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groove). In addition, the average magnitude of specific pressure was determined, and an attempt was made analytically to solve the problem of distribution of pressure in the deformation region. The measurements of the specific pressure were carried out under industrial conditions on a cold-reducing mill ХПТ-32 (KhPT-32). Specially designed rolls (300 mm in diameter) permitted direct determination of the pressure at six points of the pass with the aid of six carbon pressure gauges of the membrane type, constructed by TsNIITMASh. Fig.1 shows the expanded pass with the location of the pressure gauges indicated by dots and their distance from the wide end of the pass given in mm. Each of the two semi-circular rolls accommodated three of these gauges in the manner shown in Fig.2. All gauges were located in the plane of the crown of the pass, the problem of distribution of pressure across the groove being outside the scope of this investigation. The electrical pulses, generated by the pressure gauges, were recorded on a photographic film with the aid of a magneto-electric oscillograph ПОБ-14 (POB-14). The groove and the mandrel were

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designed to give a pass which tapered from 34 x 3.0 to 23 x 1.0 mm. The pressure measurements were carried out during rolling of tubes of aluminium alloys АМГ (AMG), Д-1 (D-1) and Д-16 (D-16). The stock (33.2 outside diameter, 3.0-3.2 mm wall thickness) was rolled to the following final sizes: 23 x 0.75, 23 x 0.83, 23 x 1.0, 23 x 1.1, 23 x 1.5, and 23 x 1.75 mm. Both the roll grooves and inside walls of the tubes were lubricated with mineral oil. The magnitude of feed was determined from the number of reversals per 100 mm of the length of the stock rolled. Owing to the difficulties encountered in measuring the pressure at normal rolling speeds, a speed of 10-12 reciprocal revs/min was used in the experiments. In addition to the specific pressure, the total roll pressure was measured with the aid of a gauge accommodated in the roll housing. Preliminary to experiments proper, a formula was derived for the critical angle, β, in the plane of the groove crown, and the values of this angle and of the contact angle θ_0, were calculated for various feeds, m. It was shown that at small m (e.g. m = 1.5 mm) $\beta < \theta_0$ for the entire length of the

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pass; this means that under these conditions the metal lags behind the rolls in the entire deformation region. At large m, $\beta > \theta_o$, and the deformation region (contact zone) comprises two zones: a zone where the metal lags behind the rolls, and the zone of forward slip, the latter increasing with increasing m. (Fig.3). Measurements of specific pressure, p, were carried out at m = 4-12 mm, i.e. under conditions of 2-zone deformation region. The results for alloy D-1, rolled to elongation μ_o = 5.4, are reproduced in Fig.4 where p (kg/mm^2) is plotted against the distance, x (mm) from the wide end of the pass, the three curves relating to data obtained at m = 6, 8 and 11 mm. It will be seen that p varies along the pass, passing through a maximum at a point approximately 180 mm distant from the wide end of the pass, the magnitude of the pressure peak increasing with increasing m. The ascending portions of the curves in Fig.4 correspond to the rolling stage during which the wall thickness is considerably reduced and the metal is rapidly work-hardened; the descending parts of the curves correspond to that stage of the process during which the reduction of the wall thickness attained rapidly

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decreases. The results of some other experiments are also reproduced graphically. In Fig.5, p (kg/mm^2) at various points of the pass during the forward movement of the rolls, is plotted against m (mm), the curves obtained for alloy D-1, rolled to μ_o = 4.34, relating to points at a distance of 53, 99, 140 and 177 mm from the wide end of the pass. Fig.6 shows how p at various points of the pass (distance from the wide end of the pass indicated by each curve) varied with the magnitude of the absolute deformation Δt, the graphs relating to the forward movement of the rolls in rolling alloy D-1 to μ_o = 4.13. The effect of the relative deformation, ($\Delta t/t_*$) x 100%, on p is illustrated in the same manner (and for the same rolling conditions) in Fig.7. In Fig.8, p is plotted against the final thickness, t_{tp} (mm) of the tube (the upper horizontal scale) and against the total elongation, μ_o, (the lower horizontal scale); the curves, determined for alloy D-1 (wall thickness of the stock = 3.1 mm) rolled at m = 7.8 mm, relate to points of the pass whose distance (mm) from the wide end of the pass is indicated by each curve.

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In the second part of the investigation, the average specific pressure p_{cp} was determined from the measured magnitude of roll pressure P_{Σ}, and calculated contact area F_K. The results obtained on various materials rolled on cold-reducing mills, ХПТ-32 (KhPT-32), ХПТ-1$^1/_2$ (KhPT-1$^1/_2$) and ХПТ -2$^1/_2$ (KhPT-2$^1/_2$) are reproduced graphically in Figs. 9-11, all of which relate to the forward movement of the rolling process. Fig.9, relating to copper, rolled on mill KhPT-1$^1/_2$ (m = 6.3 mm, μ_o = 4.95) shows how p_{cp} (kg/mm^2) varied with the distance, x (mm) from the wide end. In Fig.10, p_{cp} is plotted against m (mm); the curves, constructed for alloy D-1 rolled on mill KhPT-32 (μ_o = 4.13), relate to points of the pass whose distance from the wide end is shown by each curve. The same relationship for brass Л-62 (L-62) rolled on mill KhPT-1$^1/_2$ to μ_o = 4.95, is illustrated in Fig.11. To explain the fact that p_{cp} was found to be practically independent to m, the present authors postulated that the variation of m brings about redistribution of the additional pressure across the pass so that although the

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pressure at some points may increase, its average value remains the same. Fig.12 shows the hypothetical distribution of pressure across the pass; for the sake of clarity, the semi-circle representing the circumference of the groove is shown as a straight line πR_x long, where R_x is the radius of the groove: graphs a and б relate to rolling at m = 4 and 12 mm respectively. Based on the results of the present investigation, an empirical formula for p_{cp} was derived in the form

$$p_{cp} = \sigma_B \left[1 + \frac{f\sqrt{D}}{7.9}\left(\frac{t_3}{t_x}\right)\right] \quad (5)$$

where σ_B - U.T.S. (kg/mm^2) of the metal rolled, corresponding to the degree of work-hardening attained in a given point of the pass; f - coefficient of friction between the metal and rolls; D - roll diameter, mm; t_3 - wall thickness of the stock; t_x - wall thickness of the tube at the point of the pass for which p_{cp} is

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calculated. The above formula (which is applicable only when the reduction in the wall thickness of the tube is not less than 0.04 mm) gave results which were in good agreement with the experimental data. In the last chapter of the present paper the distribution of pressure along the momentary deformation region (contact zone) is analytically studied, and two formulae are derived for the pressure in the zones before and after the neutral point (referred to as the lagging and forward slip zones). The values of pressure, obtained with the aid of these formulae, agree with experimental data only for the narrow end of the pass. The results of the present investigation can be summarized as follows. (1) The diagram of the distribution of pressure along the deformation region constitutes an arched curve which is characteristic for a 2-zone deformation region, and which supports the postulated existence of a "critical" section in the plane of the crown of the pass. (2) The specific pressure reaches a maximum approximately in the middle of the pass. The peak pressure is 2-2.5 times higher than the U.T.S. of the metal rolled.

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(3) Near the leading (wide) end of the pass, the specific pressure is practically independent of the magnitude of feed, m. Near the exit (narrow) end of the pass, the specific pressure increases almost linearly with increasing m, the increase being more pronounced in sections corresponding to small wall thickness of the tube. (4) With increasing total elongation (or decreasing final wall thickness) the specific pressure increases hyperbolically. (5) The average specific pressure is practically independent of m. (6) The average specific pressure can be calculated (with accuracy sufficient for practical purposes) from a formula derived by the present authors.
There are 14 figures, 3 tables and 6 Soviet references.

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AUTHORS: Pavlov, I.M., and Piryazev, D.I.

TITLE: Axial Loads in Cold Rolling (Cold Reducing) of Tubes

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy, No. 4, 1960. Metallurgiya, metallovedeniye, fiziko-khimicheskiye metody issledovaniya, pp.135-140.

TEXT: Many of the mechanical failures, encountered in the cold-reducing process (seizure of the stock, bending of the rod supporting the mandrel, excessive wear of various parts of the feeding mechanism) are caused by axial loads which, in addition, constitute a factor limiting the protective capacity of the mill. It was for these reasons that the present investigation, concerned with axial loads in rolling non-ferrous metals and alloys, was undertaken. The measurements were carried out on cold-reducing mills ХПТ-1 1/2" (KhPT-1 1/2") and ХПТ-2 1/2" (KhPT-2 1/2"), used for rolling copper and brass tubes. The axial loads, acting directly on stock, were measured with the aid of carbon pressure gauges, mounted in a special device attached to the end of the stock. In the case of mill KhPT-1 1/2, only the

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compressive loads were measured; the device used during rolling on mill KhPT-$2^1/2$" was designed to measure both compressive and tensile loads. A general view of this device is reproduced in Fig.1, which shows a cylinder (1) to which the stock (2) was rigidly attached, and flanges (3) and (4); the compressive loads were measured with the aid of three carbon gauges (5), similar gauges of the membrane type having been used to measure the tensile loads. The electric pulses generated by the gauges were recorded with the aid of a magneto-electric oscillograph ПОБ-14 (POB-14). In addition to the axial loads, the roll pressure was also determined. In the case of mill KhPT-$1^1/2$", the measurements were carried out during rolling of copper and brass tubes through six different passes. Mill KhPT-$2^1/2$" was used to study the variation of axial loads during rolling of brass tubes through a tapered pass (61 x 6 - 36 x 3 mm) and through a 4-zone pass (61 x 6 - 38 x 3 mm). Some of the typical results are reproduced graphically. In Fig.2, the roll pressure, P_Σ (kg, left-hand scale) is plotted against the distance, x (mm) from the leading

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end of the pass, curves 1 and 2 relating to the forward and reverse movements of the rolls respectively. Similarly, curves 3 (forward movement) and 4 (reverse movement) show the variation of the axial load, Q_Σ (kg, right-hand scale). The results, reproduced in Fig.2, relate to copper tubes rolled on mill KhPT-1½" through a pass 40 x 3 - 27 x 0.8 mm, the other rolling parameters being μ_o (elongation) = 3.9 and m (feed) = 8.3 mm. The results for brass Л-68 (L-68) rolled on mill KhPT-2 1/2" through a 4-zone pass 61 x 6 - 38 x 3.0 mm (μ_o = 2.9, m = 4 mm) are reproduced in the same manner in Fig.3, except that in this case P_Σ is given in tons. In Fig.4, the axial load Q_Σ (kg) is plotted against the distance x (mm) from the leading end of the pass, curves 1 and 2 relating respectively to the forward and reverse movement during rolling of brass L-68 through a tapered pass 61 x 6 - 36 x 3 mm (μ_o = 3.5, m = 4.0 mm). The combined effect of the variation of feed, m, and elongation, μ_o, on Q_Σ (kg) during rolling of copper (reverse movement) on mill KhPT-1 1/2", through a pass 40 x 2 - 27 x 0.8 mm, is plotted against m (mm), curves 1, 2 and

