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Research Article

TECHNOLOGY FOR THE PRODUCTION OF BLANKS AND FINISHED PRODUCTS FROM PUFF AND SHAPED ROLLS

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ABSTRACT

In this article, the importance of the production of semi-finished products made of metal coils and sheet metal sheets, which is developing year by year in the country, in the machine building and automobile industry, and extensive work has been carried out on new examples and styles of technological processes. The article talks about different methods in this field.

KEYWORDS

Rolled sheets, layer, mould, stamp, press, hammering, punch, matrix, steel, non-ferrous metal, alloys, elements, profile, pipes, cutting, shearing, bending.

INTRODUCTION

Stamping of laminated sheets - stamping of metal in the cross-section of the pre-processed part to a significant extent, without redistribution of metal consumption of rolled sheets or shaped rolled products.

Stamping of laminated plates produces flat and three-dimensional thin-walled products from

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various metals and alloys, non-metallic materials, plates, forms, tapes, profiles, and pipes, for which stamps or their working elements are used.

The plate stamping technology and the designs of the stamping tool are determined by the size and shape of the stamped part, the precision of the stamping, and the serial production. High automation of mass and large-scale production processes, as well as complex and expensive moulds, justify themselves because the cost of manufacturing moulds for a stamped product unit is very small and does not significantly affect the total cost of the product [1-3].

Materials and methods

Technological lubrication systems play an important role in the stamping of sheet plates. During sheet metal stamping, lubrication is used for processes such as reducing deformation forces, protecting the surface of the deformed metal from damage, increasing tool corrosion resistance, facilitating the removal and extraction of parts, etc. Lubricants must provide a significant reduction in the coefficient of friction in the mould part of the workpiece, form a strong film that can withstand significant pressure on the surface of the workpiece, be well held and evenly distributed on the metal surface, be easily removed from the surface, not damaged and harmless. will provide. The lubricants used are liquid, viscous or solid. can be Soap emulsions, mineral oils and special compounds used as liquid lubricants, solid, petroleum jelly, etc. are used as viscous lubricants, and special chemicals such as phosphate layer, copper, molybdenum disulfide are used as solid lubricants.

Equipment for stamping laminated boards (Table 1) is divided into mechanical-automatic presses hydraulic presses (Fig. 1), hammers, rotary machines, automatic machines, various scissors, devices using energy pulses, stamp moulds and used by others [4-7].

Automatic equipment used in stamping shops is built with hammer-press machines, in which the delivery of the initial billet part, its transfer from place to position, and the production of products are automated. In stamping workshops, cutting the material of layered boards into sheets or individual boards is done with scissors or presses using special stamps. In the purchase departments of cold stamping shops, parallel blades, patterning machines, shape-cutting blades and disk shears are installed. Parallel blade cutting shears are used for cutting thin metals with high requirements for the accuracy and quality of the cut surface and non-metallic materials. Working on such scissors, cutting the entire separation sheet surfaces [8-13]

Front, back, side stops, corner and square supports are used to get the desired size and shape of sheet boards and forms.

Table 1. Classification of technological equipment for layer stamping

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Technological equipment for layer stamping			
Mechanical workbenches		Hydraulic workbenches	
To perform general tasks	Especially directed automata	Scissors for sheet metal	Bending and trimming the edges of thick sheets
Scissors for roll sheets and planks	Multi-positional	Simple and two-way stamping	
Universal presses	Lower gear	Stamping with rubber	
Perforating presses	Fluid Slider	Fold and board the edges of the sheet	
Pulling presses		Stretching equipment and compression presses	
Bending presses		Sheet stamping for thick sheets	

