

Acoustic method to measure the geometric parameters of pallets

Beer production is a complex process, which includes a large number of stages. The last step is the delivery of beer from the producer to the consumer. Transportation of alcoholic beverages is a complicated and important process. Consider an automatic line for bottling beer in a plastic bottle with an average capacity of 40 000 bottles per hour. The raw material for the line is beer, a plastic bottle, a cap, a package and a pallet. Impaired geometry of the pallet can cause an error in the operation of the automatic device for packaging bottles on a pallet that can interrupt the line for at least 30 minutes, during which the company produces 20,000 bottles. Thus, the enterprise will lose money and customers.

Disposable trays are usually designed by the product supplier that their size is most consistent with the size of the platform of the products to be delivered. Therefore, the sizes of disposable pallets are not regulated and therefore, they should be controlled. The quality of pallets is also to be monitored: board integrity, cracks, fracture, protruding nails etc. The purpose of the research is to develop and produce a simple and easy-to-use prototype device to perform the control of geometrical parameters and quality of pallets.

The measurement principle is based on the method of echolocation by means of ultrasonic pulses. Ultrasonic echolocation allows determining spatial coordinates of the reflecting object.

Ultrasonic echolocation is methods and technical means to obtain information on the internal structure of various objects and environments through the use of the phenomena of reflection, scattering and absorption of ultrasonic vibrations. The first echolocation system sent a signal to a certain point in space. The known speed of signal travelling in the environment and the ability of the obstacle to reflect this type of signal made possible to determine the distance to the object through the delay in response. Application of ultrasonic echolocation for practical use is of current interest since it allows diagnostics of the optical and radiopaque structure. An important advantage of ultrasonic echolocation is the fact that low-intensity ultrasonic vibrations are harmless to living organisms. Methods of ultrasonic echolocation are widely used to perform control of industrial materials and products, that is, in ultrasonic non-destructive testing.

Technical description of the device

The equipment is designed to measure the geometrical parameters of the pallet blocks for beer bottles. The measurement principle is based on the method of echolocation by means of ultrasonic pulses. The sensors are designed as separately combined searchers operating at a frequency of 40 kHz.

The device contains eight measuring channels. Each of the channels includes

1. ultrasonic generator;
2. emitter;
3. receiver;
4. amplifier;
5. interface with a microcontroller.

The block diagram of the device is shown in fig. 1.

Each of the ultrasonic generators comprises a cascade transistor operating in a switching mode. They switch in turn to avoid interchannel interference. The design of the sensor is shown in fig. 1. The receiving and emitting transducers are placed at a distance of about 10 cm from each other. Each of them is put in a special conical concentrator. This type of arrangement is caused by two factors. Firstly, the acoustic zone to be controlled is reduced and this improves resolution. An increase in the concentration of the acoustic field leads to an increase in signal-response. Secondly, parasitic coupling between the receiver and the generator sharply decreases. The amplifier in each

of the channels is assembled on a separate board, placed in a separate metal casing. This is required to eliminate interchannel interference within the electron path. The input cascade is a differential amplifier on transistors VT1...VT3. The second cascade is a band filter provided by the oscillating circuit on elements L4, C3 included in the collector circuit. This combination significantly reduces the noise caused by high-power operation of electrical machines. The third cascade harmonizes the analog part of the receiver with the input circuit of the microcontroller. An amplitude detector is placed at its output to increase ease of adjusting operations.

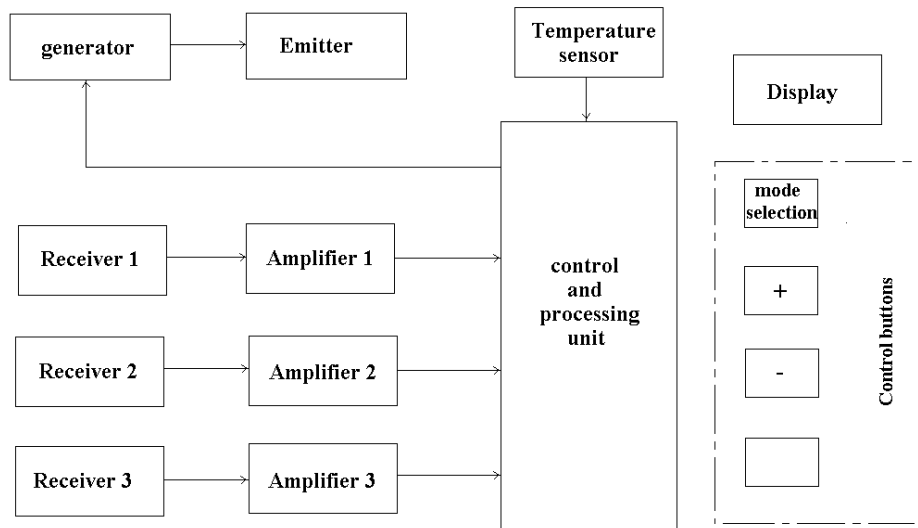


Fig. 1. Block diagram

The prototype of the device to control the geometrical parameters of the pallet blocks for beer bottles is to be built and tested.

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