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3 relating to μ_o = 3.0, 3.9 and 5.6 respectively, see Fig.5). In Fig.6, Q_Σ (kg) during rolling of brass L-68 on mill KhPT-1$^1/_2$" through a pass 36 x 3 - 24 x 1 mm (μ_o = 3.9) is plotted against m (mm), curves 1 and 2 relating respectively to points at a distance of 154.7 mm from the leading end of the pass (forward movement) and 126.7 mm (reverse movement). In the final experiments, the effect of various lubricants on Q_Σ was studied. The results, obtained during rolling of brass L-68 on mill KhPT-1$^1/_2$" through a tapered pass 36 x 3 - 24 x 1 mm (μ_o = 3.9, m = 8.3 mm), are reproduced in Fig.7, showing the variation of Q_Σ due to change of the lubricant, curves 1 and 2 having been constructed for the forward and reverse movement of the rolls, and the experimental points relating to an oil/graphite mixture (open circles), solidol (full circles), emulsol (full triangles), and mineral oil (full squares). The main conclusions reached by the present authors can be summarised as follows. (1) In analogy to the roll pressure, the axial loads during cold reducing of tubes vary along the pass. The axial loads during the reverse movement are considerably higher

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than those during the forward movement rolls, constituting 8-10% of the roll pressure in the former, and only 2.5-6% in the latter case. If, therefore, seizure of the stock occurs, it probably takes place during the reverse movement of the rolls.
(2) Two-fold increase in the feed increases the axial loads 1.5-1.8 times; a similar increase in the wall thickness of the stock increases the axial loads by a factor of 2.3.
(3) Minimum axial loads are ensured by using an oil/graphite mixture for lubrication; mineral oil, used for this purpose, raises the magnitude of the axial loads to its maximum.
There are 7 figures, 2 tables and 2 references: 1 Soviet and 1 German.

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E193/E183

AUTHORS: Pavlov, I.M., and Piryazev, D.I.

TITLE: Investigation of the Total Roll Pressure During Cold Rolling (Cold Reducing) of Tubes

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy, No. 4, 1960. Metallurgiya, metallovedeniye, fiziko-khimicheskiye metody issledovaniya, pp.141-149

TEXT: The object of the present investigation was to study the effect of various parameters of the rolling process on the pressure exerted on the rolls during cold reducing of tubes made of aluminium alloys Д-1 (D-1) and АМГ (AMG), brasses Л-62 (L-62) and Л-68 (L-68), German silver, and copper. Mills ХПТ-1 " (KhPT-1"), ХПТ-2" (KhPT-2"), ХПТ-32 (KhPT-32) and ХПТ-75 (KhPT-75) were used in the experiments, and the measurements were carried out with the aid of carbon pressure gauges accommodated in the housing of the rolls, the electrical pulses generated by the gauges being recorded by a 14-loop oscillograph ПОБ-14 (POB-14). The long-term object of the investigation was to gather data that could be utilized for improvement of the roll

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pass design developed at Kafedra prokatki Instituta stali (Mechanical Rolling Department of the Steel Institute). To this end, the passes in the rolls used in the present investigation were calculated from the formulae due to I.M. Pavlov et al. (Ref.3):

$$t_x = \frac{t_z}{\frac{\mu_\varepsilon - 1}{1 - e^{-n_1}}\left(1 - e^{-n_1 \frac{x}{l}}\right) + 1} \qquad (1)$$

and

$$t_x = \frac{t_z}{\frac{\mu_\varepsilon - 1}{1 - n_2}\left(1 - n_2 \frac{x}{l}\right)\frac{x}{l} + 1} \qquad (2)$$

where: t_x - wall thickness (mm) at the given point of the pass;

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t_z - wall thickness (mm) of the stock; $\mu_\epsilon = t_z/t_{tp}$ - total reduction in the wall thickness; ℓ - length (mm) of the reducing portion of the pass; x - the coordinate (distance from the wide end) of the given point of the pass (mm); n_1 and n_2 - constants ($n_1 = 0.64$, $n_2 = 0.1$). Formula (1) was used to design the roll passes for mills KhPT-2½" and KhPT-75, formula (2) having been used for the two other mills. Some of the results obtained during rolling of alloy AMG (mill KhPT-32) through a tapered pass 34 x 3 - 23 x 1.0 mm (elongation $\mu_o = 4.32$, feed m = 8.0 mm), are reproduced in Fig.1, where the roll pressure P_Σ (kg, left-hand scale, lower curve) and the decrease Δt_x (mm, right-hand scale, upper curve) in the wall thickness are plotted against the distance x (mm), from the leading end of the pass. In Fig.2, P_Σ (kg) is plotted against the distance ℓ_p (mm) from the leading end of the pass, curves 1 and 2 relating respectively to the forward and reverse movement of the rolls of the mill KhPT-75, used for rolling alloy D-16 through a 4-zone pass 54 x 4 -

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35 x 1.75 mm (m = 10 mm). In Fig.3, P_Σ (kg) during the forward movement of the rolls (mill KhPT-1½" used for rolling copper through a pass 40 x 2 - 27 x 0.8 mm) is plotted against feed m (mm), curves 1, 2 and 3 relating to rolling to attain elongation μ_o of 3.0, 3.9 and 5.6 respectively; the variation of P_Σ during the reverse movement under the same conditions is similarly illustrated in Fig.4. The effect of elongation, μ_o, is illustrated in Fig.5, where P_Σ during the forward movement of the rolls is plotted against μ_o, graphs (a) and (b) relating respectively to points at a distance of 99 and 140 mm from the leading end of the pass: the graphs were constructed for alloy D-1, rolled on mill KhPT-32 through a pass 34 x 3 - 23 x 1 mm (m = 7.9 mm). Fig.6 shows P_Σ (at x = 177 and 53 mm) as a function of the absolute deformation Δt (mm), the data having been obtained during rolling of alloy D-1 on mill KhPT-32 (μ_o = 4.13). Fig.7 shows P_Σ (at x = 201.5 and 59.5) as a function of the relative deformation $\Delta t/t$ x 100%, the curves

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having been constructed for copper rolled through a pass 32 x 3 - 20 x 1 mm (μ_o = 4.65). In Fig.8, P_Σ at x = 94.7 mm (curve 1) and x = 235.7 mm (curve 2) is plotted against the wall thickness t_z (mm) of the stock; this graph relates to brass L-62 rolled through a pass 38 x 3 - 25 x 1 mm (forward movement). The results reproduced in Fig.9, where P_Σ is plotted against the rolling speed n (reciprocal revs/min), relate to alloy AMG, rolled on mill KhPT-32, through a pass 29 x 3 - 18 x 0.8 mm (m = 7.8 mm). Finally, the results of lubricating tests are reproduced in Fig.10, where P_Σ is plotted against various types of lubricants used in the rolling of brass L-68 on mill KhPT-1½" through a pass 36 x 3 - 24 x 1 mm (μ_o = 4.65, m = 8.3 mm), curves I and II relating to the forward and reverse movement respectively. The type of lubricant is shown as follows: open circles - oil/graphite mixture; full circles - solidol; full triangle - emulsol; full circle (on the extreme left) - mineral oil. The following conclusions were reached.

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(1) Irrespective of the size of the mill and type of alloy rolled, more favourable distribution of the roll pressure along the pass is obtained if instead of a 4-zone pass, a tapered pass calculated from the formulae (1) and (2) is used. Since the maximum roll pressure in a tapered pass is 1.5 times lower than that in a 4-zone pass, the introduction of the former in industrial practice should increase the output of the mill and improve the quality of the product. (2) A two-fold increase in the feed increases the roll pressure by a factor of 1.3-1.5. (3) In rolling tubes to the final wall thickness > 1.3 mm, the increase in the roll pressure due to increased feed is approximately the same as that due to increased elongation; when the final wall thickness is below 1.3 mm, the effect of elongation becomes more pronounced. (4) Doubling the wall thickness of the stock increases the roll pressure by a factor of 1.2 during the forward movement, and by a factor of 1.3 during the reverse movement of the rolls. (5) Within the range of the rolling speeds studied

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(10-80 reciprocal revs/min), the roll pressure remains practically constant. (6) Best results (lowest roll pressure) are obtained when an oil/graphite mixture is used for lubrication. However, this lubricant is difficult to remove from the finished product, and the application of emulsol or solidol is recommended instead. There are 10 figures, 1 table and 4 Soviet references.

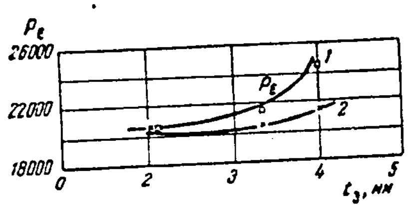

Fig.8

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PAVLOV, I.M.; SUVOROV, I.K.; FOMENKO, Yu.Ye.

Improved cylindrical torsiometer with a cut-in strip. Izv. vys.ucheb.zav.; chern.met. no.5:72-75 '60. (MIRA 13:6)

1. Moskovskiy institut stali.
(Torsion) (Measuring instruments)

PAVLOV, I.M.; MEZIS, V.Ya.

Relation of metal hardness during cold working to the reversal of the deformation stress. Trudy Inst.met. no.5:100-112 '60. (MIRA 13:6)
(Metals--Cold working) (Brinell test)

PAVLOV, I.M.; MEZIS, V.Ya.

Dependence of the strength limit, the yield limit and the elongation per unit length on stress reversal during plastic metal deformation. Trudy Inst.met. no.5:113-126 '60. (MIRA 13:6)
(Metals--Testing)
(Deformations (Mechanics))

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E111/E135

AUTHORS: Belosevich, V.K., and Pavlov, I.M. (Moscow)

TITLE: The Destruction of Metal under the Influence of a Technological Lubricant During Rolling

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1960, No.5, pp 224-226

TEXT: It is pointed out that the influence of a technological lubricant on the process of cold rolling was investigated mainly from the point of view of its influence on the friction coefficient and the related problem of the thickness of sheets obtainable on a given rolling equipment. The lubricant can also have a strong influence on the quality of the surface of sheets. This is illustrated by examples of steel strip from steel CB-08 (SV-08) rolled with castor and palm oil (Fig.1) and stearic acid (Fig.2a) and titanium strip rolled with natural wax (Fig.2б). It is considered that in addition to known phenomena of surface activity of the lubricant and the subsequent hydrostatic action of the lubricant squeezed into fissures, the destruction of strip can be caused by some specific phenomena in the focal point of deformation which, apparently, were not yet investigated.