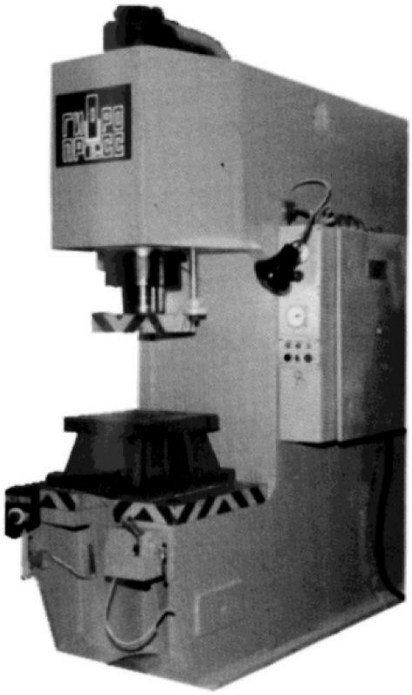

Figure 1. Mechanical-automatic pressing, hydraulic bench

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Curved shears with template blades are widely used for cold-cutting metal sheets with a thickness of 0.5 to 30 mm or more and a cut length of several meters. Cutting on such a scissor machine is not carried out simultaneously along the entire width of the laminated sheet, only a separate shape is visible. This reduces the force required to cut the same material with scissors with parallel blades several times. On the rolls, one or more cylindrical disk blade shears mounted on parallel shafts are used to cut the wide tape into small shaped pieces [12-13].

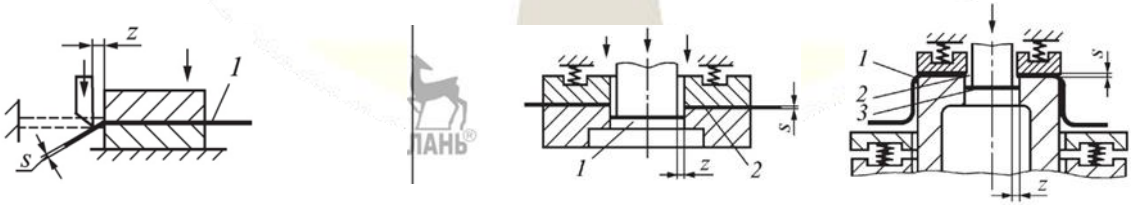
Such shafts are driven by electric motors using V-belts and gears. The blades retract the tape they cut. Sheet layers are rolled into one roll, and after cutting, they are rolled into another roll of several small widths, the number of which corresponds to the number of tapes received. Straight and shaped metal sheets are cut in one template and approximated to the required dimensions. Appearance production hydraulic press adopted disc shears with conical blades and shears.

Often, cold forging is carried out on mechanical crank presses. Such presses are reliable, economical and convenient to use. The working movement in the mechanical presses of the crank is driven by the crank mechanism.

Sheet metal stamping can be done with or without heating the original workpiece, i.e. it can be hot or cold. Hot-rolled sheet metal stamping is less common and used for low-plastic materials (magnesium alloys, chromium steels, etc.) and plates with a thickness of more than 10...15 mm. Cold-stamped large parts (car frames and bodies, aircraft fuselage elements, ship covers) and very small parts (clock movements, radio lamps, auto pens, etc.) are produced.

The advantages of cold-layer plate stamping compared to other processing methods include saving metal (waste no more than 15 ... 20%), low cost, high dimensional accuracy and good surface quality of stamped products, high labour productivity and high level of automation.

All sheet stamping operations are divided into two groups: separation (Fig. 2) and forming (Fig. 3).



