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AN AUTOMATIC COUNTING AND RECORDING DEVICE

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This article states briefly the conditions, which an apparatus has to satisfy for counting manufactured articles and semi-finished products, and recording the work and idling of each unit of a manufacturing plant. A description is given of a counting recording device which satisfies the presentation requirements and is calculated to handle 20 machines simultaneously. The device consists of a corresponding number of transmitting elements and the counting and recording apparatus; the latter is comprised of integrating mechanisms and a recording apparatus, marking the completion time for production of each recorded unit (1000 manufactured articles) for every machine individually, by a line on the counting and recording card.

In mass production, the counting of manufactured articles and recording the work of every unit of manufacturing equipment acquires great importance. Automatic counting and recording not only reflect the results of the work in the plant and factory, but also influences mass production.

The counting and recording card, filled in automatically, reflects the working rhythm of every machine and serves as an objective indicator of its production and standstills at different times of the day. This is one of the conditions for proper production management, technically and organisationally having the goal of increased production output with the same facilities and labor force. The presence of an objective recording instrument increases the interest of the workers in raising the level labor productivity. Studying the counting-recording cards per-

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taining to different time intervals, makes it possible to analyze mass production, and to determine the influence of technical and organizational measures that have been carried out. Information on actual production of each manufactured unit makes possible a fixed time for repairs on a technical basis; these data also permit ~~also to~~ keeping track of the transportation of material and semi-finished articles throughout the shops and factory, and to point out the points where ~~the~~ unfinished production accumulates, and rejets appear. Automatic counting and recording simplifies the transport-technological line, since there is no more need to transport the production to the recording points and back again to the benches, reducing ~~decreasing~~ at the same time the number of persons handling the work.

In various factories and in individual shops certain requirements are formulated ~~made, in~~ regarding ~~to~~ systems of counting and recording, which permit the complete or partial utilization of the mentioned possibilities, and therefore the corresponding installations are very diverse in ~~their~~ operating principles and ~~in~~ construction features.

The device described below aims to satisfy as completely as possible the requirements presented in counting and recording mass production. The general diagram of the device is shown in Fig. 1. The device consists of three basic parts: the transmitting elements, the integrating mechanisms, and the recording apparatus.

The machine whose work is to be recorded, is equipped with a transmitting element conveying the primary electrical impulse during the passage of one piece of work. The number of machines served and the equal number of transmitting elements determine the capacity of the installation comprising 20 items for the device described.

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At a high production tempo when tens of thousands of ~~products~~ items pass through every machine during ~~a~~ shift, it is ~~un~~ advisable ~~not~~ to register every ~~product~~ item produced, but rather to use consolidated indicators in order that the quantity of registered recorded units does not exceed ~~several tens~~ a few score. Consequently, it is necessary, first of all, to summarize the primary impulses of the transmitters. This operation is accomplished through the integrating mechanism which conveys the secondary impulse, when the number of the primary impulses form a computed unit ~~which~~ that is recorded.

The secondary impulses act on the recorders, which are joined together in the recording apparatus, and on one sheet of steadily moving paper every recorded unit of production which passes through each machine is marked down with a convential symbol (line). Thus, every bench has its transmitter, integrating mechanism and recorders. ~~Such~~ This is the general system for all the counting-recording devices. Let us ~~look over~~ examine in detail ~~its~~ the separate elements.

The machines - presses - equipped with this device, had individual electric drives. A special characteristic in this case is that during the working stroke (or with some phase displacement), ~~then~~ the power required by the electric motor increases ~~abruptly~~ suddenly. Fig. 2 ~~pictures diagrammatically~~ shows the oscillogram of the electric motor current intensity. During the working stroke the current intensity increases rapidly up to a maximum value i_{max}, and then decreases gradually to i_{min} ~~after which everything repeats again~~. When the machine is idling, the current intensity drops to i_0. This variation-characteristic of the current intensity in the electric motor circuit was utilized in developing the transmitter, called "impulse"; actually, it represents an overload relay. In reality the armature of

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the impulse transmitter has to remain in its extreme position, when the current intensity does not exceed i_g, and passes into its other extreme position when the current intensity exceeds i_g. The greater the relationship i_{max}/i_g, the more reliable is the work of the impulse transmitter.

In designing the transmitter system, special characteristics of its operation under the given conditions have to be considered: without disturbing the adjustment, it must withstand an extremely heavy overload when the machine is started; it must operate during a long period of time, in spite of tens of thousands of impulses daily, ~~etc. and so on.~~ ~~Fig. 6 shows the impulse transmitter (with cover removed).~~ The magnetic circuit of the impulse transmitter consists of an L-shaped bracket with a horizontally arranged cylindrical core on which is placed a winding connected in series with one of the wires of the electric motor. There is a weight on the armature which causes it to remain normally in a pulled - out position; the adjustment of the transmitter is carried out by shifting the weight on the armature. This type of transmitter ~~proved~~ durable, when operating ~~qualities~~ under production conditions ~~during~~ for a period of several months, without additional adjustment.

