Feb. 7, 1961 D. A. CHEYETTE 2,970,783

COMPOSITE WEARING PARTS FOR CRUSHERS AND THE LIKE

Filed May 1, 1958 2 Sheets-Sheet 1

FIG. 1

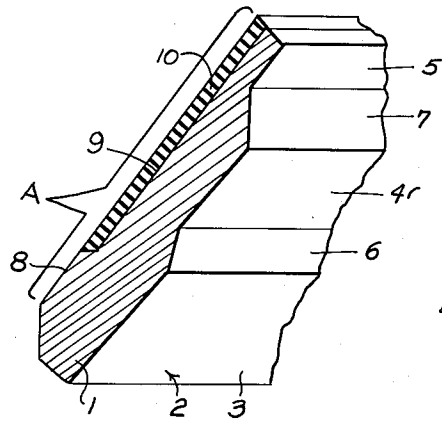


FIG. 2

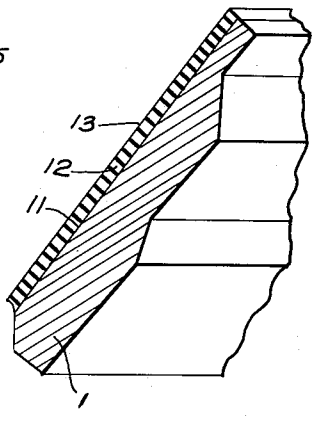


FIG. 4

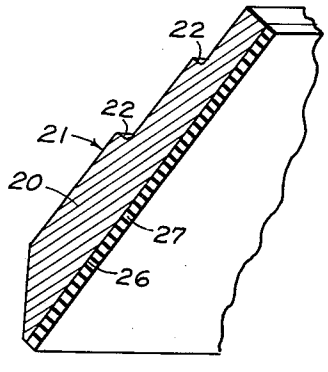
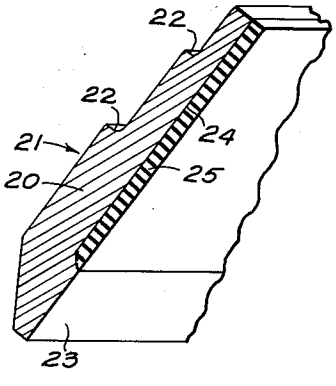


FIG. 3



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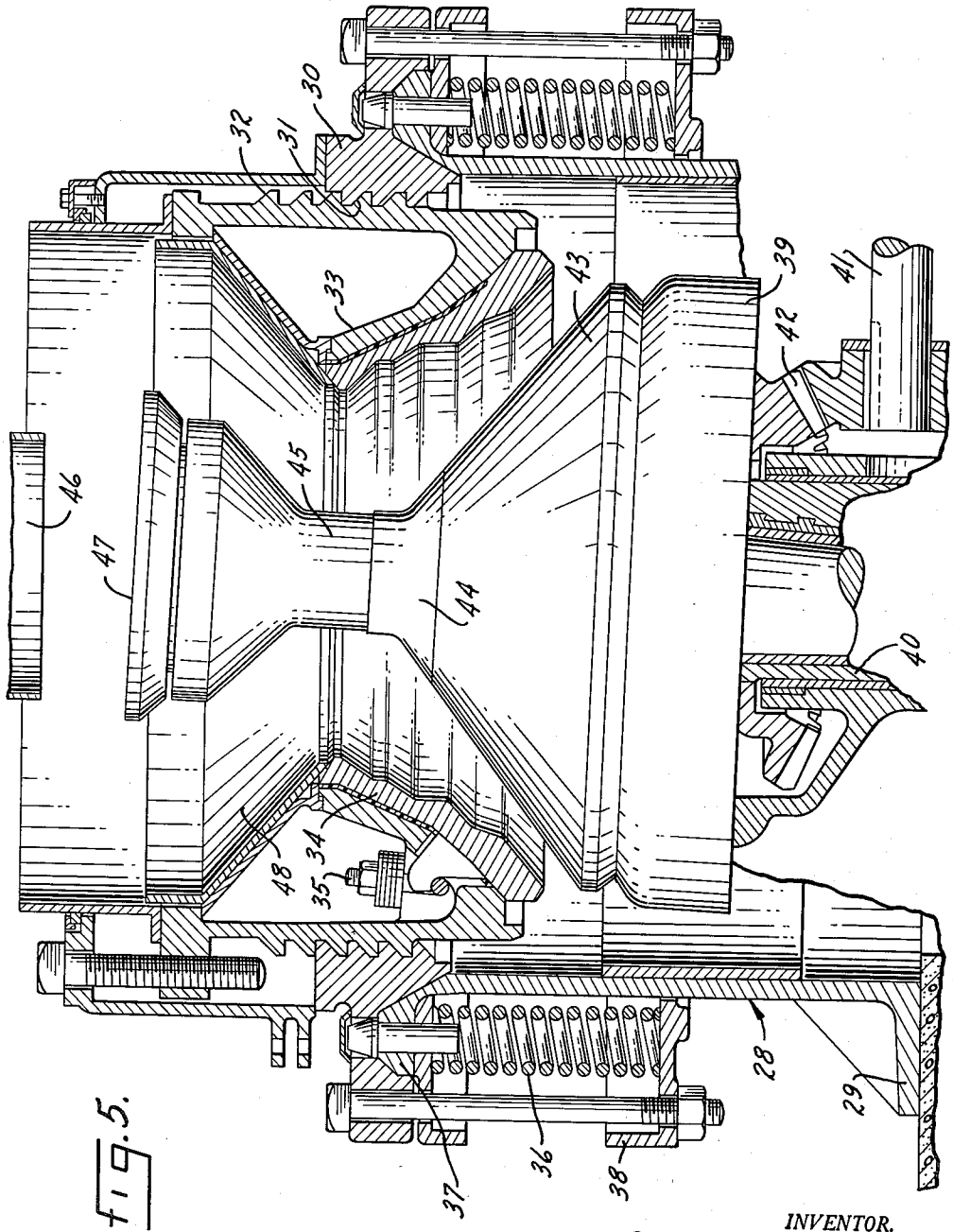


