

[54] **HAMMER ASSEMBLIES WITH
REVERSIBLE TIPS FOR HAMMERMILLS**

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[51] Int. Cl. **B02c 13/28**

[58] Field of Search 241/197, 294, 298, 300

[56] **References Cited**

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Primary Examiner—Granville Y. Custer, Jr.

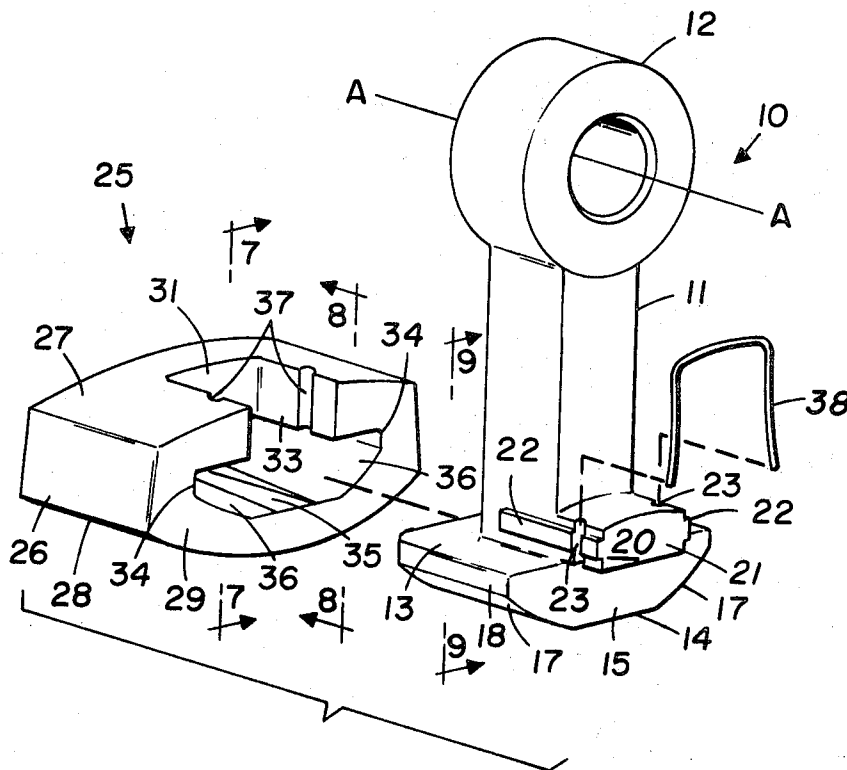
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[57] **ABSTRACT**

A hammer assembly for a hammermill employs a reversible hammer tip removably secured to the hammer arm by means of an interlocking joint, preferably of a generally T-shaped configuration. A large portion of the joint is formed by complementary tapered surfaces in order to ease removal of the tip after the joint has become "limed." The remainder of the joint is formed by several pairs of complementary surfaces parallel to the swinging axis of the hammer assembly. These surfaces receive the centrifugal, centripetal and side crushing forces on the tip which otherwise would tend to separate the tip from the arm, especially before the joint has become limed, owing to the tapered portions of the joint. A wire clip temporarily interlocks the arm and the tip until liming of the joint is sufficient to retain the tip on the arm.

