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## KEY FEATURES FRICTION WELDING

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*The main features of obtaining fixed joints and friction welding are shown benefits of this type of welding, and the need for its implementation have special machines friction, able to provide rapid shutdown of rotation and considerable effort clip the second stage of the process of welding.*

**Keywords:** friction welding, advantages, disadvantages, machinery for welding.

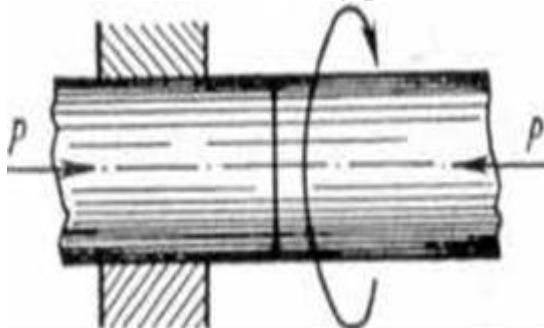
**Introduction.** Currently, the manufacture and repair of machines and mechanisms and a variety of compounds using various ACT CO to and which provide real connection materials [1-3]. Prominent among them is welding, all known methods which usually divided into two groups: fusion welding and pressure welding (or otherwise - plastic deformation).

**Analysis of recent research and publications.** In fusion welding the edge parts connecting melted and the gap between them is filled with molten metal; the formation of permanent connection occurs as a result of cooling and crystallization of common metal parts to be welded and the filler metal (in cases where it is attached). Welding pressure is usually in the solid phase without melting the metal; permanent connection is formed as a result of the convergence of surfaces to be welded to such small distances (compared with between atomic) at which in certain conditions between the United kami point of these surfaces having strong ties similar forces of the interaction of atoms in a single piece metal. Each single link insignificant in size; welded connections can come only when the number of connections (interacting point ca) to be very large to them. However, power iyeyu th of the necessary (but still oyu insufficient) condition for this is the high ductility of the metal parts on the mating surfaces to be welded. Some metals, such as copper, aluminum, lead, silver (plastic enough in normal circumstances), welded pressure at ambient and even subzero temperatures. This process plastic compounds called metal cold welding. Other metals for welding in the solid phase should be subjected to an artificial increase plasticity by heating surfaces, connecting to more or less high temperatures not exceeding, however, the melting point of approx. To include forging pressure welding,-gas, electric contact and others. Welding is also a kind of friction pressure welding, welded connection is formed as a result of plastic deformation joint parts connecting a solid phase. From other types of welding pressure it differs primarily heating method, rather - in the way of keeping heat in the parts to be welded. When welding friction mechanical energy is converted directly into heat, and heat generation is strictly locale and

Busi- in thin near-surface layers of metal. This feature determines the main advantages of the process of friction welding.

**The purpose of research.** The article is to study the main advantages of friction welding and possibilities of its use in the industry.

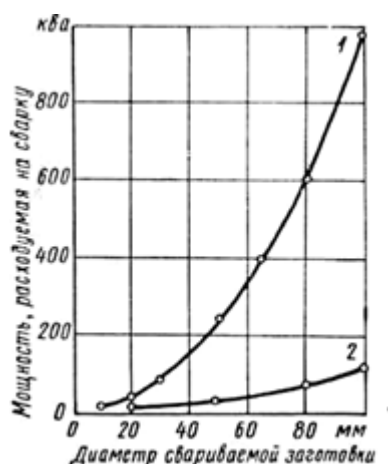
**Results.** The simplest scheme friction welding process Images and Fig. 1.



**Fig. 1.** Schematic diagram of the friction welding process.

Two parts to be welding, are spivvi START terminals in vehicles; one of them still fixed, the other driven by friction welding process rotation around their common axis. In the mating surfaces of parts, pressed one to the other axial force  $P$ , the forces of friction. Work Spent with relative rotation of parts to overcome these forces is converted into heat generated by friction on surfaces and causes them intense heating to temperatures necessary for the formation of a welded connection (with respect to welding ferrous metals these temperatures, depending on the treatment process lie within the  $950-1300^{\circ}\text{C}$ ). Upon reaching the desired temperature relative movement surfaces must be possible to quickly (almost instantly) suspended; with stops and heat. The formation of welded connection end stage "prokovuvannya": the hot, but the real detail for some time applied squeezing force. During and after the natural cooling prokovuvannya is welded parts. Friction Welding has next important advantages, many of Worms's characteristic is the result of this process localized heat in near-surface layers of thin metal, that is exactly where it is required for welding purposes. Briefly consider them. *High performance.* Volume thin layer of metal that is heated, so insignificant that all its heating cycle is usually placed in a very short period of time - from a few seconds up to half a minute (Depending on the material properties and dimensions of the intersection parts, welded); so performance friction welding is very high and compete with it in this respect can only electric welding.