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E193/E483

10.9230 also 1418, 1416, 1454

AUTHORS: Pavlov, I.M. and Mekhed, G.N.

TITLE: Determination of the Resistance to Deformation of Metals in Impact Bending and Tension

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy, No.7. Moscow, 1960. pp.3-14. Metallurgiya, metallovedeniye, fiziko-khimicheskiye metody issledovaniya

TEXT: Proper understanding of the behaviour of polycrystalline aggregates, deformed at elevated temperatures at high rates of strain, has an important bearing on the problems of selection, design and construction of equipment for hot plastic working of metals. Owing to experimental difficulties, encountered in studies of the resistance to deformation of metals subjected to dynamic loads, data yielded by static tests or obtained by indirect dynamic methods have been used for this purpose, leading often to erroneous results. The object of the investigation described in the present paper was to explore the possibility of using a direct method to obtain accurate data on the load-strain-time relationship for metals, deformed under conditions of dynamic

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Determination of the Resistance ... E193/E483

loading. To this end, a specially designed impact testing machine PSWO-1000 (VEB WPM - Leipzig) of the pendulum type was used, in which both tensile and bending tests could be carried out. In addition to the usual facilities for measuring the work done in bending a notched bar (of the beam type) or in fracturing a tensile test piece, the machine was equipped with photo-cells, piezo-electric gauges and an oscillograph. With the aid of these devices, the load-strain and strain-time diagrams could be recorded in the form of oscillograms from which the impact strength and mean resistance to deformation of the metal studied could be calculated, as well as the duration of the deformation process. The equipment (whose detailed description is given) was used to conduct impact bending tests on technical iron with the combined C, S and Mn content of 0.02% at 20 to 1200°C, and impact tensile tests on copper at room temperature. An oscillogram of the type obtained in the bending tests is reproduced in Fig.6 which shows how the load exerted on the test piece (h, middle curve) varied with time (upper waveform, 1 wavelength representing 1/1000 sec) and with the distance travelled by the pendulum (lower waveform, 1 waveform representing 2 mm). By dividing the area under the

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18.8200

AUTHORS: Pavlov, I.M. and Krupin, A.V.

TITLE: An Approximate Graphical Method of Determining the Defect-Induced Stress Concentration in Metals

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy, No.7. Moscow, 1960. pp.15-19. Metallurgiya metallovedeniye, fiziko-khimicheskiy metody issledovaniya

TEXT: Defects in the form of discontinuities (voids) in metals act as stress risers. The stress concentration due to such a defect is always less if the defect is completely filled with another substance (subsequently referred to as "filler"), the existence of a bond between the filler and the parent metal being a necessary condition for this decrease in the stress concentration to occur. The results of photo-elastic studies, conducted by the present authors on thin flat test pieces, showed that in the case of hard and notch-sensitive metals the defect-induced stress concentration depends on the shape of the defect and on the nature of the filler, the quantitative measure of the influence of these two factors being given by the, so-called, shape coefficient K_Φ

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and filler coefficient K_3. It was shown also that the integrated coefficient of stress concentration due to any defect is given by $K = K_\Phi K_3$. The magnitude of K_Φ of a filler-free defect can be determined experimentally or analytically; in the case of an elliptical or circular hole it can be calculated from a formula derived by G.Kolosov $K = 1 + 2a/b$, where a and b are the main semi-axes of the ellipse. K_3 can be found from an empirical formula

$$K_3 = \frac{1}{0{,}62\frac{E_3}{E_0} + 1}.$$

where E_3 and E_0 are elastic moduli of the filler and parent metal respectively. Thus the integrated coefficient of any defect-induced stress concentration can be calculated from

$$K = \frac{K_\Phi}{0{,}62\frac{E_3}{E_0} + 1}.$$

The approximate values of K can be found with the aid of the nomogram, reproduced in Fig.2, which consists of a $K_3(E_3/E_0)$ curve

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(left-hand side diagram) and a set of lines passing through the origin of the coordinate system and corresponding to various values of K_Φ (right-hand diagram). The following procedure is used: (1) the E_3/E_0 ratio is calculated for the given case and the corresponding value of K_3 is found from the left-hand curve; (2) from the point determined by these two coordinates, a horizontal line is drawn to intersect a line corresponding to K_Φ of the given defect, the appropriate magnitude of K_Φ having been determined experimentally or analytically; (3) a vertical line is drawn from the point of intersection to intersect the axis of abscissae on which the sought value of K is read off. The method proposed is illustrated by various numerical examples. There are 3 figures and 1 table.

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11300 also 1454, 1413

AUTHORS: Pavlov, I.M. and Shelest, A.Ye.

TITLE: Investigation of Basic Factors in Rolling Titanium Alloys With High Reductions

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy. No.7, Moscow, 1960. pp.110-114. Metallurgiya metallovedeniye, fiziko-khimicheskiy metody issledovaniya

TEXT: The authors have previously studied the hot rolling of various titanium alloys at constant relative reductions of 20%. They now describe corresponding studies on one of these alloys, BT5 (VT5) and type 1X18H9T (1Kh18N9T) stainless steels at reductions of up to 60%. A two-high mill with smooth 200 mm diameter rolls fitted with ball bearings was used to roll specimens 10 mm thick, 15 mm wide and 150 mm long. Total rolling pressure was measured with carbon load cells in the screw-down gear. Wire strain gauges on the shafts measured torque, their output being amplified electronically and recorded, together with total rolling pressure by means of an oscillograph. Specimens were preheated to 800 - 1200°C to give uniform temperature distribution (Ref.1: V.K.Belosevich, V.F.Kalugin, H.I.Korneyev,

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Investigation of Basic Factors ...

I.M.Pavlov, I.G.Skugarev, A.Ye.Shelest, "Isv. AN SSSR, OTN", 1956, No.10). Fig.1 shows specific pressure, kg/mm^2, as functions of rolling temperature by continuous and interrupted lines for the titanium alloy and stainless steel, respectively; curves 1, 2 and 3 refer to reductions of 60, 40 and 20%, respectively. The specific pressure was less than when the authors used 220 mm diameter rolls (Ref.3: I.M.Pavlov, A.Ye.Shelest. "Nauchnyye doklady vysshey shkoly (metallurgiya)", No.3, Izd-vo "Sovetskaya nauka", 1958), the difference rising with falling roll pressure. The ratio n of the contact angle α to the central angle φ, i.e. the angle between the radius through the point of application of the total metal pressure on the rolls (acting in the direction of the vertical axis) and the axial line, varies within the range 2 - 3 for both steel and alloy, first falling and then rising with increasing reduction. The authors note the importance of this parameter. Spread was measured by finding the change in distance between two points on the side of the specimen produced in rolling. The lateral spread is plotted as a function of temperature for 20% average reduction of type ВТ1Д (VT1D) titanium in Fig.2; for 1Kh18N9T the maximum lies at 1100 and for

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the alloy VT5 at 1000 - 1050°C, and for technical purity titanium at 900 - 950°C. Spread as a function of relative reduction is shown for the steel and the alloy in Fig.3, left and right-hand graphs respectively, at 800, 1000 and 1200°C. The work has shown that for VT5 alloy the specific pressure in the beta-phase region is considerably less than in the alpha-phase region, the transformation leading to an abrupt change. The spread mechanism in rolling titanium is mainly through barrel formation, while with steel it is mainly through slip along the contact surface. The dependence of the index of spread on temperature is also affected by the allotropic transformation, the index being lower for alpha than for beta titanium: the narrower the temperature interval of the transformation the sharper the change. There are 3 figures, 1 table and 11 references: 10 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English language publication reads as follows: C.W.Starling. "Sheet Metal Industries", 35, 1958, No.379.

Card 3/5

PAVLOV, I.M.; LITOVCHENKO, N.V.

Investigating the process of rolling reinforcement bar helical rib sections. Trudy Inst. met. no.7:115-137 '60. (MIRA 14:3)
(Rolling(Metalwork))
(Reinforcing bars)

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E194/E483

15.6500 only 1583

AUTHORS: Pavlov, I.M., Belosevich, V.K. and Belousov, A.S.

TITLE: A Procedure for Assessing Wire Drawing Lubricants

PERIODICAL: Akademiya nauk SSSR. Institut metallurgii. Trudy, No.7. Moscow, 1960. pp.138-146. Metallurgiya metallovedeniye, fiziko-khimicheskiy metody issledovaniya

TEXT: This article describes a laboratory method of assessing wire drawing lubricants. The principal requirements applicable to wire drawing lubricants are first summarized. In the assessment the principal magnitudes measured were the wire drawing force and the amount of lubricant on the wire surface after drawing. The quality of the wire surface was assessed in certain cases. The tests were made on a laboratory drawbench at speed of 15 m per min. The wire drawing forces were measured with a spring dynamometer fitted with strain gauges, the outputs of which were applied through an amplifier to an oscillograph. The lubricant thickness on the surface was determined by taking samples after each draw weighing, washing with benzene and reweighing. The quality of the surface was assessed visually by examination

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A Procedure for Assessing ... E194/E483

through a lens with a magnification of x5 and in some cases a profilograph type ИС-18 (IS-18) with diamond stylus was used. It was difficult to obtain uniform raw material in large quantities. For each series of tests the wire was taken from a single melt or even from a single coil. Steel of grades 08 - 10 was annealed, etched and limed. Some of the wire was tested without liming. Steel grade 50 was copper plated and covered with a layer of liquid glass. Stainless steels 1Х18Н9 (1Kh18N9) and 2Х18Н9 (2Kh18N9) were annealed (hardened) and etched and then coated with lime and salt. So far the procedure was much the same as used in practice at the "Serp i molot" works. The materials were dried before the tests. The dried lubricants were milled and sieved. The die geometry was the same in all cases, the half angle of the inlet cone being 6°30' and the length of cylindrical part ℓ = d/2. All the dies were made of hard alloy type ВК8 (VK8). The method of finishing the dies is explained. The initial length of the wire samples was about 10 m. Both solid and liquid lubricants were applied by normal methods. The wire drawing force was measured oscillographically at ten points at intervals of

