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The Optimum Vibration Generator for the Technological Processes in Casting Bays

The performing of some experimental investigations caucering the application of vibrations to the technological processes in foundries has required in the first place a vibration generator. By an analysis of the existent generator types it has been established that the optimum generator for these processes is the pneumatic ball-generator. In the work the principle of functioning of this kind of generator is treated and the dimensional and functional characteristics for two realized prototypes are given.

Keywords: *casting bays, generator, technological processes, vibration*

1. Introduction

The study of the technological processes in casting bays led to the conclusion that the use of vibrations represents one of the modalities able to trigger the mechanisation of the said processes.

In order to perform some experimental research in this field one had to use first of all a vibration generator appropriate to the specific working conditions.

A generator of vibrations that can be used in casting bays should meet a series of technical-economic requirements, such as: simple manufacturing technology and low cost, reliability and safety in operation under conditions of dust and humidity, easy exploitation and adjustment of vibration parameters, rapid fixing and reduced size.

2. The analysis of the types of existing vibration generators. The establishment of the optimum type.

In diverse domains of technics one uses different vibration generators: electrodynamics, inertial, hydraulic, pneumatic etc.

The choice of the optimum type of vibration generator for casting bays and especially for the manufacture of cores and shapes through vibrations requires an analysis of the types mentioned above in operation conditions specific to the technological processes where they will be used.

The electrodynamic vibrators provide vibrations with variable amplitude according to the vibrator frequency and charge. The installation necessary to the vibration of the core boxes with the help of electrodynamic vibrators is complicated, it contains many electrical devices which do not have a high operational safety in conditions of dust and humidity found in casting bays, they are exposed to the risk of breakdowns when operating for longer periods and when overcharged.

The constructive solution in the case of inertial vibrators is complicated and has many bearings, which are exposed to an accented wear and tear in case of prolonged operation.

Other types of vibration generators, as for instance those hydraulically driven or those driven by means of crank gears by different types of motors have the drawback to be complicated in construction and large in size.

The pneumatic vibrators and especially the pneumatic vibrators with ball are frequently used in other countries in casting bays for different technological processes, among which the vibration of cores in the shaping process.

The main diagram of the ball pneumatic vibrator is presented in Figure 1, where: 1 is the injection nozzle of compressed air, 2 the channel for the evacuation of the compressed air, 3 the body of the vibrator and 4 the ball.

The compressed air drives the ball into a rotation motion in the circular guide way until reaching a practically constant regime angular speed. Noting with R the radius of the trajectory of the ball's gravity centre and with m its mass, the ball inertia force is its centrifugal force having of the $mR\omega^2$ value. This centrifugal force generates along any direction of the vibrator plane a harmonic perturbing force with the pulsation ω and the amplitude $mR\omega^2$.

The vibration parameters, i.e. the frequency and the perturbing force, can be easily modified by varying the regime angular speed ω, variation that is done through the parameters of the compressed air driving the ball.

The only disadvantage of this type of vibration generator is the low efficiency of the compressed air output, which is used as source of energy.

The pneumatic drive does not constitute an economical drawback if due to design and execution one manufactures vibration generators with a small consumption of compressed air per time unit and if the technological processes using them are thus conceived so that they require short-duration vibrations or vibropercussions.

The constructive solution and the low cost impose this type of vibrator as optimum for the technological processes in casting bays.

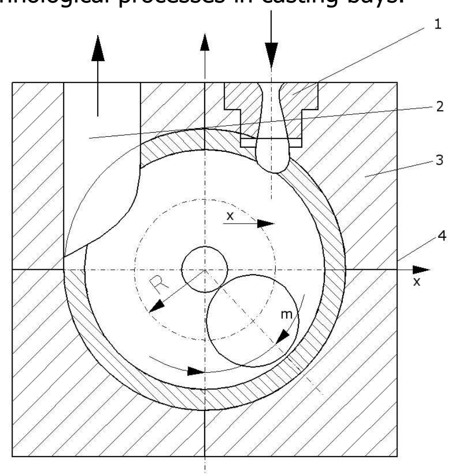


Figure 1

3. The manufacture of the prototype of ball pneumatic vibration generators for the technological processes in casting bays.