*Low power consumption and power.* A small amount of metal, heating and va is my friction welding, defines and exceptionally high is nerhetych or characteristics of the process; power consumption and capacity (Fig. 2) for welding is 5-10 times less than with welding. The major energy hub friction welding machines are usually asynchronous motor; so consumed welding power is evenly distributed among the three phases of the mains supply and besides high (engine) power factor  $\cos \varphi = 0,8-0,85$  (With electric welding network load, usually single-phase and with much lower power factor).



**Fig. 2.** The consumption of network capacity: 1 - with electric welding; 2 - friction welding.

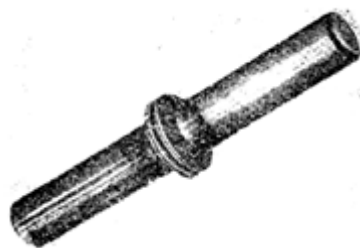
*High quality welded connection.* One of the most important advantages of friction welding is the high quality of the welded joints. When properly selected welding metal joints and adjacent zones to it has the strength and ductility not lower than the base metal parts to be welded. This is explained as follows: 1) all oxide and adsorbed film and the different parts to a third party, always covering metal surfaces and preventing the formation of welded connections in the friction welding away from crossroads of a lattice due to mechanical wear of mating surfaces in friction and deformation of metal in radial directions, resulting formed characteristic "collar" (Fig. 3). Tight contact between the friction surfaces prevents tumors oxides during welding. As a result, the junction no lack of penetration, pores, sinks, oxide and slag inclusions, cracks and other makroporoky metal; 2) adjacent to the junction and the heat affected zones it gets metal structure with vno tu p and CH and m and abruptly crushed (compared with the base metal) in grain (Fig. 4); this structure is formed as a result of rapid local heating small amounts of metal and high-speed their cooling (in the intense heat from the railway and the masses of the metal) in the presence of significant pressures that reach at 300-500 or more (under load pressure is typically 3-5 kg / mm <sup>2</sup>) In addition, there is a mechanical dribnennya grains in the friction. The fine structure of the metal-free makroporokiv determines the high mechanical performance of welded connections. Apart from the above, friction welding has also other, equally important advantages.

*The stability of the quality of welded joints.* The party components made by welding without friction Overvoltage lahodzhe ing machine has sustainability as connections and a number of indicators (temporary tensile, bend angle, impact strength) fluctuations in value does not exceed 7- 10%. This explained the basic parameters of sustainability - the relative speed of rotation, the magnitude of the axial force and heating time, and the fact that the properties of welded connection does not depend on such external (disturbing) factors as fluctuations in the mains voltage quality auxiliary materials and qualification of welder and the degree of fatigue etc. That the other types of welding greatly affect the sustainability properties of welded joints. High stability mechanical properties of welded

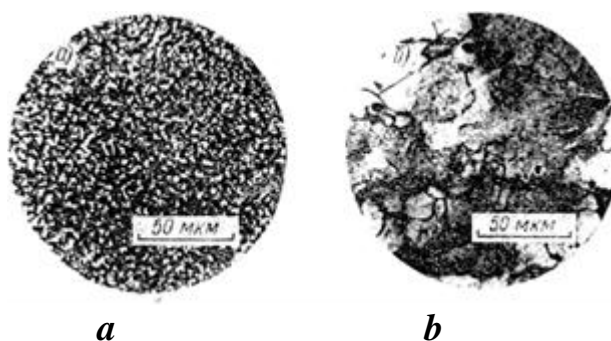
connections, which is an important feature of the friction welding process allows reasonably apply sampling products through, for example, the destruction of several parts, selected from the party. This is especially important in modern conditions of production, when virtually no simple, cheap and reliable way to control butt welded, not destroys compounds suitable for use in welding or procurement departments.

*The possibility of welding metals and alloys in various combinations.* Cheny already accumulated considerable experience of manufacturing friction welding shows that one of its major advantages is the possibility of not only strong connections with the same name, but also a large number of combinations of dissimilar metals and alloys, including such teplof and zych No properties are dramatically different. With friction welding obtained and utilized in industrial production, including metal compounds such pairs that other types of welding or were completely impracticable, or out with great efforts, such as aluminum with steel, titanium and aluminum, copper and steel and others.