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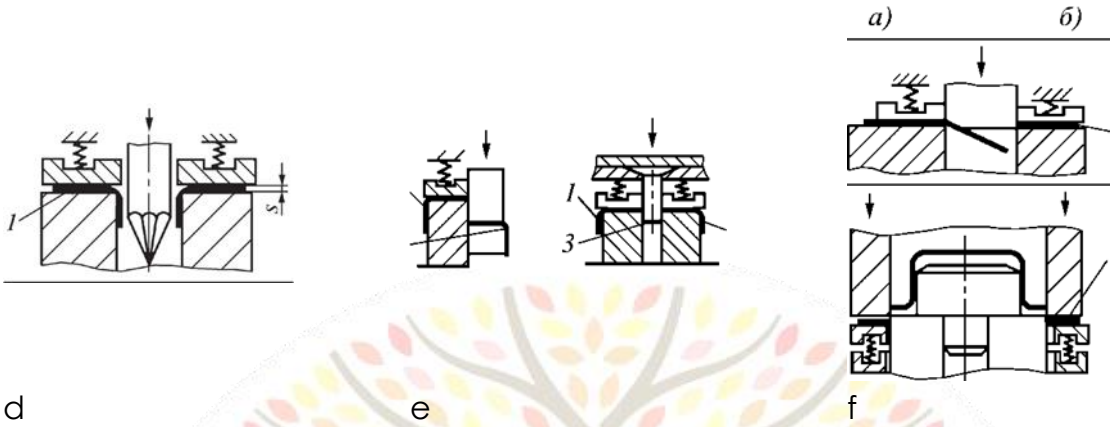


Figure 2. The main separation operations of sheet stamping

a) Scheme of operations

b) Shearing - complete separation along the open contour by cutting 1 part of the workpiece

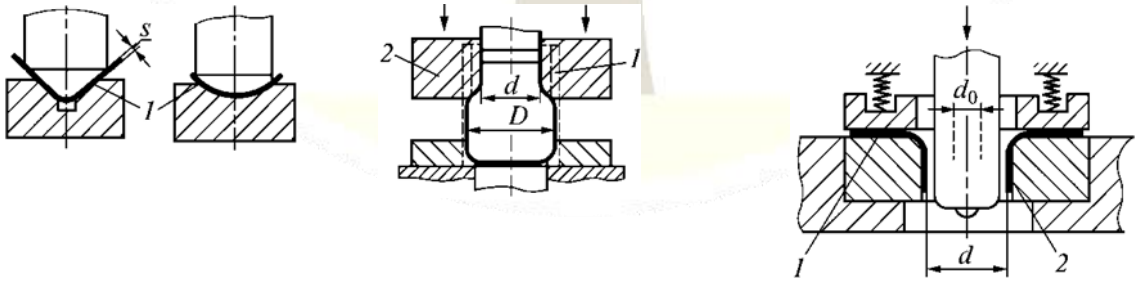
c) Shearing - complete separation of the workpiece 1 (or product) from 2 by cutting along a closed contour.

d) Opening a hole - creating a hole 2 (or groove) in the workpiece by cutting a part of the metal with the removal of waste 3.

e) Punching - opening 1 hole in the workpiece without removing metal to waste

f) Cutting - dividing the workpiece into pieces, for example, by moving along the open contour 1 and 2; a - waste-free; b - waste 3.

Cutting bending - 1 part of the workpiece is not completely separated by cutting. Forming cutting - removal of excess metal by shearing 1 (starting, pressing).



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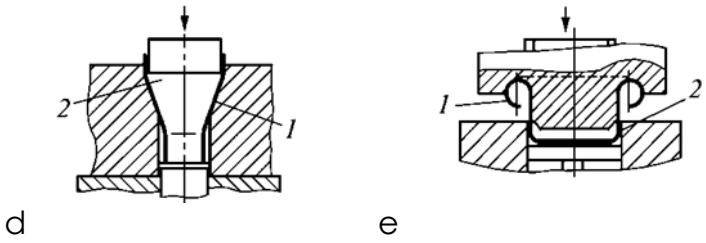

Figure 3. Basic shape-changing operations of sheet stamping

a) Scheme of operations;

b) Bending - the formation or change of angles between the parts of workpiece 1 to give it a bent shape;

c) Compression - reduction of the cutting size of part 1 of the part to be processed into the hollow billet under the influence of simultaneous pressure along the entire perimeter of the equipment 2: D - the initial diametric of the part to be processed; d - ready-made billet diametric;

d) Bending of the edges of the sheet - the formation of band 1 along the inner and (or) outer contour of the processed billet 2: do - the initial hole in the processed part; d - the hole formed in the billet;

e) Distribution - simultaneously increasing the cross-sectional size of 1 piece of a hollow workpiece under the influence of 2 colliding perimeters of a billet.

