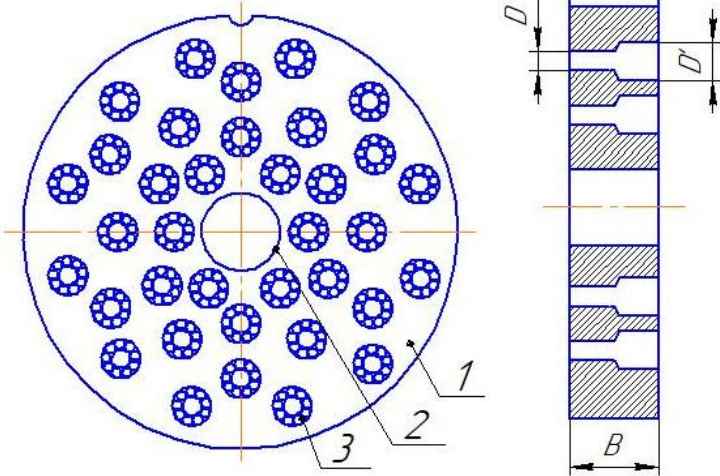


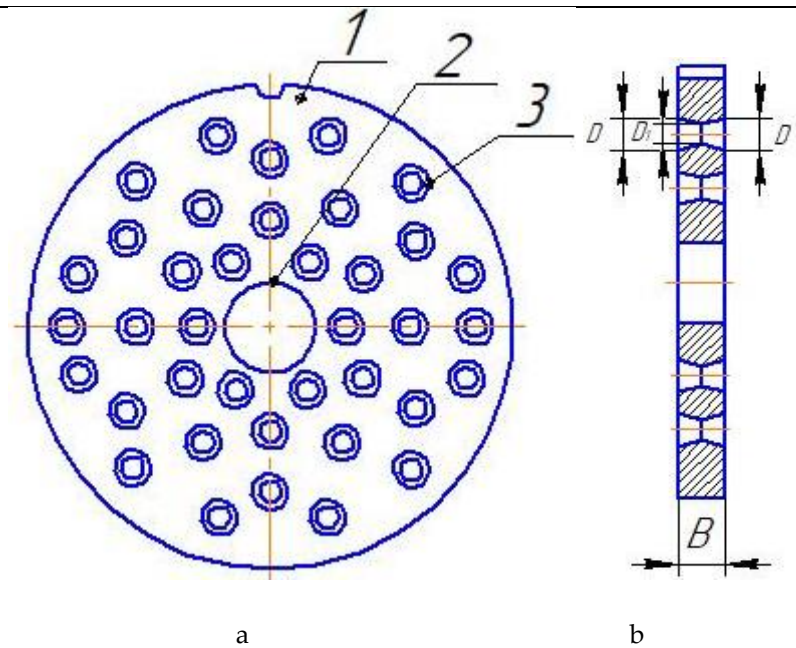
Development of the design of plate with variable diameter of holes and its impact on meat grinding quality and efficiency

Anara Bakiyeva¹, Aman Yerengaliyev¹, Aitbek Kakimov¹, Gulmira Zhumadilova¹, Galiya Abdilova¹, Erzat Serikov, Anuarbek Suychinov², Zhanibek Yessimbekov²

Supplemental Table

Table S1. Different designs of plates for meat grinders.

Drawing	Description	Ref
 1 - plate; 2 - center hole for fastening on the shaft of the equipment; 3 - holes with diameter D Plate to the equipment for grinding meat	The plate is made in the form of a disk 1, having a central hole 2 for fixing it on the shaft of the machine and holes 3 with diameter D for grinding and passing meat. On the opposite side of the plate, the diameter D' of holes 3 is increased by 25% to a depth equal to half of the disk thickness δ. The plate is fixed on the machine shaft through the central hole 2. The operation is performed as follows. A rotating knife pressed against the plate cuts the meat, which is pushed through the holes 3 with pressure P. Starting from the middle of the plate thickness, the meat is pushed into the holes with a diameter increased compared to D by 25%. The increase in diameter leads to a decrease in pressure P, which causes a reduction in the total drive power of the device and the cost of friction of the knife against the plate.	1



1 - plate made in the form of a disk; 2 - central hole for fastening on the shaft of the device; 3 - holes with diameter D_1