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about 1.5 sec, thus giving the mean force used in calculations of the coefficient of friction. The wire drawing force itself should not be used to assess the quality of the lubricant, it is better to use the coefficient of friction, formulae for the calculation of which have been given by other authors. In view of the cone geometry used, the coefficient of friction was calculated from the following simplified formula

$$\frac{k}{p} = 2\mu_{\tau p} \cdot \left(\frac{f}{F}\right)^{a} + \frac{b}{a}\left[1 - \left(\frac{f}{F}\right)^{a}\right] + 0,7698\left(0,1139 + \frac{\mu_{\tau p}}{2}\right),$$

where μ_{Tp} - the coefficient of friction; k - the specific wire drawing stress; p - the mean resistance to strain; F - the cross-section of the area before drawing; f - the cross-sectional area after drawing;

$$a = \left(\frac{1}{\cos\frac{\alpha}{2}} + \frac{\mu}{\mathrm{tg}\,\alpha \cdot \cos\frac{\alpha}{2}} - 1\right);$$

$$b = \left(\frac{1}{\cos\frac{\alpha}{2}} + \frac{\mu}{\mathrm{tg}\,\alpha \cdot \cos\frac{\alpha}{2}}\right).$$

For different values, curves of the following type may be constructed: $k/p = \Psi(\mu_{Tp})$. In practice, the value of k may be determined from the mean wire drawing stress and p may be taken as the mean of σ_o and σ_1. In each particular case the coefficient of friction is determined from the calculated value of k/p. The amount of lubricant on the surface was expressed in mg/cm^2. It was difficult to calculate the mean thickness because the specific gravity of the lubricant layer which includes the lubricant and wear products in indeterminate condition could not be determined. In addition, determinations were made of variations in wire drawing stress $(K_{max} - K_{min}) / K_{average} \times 100\%$.
Fig.3 shows typical graphs of the change in the amount of lubricant on the surface and of the coefficient of friction with increasing number of passes. The tests relate to steel lubricated with soap powder, the upper graph gives the quantity of lubricant on the surface in mg/cm^2 and the lower graph the coefficient of friction (note that rough scratches are formed after the seventh pass).
So long as there is plenty of lubricant the surface of the wire is matt and profilograms of the surface give differences of about

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5 microns between the peaks and values. There are no scratches or scorings. When the amount of lubricant has become reduced, the friction usually varies little but there is a marked change in the surface finish, there may be sometimes one or two more passes without scoring or heavy scratches but with bad lubricants scratching occurs at once. As soon as scoring has commenced, the amount of lubricant varies widely and the wire drawing stresses and coefficient of friction increase, as does the variation in wire drawing effort. The values obtained with some of the lubricants when drawing steel are tabulated. It is evident that there is no direct relationship between the coefficient of friction and the stability of lubricant assessed by the number of passes. Certain changes in the coefficient of friction when the quantity of lubricant is markedly reduced shows that it is impossible to judge of the mechanism of friction from the absolute value of the coefficient of friction as certain authors do. Still less is it justified to assert that when the coefficient of friction is less than 0.05, the friction in wire drawing is of hydrodynamic type. The fact that after the layer of lubricant has become thin, with

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most lubricants scratches are observed which are later converted to deep scoring indicates that in assessing the quality of wire drawing lubricant it is important to note the number of passes for the lubricant layer becomes too thin. The number of passes without heavy scratches and scoring in the presence of a thin layer of lubricant is also very important in assessing the lubricant. I.L.Perlin and S.I.Gubkin are mentioned for their contribution in this field. There are 5 figures, 1 table and 10 references: 6 Soviet-bloc and 4 non-Soviet-bloc. The two references to English language publications read as follows: R.Tourett. Wire and Wire Products. III, 30, No.3. 1955; W.M.Halliday. Wire Industry, XII, 24, No.228, 1957.

X

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S/148/60/000/009/013/025
A161/A030

AUTHORS: Pavlov, I.M., Suvorov, I.K., and Fomenko, Yu.Ye.

TITLE: An investigation of scale on free-cutting steel and its effect on friction in rolling

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 9, 1960, 95-101

TEXT: Free-cutting steel causes difficulties in rolling, i.e. the grip of the rollers is not firm, the rollers slip on metal, the metal cracks and tears. Same difficulties are experienced with this steel abroad. The steel per GOST 1414-54 standard contains 0.08-0.30% S, up to 0.15% P and 0.45% C. Sulphur content sometimes reaches 0.5%. The causes of the trouble in rolling have not yet been investigated and no data on the matter exist in works on the melting, deoxidation and teeming of free-cutting steel (Ref.1-4). The described investigation has been carried out in rolling in a "750" billet mill, with free-cutting "A12" and "A12A" and structural steel for comparison. Scale was collected from under the rolls in the mill

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A161/A030

An investigation of scale ...

and from ingots. The temperature of scale softening was determined in an installation of Kafedra metallurgii chuguna MIS (The Chair of Iron Metallurgy of MIS) used for testing the softening of ore and sinter (Fig.1). The softening point of the furnace scale was found at 1050°C. The softening point changed in rolling: 1000°C after the second pass; 950° after the third; 850° after the fifth and the seventh; 900° after the ninth. It drops from 1050° in the first pass to 850°, and rises again after the seventh. The content of C in the scale varied from 0.01 to 0.02%; of Mn from 0.6 to 0.7%; Si from 0.15 to 0.96%. The S content varied drastically: furnace scale contained 0.032-0.039% S, this content was maintained in the first and second pass, but in the third pass it rose to 0.15% and reached 0.39% in the fifth, then dropped to 0.15% in the seventh pass and to 0.10% after the ninth. Sulphur content in structural "20" steel scale was considerably lower. Curves of the sulphur content variation are shown (Fig.5). The curve of the roller grip (Fig.1) clearly shows the influence of the sulphur content in the scale - gripping becomes difficult with a higher sulphur content. The sulphur distribution in the metal was investigated by Baumann sulphur prints and by chemical analysis taken from different

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portions of ingots and from rolled strip. It varied only insignificantly. Conclusions: 1) A difficult grip is characteristic of free-cutting steel compared with other steel grades. 2) The chemical composition of the scale changes in the rolling process, particularly the sulphur content. 3) The softening point of the scale collected in the rolling process is in the range 850-1050°C, and the softening point is lower with a higher sulphur content. 4) Increased sulphur content in the scale makes the gripping difficult. 5) The segregation of sulphur is insignificant in rolled steel and in ingots. 6) Sulphur segregation is not clearly expressed in steel with a high sulphur content; the sulphur content difference is low on a different level and across in the ingots. 7) The sulphur distribution is more even in free-cutting steel deoxidized with aluminum, and the size of sulphurous inclusions is smaller. 8) The sulphur distribution improves in rolled metal during the rolling process. This is more clearly expressed in "A12A" steel deoxidized with aluminum. There are 5 figures, 3 tables and 5 Soviet-bloc references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: 26 January 1960

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A161/A030

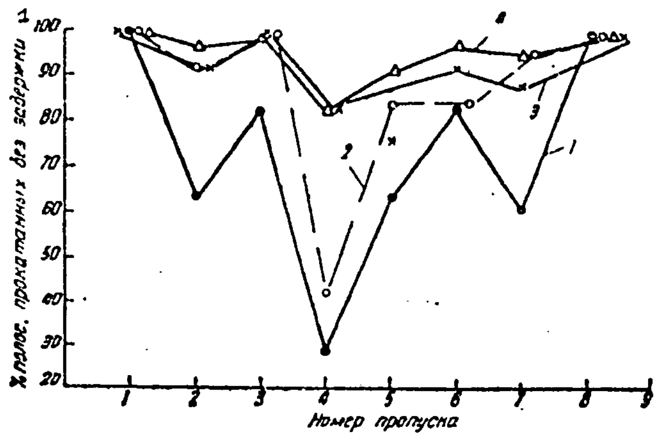

Fig. 1 - Rolls grip in the 1st stand of "750" mill :
1 - "A12" steel
2 - "A12A"
3 - "Ст.3" (St.3)
4 - "20" steel

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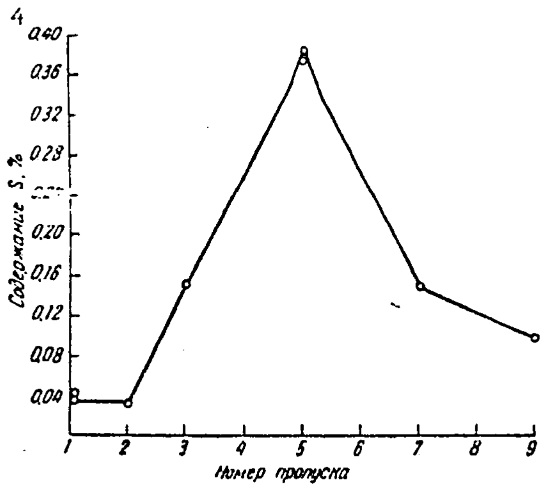

Fig. 4 - The sulphur content in scale of "A12" steel (in 9 passes)

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A161/A030

An investigation of scale ...

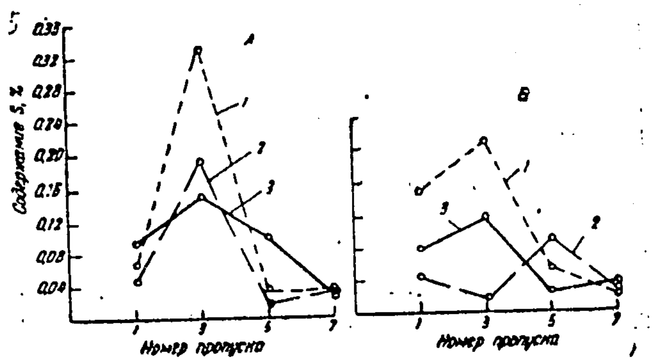

Fig. 5 - The sulphur content in scale from ingots :
A - "A12" steel;
B - "A12A"
1 - from the bottom portion of ingot;
2 - from the mid;
3 - from the top

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S/148/60/000/011/004/[illegible]
A161/A030

AUTHORS: Pavlov, I. M.; Suvorov, I. K.; Fomenko, Yu. Ye.

