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DEVELOPMENT AND RESEARCH OF THE PNEUMODYNAMIC DEVICE WITH A SHOT CIRCULAR MOTION FOR THE LOCAL HARDENING TREATMENT

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The purpose of creation of the portable device for a surface plastic deformation of details on registered invention 577750 (USSR) is an efficiency increasing of the device operating due to the circular motion of the multirow flow of the sliding shot and an opportunity of the processing of a complex surface with a longitudinal structure, for example, a joint weld.

The diagram of the device is submitted on fig.1, a general view of the installation - on fig.2. The body of the device is executed as the tubular circular channel 1 divided, on a site of input of the compressed air, by a longitudinal eject crosspiece 2. The supply of compressed air implement through the union 3. The device contains a bunker for storage of pellets 4 and mechanisms 5, 6 for a dosed supply of the shot into the channel and a return in the bunker. The body of the device has a cut in the bottom part forming a window of the contact 7. At processing joint weld the wall of the contact window are carried out under the form of a weld and obturated by elastic materials. The exhaust of the used air is made through mesh lateral windows 9.

At processing of the device in the circular channel from the bunker the certain quantity of shot, which at acceleration by the compressed air, creates rotating multirow flow of shot, impacting with a surface of a processable detail on a cut of a window of contact and strengthening the surface. Input to the ejecting part of the channel is executed as that promotes a reuse of residual energy.

Characteristics of the device:

- Dimensions – 230×220×95 mm;
- Diameter of the circular channel – 175 mm;
- Section of the circular channel – 23x5=115 mm^2;
- Pressure of air upon an input – 0.2…0.4 MPa;
- Angle of incidence of taking off shot – 30^0;

- Weight – 2.2 kg.

On fig.3 as an example some zones of processing with prints of pellets on an aluminum foil are shown at various quantity of circulating shot in the operating channel.

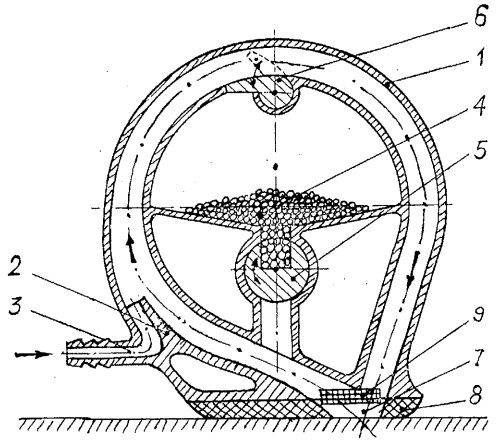

Fig.1 The circuit design of the device with circular movement of the shot for local strengthening processing

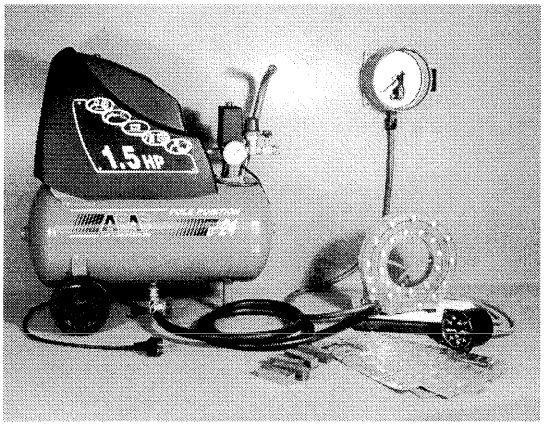

Fig.2 The general view of installation with the device for local strengthening processing

