Wiesław Piekarski*, Jaroslav Gromko, Nicolay Kogut, Bohdan Zathey**

A NEW REGENERATION METHOD OF BARETHREAD ROLLER BRACERS

Summary. In this paper a method of regeneration was presented of threadbare roller bracers of the type MBC-140A, which our ground down to the dust-like coal state, intended for incineration in the heating. Using the method an unceasing work of any thermal power-station is secured. It consists in that in place of melting on the threadbare surface of billow of metal, it is mechanically gnawed as an outward cone, and then a ring is fitted on it with an inner cone of extra-hard metal, which through puck on the butt-end surface is kept by screw-bolts, along the line of engulfed and worn-out surface, so that an immobile halving billow-ring with the primary functions at work is created.

Keywords: roller bracers, regeneration, ring, cone

INTRODUCTION

As it is known, the practice of exploitation of roller mills bracers used for the crushing of coal, corn and other raw materials results in gradual wear of their working surfaces and reduction of external diameter, up till the violation of the necessary regular crushing features, overheating of other details and elements of mill knots.

In such a case, when the worn out surface of bracer attains critical thread-bare, it is necessary either to replace the worn out rollers with new ones, which leads to considerable expenditure, or restore the old ones by the melting of wear-proof materials on the worn out surfaces which is also ineffective as it requires definite financial expenditure on the regeneration of a roller bracer and the mill may outage in the repair period. Also it should be noted that a subsequent exploitation of the restored rollers often results in unpredictable crevices and local stratification of melted metal from the basis, which can result in the separation from the bearing and eventual stop of the mill.

* Prof. dr hab. Wiesław Piekarski,Prof. Sc.D. The Agricultural University of Lublin, Poland
** Eng. Jaroslav Gromko, Prof. Nicolay Kogut, Prof., Bohdan Zathey, Lvov State Agrarian University, Ukraine

AIM OF RESEARCH

To develop such a construction of a roller mill bracer which would never change, and replace the ineffective melting method by the planting of a wearproof ring and by the same shortening a mill outage time in the repair period.

METHOD AND RESULTS OF RESEARCH.

The suggested method of the regeneration of the worn out roller bracers consists in that instead of melting of the working threadbare surface by the powder-like wire or powder-like ribbons, through the surface of an axle it is mechanically gnawed as an external cone. After that a ring is implanted on it with an inner cone, made of super hard metal which, through the puck from the butt-end side, is stopped up by screw-bolts, screwed up along the line of engulfed surfaces, and creates an immobile halving billow-ring with the initial operating functions of a new roller.

Notice, that it is possible to attain an increased hardness of the metal of purveyance of such a ring when the chemical composition of its components will answer the percent correlation, presented in the Table 1.

Table 1. The chemical composition of alloying elements of ring purveyance

Name of the alloying elements	Maintenance size %		Method of receipt of the purveyance founding
	min	max	
Carbon	1.2	1.3	Get the founding by casting in form or in earthen model after the alloy fusion
Chrome	7.5	8.0	
Titan	0.9	1.0	
Silicon	0.8	1.2	
Nickel	0.4	0.5	
Iron	other		

Here is the obtained founding of purveyance of external diameters of D = 1075mm and d = 920mm and inner diameters of D = 985mm and d = 810mm with the H = 280mm height by the indicated method (see Table 1.) at low temperature in the special stove at such mode: heating 200 – 250^0C, self-control of 2 hour, cooling on air. The parameters of the obtained founding must fulfill the recommendations [1]. The hardness of the working surface of the A result – not less than 630 HB. The metal of the founding must be homogeneous without the inclusions, shells, cracks and other mechanical defect of structure.

Admittance of the radial beating of the external surface of the A founding of purveyance in regard to the inner surface B – no more than 1.0 mm. For the other surfaces of the founding the remains of the casting races in places of joint of form are assumed, the casting ringes and radiuses no more than 0.8 – 1.0 mm.

The process of the founding purveyance tooling, from which it is necessary to get a detail-ring (Fig. 1) is carried out according to the following technological operations:

– paring butt-ends of ring from the 2 sides, bearing a length of l = 275 ± 0.3 mm;
– boring the cone surface B to the diameters ∅814 ± 0.2 mm on the butt ends, bearing a length of l = 275 ± 0.3 mm;
–
– dulling the sharp edges 1.5mm×45° on diameters ∅814 ± 0.2 mm and ∅990 ± 0.2 mm accordingly.

