A photoresistor PR and an actuating section AS form the cell of the threshold circuit in converters of the PFS type (Fig. 1) in which the cell corresponds to a specific sorting group in a monitoring-sorting robot when the item is situated in the measurement position and the light index LI of the converter illuminates the photoresistor corresponding to the size of the item. If the conductivity of the illuminated photoresistor becomes equal to or greater than the threshold value G t, then the actuating section which is situated in the circuit of this photoresistor transmits a signal to the sorting circuits (not shown in Fig. 1) for closure of the contact Pb. For item sizes which are close to the limiting values for two neighboring sorting groups the light index simultaneously illuminates two neighboring photoresistors. In order to eliminate the entry of information via two sorting channels it is usual to introduce normally closed contacts CAS of the actuating sections into the circuit. For operation of the actuating section its contact breaks the power-supply circuit of all subsequent cells, thereby creating predominance of one sorting group over the other [1].

At present, no consideration is given to the fact that the choice of predominance of one group over the other has a substantial effect on the reliability and performance of the robot in the design of high-performance robots in which measurement stations of the "knife" type are used and the items are monitored while they are in motion. In such robots the voltage is applied to the circuit through the contact Pb during a period of time t t, but only one item I1 is under the knife K (Fig. 2). Before the departure of this item from under the knife, the next item I2 moves under the knife. Under these conditions three cases may be observed. In the first case, the size of the item I2 is smaller than the size of the item I1. Then, the light index shifts from the photoresistor PR I1 corresponding to the size of item I1 to the photoresistor PR I2 corresponding to the size of item I2 only after the departure of item I1 from under the knife. In the second case, the size of item I2 is greater than the size of item I1, and the light index shifts from the photoresistor PR I1 to the photoresistor PR I2 immediately after entry of item I2 under the knife. In the third case, the sizes of items I1 and I2 are equal, and the light index is situated on the same photoresistor.

With allowance for the fact that the time required for the light index to move from one photoresistor to the other is considerably shorter than the time for which the light index is situated on the photoresistor itself, the time T de allotted to the decay of the conductivity of the photoresistor PR I1 may be taken to equal the time T r allotted to the rise of the conductivity of the photoresistor PR I2. Then T r and T de are equal for the following cases at the instant that voltage is applied to the circuit:

- first \( T_{r1} \approx T_{de1} = t_c - (t_t + 0.5 t_c) \);
- second \( T_{r2} \approx T_{de2} = t_c - t_t \);
- third \( T_{r3} \approx T_{de3} = (t_c + 0.5 t_c) (n-1) \),

where \( t_c \) is the time required for one operating cycle of the robot; \( t_c \) is the time required for the item to pass through the error sector (the presence of an error sector is due to the errors in the robot parameters, as a consequence of which constancy of the measurement of an item at a specified point along the knife is
As is well known, the conductivity of photoresistors under illumination and in darkness varies according to a law close to an exponential law [2]. Figure 3 displays the graphs for the time variation of the conductivity of the photoresistors. Curve 1 characterizes the rise, while curves 2, 3, and 4 characterize the decay of the conductivity as a function of the initial value. During the time $T_{r1}$ the conductivity rises from zero to the value $G_{r1}$, while during the time $T_{r2}$ it rises to the value $G_{r2}$; during the time $T_{t}$, it rises to the value $G_{r_{max}}$ for several successive items that are close in size.

Let us dwell solely on the worst case in which the conductivity of the photoresistor $PR_{I1}$ has reached the value $G_{r_{max}}$, while an item $I_2$ whose size differs from the size of the preceding item $I_1$ has moved under the knife.

On arrival of the item $I_2$, which has a size smaller than the item $I_1$, under the knife the conductivity of the photoresistor $PR_{I1}$ will drop to the value $G_{de1}$ during the time $t_{de1} = t_{ri}$ (Fig. 2), while the conductivity of the photoresistor $PR_{I2}$ will increase to the value $G_{r1}$. If the threshold circuit is designed in such a way that the sorting group having the greater size has predominance (large-size predominance - LSP) (i.e., the cell $PR_{1}$, $AS1$ - see Fig. 1 - corresponds to the group having the largest size, while the cell $PR_{n}$, $ASn$ corresponds to the group having the smallest size), it follows that for reliable operation of the robot it is required that the threshold conductivity be within the limits

$$G_{r1} > G_{t} > G_{de1},$$

for predominance of the sorting group which is smaller in size (small-size predominance - SSP) the condition for reliable operation is determined by the inequality

$$G_{r1} > G_{t}.$$  \hspace{1cm} (2)

For condition (2) the cell of the threshold circuit corresponding to the size of item $I_2$ breaks the circuit which supplies all of the remaining cells, including the cell corresponding to the size of the item $I_1$, by opening its contact $CAS$.

When the item $I_2$ having a size greater than that of the item $I_1$ arrives under the knife, the conductivity of the photoresistor $PR_{I1}$ will drop to the value $G_{de2}$ during a time $t_{de2} = t_{t}$, while the conductivity of the photoresistor $PR_{I2}$ will increase to the value $G_{r2}$.

Then in the LSP the conditions for reliable operation must correspond to

$$G_{r2} > G_{t},$$

while in the circuit with SSP we have

$$G_{r2} > G_{t} > G_{de2}.$$

From (1) and (3) we derive the general condition for reliable operation of a threshold circuit with LSP:

$$G_{r1} > G_{t} > G_{de1},$$

while from (2) and (4) we derive the general condition for reliable operation of a threshold circuit with SSP:

$$G_{r1} > G_{t} > G_{de2}.$$

For a comparison of conditions (5) and (6), it is evident that in (6) the allowable limit of variation of the threshold photoconductivity is wider. But, since there is a variation of the supply voltage, a drift of the parameters of the photoresistors and of the actuating devices with time and other factors may affect the value of $G_{t}$, it follows...