Relief moulding - formation of relief on a sheet plate due to local stretching without a conditional change in metal thickness 1.

In the performance of separation operations, there is a process of complete or partial separation of the workpiece by cutting one piece from another. Thus, products from rolled and layered billets are cut flat and into shapes, billets formed on the surface are cut, holes are opened, edges, edges of the surface are bent and other processes are carried out. Forming operations are designed to irreversibly change the shape and size of workpieces obtained from sheet, formed or three-dimensional thin-walled semi-finished products (including pipe parts). Unlike parting operations, workpieces are subjected to plastic deformation. Sheet stamping as a progressive processing method is used in the automotive industry, radio engineering [14-16].

Shearing is done with scissors (guillotine, vibration, disc) and presses lab stamping. To ensure good cutting quality, the cutting edges should not be sharp, and the gap between them should be 3... 5% of the thickness of the cut sheet.

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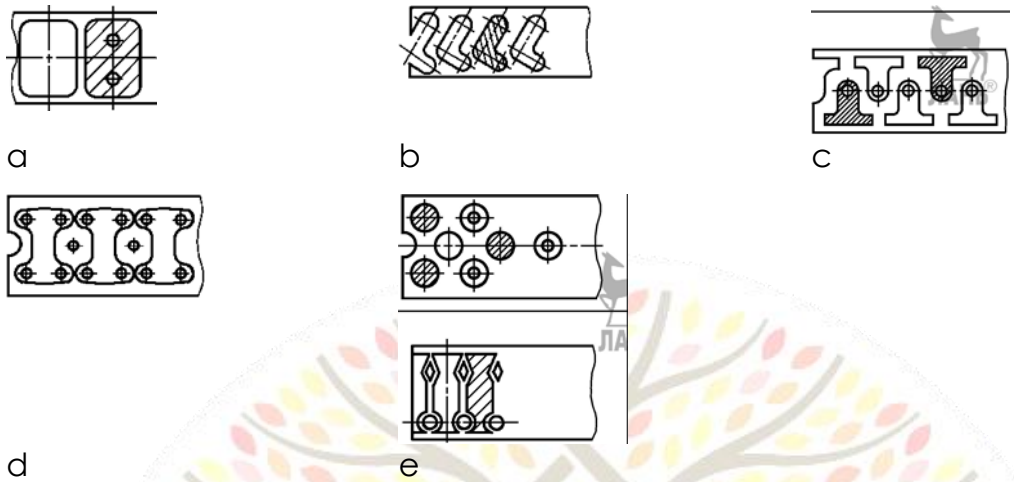

Figure 4. Examples of mowing with waste

In the upright position (Fig. 4a)

For parts with a simple geometric shape (rectangular, round, square)

In the prone position (Fig. 4b)

To avoid large waste of metal for parts with the bent shape or other complex configurations placed directly.

In the opposite case (Fig. 4c)

For T-, U-, and W-shaped parts with a saving of large metal waste with a direct and inverted position of the part to each other

In combined forms (Fig. 4d)

For large-scale and mass production of two types of billet with the same thickness and metal grade

Multi-row and truncated pre-mich (Fig. 4e)

It is used for small billets in multi-series and mass production, for small and narrow parts (hour hands and the like) or for continuous stretching of strips in production.

The lower part of the product, which is located under the punch, is practically not deformed, and the remaining part of the billet (flange) is stretched in the radial direction and compressed in the tangential direction. When the flange is compressed, if (D - d)/s > 18...22, the strength may decrease and a mould may form to prevent the appearance of cracks, it is necessary to press the flange against the end of the matrix with a specific force of 1.. .3 MPa.

The change in shape during stretching is evaluated by the degree of stretching

$k=D/d$,

Here: D and d are the diameters of the workpiece and the part to be processed, respectively. The

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maximum permissible value of the traction level is k = 1.8...2.1.

