Oct. 28, 1969 T. F. GUNDLACH 3,474,973

CRUSHING AND SIZING ROLLS

Filed Dec. 27, 1966

FIG. 1

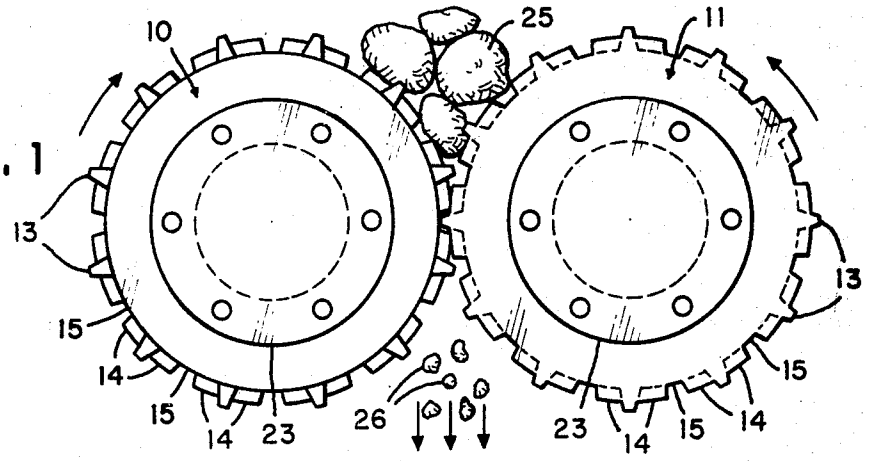


FIG. 2

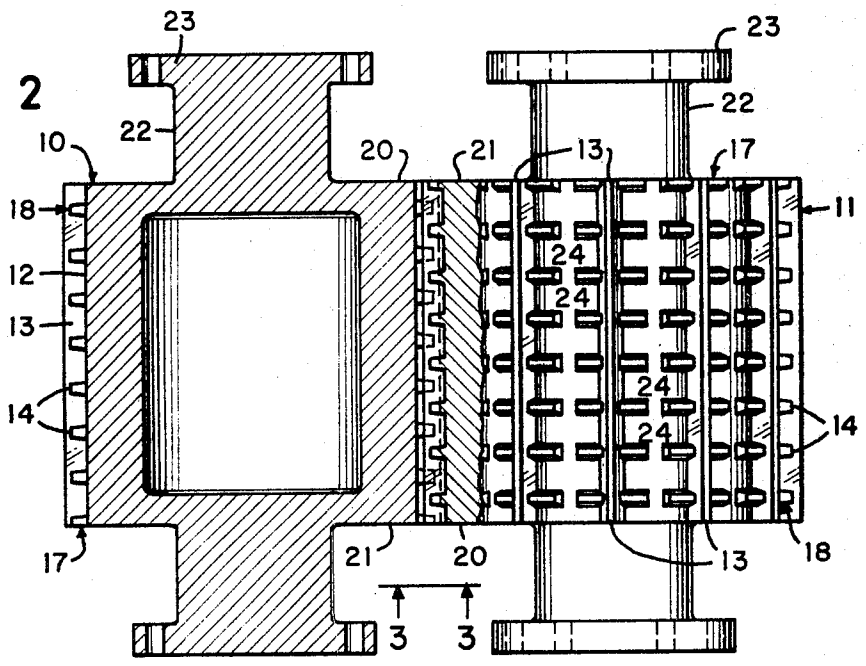
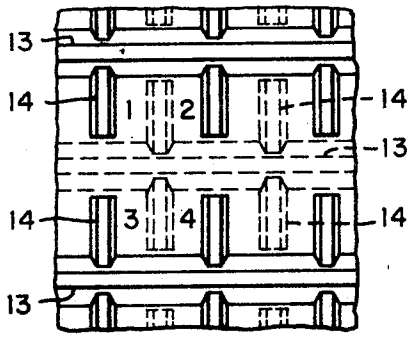