TITLE: Investigation of free-cutting steel alloyed with titanium

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 11, 1960, 61 - 65

TEXT: As had been stated in a previous investigation (Ref. 1, same authors, Izv. vyssh. ucheb. zav. Chern. Metallurgiya, 1960, No. 7, 9) the cause of the difficult grip in rolling 'A' " steel is the high sulfur content in scale. It lowers the softening point of scale, turning it into a lubricant. Besides, this steel contains low melting Fe-FeS eutectic which can also decrease friction and this drastically decreases the plasticity of steel at the rolling temperature and the strip ends thus become rugged. Data of a work on systems Fe-Ti-S and Fe-Ti-C-S (Ref. 5, Fishel, V. Ru, D. Ellis. The desulfurating effects of titanium in steel, "Stal'", 1953, No. 2) lead to the conclusion that the addition of titanium may improve the workability of hot steel, but there are no data in literature that would indicate the effect of titanium on the rolls grip on sulfurous steel,

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APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012396

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A161/A030

Investigation of free-cutting steel alloyed ....

as well as the machinability and mechanical properties. Experiments [illegible] been carried out to this end at the electrometallurgical laboratory of the Moscow Steel Institute. The most even distribution in sulfides has been found in ingots alloyed with 0.19 % Ti. The machinability was tested by the standard "Two-cutters method" consisting in cutting with two cutters on a lathe (in this instance one cutter was carbide tipped and the other made of free-cutting steel), with electric wires welded to the cutters and connected to a galvanometer; the e.m.f. appearing in the circuit due to different thermoelectric properties of the cutters is proportional to the heat forming in the metal being machined, and the higher the resistance to cutting is, the higher the current in the circuit. "A12" steel with 0.19 % Ti had the same machinability as the standard steel without Ti, but the machinability was perceptibly a [illegible] when the Ti content was [illegible] 0.[illegible] %. The friction factor in "A12" steel with [illegible] % Ti was considerably higher than in normal "A12" steel and even higher than in rolling the CT [illegible] (St.[illegible]) steel. Conclusion: Sulfurous "A12" steel with titanium has a high machinability, high friction factor in rolling and will [illegible] gripping diff.

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Investigation of free-cutting steel alloyed A161/A030

culty; the effect of titanium addition on plasticity at high temperature is positive. There are 5 figures, 3 Soviet references and 1 non-Soviet.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: May 14, 1960

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S/032/60/026/01 23 036
B020/

AUTHORS: Pavlov, I. M. and Ushakov, Ye. V.

TITLE: The Method of the Flat Recesses in the Front Surfaces, Which Are Filled With Lubricants

PERIODICAL: Zavodskaya laboratoriya, 1960, Vol. 26, No. 12, pp. 1403-1404

TEXT: The effect produced by the width of the collar upon the specific pressure, and the possibility of determining the true deformation resistance by means of the method mentioned, was investigated. In this connection, the aluminum alloy Д1 (D1) was investigated, from which specimens having a diameter of 12 and a height of 15 mm were cut, and into which 0.5 mm deep recesses were drilled. The width of the recesses was variable with their depth being constant. Paraffin was used as a lubricant, which warranted largely uniform deformation. The specimens were tested by means of a 5-t machine of the type P-5 (R-5) and by means of a device warranting the parallel position of the working surfaces. The deformation rate varied from 0.012 sec^{-1} at the beginning to 0.03 sec^{-1} at the end. At such low rates, their influence upon the deformation resistance may be
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The Method of the Flat Recesses in the Front Surfaces, Which Are Filled With Lubricants S/032/60/026/012/022/036 B020/B056

neglected. The compression diagrams for specimens with different widths of the recesses were drawn. The dependence of the specific pressure upon the width of the recess at various stages of deformation is shown in Fig. 1. In consideration of the fact that the inclination of the curves is small, it may be expected that the curve of the true deformation resistance differs little from the compression diagram at low widths (e.g., 0.5 mm). This is confirmed by the curves given in Fig. 2. The difference between the stresses determined from these two curves is not more than 4% of the true deformation resistance, i.e., not greater than the possible experimental error. M. V. Rastegayev is mentioned. There are 2 figures and 2 Soviet references.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences USSR)

Card 2/2

PAVLOV, I.M.; CHZHAO LIN-CHUN' [Chao Ling-ch'un]

Investigating the relation of longitudinal and transversal deformation to groove shape in rolling. Izv. vys. ucheb. zav.; chern. met. no. 1:121-129 '61. (MIRA 14:2)

1. Moskovskiy institut stali.
(Rolling (Metalwork)) (Deformation (Mechanics))

20264

S/180/61/000/002/002/012
E073/E535

1.1300A

AUTHORS: Pavlov, I.M., Sigalov, Yu.M., Shelest, A.Ye., Zubko, A.M. and Gurevich, Ya.B. (Moscow)

TITLE: Investigation of the Process of Hot Rolling of Aluminium in Vacuum and in Air

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1961, No.2, pp.64-67

TEXT: The influence on the friction coefficient of scale or an oxide film layer on the surface of a metal being rolled has been the subject of numerous papers. However, no direct comparison was made of the ordinary process of rolling aluminium in air and in vacuum. Such a comparative study will permit direct elucidation of the influence of oxide films on the conditions of rolling. The authors investigated the power consumption, the speed and deformation conditions and the friction coefficient during hot rolling of aluminium in vacuum and in air. The rolling was on TsNIIChermet laboratory vacuum equipment permitting heating, rolling and cooling of 15 x 20 mm, 200 mm long specimens in a vacuum down to 10^{-5} mm Hg. From a forged and annealed blank 150 x 10 x 12 mm

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specimens were cut. These were heated in a tubular electric furnace. The heating temperature was maintained within ±15°C. Rolling was at 400°C with reductions of 20 to 70% per pass. The diameter of the rolls was 85 mm, the rolling speed 6.5 m/min. The rolls were of steel ШХ-15 (ShKh-15) (hardness 55 R_c) and had a polished surface. The pressure was measured by wire strain gauges. Fig.1 shows a typical oscillogram in which 1 is the torque on the top spindle, 2 and 5 - pressure measured by the strain gauges, 3 - recorded roll speed, 4 - recorded strip speed, 6 - torque on the lower spindle, 7 - oscillation curve (500 c.p.s.). Fig.2 shows the dependence of the broadening $\psi = B_2/B_1$, % on the relative reduction $\Delta B/\Delta h$, where H, B_1 and L_1 are respectively the height, width and length of the specimens before rolling and h, B_2 and L_2 are respectively the height, width and length after rolling, $\Delta B = B_2 - B_1$ and $\Delta h = H - h$. (Here and in the following plots the dashed line curve refers to results obtained in vacuum and the continuous line curve refers to results obtained in air). Fig.3 shows the lead S_h as a function of the broadening, whereby

$$s_h = \frac{L_{strip} - L_{roll}}{L_{roll}} \quad (1)$$

where L_{strip} is the distance between the markings on the strip and L_{roll} is the distance between corresponding markings on the roll. Fig.4 shows the dependence of the specific pressure P, kg/mm² on the broadening ψ,%. Fig.5 shows the friction coefficient f' as a function of ψ,%. Fig.6 shows the torque M, kgm as a function of ψ,%. It was found that the friction coefficient and the required force, which depends directly on the friction coefficient, for vacuum hot rolling of titanium, grade ВТ-1 (VT-1), is considerably lower than for rolling in air, whilst for nickel and iron (C - 0.01%) it is higher in the same way as it is for Al. This again confirms the dependence of these quantities on the chemical composition of the rolled metal. The following conclusions are arrived at:

1. It was established that for Al the coefficient of friction

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Investigation of the Process ... S/180/61/000/002/002/012
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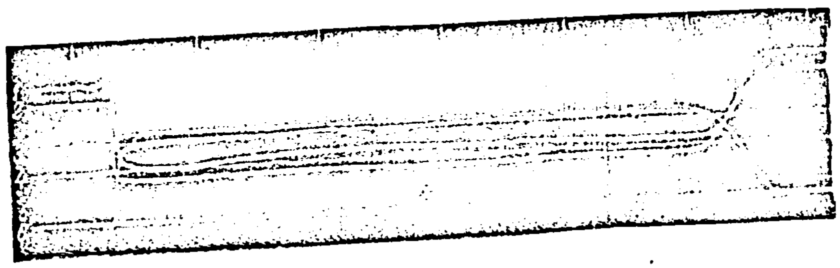
during rolling in vacuum is higher than for rolling in air, whereby the greatest difference (by a factor of about 1.4) was observed for smaller reductions;
2. it was confirmed that the friction coefficient during rolling decreases with increasing specific pressure both in air and in vacuum. There are 6 figures and 7 references: all Soviet.

SUBMITTED: August 8, 1960

Fig.1



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GUREVICH, Ya. B. (Moskva); ZUBKO, A.M. (Moskva); PAVLOV, I.M. (Moskva); (SIGALOV, Yu.M. (Moskva)

Effect of the state of specimen surfaces on the coefficient of friction and other parameters during the rollings of iron in vacuum. Izv. AN SSSR. Otd. tekh. nauk. Met. i topl. no.2:144-145 Mr-Ap '61. (MIRA 14:4)

(Rolling(Metalwork))
(Friction)

PAVLOV, I.M.; GANIN, N.P.; YEGOROV, B.V.; SHELEST, A.Ye.: SYUY TSUO-KHUA

Investigating the process of rolling with smooth rolls by the method of rotating bearings. Izv.vys. ucheb. zav.; chern. met. no.3:67-73 '61. (MIRA 14:3)

1. Moskovskiy institut stali i institut metallurgii AN SSSR.
(Rolling(Metalwork))

S/148/61/000/003/007/015
A161/A133

AUTHORS: Pavlov, I. M., Musikhin, A. M.

TITLE: Investigation of helical tube rolling in three-high reeling mill

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no. 3, 1961, 91 - 101

TEXT: The existing process investigation data are either obsolete, or they do not elucidate some problems that arose with time. The purpose of the subject investigation was to find some new data and study the dependence of the axial slip, rolling time per 1 meter tube, metal pressure, load on the motor and power consumption on the shell wall reduction on the grip cone, peripheral velocity, feed angle, and height of the roll crest. The metal pressure on the rolls was measured with dynamometers with strain wire gages. Over 700 oscillograms were recorded in rolling tubes of different dimensions and steel grades, apart from mass rolling to determine the effect of various process parameters on the quality of the tubes. The determined interdependences are discussed and illustrated in three graphs. Practical recommendations are made and the determined optimum values are given of the relative shell wall reduction (15 - 25% of the roll crest height), of the peripheral velocity of rolls, feed angle, etc. It is recommended for new mills

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S/148/61/000/003/007/015
Investigation of helical tube rolling in three-high... A161/A133

being designed to diminish the gap between the reeling mill mandrel and the internal surface of the shell (or tube) and prevent crumpling of the front shell end by turning the piercing mill through 180° (around the vertical axis) from the presently used position, so as to feed shells into the reeling mill rolls with the rear end first and move in the reeling mill mandrel from the front side. It is claimed that the investigation and the analysis of the results present some interest for production engineers as an aid for more conscious control of the process, and may be utilized for further improvement of the existing rolling mill operation, as well as in designing new rolling units with reeling mills. There are 4 figures and 4 Soviet-bloc references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: June 1, 1960

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89493

12206

S/136/61/000/004/006/006
E073/E135

AUTHORS: Pavlov, I.M., and Brinza, V.N.