When the tension is exceeded, the tensile force is generated to the extent that it exceeds the strength of the section wall. The material causes breakage - the lower part of the product is torn. If it is necessary to obtain a product with a drawing level greater than the threshold value, weighing is used in several operations. Depending on the type of semi-finished product being drawn, punches and dies for stretching can be divided into cylindrical, conical, spherical, rectangular, shaped and other forms. They are made with rounded working edges, the value of which is affected by the drawing force, the degree of deformation, and the possibility of the formation of flanges. The dimensions of the punch and the matrix are such that the gap between them is equal to the thickness of the deformed metal 1.35 ... 1.5 is chosen to be The radius of curvature of the surfaces in drawing has a significant effect on the drawing process. The radius of curvature of the working edge of the matrix determines the stresses caused by the stamped material and, as a result, the number of drawing operations, the probability of breaks, the formation of cracks, etc. If there are no requirements to increase the strength of the stamped parts, then the thickness of the material should be selected depending on the design and technical requirements to ensure the minimum material consumption and so on.

The combination of stamping operations is achieved by using a poison matrix for cutting edges as working equipment. In addition, the angle of inclination of the edges, after performing the calibration operation, is carried out in the lower, "dead" point, in such a way as to reveal the desired angle of inclination of the part. When using such equipment, the process of cutting and piercing continues in sequence, just like cutting with a scissor knife with crank shears. Cutting-piercing strength decreases by 30...40%. At the same time, the use of scissor blades in the equipment leads to the bending of the part of the metal connecting to the tool, and therefore, corners are formed in the matrix so that the resulting products remain horizontal during the cutting process. Ladi and punches are formed when pressed. But since the punching operation is followed by the bending operation of the workpiece to obtain the V-shaped groove, the edge shearing is done by the punching.

Technological equipment

As technological equipment for sheet stamping, stamp dies and curved presses are used. Moulds for sheet stamping are classified according to the types of operations, technological features, the versatility of use and other features. According to the types of operations, moulds are distinguished for shape change, forming and assembly operations, which provide connection of individual parts of products. Figure 5 shows the diagrams of the cutting and drawing stamp dies.

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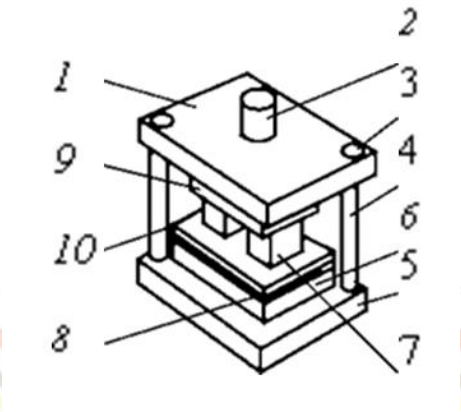

Figure 5. Typical schemes for cutting and drawing dies Die-cut stamp dies

1 - upper plate; 2 – tail part; 3 – guide bush; 4 - guide column; 5 - lower plate; 6 - matrix; 7 - poinson; 8 - installation parts; 9 - punch holder; 10 – puller

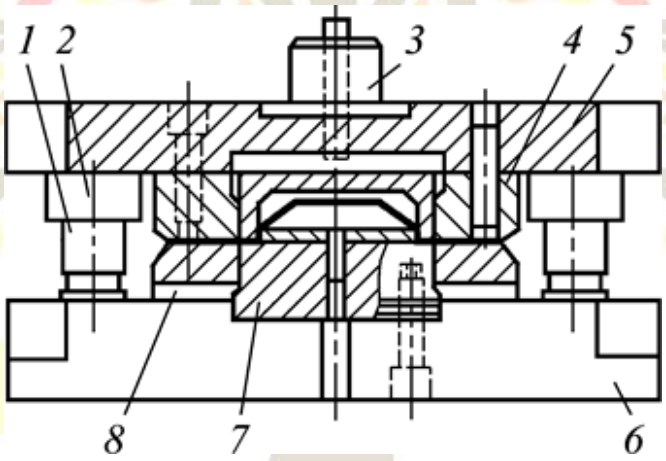

Figure 6. Dies for drawing stamps

1 – guiding columns; 2 - guide bushings; 3 – tail part; 4 - matrix; 5 - upper plate; 6 - lower plate; 7 - poinson; 8 - punch holder

According to technological features, stamps are divided into simple moving, combined moving and sequential movement stamps. Single-acting dies are designed to perform the same or several operations of the press slides in one step of feeding the workpiece.