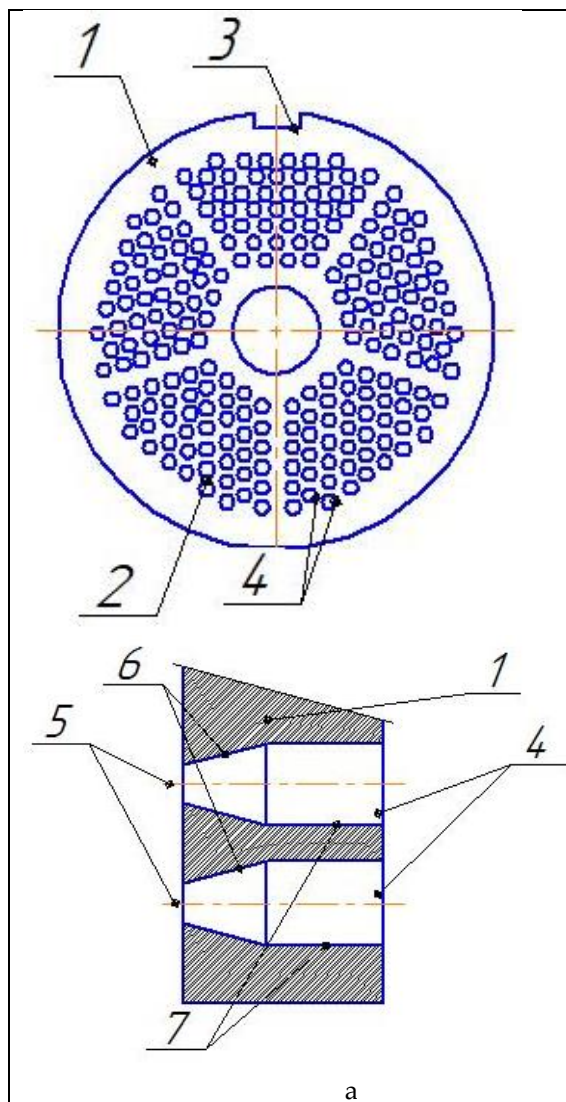
Plate to the device for grinding meat

The following plate to the device for meat grinding is developed by Yurkov S.G. et al. The invention core consists in the fact that the holes for grinding and meat passage are made with variable diameter. From the beginning of the working surface, the diameter of the holes smoothly decreases to the middle of the depth, and then, also smoothly expands, due to which the plate has two working surfaces. The diameter of holes at the working surface of the disk in relation to the middle of its depth is 25%.

The plate 1 is made in the form of a disk having a central hole 2 for fixing it on the shaft of the device and holes 3 with diameter D_1 for grinding and meat passage. On both sides of the plate the diameters D and D' of holes 3 at the working surfaces are increased by 25% in relation to the depth of the hole having diameter D_1 . The plate is mounted on the shaft of the device by means of the central hole 2 and fixed by the fitting notch 4.

The operation is carried out as follows.

A rotating knife pressed against the plate 1 cuts the meat, which is pushed through the holes 3 with the pressure P , which smoothly increases up to the middle of the hole depth, where there is a minimum diameter, and then decreases as the hole diameter increases.



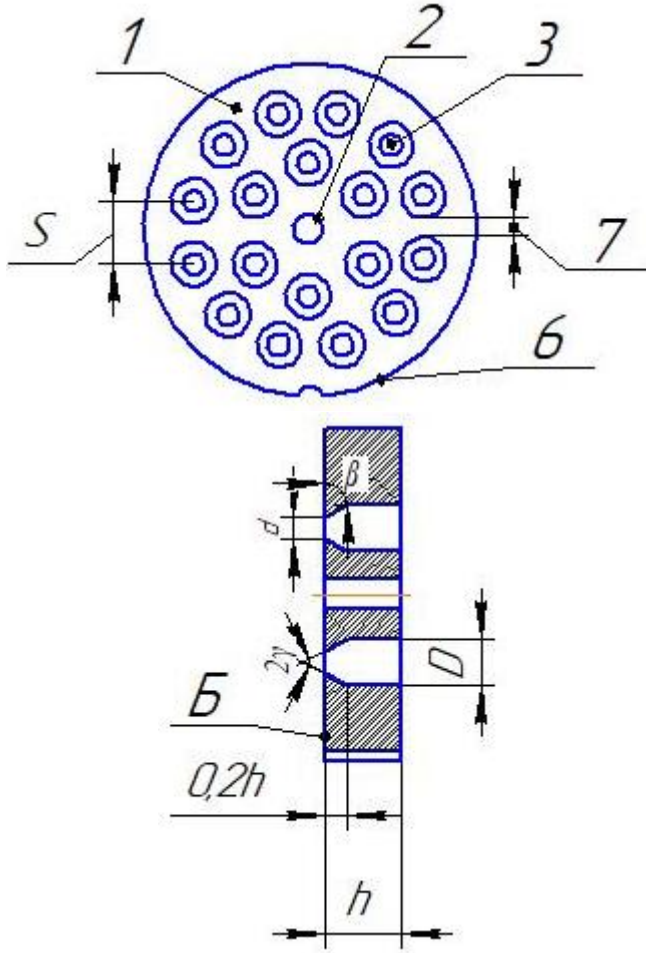
1 - plate; 2 - seating hole; 3 - fixing cutout; 4 - through hole; 5 - longitudinal axes; 6, 7 - confusor and cylindrical sections of through holes.