Fig. 5.

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United States Patent Office 2,970,783 Patented Feb. 7, 1961

2,970,783

COMPOSITE WEARING PARTS FOR CRUSHERS AND THE LIKE

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Filed May 1, 1958, Ser. No. 732,199

7 Claims. (Cl. 241—300)

My invention relates to an improvement in composite wearing parts for crushers and grinders, and has for one purpose to provide improved wearing parts having a material engaging grinding or crushing surface portion of properly resistant material and a backing portion of a material having different characteristics.

Another purpose is to provide improved composite bowl liners and mantles for gyratory crushers.

Another purpose is to provide improved composite wearing parts in which a metal body is provided for engaging material to be ground or crushed, and in which a backing layer is provided for engaging a supporting portion of the machine with which the wear taking part is employed.

Another purpose is to provide a backing which differs from the backed part in resilience, elasticity and responses to strain, and has advantageous cushioning characteristics.

Another purpose is to provide a composite wearing part or element which includes a metal body portion of manganese steel or other suitable metal, to which is bonded a non-metallic backing layer which is in use situated between the rear or non-working face of the body and the abutting supporting part of a mill or crusher, the backing layer being preferably effective not only to constitute an adequate backing or cushion, but also to prevent any metal-to-metal contact between the body portion and the machine with which the wearing part is used.

Another purpose is to provide a wear taking part of manganese steel or the like to which is bonded a thin layer of plastic, such as an epoxy resin, which will serve as a backing having a life as long as the expected life of the wearing part.

Other purposes will appear from time to time in the course of the specification and claims.

The present application is a continuation-in-part of my copending application Serial No. 661,496, filed on May 24, 1957, now abandoned, for "Improved Composite Wearing Parts for Crushers and the Like."

I illustrate my invention more or less diagrammatically in the accompanying drawings wherein:

Figures 1 and 2 represent radial sections through a bowl liner for a gyratory crusher in which the bowl overhangs the head;

Figures 3 and 4 represent radial sections through mantles to be positioned upon the conic crushing head of a gyratory crusher; and

Figure 5 is a vertical section through a crusher embodying my invention.

The invention should be considered in its relation to the problem of mounting metal wear taking parts on crushers, grinders and the like. It may advantageously be discussed in its application to the head surrounding mantles and to the bowl liners of gyratory crushers. As a matter of illustration, it is herein shown as applied to the liners and mantles of gyratory cone crushers.

