

DEMOLITION MACHINE AND ATTACHMENT

BACKGROUND

1. Field

The present disclosure relates to a demolition machine and an attachment used to demolish buildings or the like.

2. Description of Related Art

When using a demolition machine such as a giant breaker to demolish a building made of reinforced concrete, a chisel may be attached to a proximal end of an arm of the giant breaker. The demolition machine produces a great amount of noise when performing demolition work. Thus, there is a demand for a demolition machine that reduces noise. Japanese Laid-Open Patent Publication No. 2018-105044 describes a giant breaker including a supply unit located above the chisel, which is disposed on the proximal end of the arm, to supply foam that reduces noise. When demolition is performed with the chisel, the chisel is enveloped in the foam to reduce noise.

However, when the chisel is unevenly enveloped by the foam, it becomes difficult to consistently reduce noise.

SUMMARY

One aspect provides a demolition machine. The demolition machine includes a breaker attachment, and the breaker attachment includes a chisel and a side bracket. The demolition machine includes a foam formation tube configured to form foam from a solution, a foam ejector configured to supply the foam around the chisel, and a fastener that attaches the foam formation tube to the breaker attachment so that the foam formation tube extends in

a direction orthogonal to one plane of the side bracket. In this case, the orthogonal direction does not need to be a direction that forms an angle of 90 degrees relative to the one plane of the side bracket as long as the foam can be consistently formed from the solution. The orthogonal direction may be a direction that forms an angle in an angular range of plus/minus 15 degrees relative to the orthogonal direction.

With the present disclosure, noise generated during demolition work can be consistently reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view entirely showing a demolition machine in accordance with one embodiment.

Fig. 2 is a side view of a breaker attachment attached to a proximal end of an arm of the demolition machine of Fig. 1.

Fig. 3 is a perspective view of the attachment shown in Fig. 2 taken from the side of a chisel of the attachment.

Fig. 4 is a side view of a main part of the attachment shown in Fig. 2 taken from a rear side of the attachment.

Fig. 5 is a schematic diagram showing the relationship of a foam formation tube and pipes in the main part of the attachment shown in Fig. 2.

Fig. 6 is a diagram illustrating a demolition action of the demolition machine shown in Fig. 1 when the arm is extended and the chisel is tilted.

Fig. 7 is a diagram illustrating a demolition action of the demolition machine shown in Fig. 1 when the arm is retracted and the chisel is vertical.

Fig. 8 is a diagram illustrating the proximal end of the chisel partially enveloped in

foam.

Fig. 9 is a diagram illustrating the proximal end of the chisel entirely enveloped in foam.

DETAILED DESCRIPTION

One embodiment of a demolition machine and an attachment will now be described with reference to Figs. 1 to 9.

As shown in Fig. 1, a giant breaker 10 (hammer crusher) serving as a demolition machine in accordance with the present embodiment includes a base machine 11 and a breaker attachment 20. More specifically, the base machine 11 includes an undercarriage and an upper swing structure. The undercarriage includes crawlers 12, and the upper swing structure includes a cab 13 and a boom 14. The boom 14 has a proximal end to which an arm 15 is coupled. The arm 15 is rotatable about the proximal end of the boom 14 along a vertical plane. A breaker attachment 20 is attached to the proximal end of the arm 15. The cab 13 is located rearward from the breaker attachment 20.

As shown in Fig. 2, the breaker attachment 20 includes a hydraulic drive unit 21, a chisel 25, and a bracket. The hydraulic drive unit 21 is located toward the front of the breaker attachment 20, and the bracket holds the hydraulic drive unit 21 and the chisel 25. The chisel 25 is a rod-like component having a generally conical and sharp proximal end. The hydraulic drive unit 21 is box-shaped and includes a drive mechanism that moves the chisel 25 back and forth with hydraulic force in the extending direction (axial direction) of the chisel 25. The chisel 25 has a proximal end that projects out of the hydraulic drive unit 21.

The hydraulic drive unit 21 is attached to the proximal end of the arm 15 by two

side brackets 22 of the bracket. Each side bracket 22 is a generally triangular plate. The two side brackets 22 are fixed to the hydraulic drive unit 21 sandwiching the opposing side surfaces of the hydraulic drive unit 21 to support the hydraulic drive unit 21. A connecting portion 23 connects central parts of the two side brackets 22. The connecting portion 23, which connects the central parts of the two side brackets 22, keeps the distance constant between the two side brackets 22 to allow for attachment of the proximal end of the arm 15.