TITLE: Investigation of the Bonding Between Titanium and Steel

PERIODICAL: Tsvetnyye metally, 1961, No. 4, pp. 58-61

TEXT: Relatively little work has been published on the problem of cladding with titanium. To obtain a strong metallic bond between two unequal metals, the contact surfaces must be clean and the surface atoms must reach a certain energy state. Heating and plastic deformation bring about bonding between the metals. The duration of the pressure application has a considerable influence. Specimens of Steel 2 of 14 mm diameter with an intermediate layer of grade BT1-1 (VT1-1) titanium of 14 mm diameter were placed into a split tubular sleeve. The contact surfaces of the specimens were ground, etched and degreased. To protect titanium from absorbing gases from the ambience, the junction spot between the titanium and steel was covered with a thin layer of an insulating paste (magnesite powder in liquid glass), which contained additions of magnesium chips. The specimens were heated to 700-800 °C by passing a current through them from a welding transformer and also in a

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S/136/61/000/004/006/006
E073/E135

Investigation of the Bonding Between Titanium and Steel

specially designed vertical tubular electric furnace (located under the press), which was preliminarily heated to temperatures at which the specimens were plastically deformed (700-1000 °C). The temperature in the furnace was monitored by means of a regulating transformer and was recorded with a galvanometer; the temperature of the specimens was monitored by means of a contact thermocouple. Prior to heating, the specimens were preliminarily pressed together for 1 min under the press so as to eliminate the residues of air between the titanium and the steel. The heated specimens were pressed in a press capable of a maximum pressure of 12 tons at various temperatures, pressures and holding times. The influence was also investigated of the thickness of the titanium layer on the strength of the bond between the titanium and the steel; the best results were obtained for a titanium layer of about 2 mm thickness and therefore in the main experiments 2 mm thick titanium sheet was used throughout. After cooling in air, the specimens were removed from the tubular sleeve and used for machining from them tensile test specimens. By means of metallographic analysis, the zone of

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contact was studied and the depth of the diffusion layer determined. The deformation temperature influences greatly the strength of the bond between the titanium and the steel. Fig.1 shows the bond strength, kg/mm^2, as a function of the bonding temperature (curve 1 - 12.75 kg/mm^2, curve 2 - 8.50 kg/mm^2, curve 3 - 4.25 kg/mm^2). The dependence of the bond strength on the temperature for various pressures has approximately the same general character; the bond strength increases with increasing temperature, reaching a maximum at 1000 °C. In the temperature range 800-900 °C a decrease in the bond strength was observed. Apparently this is explained by the influence of the polymorphous α to β transformation of the titanium. The increase in the strength of the bond indicates formation of a brittle intermetallic zone. Fig.2 shows the influence of pressure on the bond strength between titanium and steel, bond strength kg/mm^2 vs. pressure, kg/mm^2 (curve 1 - cladding at 1000 °C, curve 2 - 900 °C, curve 3 - 800 °C, curve 4 - 700 °C). It can be seen that for all the cladding temperatures the bond strength increases with increasing cladding pressure.

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At 1000 °C and 4.25 kg/mm^2 the specimens were pressed together for durations of 1 to 5 min. Fig.3 shows the influence of the duration (min) of pressure application on the bond strength, kg/mm^2. An increase in time to 3 min results in a decrease of the bond strength. A further increase in the duration of pressure application (4 to 5 min) did not have any appreciable influence on the bond strength. Simultaneous plastic deformation of titanium and steel produces complicated diffusion processes. The diffusion zone progresses to a depth which depends on the temperature and pressure of the deformation. Metallographic investigations enabled establishing the presence of a considerable diffusion zone; the dependence of this diffusion zone on the deformation temperature and pressure is plotted in Figs. 4 and 5. Fig.4 shows the dependence of the thickness of the diffusion zone of a bimetal Ti-steel strip on the temperature, depth of the diffusion layer 1 x 10^4 cm vs. 10 000/T_{abs} (curve 1 - 4.25 kg/mm^2, curve 2 - 8.5 kg/mm^2, curve 3 - 12.75 kg/mm^2). Fig.5 shows the dependence

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on pressure, diffusion coefficient 10^{-9} cm^2/sec vs. pressure, kg/mm^2 (curve 1 - 1000 °C, curve 2 - 900 °C, curve 3 - 800 °C, curve 4 - 700 °C). The experimental results confirm the data obtained by S. Storchheim (Ref.5) on the possibility of controlling the depth of the diffusion zone by varying the applied pressure. The following conclusions are arrived at: 1) The thickness of the titanium layer did not have any appreciable influence on the strength of the bond between titanium and steel. 2) The greatest strength of the weld was obtained for a temperature of 1000 °C and a pressure of 12.75 kg/mm^2. 3) The depth of the diffusion zone depends on the deformation temperature and the pressure, and by changing the pressure it is possible to control the depth of the diffusion zone, whereby the greater the pressure the less deep will be the diffusion zone. There are 5 figures and 5 references: 3 Soviet and 2 non-Soviet.
(Abstractor's Note: This is a slightly abridged translation).
ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

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BOCHVAR, A.A.; BELYAYEV, A.I.; PAVLOV, I.M.; PLAKSIN, I.N.; CHIZHIKOV, D.M.; PERLIN, I.L.

Petr Stepanovich Istomin; on his 80th birthday. Izv. vys. ucheb. zav.; tsvet. met. 4 no.4:161-163 '61. (MIRA 14:8)
(Istomin, Petr Stepanovich, 1881-)

22804

1.1300 also 1496, 1454

S/136/61/000/005/007/008
E111/E152

AUTHORS: Pavlov, I.M., and Belosevich, V.K.

TITLE: Investigation of lubricants for cold rolling titanium

PERIODICAL: Tsvetnyye metally, 1961, No.5, pp. 65-69

TEXT: In the work described the rolling of grade ВТ-1Т (VT-1T) titanium and 08КП (08KP) (rimming) steel using about 30 widely-used lubricants and others, was studied. In a subsidiary series of experiments a further material, Ст.50 (St.50) steel was used. In selecting the lubricants, results of drawing experiments in collaboration with A.S. Belousov of the "Serp i Molot" works were taken into consideration. The annealed and pickled titanium had a tensile strength of 58-60 kg/mm^2, elongation of 21-23% and Rockwell B hardness of 89-93; the corresponding figures for the steel were 35, 29-30 and 40-43. The initial thickness of both materials was 1.2 mm, thin enough to show lubricating effects clearly (Refs. 1, 2); the initial width (30 mm) was such that rolling could be effected at high pressures and degrees of reduction without width being an important factor in spread (Ref.6). A two-high mill with 220-mm diameter rolls of ШХ-15 (ShKh-15)

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steel (Rockwell C hardness after hardening and low-temperature annealing 63-64) was used, rolling speed being 0.53 m/sec and roll pressure and torque being measured. The steel was rolled in four passes, the titanium in five, the roll-setting for a given pass number being constant for all lubricants. The qualitative influence of lubricants was best represented, in the authors' opinion, by the ratio of overall reduction to final thickness. The results per pass qualitatively coincided with the overall results and the latter therefore provide a better criterion for lubricants since the lubricant influence is summated while random variations become relatively less important. The order of effectiveness of the tested lubricants was found to be the same for the titanium and the 08KP steel. The most effective for cold rolling titanium were natural fats and high-molecular saturated aliphatic acids, and also some commercially available synthetic materials (e.g. oil number 142) whose cheapness makes them additionally attractive. Natural wax was outstandingly effective. Number 142 and an ultrasonic emulsion of a high paraffin content oil ("gach") should be tested under industrial conditions. The emulsion has the advantage of being also an effective coolant.
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Investigation of lubricants for cold..E111/E152

cooling being an important factor in titanium rolling. The authors recommend water-cooling of rolls on the outlet side, as for steel strip (Ref.9), or internal roll cooling. No hydrogen pick-up by titanium from lubricant decomposition products during annealing need be feared (Ref.10). Using effective lubricants, reduction of titanium in cold rolling can be increased by 30-40%, the number of passes required being almost halved compared with that when mineral oils are used. The subsidiary experiments on St.50 steel, carried out in collaboration with I.A. Chamin and I.K. Tokar' of TsNIIChM, on an 180/370 x 400 four-high mill, confirmed the main results. The present investigation represents a further contribution by Pavlov to previous work in this field (Refs. 1, 2).
There are 1 figure, 3 tables and 10 references: 8 Soviet and 2 English. The English language references read:

Ref.4: E. Rabinowicz, E.P. Kingsbury, Lubricants for titanium, Metal Progr. 1955, 67, No.5, pp. 112-114.
Ref.9: I.C. Whetzel, Rodman Sayre, Improved lubrication in cold strip rolling. Iron and Eng., 1959, 36, pp. 123-132.

X

Card 3/3

PAVLOV, I.M.; SUVOROV, I.K.

Investigation of leading in rolling with nondriving rolls and the application of brakes. Izv.vys.ucheb.zav.; cern.met. 4 no.5:98-101 '61. (MIRA 14:6)

1. Moskovskiy institut stali. (Rolling (Metalwork))

26582

S/148/61/000/006/006/013
E073/E535

11300 also 1496 1416 1413

AUTHORS: Pavlov, I.M., Sigalov, Yu. M., Shelest, A.Ye., Zubko, A.M. and Gurevich, Ya. B.