14 Claims, 11 Drawing Figures



SHEET 1 OF 2

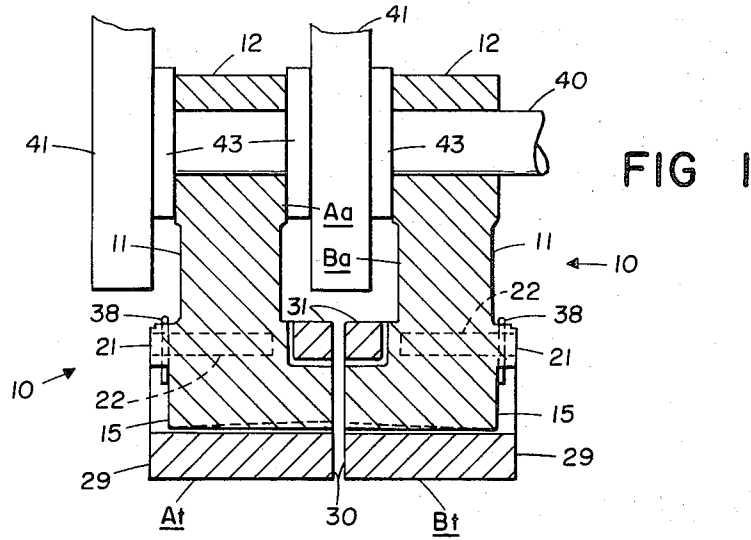


FIG 1

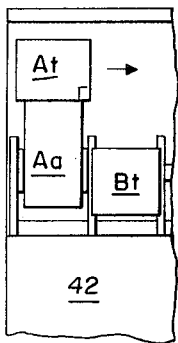


FIG 2

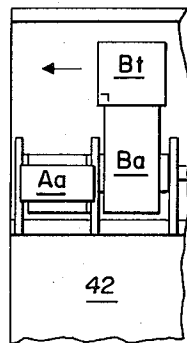


FIG 3

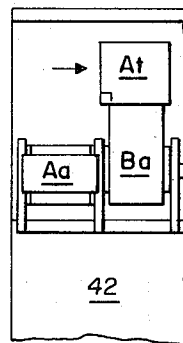


FIG 4

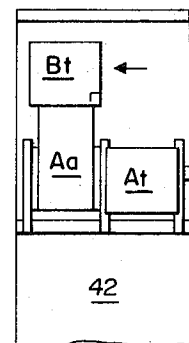


FIG 5

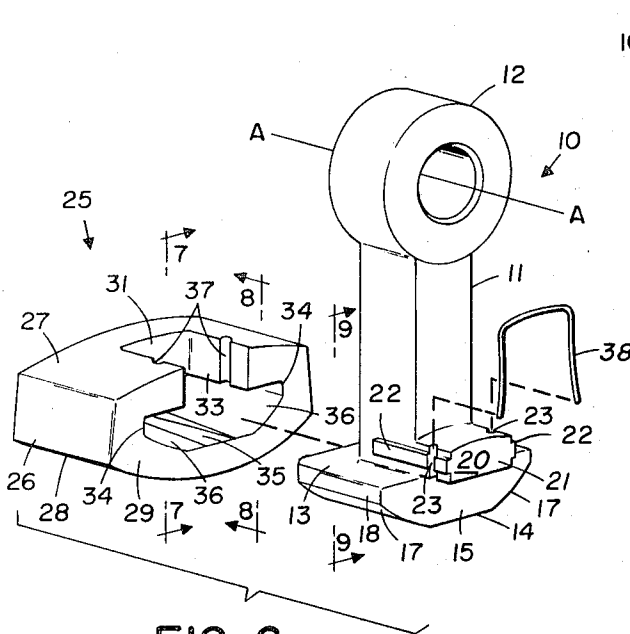


FIG 6

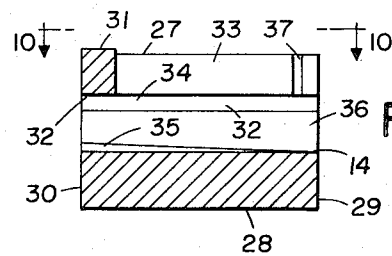


FIG 7

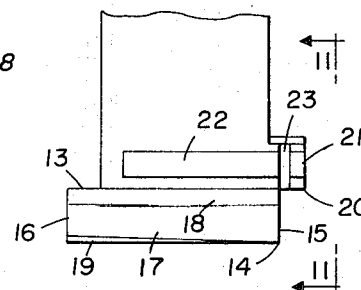
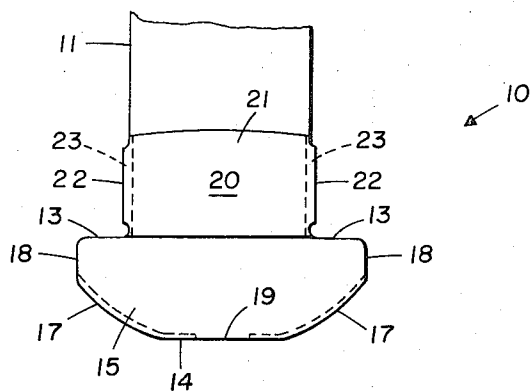
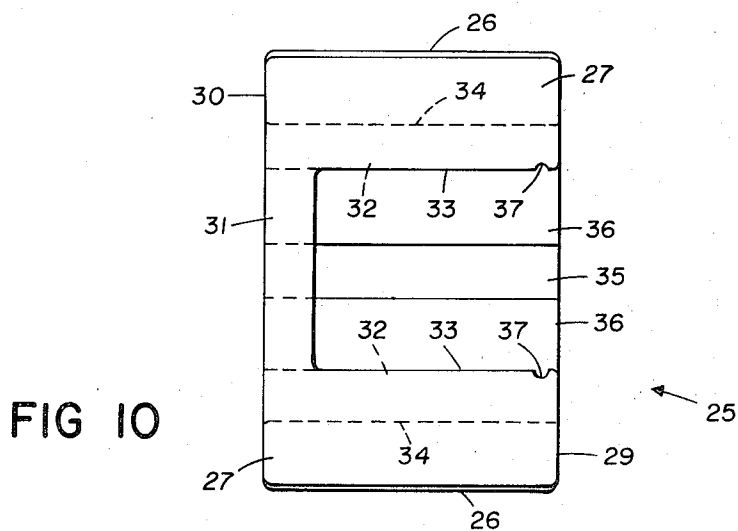
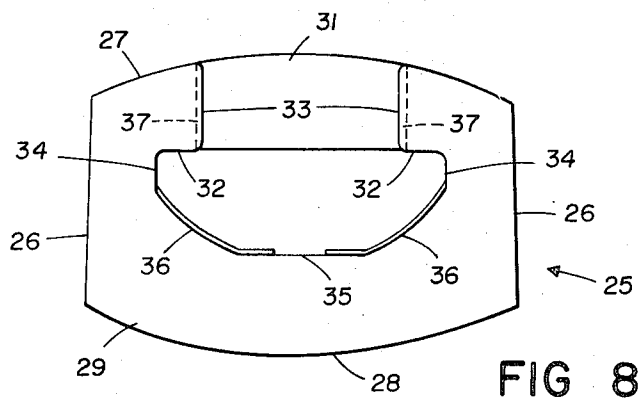


FIG 9



HAMMER ASSEMBLIES WITH REVERSIBLE TIPS FOR HAMMERMILLS

BACKGROUND OF THE INVENTION

The prior art abounds with examples of two-piece hammer assemblies so that the tips can be replaced from time to time as they wear out without requiring the entire hammer assembly to be first removed from the mill. Many schemes for attaching the tip to the hammer arm employ various forms of joints between the arm and the tip, particularly of the interlocking variety, which secure the tip against radial and crushing forces but permit it to be slid off the arm in a lateral direction. Most of the latter type of joints require in addition some sort of locking device, such as a cotter pin, bolt, key or the like, to make sure the tip does not gradually work off the arm during crushing. One of the problems encountered with interlocking types of joints, however, is "liming;" fine dust works its way into the joint and becomes so packed that the tip is thereby virtually "welded" to the arm. When this occurs, it is usually impossible to remove the tip simply by knocking it with a hammer; instead, the entire hammer assembly must be removed from the mill and the tip pressed off the arm, requiring in many instances literally tons of pressure and much downtime of the mill. Furthermore, corrosion of the mating joint surfaces, which usually occurs owing to moisture in the crush material, aggravates the problem because the fine dust then also builds up in the pits thereby formed in the joint surfaces and increases the difficulty of tip removal still more.