In such crushers it is current practice to pour a backing of zinc or the like, the metal being applied at the

point of use, when the liner or mantle is being mounted on the machine. This procedure has numerous disadvantages, including the fact that pouring the hot metal is difficult and dangerous, involves considerable extra time and expense, and causes frequent casualties to personnel. The zinc, unfortunately, even when poured with the greatest care, does not form or provide an adequate backing layer. By inspection of typical jobs one learns that the zinc, when poured into the narrow space occupied by the backing, solidifies too rapidly, even when preheated for pouring. It sets in discontinuous lobes or fingers which prevailingly do not merge even when they meet, and do not completely fill the space between the liner or mantle and the part of the machine which is supposed to support it. The trouble is increased by the fact that the zinc shrinks substantially on solidifying, and is inherently unable to fill, after it solidifies, the space into which it has been poured while in a molten condition. In use, under the inevitable pounding, to which it is subjected during the use of the crusher, it breaks up, even pulverizes, and is useless, even non-existent, as a backing, causing liners to loosen and break prematurely, with resultant production losses and frequent and expensive shut-downs for rezincing and replacement of liners.

The present invention provides a backing which avoids and corrects the faults of current practice. It provides backing layers which maintain full efficiency for the life of the backed part. The plastic employed has full dimensional stability, and, when poured, it completely fills the cavity into which it is poured. Being thermosetting, it does not cool or set prematurely, and in practice completely covers the entire area of the rear face of the wearing part. This, taken in connection with the fact that it has dimensional stability and scarcely shrinks on hardening, ensures a full backing efficiency for the life of the part. For these reasons it is possible to use a backing layer thinner than the zinc layers now being poured. The use of a plastic, such as a thermosetting epoxy resin, has the further advantage of permitting the use of various fillers or volumes of particles, which may be used to obtain a variety of desirable results. Strengthening fibers may be used, or fillers, to reduce costs or to increase heat transmission, or to reduce fluidity. Practical applications of the invention will now be described in detail, the wearing parts of a gyratory crusher being used as a matter of illustration.

Referring to the drawings, it will be understood that the shapes of bowl liner and mantle may be widely varied, depending upon the form of the bowl or head with which the liner or mantle is to be employed. It will also be understood that, whereas the drawings illustrate only bowl liners and mantles, my invention is applicable also to wearing or lining parts for rod mills, ball mills, tube mills, and compartment mills, and crushers, such as jaw, impact and roll crushers, and, in fact, for any other crushing and grinding equipment.

Referring, first, to Figure 1, A indicates generally the outer surface of a bowl liner which may be opposed to and held against any suitable overhanging crusher bowl. Any suitable means, not herein shown, may be employed for thrusting or drawing the bowl liner upwardly against the bowl with which it is used. 1 generally indicates the body of the liner, which may be of manganese steel or other suitable material. Its inner surface, generally indicated as 2, is shown as including a plurality of conic surfaces 3, 4 and 5 connected by intermediate surfaces 6 and 7. The details of the form of the liner are not, of themselves, part of the present invention. The outer surface of the body 1 has a lower, outer conic surface 8 and a recess 9. The recess is filled with a lining or material of different nature than the manganese or other metal

of which the liner is composed. This body of material, indicated as **10**, will later be described in greater detail.

The form of Figure 2 is identical with the form of Figure 1, except that in the place of the recess **9** a conic surface **11** extends from top to bottom of the body **1**. Overlying this conic surface **11** is the outer body or backing **12** which is shown as having an outer, generally conic surface **13**. The material of which the bodies **10** and **12** are formed is described below in detail.

Figures 3 and 4 represent a mantle body **20**, of manganese steel or other suitable material. The outer surface **21** is formed with a series of steps **22** which do not, of themselves, form part of the present invention. In Figure 3 the inner surface terminates with the lower conic portion **23** adapted to engage a crushing head, if desired, with a metal-to-metal contact. It thus performs the same service as the bottom conic surface **8** of the form of Figure 1. In each case the lower portion of the bowl liner or mantle has a more or less conic surface adapted to engage an opposed, similarly formed surface on a head or bowl, with a metal-to-metal contact surface. In Figure 3, the upper part of the surface **21** is recessed, as at **24**, to receive a body **25** corresponding to the body **10** of Figure 1.

In Figure 4, as in Figure 2, the supporting surface, in this instance the inner conic surface **26**, extends from top to bottom. Abutting it is a liner or backing body **27**.

It will be understood that wearing parts for other equipment, such as rod, ball, and tube mills, may similarly be provided with backing of a different material, either recessed into the wearing part, or applied to it as a separate, over-all layer.