As shown in Fig. 3, the breaker attachment 20 includes a bracket cover 24 that covers the rear of the two side brackets 22. The bracket cover 24 includes a hole 24h.

As shown in Figs. 2 and 3, a foam ejector 26 is arranged on a lower surface of the hydraulic drive unit 21. The foam ejector 26 is ring-shaped and includes a central through hole. The foam ejector 26 is disposed so that the upper end of the chisel 25 is fitted in the central through hole with a clearance.

As shown in Fig. 2, the foam ejector 26 includes a foam passage 26s. The foam passage 26s includes a plurality of openings located around the through hole. Foam is ejected from the openings into the space between the foam ejector 26 and the chisel 25. The foam passage 26s of the foam ejector 26 has a rear side connected to one end of an L-shaped pipe 27. The L-shaped pipe 27 is covered by a box-shaped metal cover 28. The other end of the L-shaped pipe 27 is connected to a foam supply hose 37, which will be described later.

As shown in Fig. 4, a cylindrical foam formation tube 30 and a mixture chamber member 31 formed integrally with the foam formation tube 30 are fixed by fasteners, such as hose ties, to the connecting portion 23, which connects the side brackets 22 to each other. The foam formation tube 30 and the mixture chamber member 31 are fixed so as to extend in the longitudinal direction of the connecting portion 23.

The foam formation tube 30 and the mixture chamber member 31 are fixed to the connecting portion 23. Thus, the foam formation tube 30 and the mixture chamber member 31 are attached to the breaker attachment 20 so as to extend in a direction substantially orthogonal to the planes of the side brackets 22. The planes of the side brackets 22 that are included in the plate-like side brackets do not have to be vertical and may be slightly tilted (e.g., up to approximately 15 degrees) relative to the vertical direction. Further, the direction substantially orthogonal to the planes of the side brackets 22 includes directions within a range in which the conditions (speed and angle) of the flow of solution to the mixture chamber member 31 or the flow of foam from the foam formation tube 30 do not significantly change from a direction that is orthogonal to the planes of the side brackets 22, and therefore foam should form and flow in substantially the same manner.

As shown in Fig. 5, the foam formation tube 30 and the mixture chamber member 31 have a center axis C1, and the mixture chamber member 31 is located at the upstream side of the foam formation tube 30. The mixture chamber member 31 includes a solution supply port 31a at an upstream side with respect to the direction of the center axis C1.

The solution supply port 31a is connected by an L-shaped pipe 32 to one end of a solution supply hose 33. The other end of the solution supply hose 33 is connected to a solution tank (not shown) storing a foam solution.

In the present embodiment, the foam solution includes an anionic surfactant, which is mainly used as a base, and a foaming agent, which is used to form foam. The anionic surfactant may be, for example, a sulfonate such as alpha-olefin sulfonate, alpha-sulfo fatty acid methyl ester, or alkanesulfonate; a sulfate such as alkyl sulfate or alkyl ether sulfate; or a carboxylate such as a fatty acid salt or alkyl ether carboxylate.

The mixture chamber member 31 includes a downstream portion connected to an air

supply hose 34 that supplies the mixture chamber member 31 with compressed air from a compressor. A pressure relief valve 35 is disposed in the vicinity of a joint 31b of the air supply hose 34. The pressure relief valve 35 opens when the pressure of the air in the air supply hose 34 becomes a predetermined pressure or greater to release air out of the air supply hose 34 and lower the pressure.

Foam is formed inside the foam formation tube 30. The foam formation tube 30 is configured by a round pipe and steel wool. The steel wool is a porous material filling the round pipe.

The foam formation tube 30 includes a discharge port 30a at a downstream side with respect to the center axis C1 of the foam formation tube 30. In the present embodiment, the foam formation tube 30, the discharge port 30a, the mixture chamber member 31, and the solution supply port 31a are disposed along the center axis C1.

The discharge port 30a is connected by an L-shaped pipe 36 to the foam supply hose 37.

As shown in Figs. 2 to 4, the foam supply hose 37 is extended through the hole 24h of the bracket cover 24 and connected to the L-shaped pipe 27 inside the cover 28. The portion of the outer surface of the foam supply hose 37 exposed from the side brackets 22 is covered by a cushion member 38.

Demolition work performed with the giant breaker 10 will now be described with reference to Figs. 6 to 9.

