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(54) Crusher

(57) An apparatus for crushing reinforced concrete elements and separating the crushed concrete from the reinforcements, the apparatus comprising a crusher for crushing the reinforced concrete elements into crushed concrete and reinforcements, the crusher (3) having at least two jaws (4,5), which jaws define the outlet (7) for discharging the crushed concrete and reinforcements, and being such that the trajectory of the crushed concrete and reinforcements on discharge is at an angle to the vertical, and a chute (13) for receiving the discharged reinforcements, the chute (13) being laterally spaced apart from the outlet (7).

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Description

[0001] The present invention relates to an apparatus and a method for crushing reinforced concrete elements, and separating the crushed concrete from the reinforcements.

[0002] With the increasing cost of new aggregates, and of disposal of scrap concrete, many countries, including the UK, are encouraging the use of recycled concrete. A large proportion of the scrap concrete available for recycling arises in the form of reinforced concrete elements.

[0003] In order to reclaim the concrete from a reinforced concrete element, it is first necessary to crush the reinforced concrete element to dislodge the concrete from the reinforcement, and then to separate the crushed concrete from the reinforcement.

[0004] A known apparatus uses magnets to separate reinforcements from crushed concrete. However, magnets do not always provide an effective method of separation. Magnetic separation will not be effective where the reinforcement is made of a non-magnetic material, for example, stainless steel. In fact, magnetic separation may not be effective even where the reinforcement is made of a magnetic material. For example, it is common practice to attach the reinforcement to spacers made of plastics material to maintain the position of the reinforcement inside the concrete. These spacers are non-magnetic, and can hold the reinforcement sufficiently far away from the magnet for its flux to be insufficient to detect and separate the reinforcement.

[0005] Other problems with the known apparatus are its extreme size and weight, which mean that the apparatus cannot be easily transported to and from the operating site, and its complexity.

[0006] It is therefore an object of the present invention to provide an improved apparatus and method for separating crushed concrete from reinforcements.

[0007] It is possible to crush reinforced concrete elements using a conventional crusher of the jaw or impact type. However, reinforced concrete elements are typically found in the form of piles, beams, posts, slats, struts or planks. With conventional crushers, the length of such elements results in problems in feeding the elements to the crusher, and in containing the reinforcements. This causes producers either not to attempt to recycle such items, or to use inefficient methods to render the items down to manageable lengths, for example, dropping a ball on them from a crane, or running over them with tracked plant, and then manually cutting the resulting exposed reinforcements, all prior to the actual reclamation.

[0008] Moreover, with conventional impact crushers of the hammer mill type, the reinforcements are a safety hazard as they readily tangle with the moving parts of such crushers.

[0009] It is therefore an object of the present invention, at least in its preferred embodiments, to provide an improved apparatus and method for crushing reinforced concrete elements.

[0010] The present invention provides an apparatus for crushing reinforced concrete elements and separating the crushed concrete from the reinforcements, the apparatus comprising a crusher for crushing the reinforced concrete elements into crushed concrete and reinforcements, the crusher having at least two jaws, which jaws define the outlet for discharging the crushed concrete and reinforcements, and being such that the trajectory of the crushed concrete and reinforcements on discharge is at an angle to the vertical, and a chute for receiving the discharged reinforcements, the chute being laterally spaced apart from the outlet.

[0011] In operation, reinforced concrete elements are fed between the jaws of the crusher. The jaws crush the reinforced concrete elements into crushed concrete and reinforcements. The crushed concrete and reinforcements are discharged at a trajectory at an angle to the vertical. The discharged crushed concrete falls through the gap between the laterally spaced apart chute and outlet. However, the discharged reinforcements are too large to fall through that gap, and so continue to follow their discharge trajectory until they are caught by the discharge chute. Thus, the crushed concrete is separated from the reinforcements.

[0012] The jaws of the crusher may both or all be moving jaws. However, preferably, the crusher comprises a fixed jaw and a moving jaw, the fixed jaw being disposed at an angle to the vertical. More accurate control of the discharge of the crushed concrete and reinforcements is then possible.

[0013] Although some degree of separation will be possible as long as the discharge trajectory of the crushed concrete and reinforcements is at an angle to the vertical, for satisfactory separation, the discharge trajectory is preferably considerably angled to the vertical. Accordingly, preferably, the fixed jaw is disposed at an angle of at least 20° to the vertical, more preferably, at least 30° to the vertical.