*Ability welding parts raw surfaces.* Friction Welding unpretentious against pollution and purity processing side surfaces of parts intended for welding and this compares favorably with, for example, electric welding, with th operation as their thorough cleaning necessary and takes a lot of time. By surface to be connection, in most cases, especially when welding parts with the same materials also are required purity and accuracy of processing permitted pollution and rust, and neperpendykulyarn st and ends rotation axis without noticeable deterioration in the quality of ' Unity can reach 5-7 °. In the friction surfaces only unacceptable dross; its presence can lead to the formation of defective connection.



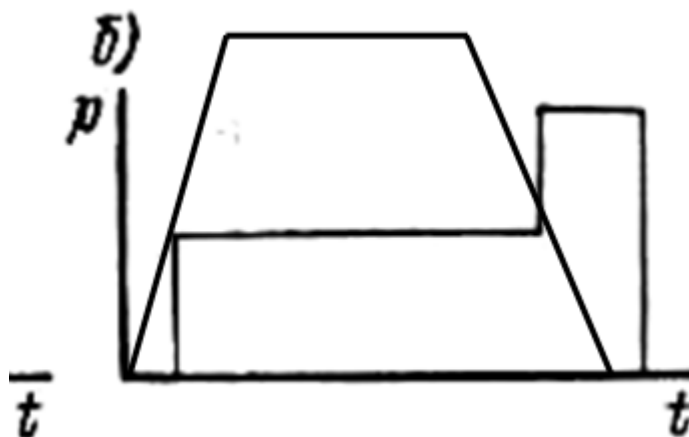
**Fig. 3.** The steel rods, welded by friction, with formed to play them.



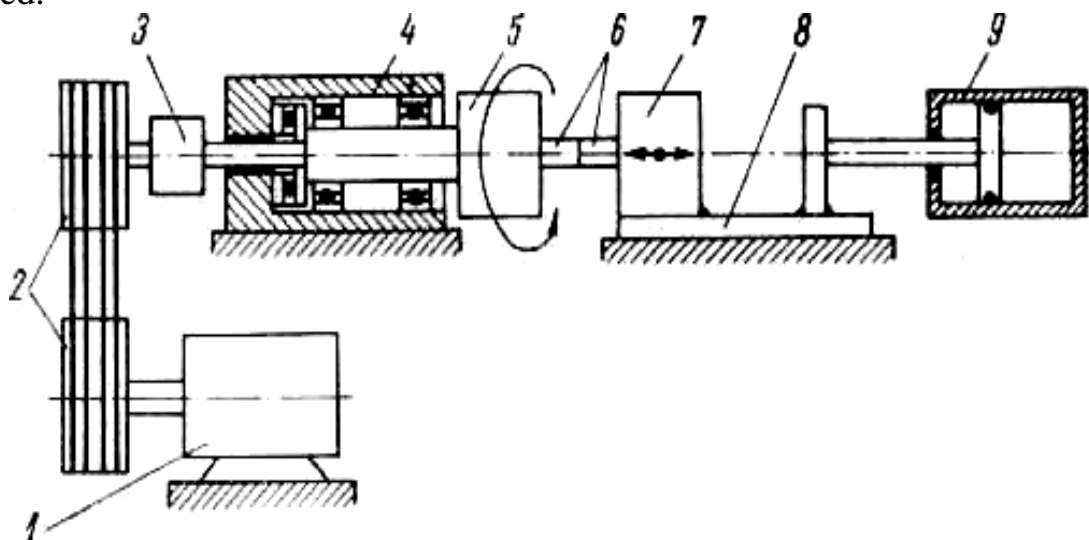
**Fig. 4.** Friction Welding little uhle steel and Zeboim. Metal junction structure (a) and base metal (b).

*Hygienic process.* Friction welding of other types of welding process distinguishes hygiene: no ultraviolet radiation, harmful gas emissions, hot metal splashes, etc. It has allowed many businesses to install machines for friction welding lines in machining, thus completely abandon from in-plant transport parts from mehanooobr oblyuvanyh in welding shops, and back and eventually obtain significant economic benefit.