Sometimes, in an effort to reduce the liming problem in the case of interlocking joints, the latter has been tapered so that when the tip is struck to remove it the joint surfaces tend to open away from each other and thus break the liming "weld;" see, for example, U.S. Pat. Nos. 1,456,987 and 2,534,301. But in these cases, the joint extends generally parallel to the swinging plane of the arm so that the tip is not reversible; instead, only one of its sides can be used and when that is worn out, the entire tip must be discarded. Were the tip in such a case to be reversed, one of its faces through which the joint opens would contact the material to be crushed, thus destroying the joint unless some sort of elaborate arrangement were employed to protect it. When the joint extends transversely of the swinging plane of the arm, however, the tip can be made reversible since the joint then extends generally parallel to two closed sides of the tip which can be alternately employed for crushing. But in this case, if the joint is also tapered to ease tip removal, crushing forces on the tip would tend to separate it from the arm unless it were restrained by some kind of additional locking means. This in turn would require a sturdier, more permanent form of locking means since it would always be subject to portions of the radial and crushing forces on the tip, especially during the initial period of operation before the joint has become well limed. Consequently, the primary object of the present invention is to provide a hammer assembly having a reversible tip secured to the arm by means of an interlocking joint, but in which the problem of tip removal owing to liming is relieved and the need of elaborate or permanent additional locking means to retain the tip on the arm is eliminated.

SUMMARY OF THE INVENTION

Essentially the present invention employs a reversible tip secured to the arm by an interlocking joint extending generally parallel to the swinging axis of the arm so that the tip is slid on and off the arm in a direction generally at right angles to the plane of the swinging movement of the arm. In the example described hereafter in detail, the joint is of inverted T-shaped configuration, though other shapes could be employed. The joint, whatever its shape, is formed of basically four sets of complementary surfaces, one set receiving centrifugal forces, the second centripetal forces, and the third side crushing forces upon the tip. Each of these sets of surfaces is parallel to the swinging axis of the arm so that none of the foregoing forces tends to separate the tip from the arm. The remaining set of complementary surfaces, however, is tapered and constitutes a significant portion of the total area of the joint. The latter set therefore functions to ease removal of the tip after the joint has become limed, yet since that set of surfaces does not receive any of the primary forces acting upon the tip during crushing, there is no tendency for those surfaces to cause separation of the tip from the arm.

Once the joint has become limed, the tip is thenceforth effectively secured thereby to the arm against slippage during operation of the mill, yet when the tip is to be reversed or replaced, a few blows with a medium weight hammer will readily break the joint loose owing to its tapered portions, whence the tip can then be easily removed by hand. For safety sake during initial operation of the hammer assembly before the joint becomes limed, a simple, inexpensive wire clip is preferably used to lock the tip on the arm. The clip is gradually destroyed during the hammer's operation, but by the time it becomes ineffective, the joint has become sufficiently limed to obviate any further need for the clip.

Other and further features and advantages of the present invention will become apparent from the drawings and the more detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional view of a pair of hammer assemblies according to the present invention installed in a hammer mill and illustrating the orientation of adjacent hammer arms and tips.

FIGS. 2 - 5 illustrate the procedure employed to replace or reverse a pair of adjacent tips without removing the hammer arms from the mill.

FIG. 6 is an exploded, isometric view of a hammer assembly of FIG. 1.

FIGS. 7, 8 and 9 are elevational views taken along the lines 7 - 7, 8 - 8 and 9 - 9 of FIG. 6.

FIG. 10 is a top plan view taken along the line 10 - 10 of FIG. 7.

FIG. 11 is an elevational view taken along the line 11 - 11 of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. 6 - 11, the arm 10 of each hammer assembly comprises a rectangular shank 11 enlarged at one end to provide a hub 12 which is apertured to be journaled in a hammermill for swinging movement about an axis indicated by the line A - A