FIG. 4



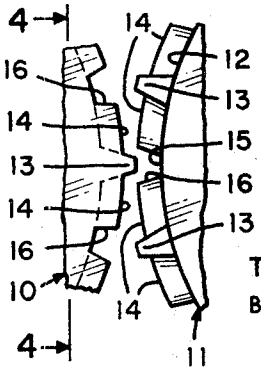


FIG. 5

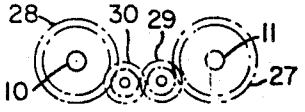


FIG. 3

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United States Patent Office 3,474,973 Patented Oct. 28, 1969

3,474,973

CRUSHING AND SIZING ROLLS

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Filed Dec. 27, 1966, Ser. No. 604,984
Int. Cl. B02c 4/08, 13/20
U.S. Cl. 241—236 7 Claims

ABSTRACT OF THE DISCLOSURE

A pair of adjacent coacting rolls in a rotary reducing and sizing machine for coal and the like, each roll having a plurality of similar, continuous elongate teeth on the contact surface, axially disposed in circumferential spaced relation around the roll, and a plurality of ribs extending laterally from each side of each tooth and disposed in axial spaced relation along each tooth, corresponding ribs on adjacent teeth being in circumferential alignment around each roll. The ribs are discontinuous, and extend from adjacent teeth on one roll, having free ends spaced apart to accommodate the teeth of the coacting roll. The teeth of one roll are in alternating relation with the teeth of the coacting roll as the rolls rotate through a common plane to divide the area between adjacent teeth on the same roll, the common plane being defined by the roll axes and the plane passing through the crushing zone. The ribs and teeth form four-sided, coal-sizing pockets, two sides of each pocket being formed by adjacent teeth and ribs of adjacent rolls.

This invention relates generally to improvements in rolls for crushing and sizing coal, rock and the like, and more particularly to an improved type of roll for a machine such as that described in U.S. Patent No. 2,578,540.

Machines such as those described in the referred patent have been in use many years. Essentially, the roll surface pocket pattern adopted on this type of machine is formed by a plurality of continuous circumferential ribs disposed in axial, spaced relation along the length of the roll, each rib including a plurality of axial elongate teeth circumferentially disposed in circumferential, spaced relation around the roll and extending laterally of each rib. These teeth are spaced apart axially to provide a gap wherein to receive the continuous, but alternating, circumferential ribs of a coacting roll.

Machines incorporating rolls of this pocket pattern have been successful in their purpose of sizing and reducing coal but have, however, suffered from the disadvantage of excessive wear at the ends of the relatively short teeth. This disadvantage apparently results from the fact that the primary crushing force is provided by the teeth, and therefore more severe wearing because of the crushing action is suffered by the teeth rather than the ribs. This crushing action is particularly severe at the ends of the teeth because of the closeness of the fit between the circumferential rib and the groove formed between the ends of the teeth to receive the circumferential rib. This closeness of fit is necessary to avoid the formation of slivers or fingers of coal which would otherwise be formed if the gap were larger. The present invention provides an improved pocket formation. It is the principal object of the invention to avoid the excessive wear at the ends of the teeth by eliminating the groove causing this wear.

An important object is realized by providing a plurality of continuous teeth extending the full length of the roll and disposed in circumferential relation around each roll, the teeth of one roll rotating in out of phase relation with the teeth of the coacting roll.

Another important object is achieved by the provision of oppositely extending ribs disposed in spaced relation along each tooth in laterally aligned pairs, the ribs of one roll alternating with the ribs of the coacting roll. The free ends of the associated ribs of adjacent teeth on one roll are spaced apart to form a groove receiving the teeth of the coacting roll, and the tooth and rib pattern of one roll superimposedly quarters the similar tooth and rib pattern of the coacting roll as the roll rotates through the crushing zone between the rolls.

A further important object is achieved in that the rolls operate in synchronized relation with each other so that the teeth of one roll pass through a common plane defined by the axes of the individual rolls, in alternation with the teeth of the coacting roll.

It is an important object to provide ribs which are integral with their associated teeth.

