches over into the second unstable situation. The trigger 54 gives out a pulse onto the base of the trigger 87, made up

on the triodes 88 and 89. At the same time this same pulse is passed onto the trigger 90 of the reverse, which changes the direction of the movement of the pulse along the ring of the counter 91.

The trigger 87 switching over from the pulse coming from the trigger 54 onto the second stable situation gives out from the collector of the triode 89 a negative voltage onto the base of the powerful triode 92, which works in the switch system. The latter on opening closes the circuit feeding the pulse generator 83. The pulse generator begins to work and give our pulses onto the input of the pulse counter 93, made up on the triodes 94, 95, 96 and 97, and onto the ring closed counter 91 through the logic circuit III_1 .

Pulses from the from the output of the counter 91, through the power amplifiers 98, 99, and 100, turn the step electric motor 101, shifting the carriage down along the vertical until it moves the given distance. On the passing through the counter 93 of the necessary number of pulses on its output there appears one stop pulse passing through the emitter repeater 102 onto the base of the triode 89 of the trigger 87 and returns the latter to the first stable situation. The trigger 87 in switching over closes the triode 92. With this the feed to the generator 83 stops, and the passing of pulses from it, both onto the input of the counter 93 of pulses, and onto the input of the ring closed counter 91, i. e., the movement of the carriage downward along the vertical, ceases.

The pulse from the output of the counter 93 passes through the retardation line 103, which serves for retarding the passing of the pulse as a start signal onto the inputs of the trigger 104 for the time necessary for the full stopping of the carriage in its movement along the vertical. In feeding the pulse as a start signal onto the bases of the triodes 105 and 106 of the trigger 104, the latter, in passing over from one stable situation to the other, gives out a voltage onto the logic circuits III_2 and III_3 , made up,

respectively, on the triodes 107 and 108 and 109 and 110. Through the logic circuit $11I_3$ the voltage passes onto the trigger 90 of the reverse, which, together with the double rectifiers 111, 112, 113, and 114 accomplishes the reversing of the pulses. To this end, in order to retard the switching in of the pulse generator 66 somewhat, the voltage from the collectors of the triodes 67 and 68 is fed to input of the circuit $11I_2$ through the retardation line 115 and 116.

With the photoelectric device described when working with material of one scale it is not necessary to set the photoelectric head on the carriage of the second plotter. In this case one can use the rigid metallic construction, on the ends of which there are fastened the photoelectric heads, and the construction itself is fastened to the carriage of the left plotter in such a way that the left photoelectric head scans the work surface on the left plotter, and the right on the right. In working with materials with different scales the photoelectric heads are set up separately.

The device described makes the process of collating automatic, increases considerably the productivity of the work, and eliminates the possibility of missing errors on the collated original. The accuracy of the collating with the use of this device does not depend on the individual peculiarities of the operator, i. e., subjective error is eliminated.

Subject of the Invention

1. A photoelectric device for establishing the identicalness of text and illustration originals, for example, of geographic maps and reproductions of the same which is distinguished by the fact that, for the purpose of eliminating the laborious visual process, and for increasing the precision of the collating, it is designed in the form of two photoelectric heads, one of which accomplishes the line-by-line scanning of the original, and the other the

the reproductions, whereby the photoelectric heads are set up on two synchronously shifting carriages, an electronic amplifier of alternating current developed by the photoelectric heads, a phase-sensitive circuit, and electron comparison unit, and also a system of light and sound signalling.

2. A photoelectric device in accordance with 1 which is distinguished by the fact that the modulator of the voltage developed by the photoelectric head is designed in the form of a C-shaped magnetic circuit the excitation coils of which are connected up to a source of AC while in the alternating magnetic field formed by the magnetic circuit there is placed the sensitive element of the photoelectric head.

3. The form of the design of the device in accordance with Pars. 1 and 2 is distinguished by the fact that as an amplifier of the direct current there is used an amplifier with indirect connection built on semiconductor triodes and working in conjunction with an emitter repeater.

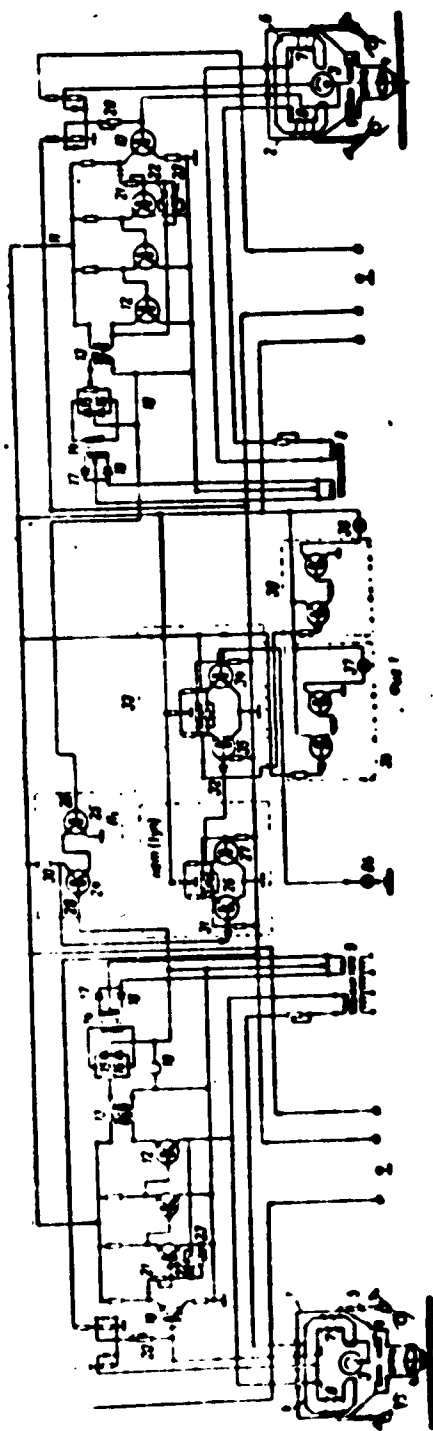
4. The form of the design of the device in accordance with Pars. 1 — 3 is distinguished by the fact that a phase-sensitive circuit switches in a transformer the windings of which are connected up to the circuit of a balancing bridge jointly with semiconductor diodes and a bridging capacitor while on one input of the circuit there are fed amplified and modulated pulses from the photoelectric head and onto the second alternating current from a power transformer.