Let us go on to the following part of the counting-recording device--the integrating mechanism. The schematic diagram of the mechanism is shown in Fig. 1. The magnetic circuit consists of an L-shaped bracket and a cylindrical core on which a coil is placed. The armature of the integrating mechanism is not shown in Fig. 1, because a cross section is presented here. With each current impulse sent by the transmitter to the coil of the integrating mechanism, the armature turns the step gear one tooth ahead, with the ~~help~~ aid of a lever and a spring. The working principle of the

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armature system--step gear is identical to ~~the~~ an analogous principle used in telephony. On the shaft of the step gear there is a screw which turns the worm gear. On the same shaft with the latter, a cam having one gear tooth is fitted on. During rotation of the cam its gear tooth acts on the contact set, and, by closing it, conveys the secondary impulse.

In the device examined, the step gear of the integrating mechanism had 25 gear teeth, the worm screw--single-cut, the worm gear--40 gear teeth; thus, one recorded unit corresponded to 1000 ~~products~~ items produced.

~~It is necessary to take into consideration that~~ The step gear push-rod is the part of the ~~whole~~ counting and recording device ~~which is~~ most susceptible to wear and tear; Therefore, the construction of the push-rod must permit very simple replacement. For the same reason, the integrating mechanisms should be easily accessible from every direction for repairs and examination. ~~Fig. 4 shows the integrating mechanism, assembled in the counting-recording device with 10 units on a hinged rockr~~

The recording apparatus consists, basically, of two joined parts - the paper pulling mechanism and the ~~writing~~ printing device. ~~Referring to~~ The ~~writing~~ printing device, ~~it is possible to~~ produces automatically, by various means, conventional symbols on paper when an electrical impulse is received. The most prevalent method in many self-recording devices is an ink entry by pen, operated through an electro-magnet. However, the utilization of this method under the considered circumstances would be inconvenient due to the necessity of caring for a large number of pens, refilling them with ink, etc. Therefore, another

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method of recording the impulses was employed, whereby the printing part operates reliably for a long, uninterrupted, periods of time, without any maintenance. A typewriter ribbon is used as the coloring material. The printing instrument--recorder--represents the usual electro-magnet (Fig. 1). Its armature is L-shaped and forms one unit with the printing plate. The fin of the printing plate is 0.5 mm wide and 6 mm long; the lines obtained on the paper are of the same length. All the recorders, equal in number to those of the transmitters, record on the same sheet of paper, and have, therefore, to be assembled close to each other in two rows. (Fig. 6).

The arrangement of the Printing screw (Meyer's spiral) is seen in Figs. 1 and 6. It is composed of a shaft, V, on which a spiral groove is cut 0.3 - 0.5 mm deep. Along this cut a tightly pulled steel wire, S, (0.7 - 1.0 diam) is wound, fastened securely to the shaft ends. Thus, the wire forms a protuberant spiral line. The Printing screw turns slowly during the operating period (2-5 rotations per min.).

The lines are printed on the paper as follows: the paper P and the coloring ribbon L are inserted between the fin of the Printing plate R and the wire of the writing screw. In a normal condition, when the current does not go through the recorder and its armature is not pulled in, the fin of the Printing plate does not press against the ribbon, the paper, or the wire of the writing screw. When current passes through the recorder, its armature is pulled in and the Printing plate presses its fin against the coloring ribbon.

If the Printing screw were not rotating the ribbon would make a dot imprint on the paper at the pressure point.

When the Printing screw rotates, the Paint where the Printing

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plate presses the fin will move steadily and leave a line trace on the paper. If the time of the current flow in the winding of the recorder exceeds the time of one full rotation of the ~~writing~~ printing screw (which can easily result) the length of the line imprinted will be equal to the length of the ~~writing~~ printing plate fin of the recorder.

The same ~~writing~~ printing screw is used for all recorders, and also the same ~~coloring~~ ribbon, repeatedly re-wound in opposite direction from one spool to the other, as in a typewriter. The speed of the motion is not important, 2--20 mm/hr is sufficient. For better exploitation of the entire width of the ~~coloring~~ ribbon L ~~the ribbon~~ is arranged (Fig. 7) in a slant direction with respect to the lines of the fins R of the recorder ~~writing~~ printing plates P.

The recording of lines on the paper, using recorders of the above type and a typewriter ribbon have a number of advantages since an appliance of this kind does not require any care and is always ~~found~~ in operating conditon ~~during a~~ for periods of many months.

The other part of the recording apparatus is a paper-pulling mechanism. The paper used in the recording apparatus can be of blank form, typographically imprinted; the counting and recording device will insert the lines in the empty vertical columns. Under the same headings, ~~these~~ dates, ~~the~~ numbers of the machines, plants, counting-recording cards, etc., are filled in by hand. One can also use a roll of printing paper for entries and tear off the filled in card at shift change.

The main part of the paper-pulling arrangement is the drum (Fig. 1) equipped with a clamping device to fasten the ~~end~~

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of the blank paper. To avoid warping or displacing the paper, it is put between two felt pads which act as a brake.