In transitions are performed in one stroke of the press. Sequential stamps are designed to perform multiple operations or stamp passes in the strokes of press slides. Each transition is made in a separate position of the stamp, and after each stroke of the press slide, the processed part or roll

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of sheets moves from the previous position to the next.

Sequential motion stamps may have the characteristics of combination motion stamps, ie. not one, but several operations are performed in individual positions. According to the versatility of application, they are divided into special and universal stamps. Special stamps are designed for the production of any individual part. Such stamps are collected only from billets and parts used in this stamp. In a universal die, you can make different parts by reconfiguring or changing individual dies.

Guiding devices in moulds are stamp posts, guide plates, and guide plungers. Stamps with free access to the zone of a combination of punch and matrix are called open; if this zone is closed, the matrices are said to be closed. In closed moulds, the worker's hands cannot get between the punch and the die. Therefore, they are safer. When working in open matrices, various protective devices are used to avoid injury to the worker's hands. According to the design of the puller, fixed and movable puller moulds are distinguished. Movable tensioners can be rigid with rods or springs.

According to the operational characteristics, moulds are divided according to the methods of supplying materials or planks, and the billet is divided according to the methods of waste removal. Both can be done manually or automatically using special devices.

Stamping devices must meet labour safety requirements.

Stamps consist of blocks, packages and working elements (matrix and punch). The block serves to fix the package and align the die and punch during stamping. A package is a node for connecting and fixing the working elements of the stamp.

The block consists of upper and lower die plates, a guide (usually posts and bushings), and tail pieces. According to the versatility of use, it is divided into special and universal blocks. The first is designed to work with a permanent package and the second is with a replaceable package.

Figures 1.6. Special types of stamping

Rubber extraction is carried out with a rubber pad (punch) 1 on a hard matrix 3 or with a hard punch on a rubber matrix. Both methods are used to obtain hollow parts 2 from thin sheet material. The rubber cushion is wrapped in a steel frame 5. Stamps for rubber pullers are simple because, for the preparation of one deformable element - punch or matrix, the second is replaced by rubber; 4 - a channel is placed for air release.

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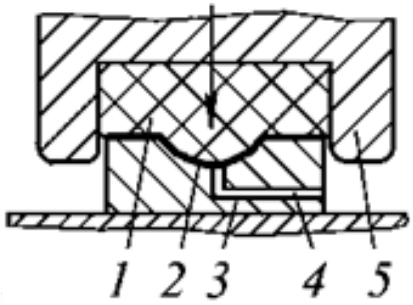

Figure 7.

With a hydraulic puller, hollow parts of cylindrical, conical, spherical and other shapes are obtained by pressing directly on the billet part with liquid or liquid wrapped in an elastic (rubber) container:

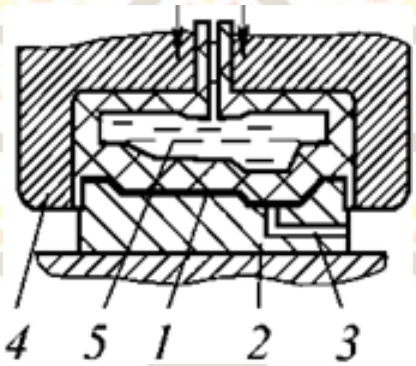

Figure 8.

1 - product; 2 - matrix; 3 - air outlet channel; 4 - iron clamp; 5 - liquid in a rubber container

The Workpiece 2 of the hydromechanical puller billet takes the shape of punch 3 and is deformed in the liquid matrix 1. When the punch moves, the fluid pressure presses the workpiece into the matrix, giving it the desired shape and size.

