In continuous conveyer scales the quantity of material that passed over the scales is determined by continuous integration of the product of the signals, which are proportional to the speed of the conveyer belt and pressure of the load on the receiving roller support (platform). Although in [1] the possibility of accurate weighing of material on scales operating according to this principle is proved, practice shows that under operating conditions conveyer scales do not provide a high accuracy [2, 3]. Furthermore, the instructions for operating such scales contain the requirement that the magnitude of oscillations of the running load be greatly limited.

It follows from an analysis of the literature sources that, in investigations devoted to conveyer scales, too little attention has been given to problems of the construction of the weighing system itself.

We will examine the operation of the weighing system of continuous conveyer scales (Fig. 1a). The load is transmitted to transducer 3 through the load-receiving roller support 2 located between stationary roller supports 1. Let P be the output signal of the transducer, proportional to load G. It will change as this load moves. The ratio of the output signal P to G is called the conversion factor of the weighing system at a point:

$$k = \frac{P}{G}$$.  (1)

If the conveyer belt is considered to be a flexible and inextensible thread, as was assumed in [1], the conversion factor depends only on the geometric position of the point of application of G. The diagram of the change of k over the length of the span is shown in Fig. 1b.

When G is located over the stationary roller support the pressure on the receiving platform is equal to zero (k = 0); when G is applied over the load-receiving roller support the pressure in the ideal case is transmitted completely to the latter (k = 1). The output signal of the transducer, as follows from (1), will vary according to the law

$$P = kG$$.

Let us examine what occurs when a load distributed on length L according to an arbitrary law q moves over the weighing system. Figure 1c, d, e shows the successive position of the load before the start of weighing, at time t, and after complete movement over the length (L + 1). At each instant the current value $P_t$ of the output signal of the transducer is equal to the integral product of the diagrams of the conversion factor k and q located on length l of the diagram of k

$$P_t = \int_l^k kqdx$$.  (2)
The mass of the material \( G_l \) on length \( l \) is

\[ G_l = \int_l qdx. \tag{3} \]

We see from an analysis of (2) and (3) that the output signal \( P_t \) of the transducer at each instant is not proportional to the load and depends on its position on the weighing section. It also follows from the aforesaid that with such a construction of the weighing system of the conveyor scales it is impossible to obtain a signal proportional to the instantaneous weight output, which is asserted in [1].

With complete movement of a unit load \( dQ \) over the weighing system the signal of the transducer will be

\[ dP = \int_l dQ kdx. \tag{4} \]

Considering \( dQ = \text{const} \), we obtain from (4):

\[ dP = dQ \int_l kdx. \tag{5} \]

We denote \( \int_l kdx = k_1 \) and call it the integral conversion factor of the weighing system of the conveyor scales.

Then

\[ dP = k_1 dQ. \tag{6} \]

When the entire load moves over the weighing system the integral signal \( P_1 \) of the transducer will be

\[ P_1 = \int_{l_1} k_1 qdx. \tag{7} \]

If \( k_1 = \text{const} \), then

\[ P_1 = k_1 Q_L, \tag{8} \]

where \( Q_L \) is the mass of the material on length \( L \).

It follows from an analysis of (7) and (8) that the integral signal \( P_1 \) will be proportional to the mass of the material that passed only if the integral conversion factor is constant. Nor will the result depend on the shape of the diagram of \( k \).

Under real conditions the integral factor depends on many factors and is a variable: it is acted on by the variable tension of the conveyer belt and by settling of the weight-receiving platform, the effect of which on the weighing accuracy is considered in [1, 2, 5, 6]. In addition, the conveyer belt in reality is not a flexible, inextensible thread, and therefore the integral factor affects directly the nonuniformity of the load on the weighing section \( l \).

The effect of nonuniform loading of the belt on the integral factor was investigated on a model of the weighing system of conveyer scales, the diagram of which is shown in Fig. 2.

Rollers 4 and 5 are fastened 330 mm apart on a metal base. Roller 2 is suspended on beam scales 3. The belt 1, 80 mm wide and 2 mm thick made of rubber (\( E \approx 85 \cdot 10^6 \) Pa) and of rubberized cloth (\( E \approx 35 \cdot 10^6 \) Pa), which simulated the conveyer belt, was stretched over the rollers by load \( F \).

The experiment was carried out in the following way. The beam scales were set at zero by means of balancing loads. In this case roller 2 and stretched belt 1 contacted. A 500-g weight was alternately set at the designated points on the belt. After this the scales were balanced by weights. The conversion factor \( k \) of the weighing system