I propose to supply to the user a composite wearing element in which the backing part, which may, for example, be of an epoxy resin, is applied at the factory, or, in any event, before the wearing part is applied to use. It is bonded to the appropriate surface of the body of the wearing element. It may be applied by casting, spraying, molding, or any suitable bonding. Of course, I may pre-form a lining or surfacing body, such as **10** or **12**, or **27** or **25**, and may apply it to and bond it to the opposed surface of the wearing parts **1** or **20**. While I do not wish to be limited to any specific material it is practical to employ an epoxy resin. The epoxy is mixed with a suitable activator. An important advantage is that no external source of heat is necessary to liquefy the backing material. In the use of epoxy, when the resin and activator are intimately mixed, they develop their own internal heat and should be poured generally just before reaching the highest temperature of 160° or less. Sealing of the lower end of the cavity is important because the hot liquid plastic is highly fluid and will seek out the smallest crack or opening.

In the example given, namely, an epoxy, the material is sufficiently inexpensive, is easy to handle, has no significant shrinkage during solidification, and is sufficiently malleable to be usable in all applications. It will cushion the crushing blows but at the same time is rigid enough to provide efficient crushing. While epoxies are satisfactory for the purpose, other plastics may be used.

The setting temperature of the epoxy may be widely varied. For instance, for convenience, one may use a room temperature setting epoxy. This plastic will withstand, without deterioration, a temperature in the region of, say, 200° F. If one needs a plastic that will withstand a continuous temperature of, say, 350° F., one uses a mixture which may be cured at, say, 150° F. In this manner the top deterioration temperature of the epoxy can be extended.

To consider more specifically the particular plastic to be used, while a range of other plastics may be used, epoxy resins have various characteristics which make them practical for the desired purpose. The modulus of elasticity of the epoxies is of the order of from 400,000 to 600,000 in contrast to the modulus of elasticity of various steels, of from, say, 28,000,000 to 32,000,000. This relationship of the characteristics of body and backing has in practice turned out to be highly practical. A highly efficient backing and cushioning effect is thereby obtained, even though the backing layer is in thickness a mere fraction of the thickness of the wearing part. Stated generally, advantageous results have been obtained where the modulus of elasticity of the backing plastic layer is in the general range of from one to three percent of that of the steel body portion. One and one-half to two and one-half appears to be the preferred range, but substantial departures therefrom appear to be practical.

The compressive strength is satisfactory. An epoxy resin, for example, may have a compressive strength of the order of 8,000 to 12,000. A thermosetting plastic, such as an epoxy resin, provides a backing which is dimensionally stable and which conforms precisely and completely to the abutting metallic surfaces. It can be bonded firmly to the wear taking body or to the backing part of the machine, or to both, or, if desired, to neither. It has little or on solidification shrinkage. It is thixotropic. While holding its general form it will seal gaps, will fill interstices, and will accommodate itself to shifts and changes.

While I find the employment of a thermosetting plastic satisfactory and find the use of an epoxy resin practical, I do not wish to be limited to any specific material or plastic. For example, I may employ a wide range of suitable plastic laminates. Laminates are available on the market in which cross-bedded plastic sheets with aligned glass filaments may be arranged with the individual sheets angularly displaced in such fashion that the glass filaments are cross-banded. Under such circumstances, it is practical to form such a cross-banded backing layer and then to apply it or bond it to the body portion **1** or **20**. However, I may employ plastics reinforced in other ways, or plastic which need no reinforcement.

It will be realized that, whereas I have described and illustrated a practical and operative device, nevertheless, many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic rather than as limiting me to my precise showing. For example, I may apply reinforcement to the backing body itself and then spray, or mold, or otherwise apply a backing layer of plastic or other material which will not be merely reinforced by such reinforcing structure but will be held partially or wholly thereby in relation to the wear taking body.

It should also be kept in mind that my invention will apply to any crushing part or concave for use in crushing and grinding equipment.

One advantage of my invention is the reduction in the cost of finishing opposed surfaces of members of alloy steel. By avoiding machining or grinding a great saving of time is obtained in finishing the wearing members. The faces of concaves which are opposed to and supported by supporting or frame parts of crushers and screens need not be finished or machined or ground down to close tolerances when the backing body or layer can readily be applied and can be formed easily to any desired form or dimension.

I illustrate in Figure 5 a typical material reduction machine, in this case a gyratory crusher. For example, a main frame is indicated generally at **28** which may have a bottom flange **29** resting on a suitable foundation. Mounted on the upper edge of the frame is a tilting ring **30** with a screw-threaded inner portion **31** in mesh with a corresponding screw-threaded outer portion **32** of a bowl **33**. **34** represents a suitable liner secured to the bowl as by lugs **35**. Springs **36** are compressed between the bottom of the upper edge flange **37** on the

frame and a suitable abutment ring **38**. Thus the springs hold the tilting ring normally fixed on the main frame.