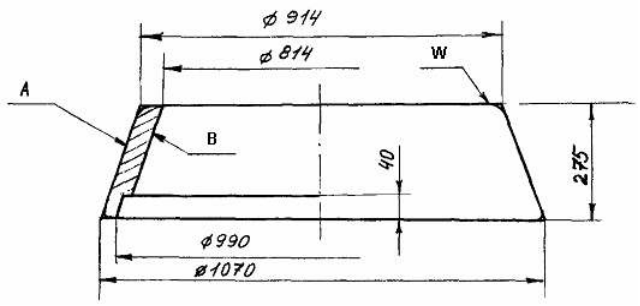

Fig. 1. Working a wear-proof ring

In a similar way the tooling of a roller bracer is carried out (Fig. 2), executing the following technological operations:

– paring butt-ends of bracer from the 2 sides, bearing a l = 275 ± 0.3mm;
– sharpening the external graded cone surface B to the diameters ∅814 ± 0.2 mm and ∅990 ± 0.2 mm, bearing l=275 ± 5.5 mm and l=40 ± 0.2 mm accordingly;
– dulling sharp edges 1.5mm × 45° on diameters ∅814 ± 0.2 mm and ∅990 ± 0.2 mm accordingly.

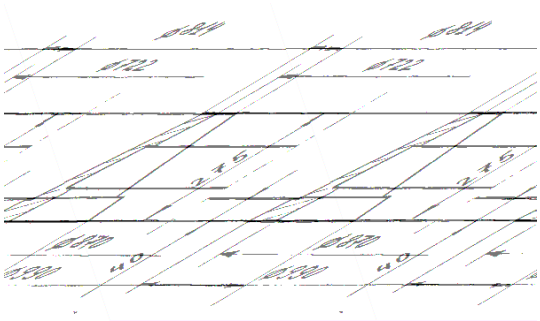

Fig. 2. Roller bracer

The modes of the cutting in case of the treatment of ring and bracer pick up after recommendations [2, 3].

The way of the pair drafting out bracer-ring (Fig. 3) carried out after recommendations [4, 5]. It contains the following technological operations:

– planting a ring (1) on the bracer (2) on the contacting surface B;

– nagging on the contact line 6 opening ∅12.5 mm on length of l = 40 mm;
– to slice of screw-thread in 6-you the M14×1.5-7H opening along the length of l = 35 mm;
– imposition of puck (3) with the 6 opening ∅14+0.2 mm on the surfaces of the W ring and bracer;
– screwing up to support 6-you the M14×1.5-7 h screw-bolts (4) with length of screw-thread of l = 32mm through the spring puck ∅17×∅14.5×2.0 mm (in Fig. 3 it is not shown).

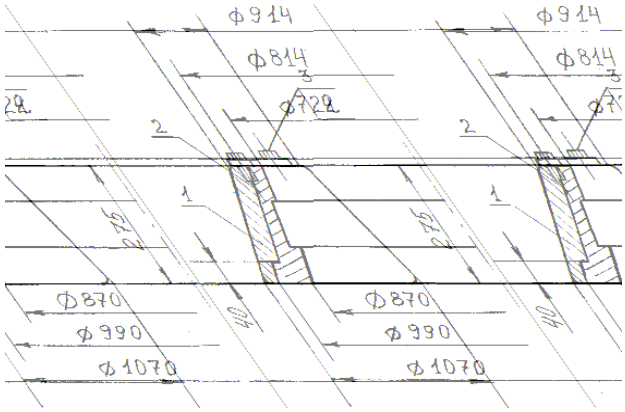

Fig. 3. Grinding down the block of the MCB-140A mill

Having the way of the founding of a ring purveyance and ways of the tooling of a ring and bracer, and also drafting a pair bracer-ring, per analogy [6] a sequence of computation of the smooth cone halving of the MBC-14OA mill is also given for the crushing of coal to the dust like state.