in FIG. 6. The other end of the shank 11 is laterally enlarged as shown to a generally inverted T-shaped configuration to provide the male half of an interlocking joint. The cross portion of the joint includes radially inward faces 13 about three sides of the shank 11 parallel to the axis A—A, and a radial outer surface area 14 centrally disposed with respect to the axis A—A and extending between end walls 15 and 16 of the cross portion of the joint. The surfaces 17 of the joint cross portion between each side of the central area 14 and a pair of outer side walls 18 of the cross portion are both arcuately curved in the plane of the swinging movement of the arm 10 up toward the respective side walls 18. The surfaces 17 are also convergently tapered from the end wall 15 to the end wall 16 to form a step 19 which begins at the end wall 15 and increases in height to the end wall 16, the side walls 18 and the radially outer face of the step 19 also being parallel to the axis A—A. The shank 11 is laterally extended at 20 to overhang the joint end wall 15, and the side walls of the extension 20 are provided with raised "pads" extending from the extension end wall 21 nearly across the shank 11, the faces 22 of the "pads" being likewise parallel to the axis of A—A. The extension 20 is provided with a pair of transverse, vertical grooves 23 thereacross just outboard of the end wall 15 for purposes to be later described.

The reversible tip 25 is of generally block-like configuration and includes inclined side walls 26, joined by arcuate top and bottom walls 27 and 28, and end walls 29 and 30. The tip 25 is recessed to form the female half of the joint, the cross portion thereof extending between the end walls 29 and 30 and opening through both, while the stroke portion of the joint is formed by a rectangular aperture in the top wall 27 opening through the end wall 29 and extending toward the end wall 30 to form a web 31. The tip joint surfaces are, of course, complementary to those of the arm 10. The tip joint faces 32, which form the radially inner surface of the tip cross portion are engageable with the faces 13 of the arm cross portion and are parallel to the axis A—A, as are the tip joint faces 33 which alternately engage the arm pad faces 22. The tip cross portion side walls 34 alternately engage the arm cross portion side walls 18, while the arm step 19 fits within a trough 35 in the radially outer surface of the tip cross portion, the trough 35 beginning at the tip end wall 29 and increasing in depth to the end wall 30. The tip side walls 34 and the floor of the trough 35 are also parallel to the axis A—A, while the remaining portions 36 of the radially outer surface of the tip cross portion convergently taper from the end wall 29 to the end wall 30 to accord with the arm tapered surfaces 17. The parts are sized so that when assembled with the arm shank 11 against the web 31, the extension end wall 21 is flush with the tip end wall 29 and the arm end wall 16 is flush with the tip end wall 30, the arm end wall 15 thus being recessed with respect to the tip end wall 29. The tip joint faces 33 are provided with a pair of grooves 37, complementary to the grooves 23, so that when the parts are assembled a U-shaped wire clip 38, as shown in FIG. 6, and preferably of spring steel, can be inserted to lock the parts together.

Turning now to FIG. 1, it will be seen that the hammer assemblies are mounted in the mill in adjacent pairs. The hub 12 of each arm 10 is journaled on one of several mounting pins 40 circumferentially disposed

about the axially spaced discs 41 of the spinner 42 (see FIGS. 2-5), all as is typical and well known. Spacers 43 may also be incorporated to accommodate the hubs 12 to the spacing of the discs 41. The hammers of each adjacent pair are disposed so that their respective tip end walls 30 are in close, opposed relation to each other as shown. When the mill is operated, it will be observed that the joint faces 13 and 32 receive the centrifugal forces on the tips 25, while the radially outer faces of the steps 19 and the floors of the troughs 35 receive the centripetal forces on the tips 25 arising from grinding action of the tip bottom walls 28 in the mill. Crushing forces on the tip side walls 26, in turn, are received by one pair of the arm pad faces 22 and tip faces 33 and by one pair of the arm side walls 18 and tip side walls 34, depending upon the orientation of the hammers in the mill. Since all of the foregoing faces are parallel to the axis A—A, the respective forces on them do not tend to separate the tips 25 from the arms 10. The clips 38 retain the parts together until the joints become limed, at which time the clips 38 have usually disintegrated and are no longer needed because the liming thereafter assumes the function of maintaining the parts together. Since the parts are normally formed as castings without machining, they are additionally sized to allow a certain amount of "play" in the joints in order to insure not only that the parts readily fit each other but also that the respective surfaces receiving the centrifugal, centripetal and side crushing forces fully contact each other without interference from other portions of the joints which might otherwise tend to diminish their effectiveness.