[0014] However, if the angle to the vertical is too great, the speed at which the reinforced concrete elements are processed will decrease. Accordingly, preferably, said jaw is, in use, disposed at an angle of not more than 45° to the vertical.

[0015] Preferably, the apparatus comprises a frame having a platform which is disposed at an angle to the vertical, and the crusher is mounted on the platform. Such an arrangement allows the use of an unmodified conventional jaw crusher, with its jaws in their normal fixing.

[0016] The fixed jaw may be positioned above or below the moving jaw, the latter location facilitating feeding, since it may result in a lower feed position. Expediently, the chute is disposed at approximately the same angle to the vertical as the jaw which is disposed at the greater angle to the vertical.

[0017] Such an arrangement results in a smooth

transfer of the reinforcements from the crusher to the chute.

[0018] Optimally, the lateral spacing between the chute and the outlet needs to be such that all of the crushed concrete falls through the resulting gap, but none of the reinforcements so fall. The optimum size of the gap will vary for different apparatus and operating conditions. Accordingly, preferably, the lateral spacing of the chute and the outlet is adjustable.

[0019] Advantageously, one or more suspended curtains is or are positioned between the outlet and the chute.

[0020] Advantageously, the or each curtain comprises a horizontal support rod, from which are vertically suspended a plurality of rods each of which forms a core on which is rotatably mounted a tube. In operation, as the mixture of reinforcements and crushed concrete leaves the outlet, the concrete is restrained by the curtain or curtains but a reinforcement is able to displace the tubes and pass between them.

[0021] Preferably, the apparatus comprises means for feeding reinforced concrete elements to the crusher, the feed means being movable from a horizontal position to an elevated position in which the feed means is disposed at an angle to the vertical. The feed means may then be loaded with reinforced concrete elements in the horizontal position, and subsequently moved to an elevated position in which the reinforced concrete elements slide into the crusher under gravity at an angle to suit the angle of feed of the crusher. Advantageously, the feed means is pivotally movable.

[0022] Preferably, the feed means comprises means to retain the reinforced concrete elements on the feed means during loading of the reinforced concrete elements on to the feed means, and during feeding of the reinforced concrete elements to the crusher. The retaining means allows the reinforced concrete elements to be loaded on to the feed means by a fork lift truck without the use of any external lifting slings or suspensions, for example chains. Indeed, this feeding method allows loading to take place without any further manual intervention at all.

[0023] Preferably, there is provided means for loading the apparatus onto and unloading the apparatus from a delivery vehicle. The apparatus may then be transported between operating sites, and may be loaded and unloaded, without requiring either a specially modified delivery vehicle or any external lifting equipment.

[0024] Preferably, the loading and unloading means comprises means for supporting the apparatus, and means for lifting the supported apparatus from the delivery vehicle, allowing the delivery vehicle to drive away. Advantageously, the supporting means is also the lifting means. Expediently, the lifting and supporting means comprises a plurality of extensible legs, which, when partially extended, support the apparatus, and then extend further to lift the apparatus from the delivery vehicle.

[0025] Preferably, the loading and unloading means is hydraulically operated. Advantageously, the feed means and the loading and unloading means are hydraulically operated.

[0026] Preferably, the crusher, the feed means, and the loading and unloading means are operated by a single power and control system.

[0027] The present invention further provides a method of crushing reinforced concrete elements, and separating the crushed concrete from the reinforcements, the method comprising feeding reinforced concrete elements to a crusher, the crusher having at least two jaws, which jaws define the outlet for discharging the crushed concrete and reinforcements, and being such that the trajectory of the crushed concrete and reinforcements on discharge is at an angle to the vertical, and collecting the discharged reinforcements on a chute which is sufficiently laterally spaced apart from the outlet to catch the reinforcements, but not the crushed concrete.

[0028] By way of example only, an embodiment of the invention will now be described in greater detail with reference to the accompanying drawings, of which:

Fig. 1 shows a side view of an apparatus according to the invention;
Fig. 2 shows an end view of the apparatus of Fig. 1; and
Fig. 3 shows a plan view of the apparatus of Fig. 1.

[0029] The apparatus comprises a frame 1 comprising a platform 2 angled at 30° to the horizontal. On the platform 2 is mounted a single-toggle jaw crusher 3 having two jaws, a moving jaw 4 and a fixed jaw 5. The two jaws 4,5 define an inlet 6 for receiving reinforced concrete elements and an outlet 7 for discharging the crushed concrete and the reinforcements. Because the platform 2 is angled at 30° to the horizontal, the jaws 4, 5 of the crusher 3 are angled at 30° to their normal fixing. The crusher 3 shown has the fixed jaw 5 uppermost. It is also possible to use a crusher having the fixed jaw lowermost.