A corner of a cone joint is fixed in the computation basis α, power and geometrical parameters of ring 1, and bandage of roller 2 (see chart in Fig. 4), and also temperature conditions of their exploitation.

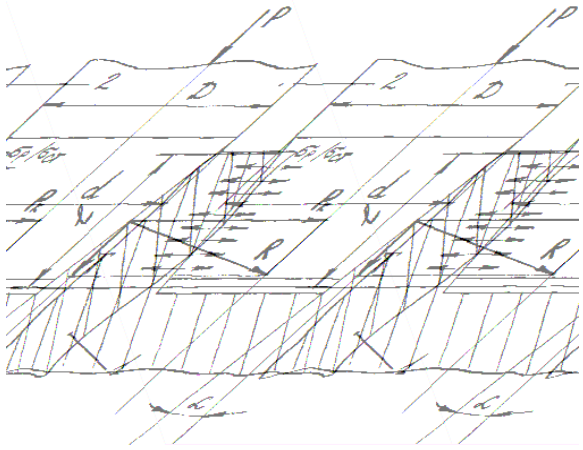

Fig. 4. Schematic image of the immobile cone halving: 1 – pin-hob; 2 – drum-billow

Lets assume a cone corner is set as α halving and its torque M t, ring material and bandage of roller, and also temperatures of their heating t_1 and t_2. It is necessary to define the circular force P_k and the radial force T from the M action, moment of the M_3 tightening of screw-bolt, radial force R, and also diametral elongation of the ring and bandage of roller due to the working temperatures t_1 and t_2.

The value of the circular force from the torque for the cone halving with the cone corner α, from condition of wedge brake, the corner of which will be optimum in lines from 50 about 100, justly count up after the formula:

$$P_k = \frac{2M}{d} \tag{1}$$

where:

d – diameter of axle at the end of contact of cone surface of the halving (Fig. 4).

Having P_k from formula (1) and set corner α cone halving, determine a radial force:

$$T = P_k \cdot tg\alpha \tag{2}$$

or resulting force:

$$R = \sqrt{P_k^2 + T^2} \tag{3}$$

The geometrical sizes of screw-bolt form and the T value calculated after the formula (2) determine the M_3 moment, which it is necessary to attach to the screw-bolt head, that is the moment of tightening:

$$M_3 = T\frac{d_2}{2}\left[f\frac{d_{aver}}{d_2} + tg(\beta + \rho)\right]$$
$$M_3 = T\frac{d_2}{2}\left[f\frac{d_{aver}}{d_2} + tg(\beta + \rho)\right] \tag{4}$$

where:

d_2 - average diameter of screw-bolt screw-thread;
f - coefficient of friction of the screw-thread halving;
d_{aver} - average diameter of supporting butt- end surface of screw-bolt (nuts), counted after the formula:

$$d_{aver} = \frac{D + d_o}{2} \tag{5}$$

D - external diameter of butt-end of screw-bolt (nuts);
d_o - diameter of the opening, in which there is cut an inner screw-thread for the screwing up a screw-bolt (drill diameter);
β - corner of the getting up a spiral line of screw-thread;
ρ - fictitious corner of its getting up (ρ = arctg f');
f' - summary coefficient of friction in screw-thread.

For the metrical screw-thread with the type corner at top $\alpha = 60^{o}$:

$$f' = \frac{f}{\cos\frac{\alpha}{2}}\cos\frac{\alpha}{2} \cong 0{,}866.$$

And, eventually, force, which it is necessary to attach on end of key handle length for the screwing up of a screw-bolt in the inner screw-thread and creation of the immobile cone halving (billow-hob) are determined after the formula:

$$P_3 = \frac{M_3}{l} \tag{6}$$

where:

l - key handle length ($l = 15 - 18d$);
d - external diameter of screw-bolt.

Taking into account the fact, that in the process of exploitation of rollers mill work at the promoted temperatures, diametral elongation of ring Δl_1 and bandage of roller Δl_2 from the heating are possible to calculate after theformulas:

$$\Delta l_1 = \alpha_{1L}\Delta t_1$$

$$\Delta l_2 = \alpha_{2L}\Delta t_2 \tag{7}$$

where:

α_1 and α_2 – coefficients of diametral thermal expansion for the ring materials and bandage of roller accordingly;
$\Delta t = t_1 - t_2$ – temperature imcrease, due to difference of temperatures of the t_1 and t_2 heating of ring and bandage of roller accordingly;
L – length of contacting surface of the cone halving, for which lateral surface $S_\delta = 2\pi(D/2 - d/2)L$, where $D/2$ and $d/2$ - large and small radiuses of the halved cone accordingly.