Yet another important object is the provision of symmetrical flat-topped ribs and teeth having a cross-section which tapers downward to a base at the roll contact surface.

Still another important object is realized by providing ribs, each tapered at its free end, the free ends of the ribs of adjacent teeth being spaced apart to form an upwardly tapered groove conforming to the configuration of a received tooth of the coacting roll.

An important object is to provide crushing and sizing rolls that are simple and durable in construction, economical to manufacture, and efficient in operation.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in conjunction with the accompanying drawings, in which:

FIG. 1 is an end elevational view of a pair of coacting rolls in operation;

FIG. 2 is a fragmentary plan view of the rolls, partly in cross-section, illustrating the pattern of the teeth and ribs forming the sizing pockets;

FIG. 3 is an enlarged, fragmentary view on line 3—3 of FIG. 2, illustrating the pocket-forming capability of coacting rolls;

FIG. 4 is a developed view on line 4—4 of FIG. 3, showing the superimposed roll pattern of coacting rolls **10** and **11**, the pattern of roll **10** being in phantom, and

FIG. 5 is a diagrammatic view of a train of gearing through which the roll shafts are operatively interconnected in timed relation.

Referring now by characters of reference to the drawings, and first to FIG. 1, it will be understood that the invention includes a pair of coacting, substantially similar rolls **10** and **11** suitable for installation in a machine such as that indicated in U.S. Patent No. 2,578,540.

Each roll in the preferred embodiment has a surface pattern of pockets formed by teeth and ribs which is asymmetrical across the roll, and in order to produce the requisite alternation of teeth and ribs between coacting rolls, the rolls are endwise reversed. Apart from this feature the description of one roll, which follows, applies to both rolls.

Projecting from the roll contact surface **12** is a plurality of elongate, continuous teeth **13** extending axially of the roll, and disposed in spaced, circumferential relation around the roll. The continuous teeth **13** are preferably flat at the top and taper symmetrically downward to a relatively wider base at the roll contact surface.

A plurality of elongate arcuate ribs **14** extend an equal distance at right angles from each side of each tooth **13**. The ribs **14** are disposed in spaced, axial relation along each tooth **13** in circumferentially aligned pairs. Axially spaced, corresponding ribs **14** on adjacent teeth **13** are

likewise circumferentially aligned to form a plurality of discontinuous rib formations around the roll. The discontinuous ribs **14** have substantially the same cross-sectional configuration as the continuous teeth **13**. However, the continuous teeth **13** project radially outward beyond the discontinuous ribs **14**.

The free ends **16** of the discontinuous ribs **14** extending in opposite directions from adjacent continuous teeth **13** are spaced apart to provide a gap which constitutes a groove **15** receiving one of the continuous teeth **13** of the adjacent coacting roll.

The plane of the free end **16** of each rib **14** is offset from the normal with respect to the contact surface **12** of the roll in order to furnish suitably sloping faces to the groove **15** to accommodate the conforming configuration of the continuous tooth **13** of the coacting roll. This arrangement is clearly shown in FIG. 3 and assists in avoiding the formation of fingers of coal which tend to become crushed against the free ends **16** of the discontinuous ribs **14** which constitute the sides of the groove **15**. As has been noted above, wear to the discontinuous ribs is less severe than wear to the continuous teeth **13** because the discontinuous ribs **14** provide a comparatively secondary crushing force. Likewise, wear to a groove **15**, formed between discontinuous ribs **14** in contrast to a groove formed between the teeth, is much less severe.

In order to provide the requisite alternation of the discontinuous ribs **14** between roll **10** and roll **11**, and yet use the same roll design for each, the roll pattern is asymmetrical with respect to the axial disposition of the discontinuous ribs **14** along the roll. FIG. 2 clearly shows that a circumferential line **17** of discontinuous ribs **14** is provided at one end of each roll **10** or **11**, while the final circumferential line **18** of discontinuous ribs **14** is spaced away from the other end of the same roll **10** or **11** respectively a distance equal to half of the spaced axial distance between discontinuous ribs **14**. Roll **10** has the same axially spaced relation between discontinuous ribs **14** as roll **11**, but roll **10** is endwise reversed with respect to roll **11** so that while the faces **20** and **21** of the ends of both rolls **10** and **11** are aligned, the discontinuous ribs **14** on roll **10** are alternately disposed with respect to discontinuous ribs **14** of roll **11**.