[0030] Also mounted on the frame 1 is a pivotable feed trough 8 having a number of retaining pegs 9. The feed trough 8 is shown (in full lines) in a horizontal position in which reinforced concrete elements are loaded onto the trough 8, and is also shown (in broken lines) in an elevated position in which reinforced concrete elements are fed to the jaws 4,5 of the crusher 3. Two reinforced concrete elements 10 are shown positioned in the elevated feed trough 8, ready for feeding to the crusher 3. The apparatus is provided with a top structure and ladder 11 to allow access to the feed trough 8. The top structure and ladder 11 are removable to facilitate transportation between locations.

[0031] The apparatus further comprises two discharge chutes 12, 13, one 12 for receiving crushed concrete, and the other 13 for receiving reinforcements. A

reinforcement 14 is shown positioned on the reinforcement chute 13. The crushed concrete chute 12 is positioned immediately below the crusher outlet 7. The reinforcement chute 13 is positioned slightly to the side of the crusher outlet 7, and is positioned at an angle to the vertical similar to that of the moving jaw 4. The reinforcement chute 13 is so arranged as to collect material exiting the crusher 3 at about the angle of the moving jaw 4, whilst allowing crushed concrete to drop vertically into the crushed concrete chute 12 below. The lateral spacing between the reinforcement chute 13, and the crusher outlet 7 is sufficient to allow the passage of crushed concrete having a particle size of 50mm or less. Beneath the crushed concrete chute 12 is a conveyor 15 to carry away the crushed concrete.

[0032] The reinforced concrete elements are loaded on to the feed trough 8 in its horizontal position from the side using a conventional fork lift truck. The reinforced concrete elements are picked up by the truck, and then raised above the level of the retaining pegs 9. The truck is then driven towards the trough 8, and the reinforced concrete elements lowered towards the trough 8, with the forks of the truck spaced. The truck then reverses and the reinforced concrete elements, retained by the retaining pegs 9, slide off the ends of the forks into the trough 8.

[0033] The feed trough 8 is then raised until it is at an angle to suit the angle of feed of the crusher 3. The action of raising the trough 8 causes the reinforced concrete elements to slide into the crusher 3 under gravity continuing as fast as the crusher 3 is able to receive them.

[0034] The crusher 3 breaks up the concrete, separates it from the reinforcements, and then further crushes the dislodged concrete. The crushed concrete and reinforcements slide along the moving jaw 4 and are discharged from the crusher outlet 7. The crushed concrete is sufficiently small to fall through the gap between the reinforcement chute 13 and the crusher outlet 7 into the crushed concrete chute 12, but the reinforcements are too large to fall through that gap, and so follow the line of the moving jaw 4 on to the reinforcement chute 13. A suspended curtain (not shown) may be included between the crusher outlet 7 and the reinforcement chute 13. The reinforcements are able to pass through the curtain, and continue onto the reinforcement chute 13, but the crushed concrete is not able to pass through the curtain, and so is forced to fall through the gap. The crushed concrete is carried away by the conveyor 15 for screening, or further reduction by another crusher.

[0035] The apparatus of the described embodiment is shown mounted on a delivery vehicle 16, so that it can be readily transported between operating sites. The apparatus is loaded on to and unloaded from the delivery vehicle 16 by means of four hydraulically extensible jack legs 17. The jack legs 17 are powered by a hydraulic power pack 18 which in turn may be powered by mains electricity or by a motor powered by a generator. The hydraulic power pack 18 is operated from a control console 19. The feed trough 8 is also powered by the hydraulic power pack 18, and operated from the control console 19.

[0036] The apparatus is driven to the operating site with the jack legs 17 in their raised position. Once the operating site has been reached, a sleeper 20 is placed beneath each of the jack legs 17, and the jack legs 17 are hydraulically extended until they rest on the sleepers 20. The jack legs 17 are then further extended until they lift the apparatus clear of the delivery vehicle 16. The delivery vehicle 16 may then be driven away, leaving the apparatus levelly positioned at the operating site. The apparatus is loaded back on to the delivery vehicle by means of the reverse procedure.

[0037] Although the described embodiment uses a single-toggle jaw crusher, it will be appreciated that any type of jaw crusher may be used.