An attempt to count Δl_1 and Δl_2 was made after the formulas (7) from the rise of temperatures only on $\Delta t = 5^0$C for the wear-proof of the set ring of chemical structure (see the Table) and bandage of roller (steel 35l) gave an increase of diameters of the cone halving $\Delta l_1 = 0{,}0063$ mm and $\Delta l_2 = 0{,}0072$ mm, accordingly.

Size of difference of the diametral elongation of the set ring and bandage of roller from overfall of temperatures on $\Delta t = 5^{o}$C:

$$\Delta l = \Delta l_1 - \Delta l_2 = 0{,}0063 - (-0{,}0072) = -0{,}0009 \text{ mm}.$$

The sign (minus) indicates the creation of a certain stretch in the cone halving of a ring-bracer pair.

CONCLUSIONS

1. A structural decision and technology of restoration of worked bracers of the rollers mill MBC-140A for the crushing hard fuel (coal) to the dust-like state is developed, thus the set aim attained.
2. Attempt at the calculation of an error of the cone halving (billow-hob) for the offered metals in case of temperature rise only to 50°C showed different values of their diametral expansion and also proved that for the creation of an additional stretching immobile cone halving of roller bracer after the drafting, it is necessary use material of middle durability, and put on a ring – made of high durability and extra-hardness material.

REFERENCES

1. Под редакцией **Косиловой А.Г.** и **Мещерякова Р.К.**, 1985: Справочник технолога-машиностроителя Т.1 . М.: Машиностроение, 655 с.
   Kosilova A.G., Mishcheriakov R.K., 1985: Spravochnik tekhnologa-mashynostritiela, T. 1. M: Mashynostryenie, s. 655.
2. Под редакцией **Косиловой А.Г. и Мещерякова Р.К.**, 1985: Справочник технолога-машиностроителя Т.2. М.: Машиностроение, 495 с.
   Kosilova A.G., Mishcheriakov R.K., 1985: Spravochnik tekhnologa-mashynostritiela, T. 2. M: Mashynostryenie, s. 495.
3. Под ред. **Бабука В.В.**, 1979: Дипломное проектирование по технологии машиностроения. Минск: Высшая школа, 464 с.
   Babuk V.V., 1979: Diplomnoye proyektirovaniye po tiekhnologii mashynostroyenia. Minsk: Vysshaya shkola, s. 464.
4. **Руденко П.О.**, 1993: Проектування технологічних процесів у машинобудуванні. К.: Вища школа, 414 с.
   Pudienko P.O., 1993: Proyektuvannia tiekhnologichnykh procesiv u mashynobuduvanni. K.: Vishcha shkola, s. 414.
5. **Когут М.С.**, 2000: Механоскладальні цехи та дільниці у машинобудуванні. - Львів, вид-во Державного університету “Львівська політехніка”, 351 с.
   Kogut M.S., 2000: Mekhanoskladal'ni cekhi ta dil'nicy u mashynobuduvanni. Lviv, vid-vo Dierdjavnogo universytetu "Lvivskaya politekhnika", s. 351.
6. **Когут М.С., Ванкевич П.І., Затхей Б.І., Хлистун Б.Т.**, 2001: Методика розрахунку гладких циліндричних і конічних з’єднань вальців борошномельних машин. Вісник Львівського державного аграрного університету “Агроінженерні дослідження”, с.141-150.
   Kogut M.S., Vankievich P.I., Zathey B.I., Hlistun B.T., 2001: Metodika rozrakhunku gladkikh cilindrichnykh i konichnykh zyednan' val'civ boroshnomielnikh mashyn. Visnik Lvivskogo dierdjavnogo agrarnogo universytietu "Agroindjenierniy doslidjeniya", s. 141–150.

Recenzent: Prof.. dr hab. Eugeniusz Krasowski