5. The form of the design of the device in accordance with Pars. 1 — 4 is distinguished by the fact that as a comparison unit there are used electron logic circuits of the type I and NFF the trigger coss of which are built up on semiconductor triodes.

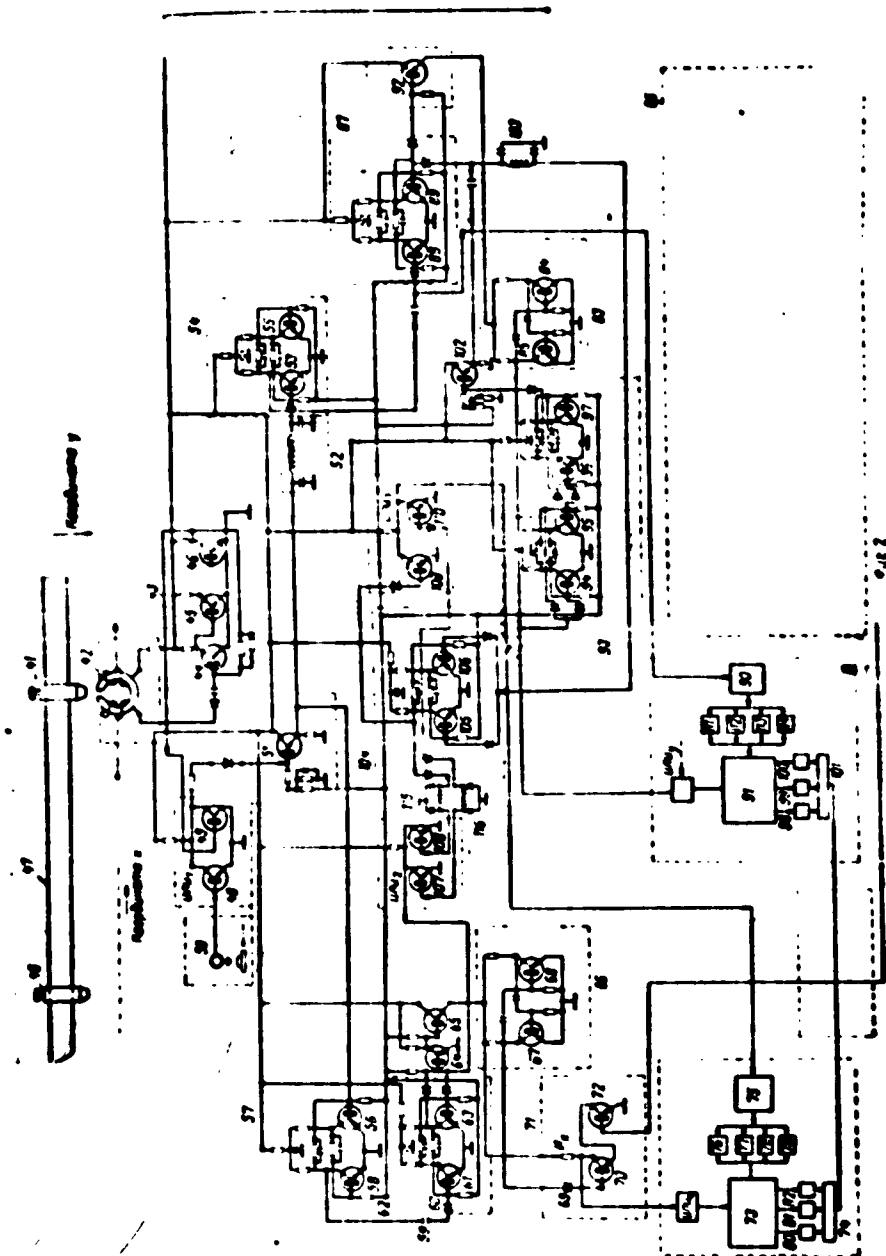
6. The use of the photoelectric device in accordance with Pars. 1 — 5 jointly with the electron device for reversing the movement of the carriages which is regulated with the aid of magnetic pick-up limiters, the pulses

or which are fixed by a tracking magnetic element the winding of which is connected up to an electron amplifying and controlling circuit.

Figs. 1 and 2 follow:



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