Claims

1. An apparatus for crushing reinforced concrete elements and separating the crushed concrete from the reinforcements, the apparatus comprising a crusher for crushing the reinforced concrete elements into crushed concrete and reinforcements, the crusher having at least two jaws, which jaws define the outlet for discharging the crushed concrete and reinforcements, and being such that the trajectories of the crushed concrete and reinforcements on discharge are angled to the vertical, and a chute for receiving the discharged reinforcements, the chute being laterally spaced apart from the outlet.

2. An apparatus as claimed in claim 1, wherein the crusher comprises a fixed jaw and a moving jaw, the fixed jaw being disposed at an angle, advantageously at least 20° and preferably at least 30°, to the vertical.

3. An apparatus as claimed in claim 2, wherein the fixed jaw is disposed at an angle of not more than 45° to the vertical.

4. An apparatus as claimed in claim 2 or claim 3, wherein the apparatus comprises a frame having a platform which is disposed at an angle to the vertical, and the crusher is mounted on the platform.

5. An apparatus as claimed in any one of claims 2 to 4, wherein the fixed jaw is positioned above the moving jaw.

6. An apparatus as claimed in any one of claims 2 to 4, wherein the moving jaw is positioned above the fixed jaw.

7. An apparatus as claimed in any previous claim, wherein the lateral spacing of the chute and the outlet is adjustable.

8. An apparatus as claimed in any previous claim, the apparatus comprising means for feeding reinforced concrete elements to the crusher, the feed means being movable, advantageously pivotally movable, from a horizontal position to an elevated position in which the feed means is disposed at an angle to the vertical.

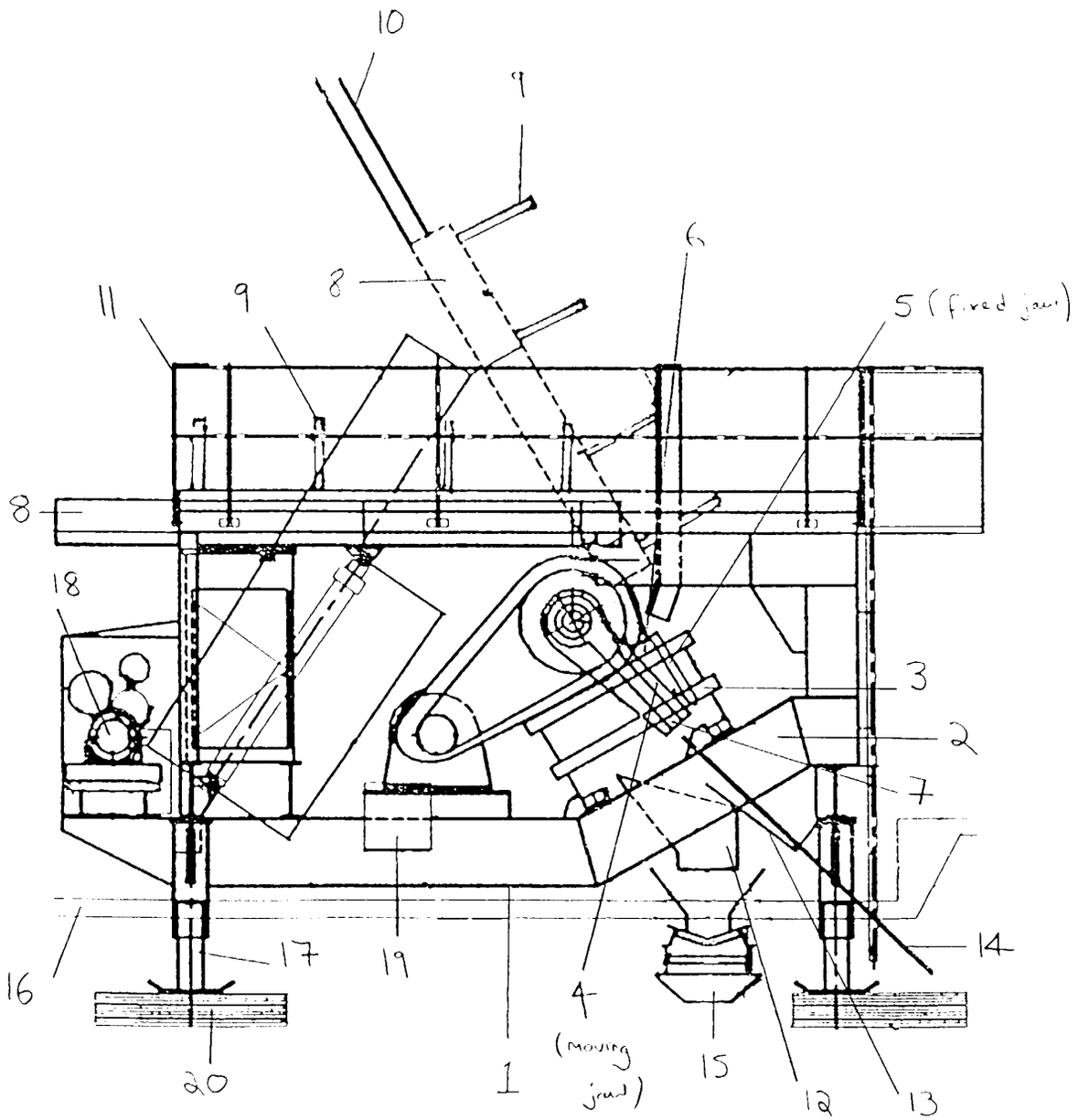
9. An apparatus as claimed in any previous claim, provided with means for loading it on to and unloading it from a delivery vehicle, the means advantageously comprising means for supporting the apparatus, and means for lifting the supported apparatus from the delivery vehicle, allowing the delivery vehicle to drive away, the supporting means advantageously also being the lifting means.