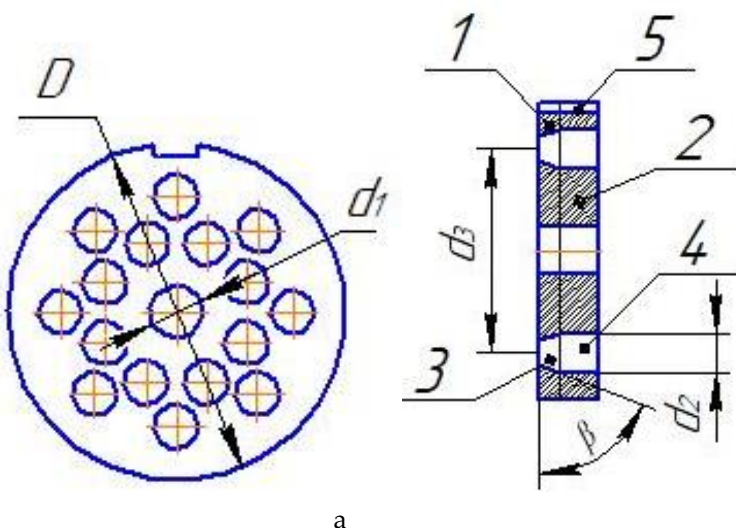
Plate for meat grinder made in the form of a disk of constant thickness, containing a mounting hole and fixing cutout and through-holes located in concentric rows, the axes of which are oriented perpendicular to the surface of the plate.

The plate has the following dimensions: outer diameter, $d_p=160$ mm; thickness, $S=25$ mm; length of the confusor sections 10-12.5 mm, initial diameter of the confusor sections of the holes, $d_1=5$ mm, final diameter 7.1-8.5 mm (with the length of the section 10 mm) or 9-10.5 mm (with the length of the section 12.5 mm).

The device works as follows.

Feeding screw of the meat grinder rotates in the feeding part of its body. Supporting its end on the walls of the mounting hole 2 provides a stable position of its axis of rotation. In the process of rotation the screw presses the ground raw material into the plate zone and knives cut the pressed mass. The cutting effect is also shown by the edges of through holes 4. The presence of a large amount of cartilage in the raw material (which do not pass through the usual plate) leads to their crushing to the size of the entrance section of holes 4 (in this case up to 5 mm), after which they are freely pushed into the holes 4 and pass through them without danger of wedging between the walls of these holes.