The paper-pulling drum is rotated by a synchronous electric-motor, in order to assure better speed stability of the moving paper. It is advantageous if the drum makes a full rotation in exactly 12 hrs. The drum diameter is selected in order to obtain a paper speed of 20 mm/hr. It is clear that reduction gears with a very high gear ratio (1.080000 if the electric-motor rotates at 1500 rpm) have to be installed between the shaft of the electric-motor and the shaft of the paper-pulling drum. The reduction gears of the counting-recording device placed in use consist of two pinion gears and three worm gears, placed in one oil gear box. The ~~writing~~ Printing screw ~~was~~ is rotated at one of the intermediate gear ratios of the reduction gears.

We have noted that the counting-recording card should make it possible to check the working rhythm of every machine, i. e., permit the determination of the completion time for each production unit recorded for any of the machines or to determine the places and ~~duration~~ length of idle periods. This will be achieved if the time of starting and stopping of the entire installation is recorded on the counting-recording card by means of a button-switch of one of the recorders, especially designated for this purpose. Knowing the paper speed and the time when the marks were recorded, it is easy to arrange the hours and minutes over the entire length of the counting-recording card in millimeters.

If the shop has a standard systemized clock system, it is easy to connect in the circuit of the recorder assigned to register the time, a special integrating mechanism in parallel with the button used for manual marking. This mechanism should have a gear ratio of 60; being controlled by each minute impulse

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of the clock system it will make hourly marks on the counting-recording card. In shops with this clock system, the electric motor and the reduction gears can also be ~~substituted for~~ replaced through by a very simple installation (mechanism of an electric clock) supplied with impulses every minute and rotating the paper-pulling drum. It is expedient, in such a case, to rotate the ~~writing~~ screw of the recording apparatus by means of a Warren motor.

For inserting and removing the counting-recording cards and also for inspecting the recorders, the rack on which they are mounted is hinged ~~(Fig. 8)~~. ~~The lines obtained on the counting-recording card are also shown here~~.

The electro-technical system of the counting and recording device is simple; its fundamental elements are shown in Fig. 9. The supply for the integrating mechanisms should be direct current ~~taken~~ from a rectifier, since with a production rhythm of one hundred articles per minute the duration of a transmitter impulse is 0.1 sec. If the integrating mechanism were supplied with alternating current, it ~~could~~ may start vibrating during its movement from one extreme position to the other, producing errors in the step gear rotations. The supply for the recorders is taken directly from the alternating current system, since the vibration of the armature does not have significance here.

In conclusion we shall point out that the counting and recording device could be utilized for signaling to a central dispatch point the status of the work of the machines or their stand-still. This could be accomplished, for example, with the aid of neon signal-lamp table in parallel with the electro-magnets of the integrating mechanism. During every impulse conveyed by the

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transmitter, the corresponding neon lamp on the table could flash and thus provide signals concerning the work of the machines.

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Figure 1: Diagram of the counting and recording apparatus

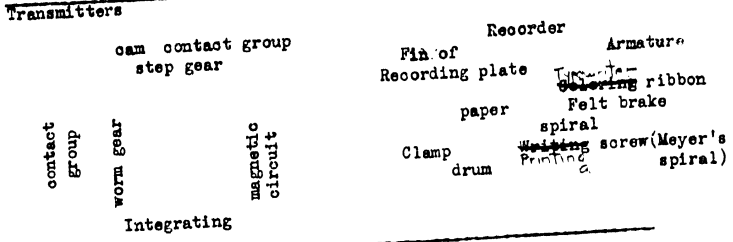

Figure 2: Schematic oscillogram of current in the circuit of an electromotor press.

Figure 3: Impulse transmitter

A - Winging; E - stop screw on the armature B, pressing on the contact set K; g - stop nuts holding the armature; H - insulating plate of contact set; L - commutator bar; M - contact nuts; P - base; Q - weight; R - fin of armature; S - magnetic circuit; T - pins for cover

Figure 4: Two groups of integrating mechanisms; at left- the recording apparatus; at right - the electric-motor;

Figure 5: Recorders

Figure 6: Method of recording the lines on paper

Figure 7: Relative position of recorders and the ~~coloring~~ ribbon

Figure 8: Recording apparatus

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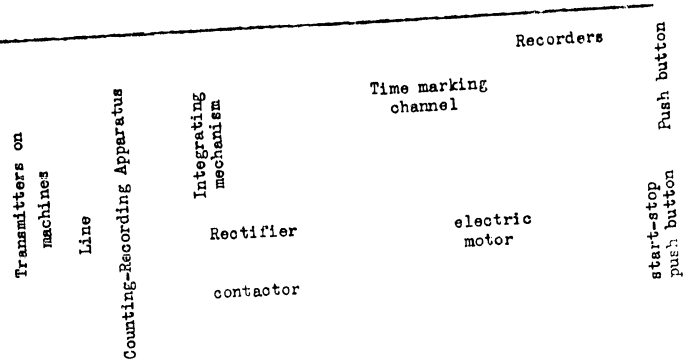
Figure 9: ~~Skeleton~~ Block diagram of Counting and Recording Apparatus



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