The head **39** of the crusher may be suitably mounted in an eccentric sleeve **40** which is rotated by a drive shaft **41** suitably geared to the eccentric sleeve at **42**. The head carries a suitable crushing mantle **43** which may be held in position by a locking sleeve **44** or the like which, in turn, is held in place by a lock nut **45**.

Feed to the crusher is supplied through a spout **46** to a feed plate **47** on top of the head. The material from the feed plate is fed to the crushing cavity between the mantle and liner by a suitable feed cone **48**.

As shown in Figure 5, both the mantle and liner are backed by the backing material throughout a substantial portion of their length and an abutting shoulder is provided at the bottom, such as shown in Figures 1 and 3. But it should be understood that the backing material in Figure 5 might extend the full length of either one or both, as in Figures 2 and 4.

The use and operation of my invention are as follows:

Stated simply, my invention involves the provision of a composite wearing part, one component of which, like the body part **1** of Figures 1 and 2, or the body part **20** of Figures 3 and 4, is of a metal or other material which can advantageously be used in crushing or grinding. In the gyratory crushing field an acceptable metal is manganese steel. In use, the wearing parts, the bowl liners and mantles of gyratory crushers, and the wearing plates of ball, rod, and tube mills, have to be quite frequently replaced. As they work they also have to be backed against a supporting surface, generally with some material in between, such as the above mentioned zinc layer. My invention frees the workers in the field from the time-consuming and dangerous process of pouring zinc or other molten backing. In accordance with my invention, the user of a crusher, or grinder, or other mill simply removes the wearing parts when they are worn, and applies the new wearing part, with its backing layer already in position.

In applying the backing to the wearing part or body all that is necessary is to provide an appropriate mandrel or form such as is shown at **40** in Figure 6 or at **30** in Figure 5.

I claim:

1. For use in gyratory crushers and the like, a generally fruso-conic annular wearing element having a body portion of metal and a backing portion adhering to and conforming closely to a generally conic surface of said body portion, said backing portion being formed from an epoxy resin with high dimensional stability and having a modulus of elasticity of the order of from 1–3% of that of steel and a compressive strength on the order of from 8–12 thousand p.s.i., the backing portion having a thickness of not more than ½ inch and extending continuously circumferentially about said body portion and conforming precisely to said conic surface of the body portion throughout its entire area and being adhesively secured thereto.

2. The structure of claim 1 characterized in that the epoxy resin includes a reinforcement of glass fibers.

3. A wearing part for use as a crushing or grinding element in material reduction machines including crushers and the like which includes a replaceable body portion intended to define a part of the crushing or grinding zone and of a metal having generally the modulus of elasticity of steel, and a plastic backing layer of an epoxy resin with a high dimensional stability, its modulus of elasticity being of the order of from 1–3% of that of steel, its compressive strength being of from 8–12 thousand p.s.i., said backing layer being bonded to an opposed surface of the body portion throughout substantially its entire area, the thickness of the backing layer being substantially less than the initial thickness of the body portion.

4. The structure of claim 3 characterized by the provision in the backing layer of an inert filler.

5. The structure of claim 3 characterized by the provision in the backing layer of an inert filler of fibrous reinforcing material.

6. The structure of claim 3 characterized in that the wearing element includes a generally frusto-conic annular metal body portion to which an annular backing layer adheres throughout its entire circumferential area.

7. In a material reduction machine such as a crusher or the like, a frame, a material reduction zone in the frame, replaceable steel wearing parts in the frame defining the material reduction zone, and a non-metallic backing layer for at least some of said wearing parts, said backing layer being of an epoxy resin with a high dimensional stability on shrinkage, its modulus of elasticity being of the order of from 1–3% of that of steel, its compressive solidification strength being of from 8–12 thousand p.s.i., said backing layer having a thickness which is a fractional part of the initial thickness of the wearing part, said wearing part having its non-metallic backing layer abutting it substantially throughout its area.

References Cited in the file of this patent

UNITED STATES PATENTS

1,396,016	Betchkaw	Nov. 8, 1921
2,575,558	Newey	Nov. 20, 1951
2,682,515	Naps	June 29, 1954
2,783,214	Homan	Feb. 26, 1957
2,795,523	Cobb	June 11, 1957