The ball pneumatic vibrator proved to be optimum for the technological processes with vibrations in casting bays. The manufacture of certain types and dimensions with performances similar to the international standard, i.e. similar to those offered in the prospectuses of the exporting companies, has become a necessity.

In order to produce such a generator it was necessary to elaborate first of all an execution documentation, which comprised the following stages:

- Adopting a ball with a known mass and diameter
- Dimensioning the ball rolling ring surface and implicitly of the R radius of the trajectory of the ball's gravity centre
- Dimensioning the injection nozzle and the compressed air purging section.

Dimensioning the vibrator and determining its characteristics constituted issues dependent on the airflow, with unknowns that could not be determined. Consequently it was necessary to adopt the constructive solution, the execution of models and experimental tests enabling us to establish the optimum dimensions.

Thus we adopted the use of Laval convergent – divergent fits in order to obtain the speed of the air entry into the generator with supersonic values. As the value of the counter pressure of fits exits cannot be measured, the ball being in continuous movement, the nozzle dimensioning was done experimentally for each model considered. We realised Laval fits of different dimensions determining the nozzle able to assure economical air consumption and the required vibration regime.

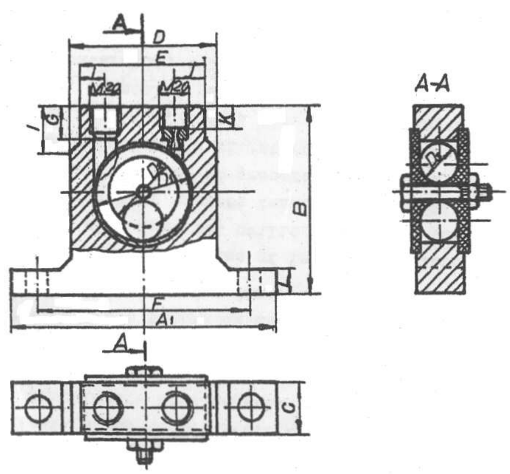
The decrease of the strengths opposed to the ball motion were done by the adjustment of the ball guideway. The establishment of the vibrator's dimensions for a certain ball was performed as a result of experimental testing.

The vibrator ball is taken from the bearings of current manufacture, and the guideway is made of OLC 15 steel, cemented and hardened in view of assuring a reduced wear due to the ball motion.

The body of the vibrator is made of aluminium so that the energy of vibrations can be used in most mechanic systems designed for a certain technology, and the air injection nozzle is made of brass to resist to corrosion.

Experimentally, for a certain ball dimension, we determined different operation regimes of the vibrator, aiming at its optimisation in view of building vibrators able to satisfy as many requirements as possible.

Figure 2 shows the dimensional characteristics of the VPB-28-1 and VPB-35-1 vibrators.



Tipul	A_1	B	C	D	D_1	D_2	D_3	E	F	G	H	L	J	K	Greutate
VBP28-1	110	125	33	100	82	40	28	87	152	25	24	20	30	24	~1,680 Kg
VBP35-1	165	165	48	150	106	69	35	130	130	25	20	20	36	15	~2,130 Kg

Figure 2

We adopted the following symbols. V of vibrator, P for pneumatic, B for ball-equipped; 28 being the diameter of the ball used, and 1 the symbol of prototype for the 28-mm diameter ball.

The characteristics of simplicity, robustness and low cost of these prototypes of vibration generators result from the same Figure 2.

For the two typo-dimensions which have reached the stage of prototype through experimental testing we established the following operation characteristics:

The VPB-28-1 pneumatic vibrator

- number of revolutions n = 2600-9000 rev/min
- perturbing force F = 131-1600 N
- supply speed P = 0,25-3,2 daN/cm^2
- consumed debit Q = 0,7-2,56 Nm^3/min

The VPB-35-1 vibrator

- number of revolutions n = 3200-6800 rot/min
- perturbing force F = 400-1800 N
- supply speed P = 0,5-3 daN/cm2
- consumed debit Q = 1-2,77 Nm3/min

The operation and dimensional characteristics as well as the cost for the vibration generator designed and executed are comparable to those offered in the prospectuses of the German company „Metter Vibratzionstehnic". In this context the creation of these prototypes for the research of the possibility to apply vibrations in the casting processes may also be appreciated as a reduction of national hard currency expenditure, as they can be used in many other domains of the manufacturing technique.

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