FIG. 2 clearly shows that rolls **10** and **11** are provided with integral axles **22**, and with outwardly extending end connection flanges **23**. The function of these parts is obvious and not critical as to form. It is therefore deemed unnecessary to discuss them.

The spaced relation of the rolls **10** and **11** with respect to each other, of course, determines the minimum distance between roll contact surfaces **12**. In addition, it is necessary to interconnect the two rolls **10** and **11** so that the rotation of one with respect to the other is synchronized to insure that the continuous teeth **13** of one roll pass through the crushing zone in alternation with the continuous teeth **13** of the coacting roll. Although mechanism for achieving these two results is not indicated on the drawings, it is felt that such a variety of choice is open to a manufacturer that a description of the same would be superfluous. One type of mechanism is disclosed in U.S. Patent No. 2,578,540 and is shown as an example.

With particular reference to FIG. 5, being the diagrammatic showing of a gear connection between the paired coacting crusher rolls, it is seen that a gear **27** is attached to axle **22** of roll **11** and a similar gear **28** is attached to axle **22** of roll **10**. Since the gears **24** and **25** must operate toward each other in directing the coal into the crushing zone between the rolls **10** and **11**, two intervening drive pinions **29** and **30** are provided, the pinion **29** meshing with gear **27**, and in turn engaging pinion **30**, and the latter pinion **30** engaging the gear **28** which drives roll **10**.

It is thought that the functional advantages of the rolls **10** and **11** have become apparent from the foregoing description, but for completeness of disclosure, the usage of the rolls **10** and **11** will be briefly described.

FIG. 1 illustrates the operation of the two rolls **10** and **11**. Large coal segments **25** are fed between the rolls **10** and **11** and, depending on the minimum spaced relation of the roll contact surfaces **12** across the common plane defined by the roll axes, the coal will be sized according to the dimensions of the quartered pockets exemplified by the portions designated by numbers **1**, **2**, **3**, and **4** in FIG. 4. This sizing operation will result in segments **26** of a reduced size.

FIGS. 2 and 4 clearly indicate that the contact surface **12** of each roll **10** and **11** is divided into relatively large, open-faced pockets **24**, each of these pockets **24** being fully bounded on two opposing sides by adjacent continuous teeth **13** of one roll. These pockets **24** are interruptedly bounded on the remaining opposed sides by four ribs **14**, two ribs **14** on each of said sides. As the rolls **10** and **11** rotate, these pockets **24** are passed through the crushing zone, and because of the synchronized alternation of the rolls **10** and **11**, the continuous teeth **13** of one roll divide these pockets **24** of the coacting roll into two parts. Since the circumferential discontinuous ribs **14** of one roll also alternate with the discontinuous ribs **14** of the coacting roll, each pocket **24** is further divided. The result of the synchronized alternation of both continuous teeth **13** and discontinuous ribs **14** of the coacting rolls is that each pocket **24** is subdivided into four quarter pockets denoted in FIG. 4 by reference numbers **1**, **2**, **3** and **4**. In the past this quartering process has been achieved by continuous ribs and discontinuous teeth, and the present design as explained above, represents a significant improvement over this earlier method. The wear, previously encountered in the sides of grooves which were necessarily formed between the ends of the discontinuous teeth is, in the present pocket design, encountered in the free ends **16** of the discontinuous ribs **14** which constitute the sides of the groove **15**. Because the continuous tooth represents the primary crushing agent, the wear at the free ends **16**, particularly at the edges of the free ends, is significantly less in the present pocket design than in previous designs.

The projection, radially outward, of the continuous teeth **13** beyond the discontinuous ribs **14** results in the production of less fines than would be the case if the tops of the discontinuous ribs **14** and the tops of the continuous teeth were flush. In the present structure, a smaller contact area producing fines is provided than in previous roll designs.