Plate for meat grinder  a 1 - plate; 2 - a hole for installation and centering at the end of the screw; 3 - working combined holes; 4 - round truncated cone; 5 - round cylinder; 6 - key groove; 7 – lintel (distance). Plate to the device for grinding products	The plate 1 has a central circular hole 2 for installation and centering at the end of the screw, working combined holes 3, consisting of round truncated cones 4 with a height equal to 0.2 thickness of the plate and circular cylinders 5 with diameters equal to the diameter of the base of the cone 4 at the inlet of the product to be crushed. On the periphery of the plate there is a key groove 6, which provides the immobility of the plate during its operation. The diameter of the base of the circular cone D and, consequently, the diameter of the circular cylinder should be of the same size and selected depending on the parameters of the perforated part of the plate, i.e. depending on the diameter of the working hole at the inlet d and the size of the pitch between the holes S. At the same time, the distance 7 between the holes at the outlet should not be less than 0.5...1.0 mm. The plate parameters d and S are determined by the normative and technical documentation on the plates depending on the required degree of grinding of the food product and constructive location of the working holes on the perforated part of the plate.	4
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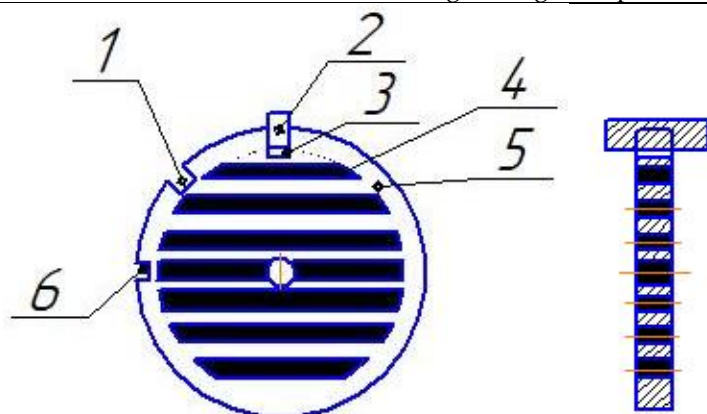
1 - cutting disk; 2 - bearing disk; 3 - conical hole of the cutting disk; 4 - cylindrical hole of the bearing disk; 5 - base key groove; β - angle of sharpening.

Plate for the device for grinding food products

The perforated plate is made in the form of a set of disks, cutting and bearing, with a central circular hole, with a keyway located on the periphery. The disks have through coaxial holes. And the cutting disk is made with cone holes, and the bearing disk is made with cylindrical holes. This design involves the use of a replaceable cutting disk, and a fixed bearing disk, and only the cutting disk is made of wear-resistant steel, and the bearing disk is made of corrosion-resistant steel.

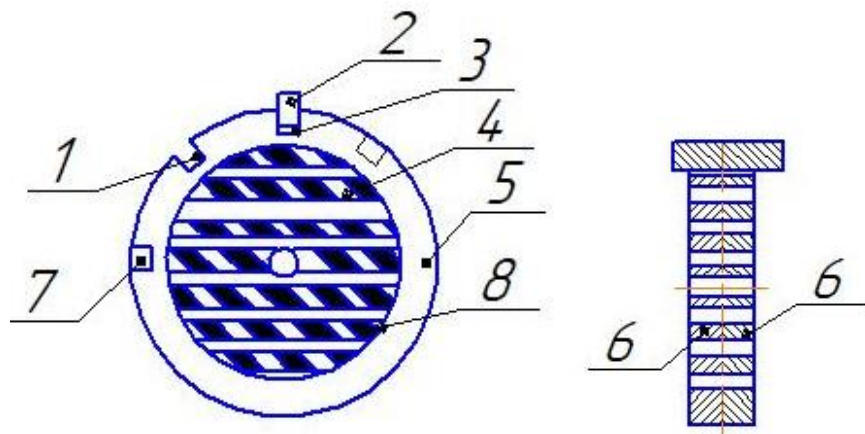
The technical result is that the use of this plate allows to reduce the energy consumption for cutting the food product and for its passage through the holes, due to the reduction of the cutting angle. Due to the reduction of the required forces for cutting and passing of the product through the holes, the productivity of the grinder is increased, and a higher quality of grinding is ensured. Also, the design of the plate allows to increase the efficiency of its use due to the application of replaceable cutting disks.

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A disk-shaped plate for a meat grinder includes holes located on it for the passage of the raw material being ground and a key groove on the outer circumference, fixing the position of the plate in the screw housing. The openings of the plate are in the form of parallel rectangular or trapezoidal grooves. The plate has several keyways for simultaneous installation of two plates, shifted by the angle of rotation to form passage openings of different configurations. The plate allows to expand technological capabilities, reduce internal pressure, increase productivity and reduce energy consumption of the meat grinder.

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a - 1, 3, 6 - key grooves of the plate 5; 2 - key of the screw housing; 4 - parallel grooves; 5 - grinding plate; A-A - cross-section of the plate 5;
 b - 5, 6 - installation of two plates, shifted relative to each other by the angle of rotation; 7 - key grooves; 4 - grooves of the first plate; 5, 6 - grooves of the second plate; 6 - second plate; Fig. 4: A-A - cross-section of plate 5 and 6

Plate for meat grinder

References

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