The correspondingly tapered surfaces 17 and 36 provide a sort of wedge-like relation in the joint, and in addition are relatively extensive in area compared with the total area of the faces 13 and 32, the radially outer face of the step 19 and the floor of the trough 35, the pad faces 22 and arm tip faces 33, and the arm and tip side walls 18 and 34, that is to say, the area of the tapered surfaces compared with the total area of the axially parallel surfaces; indeed, the greater the area of the tapered surfaces compared with the area of the axially parallel surfaces the better and, preferably the former exceed the sum of the latter. Hence, when the tip end walls 29 are struck with a hammer, for instance, a 12 pound hammer with an 18 inch handle, the wedge formed by the tapered surfaces will progressively open and break the liming. The recessed arm walls 15 aid the removal process and once the liming is broken, the tips can be removed the rest of the way by hand. There is thus no need to shear the liming which would be necessary and far more difficult to do were all the joint surfaces axially parallel. In a working embodiment of the invention, for example, the tapered surfaces total about 22 sq. inches while the axially parallel surfaces total about 18 sq. inches.

When one side 26 of the tips 25 is worn beyond limits, the tips are reversed by the procedure illustrated in FIGS. 2-5. The mill is halted, and adjacent pairs of the hammers are swung relative to each other to separate them as shown in FIG. 2. The tips A_t and B_t are then knocked off in the direction shown in FIGS. 2 and 3, then rotated 180 degrees and reinstalled in the direction shown in FIGS. 4 and 5, tip A_t on arm B_a and tip B_t on arm A_a so that their respective other side faces 26 are then in crushing position. Finally, new clips 38

are installed to retain the tips until the joints become limed.

Though the invention has been described in terms of a particular embodiment, being the best mode known of carrying out the invention, it is not limited to that embodiment alone. Instead, the following claims are to be read as encompassing all adaptations and modifications of the invention falling within its spirit and scope.

I claim:

1. In a two piece hammer assembly for a hammermill, the assembly including a hammer arm and a reversible hammer tip, the hammer arm having radially inner and outer ends, the inner end including a hub for attaching the arm to a hammermill for swinging movement of the arm about a first axis extending transversely of the arm and perpendicular to a second axis of the arm extending longitudinally thereof and radially with respect to the first axis, the tip including a pair of opposite end walls disposed transversely of the first axis and joined by at least one side wall for crushing material, the outer end of the arm and the hammer tip including an interlocking joint between and opening through at least one of the tip end walls for retaining the tip on the arm during operation of the manner assembly in a hammermill and for sliding removal of the tip from the arm in a direction generally parallel to the first axis, the improvement wherein the joint comprises a plurality of pairs of complementary surfaces on the tip and the outer end of the arm between the tip end walls, first ones of the surfaces receiving centrifugal forces on the tip, second ones of the surfaces receiving centripetal forces on the tip, third ones of the surfaces receiving crushing forces on the side walls of the tip, and fourth ones of the surfaces convergently tapering with respect to each other in a direction from the one tip end wall toward the other to form a wedge-like relation of the tip to the arm in order to facilitate removal of the tip, the first, second and third surfaces being substantially parallel to the first axis and respectively receiving substantially all of said forces during at least initial operation of the hammer assembly, the fourth surfaces having a greater area than any of the other three complementary surfaces of the joint.

2. The assembly of claim 1 including separate means for locking the tip on the outer arm end during initial operation of the hammer assembly.

3. The assembly of claim 1 wherein the joint is of generally T-shaped configuration including a stroke portion along the second axis and a cross portion transversely of the second axis, the cross portion having first areas to each side of the stroke portion forming the first surfaces and second areas radially outward of the first areas forming the second surfaces, the cross portion having additional areas forming the fourth surfaces.

4. The assembly of claim 3 wherein each of the stroke portion and the cross portion includes two pairs of opposite areas together forming the third surfaces.