A reverse puller (with rotation) is a combination of two or more pulling operations performed in one working stroke. In this case, each subsequent pull is done in the opposite direction to the previous one. Retraction is used to reduce the number of stamping operations: 1 - poinson; 2 - matrix; 3 - clamp; 4 - poinson matrix.

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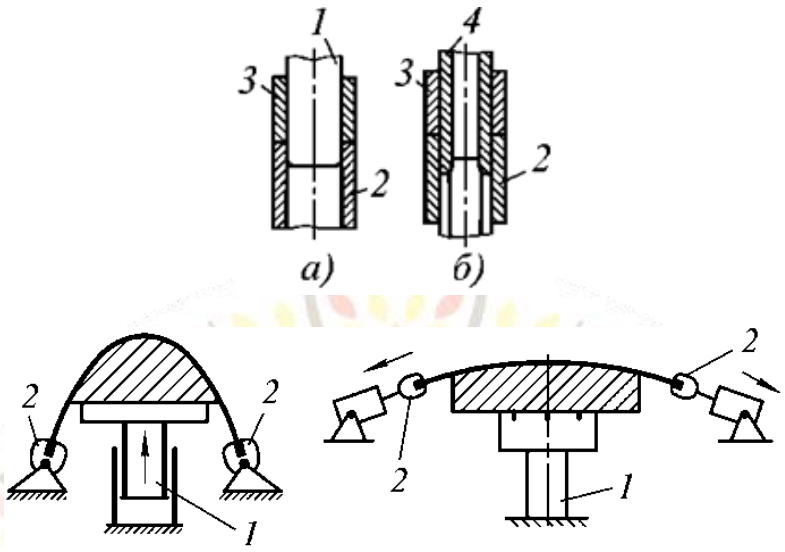

Figure 9.

By stretching the metal - it is mainly used in the production of large thin-walled parts of a simple shape (for example, busses, trolleybuses, decorative parts of cars) for close installation. Compression is carried out in hydraulic compression presses. The edges of the workpiece are fixed with the handles of the press, and then it is mounted on a punch that has the shape of the workpiece. This method is used in the production of parts with a thickness of up to 1.5 mm from low-carbon and corrosion-resistant steel, as well as aluminium and magnesium alloys with a thickness of up to 3.5 mm.

Pulling is carried out by lever 2 fixed with the punching table 1 or by movement 1 of lever 2.

Heating of the flange with cooling of the punch and die is used for the production of billet made of aluminium alloys, copper and steel. When the flange is heated, the deformation resistance of the metal decreases, which makes it possible to increase the degree of deformation of the workpiece for each pass of the billet. Local heating of the workpiece is used to relieve local deformation of the metal and in other stamping operations, for example, in moulding. In the moulds for drawing the flange with heating, cooling of the bottom and walls of the drawing part is used: 1 - punch; 2 - pipe for supplying cooling water; 3 - heating elements; 4 - channel matrix for cooling.

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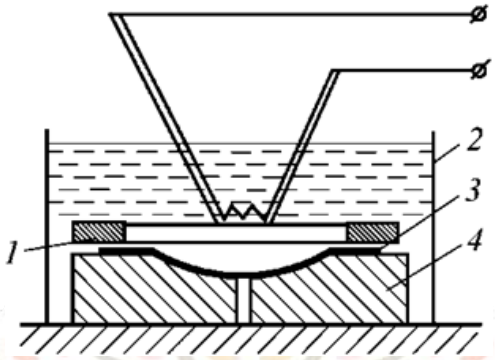

Figure 10. Electro-hydraulic stamping scheme

1 - clamp; 2 – capacity container; 3 - deformed billet; 4 - matrix; 5 – channel for air intake.