10. An apparatus as claimed in any previous claim, wherein the crusher and, if present, the feed means and the loading and unloading means are operated by a single power and control system, each advantageously being hydraulically operated.

11. An apparatus as claimed in any preceding claim, comprising a curtain located between the outlet and the chute.

12. A method of crushing reinforced concrete elements, and separating the crushed concrete from the reinforcements, the method comprising feeding reinforced concrete elements to a crusher, the crusher having at least two jaws, which jaws define the outlet for discharging the crushed concrete and reinforcements, and being such that the trajectories of the crushed concrete and reinforcements on discharge are angled to the vertical, and collecting the discharged reinforcements on a chute which is sufficiently laterally spaced apart from the outlet to catch the reinforcements, but not the crushed concrete.

FIG. 1


10
9
8
6
11
9
5 (fixed jaw)
8
18
3
2
7
14
16
17
19
4
(moving jaw)
15
12
13
20
1

FIG·2

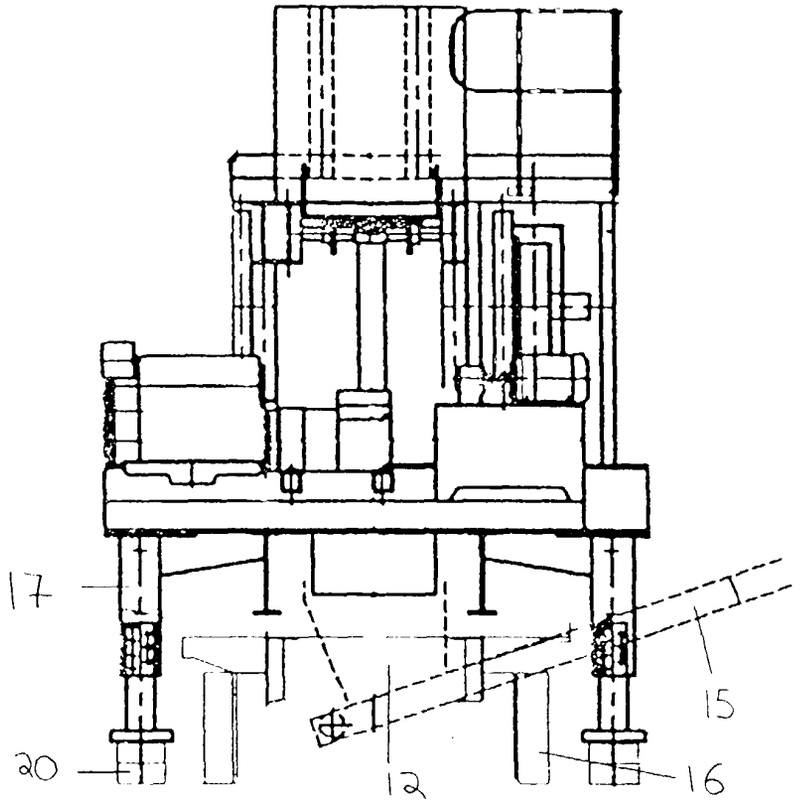


FIG. 3