5. The assembly of claim 4 including separate means for locking the tip on the outer arm end during initial operation of the hammer assembly, the locking means interlocking the third surfaces and comprising a generally U-shaped wire member, each leg portion of the member being received in a pair of complementary grooves in one pair of the third surfaces, the grooves extending transversely of the first axis.

6. The assembly of claim 2 wherein the joint is of generally T-shaped configuration, the arm forming the stroke portion and the outer arm end being extended laterally from the stroke portion in the plane of its swinging movement to form the cross portion, the tip being complementarily recessed to fittingly receive the stroke and cross portion of the arm and form the joint, radially inner areas of the cross portion to each side of the stroke portion and the complementary areas of the tip recess forming the first surfaces, part of the radially outer area of the cross portion and the complementary area of the tip recess forming the second surfaces, and wherein the area of the fourth surfaces is greater than the combined areas of the first, second and third surfaces.

7. The assembly of claim 6 wherein opposite areas of the stroke and cross portions of the arm and the complementary areas of the tip recess form four pairs of the third surfaces and wherein the second surfaces are centrally disposed with respect to the ends of the cross portion, the remainder of the radially outer areas of the cross portion and the complementary areas of the tip recess to each side of the second surfaces being arcuately curved in the plane of swinging movement of the arm toward the first surfaces and forming the fourth surfaces.

8. The assembly of claim 7 wherein the blocking means comprises a generally U-shaped wire member and a pair of complementary grooves in each pair of the third surfaces extending transversely of the first axis, the legs of the member being inserted and retained in respective pairs of the grooves.

9. A removable and reversible tip for one end of a hammermill arm adapted to be swung at its other end about an axis comprising: a generally block-like member having opposite side walls parallel to said axis for crushing material and joined by opposite end walls, a top wall, and a bottom wall arcuately formed between the side walls; and inverted T-shaped recess in the tip member extending longitudinally of the tip side walls and having stroke and cross portions, the recess opening through at least one tip end wall and through its top wall to form the stroke portion, the opposing side walls of the stroke portion and the opposite side walls of the cross portion of the tip recess being generally parallel to said axis, the cross portion of the tip recess having a lower wall and a pair of upper walls respectively adjoining the stroke side walls and generally parallel to said axis, the cross portion lower wall having a floor below and centrally disposed between the stroke portion side walls parallel to said axis, the remainder of the cross portion lower wall being convergently tapered from the one tip end wall toward the other and having an area greater than the combined area of the stroke and cross portion side walls, the cross portion upper walls and the floor of the cross portion lower wall.

10. The tip of claim 9 wherein the remainder of the cross portion lower wall is also arcuately curved upwardly from each side of the floor portion to adjoin the respective cross portion side walls.

11. The tip of claim 10 wherein at least the cross portion also opens through the other tip end wall and the stroke portion side walls are provided with a pair of opposite grooves extending from the tip top wall to the respective cross portion upper walls.

12. A hammer arm for use in a hammermill, the arm being adapted to be journaled at its radially inner end

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for swinging movement about an axis, and to remov-
ably receive a replaceable tip at its radially outer end,
the outer arm end being integrally enlarged to provide
a T-shaped configuration having end walls extending
transversely of said axis and cross and stroke portions,
the cross portion of the outer arm end being formed by
radially inner and outer facing walls extending between
the end walls and from the outer arm end laterally of
said axis, the stroke and cross portions of the outer arm
end including pairs of side walls extending parallel to
said axis, the radially outer wall including a step portion
extending between the end walls and centrally disposed
with respect to said axis, the radially outer face of the
step portion and the radially inner wall being parallel
to said axis, the remainder of the radially outer wall

convergently tapering from one end of the wall to the
other and having an area greater than the combined
areas of the cross portion inner wall, the stroke and
cross portion side walls and the aforesaid face of the
step portion.

13. The arm of claim 12 wherein the remainder of the
radially outer wall is also arcuately curved from each
side of the step portion to adjoin the respective cross
portion side walls.

14. The arm of claim 13 wherein the stroke side walls
also extend laterally from the arm to overhang one of
the end walls and are provided with a pair of opposite
grooves therein extending thereacross transversely of
said axis.

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