The giant breaker 10 is arranged in the vicinity of a demolition subject such as reinforced concrete, and the proximal end of the chisel 25 is disposed above the demolition subject.

In this case, as shown in Fig. 6, when the giant breaker 10 is relatively far from the

demolition subject, the boom 14 and the arm 15 are manipulated to be extended. Further, if a demolition subject 50 has a tilted surface, the boom 14 and the arm 15 are manipulated to dispose the chisel 25 to be substantially orthogonal to the demolished surface.

Further, as shown in Fig. 7, when the giant breaker 10 is relatively close to the demolition subject 50, the boom 14 and the arm 15 are manipulated to be retracted. Further, if the demolished surface of the demolition subject 50 is horizontal, the boom 14 and the arm 15 are manipulated to dispose the chisel 25 to be substantially orthogonal to the demolished surface.

The foam formation tube 30 is supplied with solution from the foam solution tank, which supplies solution through the solution supply hose 33 and the mixture chamber member 31. Further, the compressor is operated to supply compressed air to the mixture chamber member 31 through the air supply hose 34. This supplies the foam formation tube 30 with the solution and compressed air mixed in the mixture chamber member 31 and forms foam in the foam formation tube 30. The foam formed in the foam formation tube 30 is supplied through the foam supply hose 37 and the L-shaped pipe 27 to the foam ejector 26. Then, the foam is supplied through the foam passage 26s of the foam ejector 26 to the periphery of the chisel 25.

In this case, as shown in Fig. 8, the supplied foam flows down along the peripheral surface of the chisel 25 from the upper end to the lower end. This forms a foam body fa1 that envelopes the chisel 25 from its upper portion.

Then, as shown in Fig. 9, continuous supply of the foam entirely envelopes the periphery of the chisel 25 with the foam body fa1. In the present embodiment, foam is emitted so that the foam covering the surface of the chisel 25 has a thickness of approximately 40 mm from the surface of the chisel 25. In this state, when a hydraulic

drive device is driven, the chisel 25, which is supported by the hydraulic drive unit 21, is moved back and forth in upper and lower directions at a predetermined speed to crush the surface of the demolition subject 50.

Operation

The foam formation tube 30 is attached to the connecting portion 23 of the breaker attachment 20 so as to extend in the longitudinal direction of the connecting portion 23. The foam formation tube 30, the discharge port 30a, the mixture chamber member 31, and the solution supply port 31a are disposed along the center axis C1. Thus, the foam formation tube 30 is disposed in a direction orthogonal to the planes of the side brackets 22.

Accordingly, as shown in Figs. 6 and 7, the foam formation tube 30, the discharge port 30a, the mixture chamber member 31, and the solution supply port 31a are held at a predetermined angle relative to the ground surface even if the breaker attachment 20 is tilted.

The present embodiment has the advantages described below.

(1) The foam formation tube 30 is disposed to extend in a direction substantially orthogonal to the planes of the side brackets 22. Thus, the positional relationship and angle of the foam formation tube 30 with respect to the ground surface does not change even if the boom 14, the arm 15, and the breaker attachment 20 of the giant breaker 10 are moved. Accordingly, the conditions under which the foam formation tube 30 forms foam and the conditions under which foam flows out of the foam formation tube 30 are always substantially the same. This allows for stable foam formation. Accordingly, the periphery of the chisel 25 is uniformly enveloped by the foam body fa1. This consistently reduces noise.

(2) The foam formation tube 30, the discharge port 30a, the mixture chamber member 31, and the solution supply port 31a are disposed along the center axis C1 of the

foam formation tube 30. This allows the foam formation tube 30 to be supplied with liquid under substantially the same conditions regardless of the tilt of the boom 14, the arm 15, and the breaker attachment 20. Thus, foam is stably formed and supplied to the foam ejector 26.

(3) The foam formation tube 30 is attached to the connecting portion 23 so as to extend along the connecting portion 23. Thus, the foam formation tube 30 can be effectively disposed in the direction substantially orthogonal to the planes of the side brackets 22.

(4) The foam formation tube 30 and the mixture chamber member 31 are located between the two side brackets 22. Thus, the foam formation tube 30 and the mixture chamber member 31 are protected by the side brackets 22. Further, in the present embodiment, the discharge port 30a of the foam formation tube 30 is connected by the L-shaped pipe 36 to the foam supply hose 37. Thus, the foam supply hose 37 extends at a right angle from the foam formation tube 30 located in the narrow space between the two side brackets 22. This allows foam to be smoothly supplied to the foam ejector 26 without constricting the passage through which foam flows.