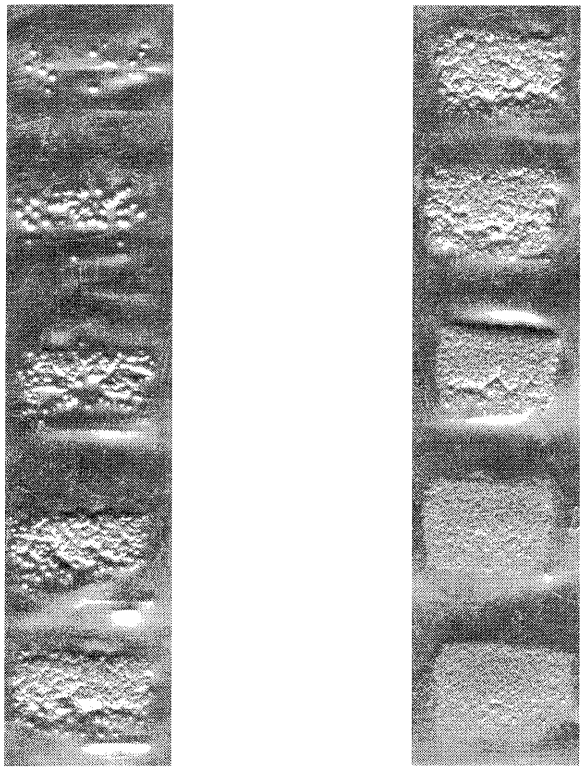

Fig.3 Prints of pellets on an aluminium foil:
The basis for a foil - firm rubber, average diameter of pellets - 2,0 mm, weight of pellet - 0.032, pressure of air – 0.3 MPa, time of processing - 8 sec.., experiment 1 - in a cavity of the device one pellet, exp. 2 - two pellets, exp. 3 - four pellets, exp. 4 - 15 pellets, exp. 5 - 60 pellets, exp. 6 - 125 pellets, exp. 7 - 250 pellets, exp. 8 - 375 pellets, exp. 9 - 625 pellets, exp. 10 - 940 pellets.

Apparently, all zones more or less are in regular intervals filled with prints against their expected concentration in a narrow strip of processing front by a virtue of exception the centrifugal force action on the last straight-line section of the circular channel and displaying actions of the regular factors as microroughnesses of the channel and the lack of the pellets roundness, resulting in prints dispersion on all zone of processing. In addition to it, some change of density prints distribution of

pellets and their depth on front of processing is seen, that may be explained as partial shielding of falling pellets by earlier recoiled [2] and as consequence, reduction of impacts efficiency.

Calculation of optimum quantity of shot in the circular channel under the formula

$$n \approx \frac{\pi D h(\alpha + \beta)}{2 d^2 (1 + V_0 / V)}, \quad (1)$$

where D, d - accordingly diameters of the channel and shot;
h - width of the channel;
α, β - angle of incidence and shot recoil;
V_0, V - velocity of incident and recoiling shot,

and its comparison with experimental values shows (see table) their satisfactory convergence.

Table

Average diameter of pellets d, mm	Calculated optimum number of pellets n, pieces	Average weight of pellets, g	Calculated weight of circulating pellets under the formula (1), g	Optimum weight of circulating pellets determined experimental, g
0,9	~ 2100	0,0035	~ 7,5	~ 3...7
2	~ 440	0,032	~ 14	~ 7...15
2,4	~ 300	0,052	~ 16	~ 8...15

Conclusions

1. To increase the shot treatment efficiency it is necessary to execute it with the optimum consumption of shot and under an optimum angle to a processable surface as much as possible to eliminate the impact of the recoiling and incident shot and to provide rapid evacuation of the recoiling shot from a zone of processing.

2. In the researched device for optimum it is necessary to count single-layered multirow movement of shot on the circular channel of the device with expressed rolling motion on external perimeter of the channel which reaches in the device at the certain quantity of the shot. Thus pellets get rotary movement component, which after impact with a processable surface, results in additional increase of speed and an recoil angle and, as consequence, leads to their rapid evacuation from

a zone of processing. Thus mechanical losses at together pellets friction essentially reduce what take place at multilayered chaotic movement of the shot. Besides at a small depth of front shot treatment decreases the collision probability of the falling and recoiled shot.

3. Single-layered movement of shot in the circular channel of the device allows to reduce the sizes of an output window and, as consequence, force of its pressing to a processable surface.

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References

1. Inventor's certificate 577750 USSR, M. Кл^2 B24 B 31/00. The device for superficial plastic deformation of details / **Drozd M.S., Matlin M.M., Slavskij J.I., Rubenchik J.I.**; VolgSTU. – Patent pending. 12.05.1974., Published. 27.06.2002. Patent bulletin № 18.

2. **Matlin M.M., Moseyko V.V.** The modeling of shot movement in portable and pneumodinamic equipment // the thesis of international conference "Mechanika-2003": - Kaunas (Lithuania), 2003. - P. 213-218.

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Summary

The results of the certain parameters research and the working conditions of the device by № 577750 invention (USSR) for the surface plastic deformation of details are presented. Finding results permit to define the optimum of the shot quantity in the operating channel. The practical desinging recommendations are provided.

Key words: pellets, shot, shot treatment, surface plastic deformation, the portable device for shot treatment.