Although the invention has been described by making detailed reference to a single preferred embodiment, such detail is to be understood in an instructive rather than in any restrictive sense, many variations being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. A pair of adjacent coacting rolls in a rotary reducing and sizing machine for coal and the like, each roll comprising:

(a) a contact surface,

(b) a plurality of similar, continuous elongate teeth on the contact surface, axially disposed in circumferential, spaced relation around the roll,

(c) a plurality of ribs extending laterally from each side of each tooth and disposed in axial spaced relation along each tooth, corresponding ribs on adjacent teeth being in circumferential alignment around each roll,

(d) the ribs extending from adjacent teeth on one roll having free ends spaced apart to accommodate the teeth of the coacting roll, the ribs being discontinuous,

(e) the teeth of one roll being in alternating relation with the teeth of the coacting roll as the rolls rotate through a common plane to divide the area between adjacent teeth on the same roll, the common plane

being defined by the roll axes and said plane passing through the crushing zone, and

(f) the discontinuous ribs extending laterally in one direction from the continuous teeth of one roll axially alternating with the ribs extending laterally in the opposite direction from the teeth of the coacting roll to axially subdivide the area between adjacent teeth on adjacent coacting rolls, thereby forming four-sided, coal-sizing pockets, two sides of each pocket being formed by adjacent teeth and the ribs of adjacent rolls.

2. A pair of rolls as defined in claim **1**, in which:

(g) the ribs, oppositely extending laterally of each tooth, are disposed in spaced, axial relation along the tooth in laterally aligned pairs, and

(h) the pattern on each roll is identical and the rolls are endwise reversed.

3. In a crushing and sizing device:

(a) a pair of adjacent coacting rolls, each roll comprising:

(b) a contact surface,

(c) a plurality of similar, continuous elongate teeth on the contact surface, axially disposed in circumferential, spaced relation around the roll,

(d) a plurality of ribs extending laterally from each side of each tooth and disposed in axial spaced relation along each tooth, corresponding ribs on adjacent teeth being in circumferential alignment around each roll,

(e) the ribs extending from adjacent teeth on one roll having free ends spaced apart to accommodate the teeth of the coacting roll, the ribs being discontinuous,

(f) the teeth of one roll being in alternating relation with the teeth of the coacting roll as the rolls rotate through a common plane to divide the area between adjacent teeth on the same roll, the common plane being defined by the roll axes and said plane passing through the crushing zone, and

(g) the discontinuous ribs extending laterally in one direction from the continuous teeth of one roll axially alternating with the ribs extending laterally in the opposite direction from the teeth of the coacting roll to axially subdivide the area between adjacent teeth on adjacent coacting rolls, thereby forming four-sided, coal-sizing pockets, two sides of each pocket being formed by adjacent teeth and the ribs of adjacent rolls, and

(h) synchronizing means operatively interconnecting the rolls in timed relation so that the continuous teeth of one roll pass through the common plane in the crushing zone in alternation with the continuous teeth of the coacting roll.

4. A crushing and sizing device as defined in claim **3**, in which:

(i) the discontinuous ribs oppositely extending from the continuous teeth are integral with the continuous teeth.

5. A crushing and sizing device as defined in claim **3**, in which:

(i) the oppositely extending, discontinuous ribs are integral with and normal to the circumferentially spaced, continuous teeth.

6. A crushing and sizing device as defined in claim **5**, in which:

(j) the continuous teeth and the discontinuous ribs have a substantially symmetrical configuration in cross section including a flat top and a relatively wide base at the contact surface of the roll.

7. A crushing and sizing device as defined in claim **6**, in which:

(k) the discontinuous ribs extending from adjacent teeth have free ends that are outwardly tapered to the base to allow the received continuous teeth of the coacting roll substantially complete penetration up to the contact surface of the opposing roll, and

(l) the continuous teeth project radially outwardly beyond the discontinuous ribs.

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