(5) The pressure relief valve 35 is disposed on the air supply hose 34 in the vicinity of the joint 31b at the upstream side of the foam formation tube 30. This prevents the pressure of the air in the air supply hose 34 from becoming higher than the predetermined pressure.

(6) The L-shaped pipe 27 disposed in the foam ejector 26 is covered by the box-shaped cover 28. Further, the portion of the foam supply hose 37 exposed from the side brackets 22 is covered by the cushion member 38. This protects the foam-supplying portion exposed from the brackets of the breaker attachment 20. Thus, damages to the foam-supplying portion are reduced that would otherwise be inflicted by debris flying from

the demolition subject 50 striking the foam-supplying portion.

The present embodiment may be modified as described below. The above embodiment and the modified examples described below may be combined as long as there is no technical contradiction.

In the above embodiment, the foam formation tube 30 is configured by a round pipe and steel wool, with which the round pipe is filled. Instead, for example, the pipe of a foam formation tube may be filled with a sponge, beads, or the like. Further, the pipe may have a square cross-section.

In the above embodiment, the foam formation tube 30 is fixed to the connecting portion 23 of the breaker attachment 20. However, the foam formation tube 30 does not have to be fixed to the connecting portion 23. For example, the foam formation tube 30 may be fixed to the boom 14 or the arm 15.

In the above embodiment, the breaker attachment 20 has the bracket including the two side brackets 22, the connecting portion 23, and the bracket cover 24. However, the configuration and shape of the breaker attachment are not limited in such a manner. For example, the bracket cover can be omitted from the breaker attachment.

In the above embodiment, the breaker attachment 20 includes the chisel 25 that has a generally conical and sharp proximal end. Instead, the chisel 25 may have the shape of, for example, a scraper or any other shape as long as it can be used for demolition.

The above embodiment uses a breaker, which crushes by hammering, as a hammering tool. In a demolition machine (construction machine) including other hammering tools (demolition tools), demolition work can be performed in a state in which a noise generation source is covered by the foam body fa1.

In the above embodiment, the demolition subject 50 is reinforced concrete.

However, the demolition subject 50 is not limited to reinforced concrete and may be another material, for example, steel-frame structure or the like.

A technical concept that can be recognized from the above embodiment and modified examples will now be described.

(a) The demolition machine according to claim 1 or 2, further comprising:

a solution supply port through which the solution is supplied to the foam formation tube;

a discharge port from which the foam is discharged out of the foam formation tube, wherein the solution supply port and the discharge port are opposed in a longitudinal direction of the foam formation tube; and

an air supply port disposed at an upstream side of the foam formation tube to supply air to the solution.

Description of Reference Characters

C1) center axis; fa1) foam body; 10) giant breaker; 11) base machine; 12) crawler; 13) cab; 14) boom; 15) arm; 20) breaker attachment; 21) hydraulic drive unit; 22) side bracket; 23) connecting portion; 24) bracket cover; 24h) hole; 25) chisel; 26) foam ejector; 26s) foam passage; 27, 32, 36) L-shaped pipe; 28) cover; 30) foam formation tube; 30a) discharge port; 31) mixture chamber member; 31a) solution supply port; 31b) connecting portion; 33) solution supply hose; 34) air supply hose; 35) pressure relief valve; 37) foam supply hose; 38) cushion member; 50) demolition subject

CLAIMS

1. A demolition machine including a breaker attachment, wherein the breaker attachment includes a chisel and a side bracket, the demolition machine comprising:
a foam formation tube configured to form foam from a solution,
a foam ejector configured to supply the foam around the chisel, and
a fastener that attaches the foam formation tube to the breaker attachment so that the foam formation tube extends in a direction orthogonal to one plane of the side bracket.

2. The demolition machine according to claim 1, wherein
the side bracket is a first side bracket,
the breaker attachment further includes a second side bracket, and
the foam formation tube is located between the first side bracket and the second side bracket.

3. An attachment disposed on a proximal end of an arm of a demolition machine, the attachment comprising:
a chisel;
a side bracket;
a foam formation tube configured to form foam from a solution,
a foam ejector configured to supply the foam around the chisel, and
a fastener that attaches the foam formation tube to the attachment so that the foam formation tube extends in a direction orthogonal to one plane of the side bracket.