*Selecting modes friction welding. The choice of specific values of heat and pressure prokovuvannya.* Specific pressure as noted above, plays an important role in heating parts and especially in the last - fourth - phase welding process when necessary effort applied to the parts to be welded for maximum convergence their surfaces. Similar to forge welding fourth phase of friction welding process was called prokovuvannya. There is a typical graph of friction welding, shown in Fig. 5. Curve 1 corresponds to the pressure; 2 - speed friction. In its apparent simplicity of the present graphics in a real installation very difficult. First of all because of the need quick stop rotation of the sample. Friction welding machines usually include the following basic components (Fig. 6) Two clamps 5 and 7 parts welding operations subject to 6, one of which is rotating; front pastern 4 of the spindle that bears the rotating clamp 5; junction 8, which is clamp neobertovyy 7; drive spindle of the motor 1, 2 and belt drive device for belt tension; friction clutch 3 for coupling with a drive spindle device, as well as inhibition of spindle, pneumatic or hydraulic cylinders 9, ensuring the creation of necessary workers (axial) efforts machines; Mr nevmatychna, Pneumohydraulic or hydraulic actuation circuit control machines; control circuitry of the machine; machine bed, wardrobe management. Technical characteristics of friction welding machines shown in Table 1. It is seen that warm-up parts to be welded is 10 ... 50 seconds, and prokovuvannya 1.5-2 seconds. Hence the high performance welding in order 1000-150 hour. However, when heated clamping force range from 0,5 103 kg (5103 N) to 10 103 kg (10 104) during welding parts up to 50 mm. This feature requires equipment machines for welding by friction brake efficient, almost instantaneous, and bearings, which receive high axial thrust bearing.



**Fig. 5.** A typical schedule friction welding. 1 - pressure change over time, 2 - speed.



**Fig. 6.** The principal structural and kinematic location modern machines for welding by friction.

In practical terms, the use of friction welding is particularly interesting manufacturing exhaust valves of internal combustion engines, advantageously made from different materials. Parts of these valves work in conditions that require the use of steels with properties that are different. Thus, the valve plate ispytuyut di th high temperatures in Abrasive corrosive environments, while stocks are not ispytuyut these influences. Therefore, with tons of rides cost of parts Valve significantly different.

Table 6.1.

**Specifications of general application.**

Name Specifications	Units measurement	Sizes machines			
		MST-23	MST-35	MST-41	MST-51
Power (nominal)		10	22	40	75
Axial force:					
by heating to maximum	kW kG kG	2500 5000	5 000 10 000	10 000 20 000	20 000 40 000
Diameter welded rod blanks					
minimum	mm	10	16	22	32
maximum	mm	25	36	50	70

Diameter tubular blanks (Maximum)	<i>mm</i>	32	39	52	75
Diameter of disc blanks (Maximum)	<i>mm</i>	110	180	180	320
Workpiece length obertayemoyi minimum top	<i>mm</i> <i>mm</i>	45 600	50 500	60 900	65 1200
Length motionless Logging minimum top	<i>mm</i> <i>mm</i>	50	60	70	80
		A b s o l u t e l y			
Term heating	<i>s</i>	10-20	10-30	15-45	20-50
Forging term	<i>s</i>	1.5- 2.0	1.5- 2.0	1.5-2.0	1.5- 2.0
Productivity	<i>Welding in hours</i>	Up to 150	Up to 120	Up to 100	Up to 70
Voltage zhyvlenoyi network	<i>In the</i>	380	380	380	380
Air pressure (nominal)	<i>kg / cm<sup>2</sup></i>	4.5	4.5	4.5	4.5
Overall dimensions machine: length	<i>mm</i>	1825	1800	2150	2910
width	<i>mm</i>	580	720	770	1110
height	<i>mm</i>	1250	1300	1350	1675

**Conclusions.** 1. Friction welding is very economical and has high performance, fire safety with ease of use. 2. To use friction welding must have equipment with the possibility of increasing pressures with instant termination rotation parts to be welded to their cooling. 3. Friction welding has the advantage to carry out permanent connection for computer time order of 50-120 seconds without pretreatment ends of parts to be welded. 4. When friction welding is a slight decrease in the length of parts to be welded, which is taken into account in the appointment of their size. 5. Powered possible calculation to determine the required temperatures and pressures during welding and friction welding Recommended in practical purposes.

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## THE BASIC FEATURES OF THE FRICTION WELDING

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**Key words:** a friction, welding, advantages, deficiencies, cars for welding.

### Summary

*The basic features of reception of fixed joints of a friction welding are observed and advantages of this aspect of welding, and also necessity to have for its realisation special cars of the friction, capable to provide sweeping twirls and considerable force of a clip in the second stage of process of welding are shown.*