TITLE: Investigation of some conditions of hot rolling of titanium in vacuum and in air

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, 1961, No.6, pp.106-110

TEXT: The authors investigated the force, velocity and deformation conditions during the process of rolling of titanium in vacuum and compared the results with similar results obtained for rolling in air. This was done to elucidate the influence of the scale on the friction coefficient, specific pressure and other parameters of the rolling of commercially pure titanium. From a pre-forged blank, specimens 15 x 20 mm. 200 mm long were cut. Those specimens which were to be rolled in vacuum (3×10^{-5} mm Hg) were heated in a small-chamber electric furnace with molybdenum heater filaments; those to be rolled in air were heated in an electric furnace with nichrome heater filaments. The specimens were rolled in the temperature range 800-1200°C on a two-high mill

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with rolls of 85 mm diameter. The average reduction was 20%, the speed of rolling was 6.5 m/min. The rolls had a ground surface with a hardness of 55 RC. The rolling parameters, i.e. the total pressure, the torque, the speed of the rolled strip and the circumferential speed of the rolls were recorded by means of an 8-loop oscillograph. Fig.3 shows the dependence of the friction coefficient f''' and of the specific friction force τ_s, kg/mm^2 on the rolling temperature, °C. Fig.4 shows the dependence of the friction coefficient f' and of the forward slip S_h on the rolling temperature, °C. Fig.5 shows the dependence of the specific pressure, kg/mm^2, on the rolling temperature, °C. Fig.6 gives the dependence of the specific pressure, kg/mm^2, and the friction coefficient f' on the reduction, %. In all these graphs the continuous line curves apply to rolling in air and the dashed line curves to rolling in vacuum. In the paper the authors apply three differing friction coefficients, one f''' determined according to the formula of S. I. Gubkin (Ref.12: Theory of shaping metals by pressure, Metallurgizdat, 1947), another f'' determined on the basis of the theoretical formula for the torque proposed by

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V. Bayukov and the third, f', determined from the value of the forward slip. The following conclusions are arrived at:
1. In all cases of rolling in air the curve expressing the dependence of the friction coefficient on the temperature has a convex-shaped section with a maximum in the temperature range 1050-1150°C. If titanium is rolled in air at 800-1100°C, a dense layer of titanium dioxide scale forms which leads to an increase in sliding friction coefficient and spreading. At rolling temperatures above 1100°C, a dense layer of scale of a fine grain structure forms which peels off easily from the base metal and leads to a reduction of the friction coefficient, the friction coefficients f' and f" are similar and their values are very near to each other. When rolling was performed in vacuum, the friction coefficient was considerably lower and showed a tendency to increase with increasing rolling temperature. This is attributed to a drop in the specific pressure with a minimum effect of other factors.
2. Changes in the specific pressure p and the specific friction force τ_s were similar during rolling in vacuum and in air. The

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values p and τ_s, and consequently also the torque, are affected by the sudden α to β transformations and this explains the sharp drop in the friction coefficient, forward slip and the slight increase in spreading in the temperature range 850-950°C.
3. With increasing reduction an increase is observed in the specific pressure and a decrease in the friction coefficient.
4. The experiments revealed considerable qualitative and quantitative differences in the force, velocity and geometrical factors pertaining to rolling titanium in vacuum and in air. Experiments carried out earlier by some of the authors (Ref.14: Stal', 1959, No.10, 929-931) yielded differing results, namely, the coefficient of friction and the geometrical and force conditions depending on it were considerably higher in vacuum than in air in the case of rolling pure iron with a carbon content of 0.01%. This clearly indicates that the investigated quantities depend on the chemical composition of the rolled metal. There are 6 figures and 14 references: 13 Soviet and 1 non-Soviet.

ASSOCIATION: Institut metallurgii imeni A.A. Baykova (Institute of Metallurgy imeni A. A. Baykov)

Card 4/6

PAVLOV, I.M.; OSADCHIY, V.Ya.

Sticking of the metal to tools in sliding friction. Izv. vys. ucheb. zav.; chern. met. 4 no.7:105-111 '61. (MIRA 14:8)

1. Moskovskiy institut stali.
(Metalworking machinery)
(Friction)

PAVLOV, I.M.; SIGALOV, Yu.M.

Effect of vacuum and inert gas atmospheres on the properties of metals for their plastic deformation. Izv. vys. ucheb. zav.; chern. met. 4 no.8:195-197 '61. (MIRA 14:9)
(Rolling (Metalwork)) (Vacuum metallurgy)

PAVLOV, I.M.; BELOSEVICH, V.K.

Negative leading during the rolling process. Izv. vys. ucheb. zav.; chern. met. 4 no.10:46-49 '61. (MIRA 14:11)

1. Institut metallurgii im. Baykova.
(Rolling (Metalwork))

S/145/61/000/010/007/008
D221/D304

AUTHORS: Pavlov, I. M., Corresponding Member AS USSR, and
Zhuchin, V. N., Engineer

TITLE: Developing methods and experimental determination of energy and force parameters in the cold rolling of Э79НМ (E79NM) alloy

PERIODICAL: Izvestiya vysshikh uchebnykh zavendeniy. Mashinostroyenie, no. 10, 1961, 180-190

TEXT: In 1960, at the "Elektrostal' Plant", experimental investigations were carried out in production conditions for determining the conditions of cold rolling in a four-high mill with soft magnetic alloy E79NM. The article describes the examination method for measuring the pressure distribution in the center of deformation, along the length and width of contact zone between the working and supporting rollers, and the deformation resistance of metal. The actual contact area between the metal and the roller was found from

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...the above ...ned by a spe... ...s incorporated. The ... with recommendations of A. ... The transduceres were guarded against ingress of dampness, oil etc. by a special varnish ПХВ (PKhV). The current take-off was ensured by slip rings. The calibration was made by a system of levers and weights. The torque transducer was calibrated by direct torsion of the roller by a known torque in a special fixture. The mean coefficient of friction was determined by the equation $\alpha - \beta - \gamma$ which requires knowledge of ratio γ/α at the insert. Two center punches were made in the fore and aft of the insert, and this permitted experimental measurement of the advance. The ratio is then calculated by $S = \gamma^2 \frac{R}{h}$, and $\frac{\gamma}{\alpha} = 0.1\sqrt{\frac{Sh}{\Delta h}}$, where S is the advance in %; h is the height of strip after rolling in mm; Δh is the absolute compression of strip in mm. The relationship between $\frac{\gamma}{\alpha}$ and $\frac{\Delta h}{H}$ is shown graphically. The relative compression of strip under the insert is smaller than under the main body of the roller. The curves were used to determine $\frac{\gamma}{\alpha}$ under the strip. The actual experiments are then described in de-

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tail. The above permitted assessment of the mentioned quantities as well as the following magnitudes: The effect on friction by the relative compression, initial thickness of strip, degree of the preliminary work hardening, and the position of the resulting pressure of metal against the rollers. Data on the position of this resultant, effect of pinching on the resistance of metal deformation, total deformation of rollers in the deformation center and other items were also recorded. The results obtained are to be published. There are 6 figures and 5 Soviet-bloc references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: July 3, 1961

33167

S/148/61/000/011/007/018
E111/E480

18 7500 1418

AUTHORS: Pavlov, I.M., Makeyev, D.I.

TITLE: The influence of deformation conditions on the recrystallization process of type 08 steel

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Chernaya metallurgiya, no.11, 1961, 110-115

TEXT: One of the authors, I.M.Pavlov, has previously shown the usefulness of studying the effect of the relation of longitudinal and transverse deformation on the structure and properties of alloys. The other has described the structure and properties of 08 steel in the initial state (Ref.4: Izv.VUZ. Chernaya metallurgiya, no.2, 1960). This steel, initially in the form of a 50 x 50 mm square billet, was used for the present work. Before rolling, the steel was normalized at 950°C (Ac_3 = 930°C, Ar_3 = 900°C). 15.5 x 50 x 55 mm plates cut from the billet were cold-rolled with total reductions of 9 to 84%, reduction per pass being 1 to 1.5 mm. The ratio of longitudinal to transverse deformation coefficients μ/β was 1 to 6.08. Reductions of 9 to 12% led Vickers hardness to rise from 80 - 90 to 126 - 128. Hardness remained independent of changes in the μ/β ratio, but

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became dependent when deformation was raised to 21%. With 52% reduction, Vickers hardness rose to 163 - 174, the lower value corresponding to a deformation-ratio value of unity, the higher to one of 1.94 and measured transversely to the rolling axis (170 along). With 84% deformation, there was little further increase in hardness for specimens rolled with $\mu/\beta = 1$, but on rolling in only one direction it rose to 201 transversely and 180 along the rolling axis. As expected from these effects microstructure observations showed that recrystallization of steel rolled in one direction began earlier and proceeded faster at 600 °C than that of steel rolled with $\mu/\beta = 1$. Heating to 700 °C made the structure more uniform and grains more equiaxial. With $\mu/\beta = 2$, grains were finer than with the ratio equal to 1, this relation holding even on complete annealing at 950 °C. although recrystallization produced mainly equiaxial grains, size differences persisted. Increase in reductions to 84% led to a more elongated structure and a greater effect of deformation ratio e.g. with $\mu/\beta = 6$, a grain in the end plane was only reduced (compressed) while along the strip length it was both reduced and longitudinally extended. Recrystallization at 600 °C resulted in

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grains similar in the longitudinal and transverse planes. Increase in reduction from 51% to 84% gave a considerably finer grain after recrystallization. Annealing in a salt bath (temperature fluctuations ± 5°C) was also carried out. A characteristic peculiarity of the structure is that directionality is more pronounced in the longitudinal plane. It appears that an increase in second and third order strains leads to earlier recrystallization with more centres of crystallization and finally to a finer grain. There are 5 figures and 4 Soviet-bloc references.

ASSOCIATION: Moskovskiy institut stali (Moscow Steel Institute)

SUBMITTED: August 30, 1960

Card 3/3

PAVLOV, I.M.; YEGOROV, B.V.; SHELEST, A.Ye.; SYUY TSUO-KHUA

Investigating the process of rolling with smooth rolls with the help of a split roll strain gauge. Izv.vys.ucheb.zav.; chern.met. 4 no.9:87-94 '61. (MIRA 14:10)

1. Moskovskiy institut stali i Institut metallurgii Akademii nauk SSSR.
(Rolls (Iron mills)—Testing) (Strain gauges)

21159
S/032/61/027/004/019/028
B103/B201

15.6000 1583 only

AUTHORS: Pavlov, I. M., Belosevich, V. K., and Ushakov, Ye. V.