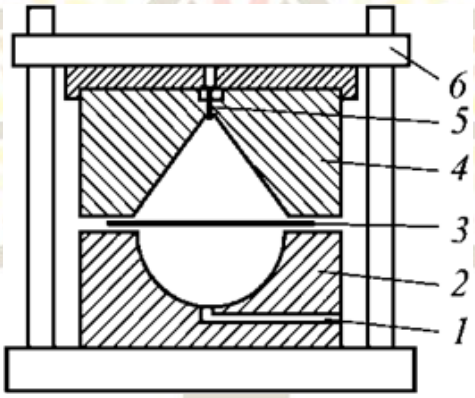

Figure 11. Explosive stamping scheme

1 - channel for air release; 2 - matrix; 3 - billet; 4 - the body of the explosive chamber; 5 - charging; 6 – frame

Radial compression. The essence of the radial compression process is the axisymmetric plastic deformation of the workpiece by applying a pulsating load from two or more impactors, as a result of which the area of collisions of the workpiece is reduced and its length increases. After each transfer, the workpiece moves along its axis by a certain amount, which is called transfer. Rotary compression dies to rotate (rotation) around the axis of the circular billet (see Fig. 1.7), while radial crimp dies do not rotate. Radial pressing is performed with or without heating the workpiece. The hard-to-deform profile (Fig. 12) is close to all-around compression, so it is hard to deform. low plasticity materials (tool steels) may undergo radial compression. A machined part with a small deformation relative to a single reduction cannot have a sufficiently high total deformation level for the entire reduction period.

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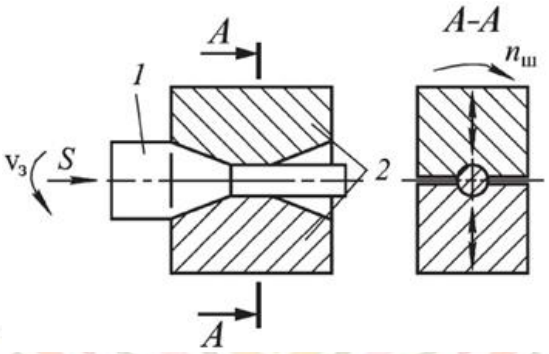

Figure 12. Radial compression scheme:

1 - billet; 2 - attackers

Compared to cutting, the radial compression method has the following advantages: high (3..10 times) productivity, significant saving of metals (up to 30 ... 60%), high machining accuracy (7-9 quality) and small surface cleanliness parameter Ra = 0.63...1.25 μm.

Disadvantage - production noise during the operation of rotary compression machines is high. Radial compression machines eliminate this shortcoming. Cold pressing in rotary pressing machines are used to process bars with a diameter of up to 60 mm and hollow billet with a diameter of up to 150 mm.

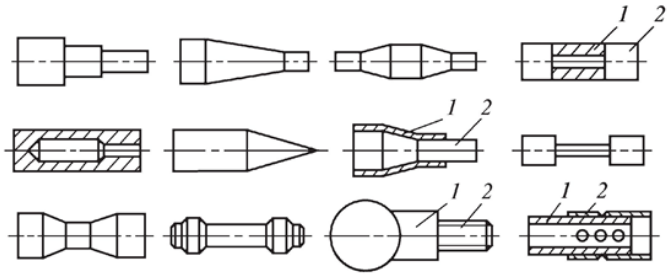

Figure 13. Typical parts obtained by radial compression:

1, 2 - connected parts

Small machines process very small miniature parts, such as sewing needles with a diameter of 0.3 mm, and large machines process steel pipes with a diameter of up to 320 mm and rigid shafts with a diameter of up to 250 mm.

Thus, radial compression - for the serial production of stepped shafts, for obtaining slots,

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grooves, and parts with a complex cavity configuration, and for performing some assembly operations (connecting cables, connecting pipes, etc.) is a progressive metal-saving method. Typical parts obtained by compression are shown in Figure 1.8. The toolset for compression machines includes punches and flat-faced punches used to obtain hollow products. material for the production of punches and parts with a flat surface - tool steels (U10, XVG, X12F1) and hard alloys (BK15, BK20) can be used.

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