TITLE: Device for studying the external friction in the plastic deformation of metals

PERIODICAL: Zavodskaya laboratoriya, v. 27, no. 4, 1961, 462-463

TEXT: The apparatus described here is suited for measuring the frictional force at high pressures and rubbing speeds arising in the pressure treatment of metals. The authors achieved their purpose by making use of a flywheel. They state that the effect of speed and pressure upon the coefficient of friction is often difficult to be studied. In devices known so far, samples have been shifted by hand over deforming plates in the process of plastic deformation. The consequence has been a strongly fluctuating rubbing speed which did not exceed 0.05 m/sec. In the authors' device (Fig. 1), samples are shifted by a mechanical system. Sample 1 is compressed by plane-parallel plates in a hydraulic 30-ton press. The parallel position of the working planes is ensured by guides 2, in which punches 3 move. Rubber shock absorbers 4 ensure a constant pressure

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Device for studying the external ...

on the sample. Inside the deforming device, the sample is shifted by means of an elastic fork 6. The sample is altogether prevented from bending. Fork 6 is fastened onto bar 7 which moves in guide 8 and which carries a pressure cell which records the sample resistance to shift, viz. the frictional force. Bar 7 is put into motion by the already turning flywheel 9. The mobile end of bar 10 is connected to armature 13 of electromagnet 14 via 11 and 12, and, when 14 is switched on, it is lowered to the position indicated by a dashed line. Striker 15 of the flywheel shifts bar 7 so far ahead that the sample is pushed out of its position between the plates. Flywheel 9 is driven by friction step pulley 16 which is fixed to shaft 17 of a weighted rocking lever 18. Wheel 16 is pressed onto flywheel 9 by the weight. Shaft 17 is driven by an electric motor. By means of this mechanism the sample can be shifted at a rate of up to 4 m/sec. Fig. 2 presents the device serving to produce lower speeds (0.05-0.8 m/sec). The bent lever 1 has a shoe 2 which is pressed onto eccentric 3. The mechanism is inserted into the position indicated by the solid line by folding of 2. The rough adjustment is done by means of step pulley 16 (Fig. 1), the fine adjustment by a partial braking of flywheel 9. The frictional forces are recorded

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Device for studying the external ...

by a wire strain gauge as well as by an amplifying recording apparatus (МПО-2 (MPO-2) oscilloscope and tensometric electronic amplifier). The apparatus is used to study the dependence of frictional forces on the rubbing speed, on pressure, and other factors. Fig. 3 presents, as an example, the coefficient of friction as a function of the relative rubbing speed of aluminum on a hardened steel surface (type ШХ15 (ShKh15)) with castor oil as a lubricant, and at constant pressure (14.1-13.5 kg/mm^2). There are 3 figures and 3 Soviet-bloc references.

ASSOCIATION: Institut metallurgii im. A. A. Baykova Akademii nauk SSSR (Institute of Metallurgy imeni A. A. Baykov of the Academy of Sciences USSR)

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30656

S/136/61/000/011/006/00?
E193/E135

1.1300

AUTHORS: Pavlov, I.M. and Brinza, V.N.

TITLE: A study of deformation of titanium-clad steel during rolling

PERIODICAL: Tsvetnyye metally, no.11, 1961, 59-64

TEXT: The object of the present investigation was to study the effect of various factors on the strength of bond between the components of titanium-clad steel. The method of preparation of test pieces is best explained with reference to Fig.1, showing: 1 - two "Steel 2" plates; 2 - two Ti plates; 3 - end spacers; 4 - rivets (preventing the relative movement of the pack components during rolling); 5 - a separating compound film. Prior to rolling, each pack was compressed in a 12-t press to ensure good contact between steel and Ti, and to expel from the pack as much air as possible. To protect the interior of the pack from oxydation during pre-heating and rolling, its edges were either arc-welded or sealed with a protective paste (unspecified). Magnesium shavings, acting as oxygen getters, were packed in the space between Ti plates and spacers. Preheating to 700-1000 °C

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E193/E135

was carried out in a protective atmosphere. A "360" two-high reversible plate mill was used for rolling. The form of test pieces used to determine the bond strength is shown in Fig.8. The results can be summarized as follows: 1) The bond strength increased with increasing total reduction and with raising rolling temperature. This effect is illustrated in Fig.2, where bond strength (kg/mm^2) is plotted against total reduction ($\frac{H - h}{H}$ 100%), curves 1-4 relating to rolling temperatures of 700, 800, 900 and 1000 °C respectively. 2) The lower the initial Ti/steel plate thickness ratio, the higher is the bond strength of the clad material. Maximum strength was attained when Ti constituted 11.1% of the total thickness of the pack before rolling. 3) The bond strength decreases slightly on increasing the rolling speed to 0.4 m/sec, after which it remains constant. 4) Although the thickness of the diffusion layer increases with increasing preheating time, the bond strength is not affected by this factor. 5) The greater the total reduction, the smaller is the difference between the reduction of steel and Ti plates.

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PAVLOV, I.M.

Main problems in rolling. Izv. AN SSSR. Otd. tekh. nauk. Met. i topl. no.3:3-9 My-Je '62. (MIRA 15:6)
(Rolling (Metalwork))

S/598/62/000/007/027/040
D217/D307

AUTHORS: Pavlov, I. M., Sigalov, Yu. M. and Gurevich, Ya. B.

TITLE: Study of the process of hot rolling titanium in vacuo and in air

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Titan i yego splavy. no. 7, Moscow, 1962. Metallokhimiya i novyye splavy, 197-203

TEXT: In order to study the influence of scale formed on the surface of the metal during heating on the coefficient of friction, specific pressure, expansion and other parameters of rolling, specimens of commercially pure Ti were heated and rolled in a vacuum of the order to 10^{-5} mm Hg, and in air. The work was carried out at a TsNIIChM laboratory vacuum plant. It was found that in every case of rolling Ti in air, the dependence of the coefficient of friction on temperature is cupola-shaped in character, with a maximum in the temperature range 1050 - 1150°C. The changes in specific pres-

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sure and specific frictional force are identical in nature with air- and vacuum-rolled Ti. On increasing the percentage reduction in area of titanium, the specific pressure increases and the coefficient of friction decreases. There are 8 figures.

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38701

S/598/62/000/007/028/040
D217/D307

1.1300
18.1285

AUTHORS: ~~Pavlov, I. M.,~~ Shelest, A. E., Tarasevich, Yu. F. and Shakhov, V. L.

TITLE: Investigation of rolling of certain titanium alloys

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Titan i yego splavy. no. 7, Moscow, 1962. Metallokhimiya i novyye splavy, 204-212

TEXT: Hot and "warm" rolling of Ti alloys containing 1 - 2.5% Al and 0.8 - 2% Mn (alloy 1), 2 - 3.5% Al and 0.8 - 2% Mn (alloy 2), 4 - 5.5% Al and 2 - 3% Sn (alloy 3) was studied and compared with rolling of commercially pure Ti. Microstructure of the alloys, the phenomena of gas saturation and scale formation and the hardness of the alloys were also studied. It was found that commercially pure Ti has a smaller tendency to oxidize than the alloys. Apart from scale formation, the extent of gas saturation increases on heating. Saturation of the surface layer of titanium with oxygen and nitrogen leads to the stabilization of the α-phase. At the

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warm-rolling temperatures (750°C and below), the scale formation proceeds slowly or ceases, but gas saturation continues even at these temperatures. The authors investigated thermal expansions of titanium ВТ-1 (VT1) and of alloy VT5 in the pure state and after complete gas saturation of dilatometric specimens. They found that the gas-saturated specimens do not undergo a phase transformation and have a somewhat higher coefficient of thermal expansion than the pure metal. On cooling, the difference between the coefficients of thermal expansion of the α-layer and the basis metal can lead to the formation of microcracks on the surface. These cracks, acting as stress concentrators, deteriorate the mechanical properties of Ti articles, and on further cold rolling, can be one of the reasons for the failure of the metal. There are 5 figures and 8 tables.

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38702
S/598/62/000/007/029/040
D217/D307

11300

AUTHORS: Pavlov, I. M., Belosevich, V. K. and Chamin, Yu. A.

TITLE: Cold rolling of commercially pure titanium as compared with rolling of steel and aluminum

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Titan i yego splavy. no. 7, Moscow, 1962. Metallokhimiya i novyye splavy, 213-218

TEXT: Commercially pure titanium ВТ1Т (VTIT), steel [illegible] (08KP) and aluminum А (A) were used in this study. The lubricants used were vegetable and animal fats, synthetic products of similar composition (nos. 142, 151), and mineral oils, both in the pure state and with additions (paste [illegible] (59S)). The influence of standard lubricants on the parameters of rolling in passes with fixed roll positions is discussed. The authors recommend new synthetic lubricants of the complex ether type for cold-rolling of Ti. Their use enables the number of passes or the number of intermediate annealing processes to be reduced, whilst retaining

X

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Cold rolling of ...

S/598/62/000/007/029/040
D217/D307

the properties of the metal. Cold-rolling of technically pure Ti with a total reduction of up to 50% is possible, which enables sheet in the cold worked condition to be manufactured, as in the case of stainless steel. The surface quality of Ti sheet produced by a given set of rolls can be regulated by the use of various lubricants. There are 3 figures and 2 tables.

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PAVLOV, I.M.; ZHUCHIN, V.N., inzh.

Dependence of the strain resistance of precision alloy E79[illegible] on various factors of cold rolling. Izv.vys.ucheb.zav.; mashinostr. no.8:178-186 '62. (MIRA 15:12)

1. Moskovskiy institut stali. 2. Chlen-korrespondent AN SSSR (for Pavlov).

(Rolling (Metalwork))

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012396

PAVLOV, I.M.

Some basic conditions and regularities in metal-rolling processes. Trudy Inst.met. no.9:23-54 '62. (MIRA 16:5)
(Rolling (Metalwork))

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012396

PAVLOV, I.M.

Consecutive relationship between certain processes of die forging. Trudy Inst.met. no.9:55-60 '62. (MIRA 16:5)
(Forging)

S/509/62/000/009/001/014
D207/D308

AUTHORS: Pavlov, I. M. and Ushakov, Ye. V.

TITLE: Determining the true resistance to deformation by extrapolation of the curves resistance to deformation - coefficient of friction

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Trudy. no.9, Moscow, 1962. Voprosy plasticheskoy deformatsii metalla, 67-71

TEXT: Annealed Armco iron cylinders (12 mm diameter and 6 mm height) were compressed between two steel plates. The contact between the plates and the samples were lubricated with one of the following: СУ (SU) engine oil, oleic acid, purified vaseline, graphite mixed with engine oil, etc. The tests were carried out on a universal ИМЧ-30(IMCh-30) machine and the rate of deformation was 0.003 - 0.004 sec^{-1}. Simultaneously with the axial stress, the lateral friction was measured at the contacts of the samples with the plates. The resistance to deformation (axial stress) plotted ag-

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Determining the true ...

ainst the coefficient of friction for different degrees of deformation (defined here as the natural logarithm of the ratio of the initial to final height of the sample) gave straight lines which were only partially matched by the theoretical formulas of Unksov, Petrov and Siebel. Following I. M. Pavlov and Ya. S. Gallay the stresses were extrapolated to zero coefficient of friction and the resultant values of the axial stress were called the "true resistances to deformation". The resistances to deformation obtained in this way agreed satisfactorily with the values found by the method of M. V. Rastegayev (cylindrical samples with recesses at the two plane ends filled with stearic acid to reduce the friction with the steel plates). There are 5 figures.

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