

Hydraulic Excavator

The present invention relates to an excavator, particularly to a mini-size universal hydraulic excavator suitable for narrow sites and small work load.

For some engineering projects, such as laying cables or pipelines, it is necessary first to dig a trench, then to lay the cable or pipeline and finally to backfill the trench; when meeting with hard objects, it is necessary to break them. In order to mechanically perform various works for these projects, many kinds of machine, such as excavators, bulldozers and chippers can be employed to operate in coordination. This is very uneconomical in the cases of a narrow site and/or small workload, even resulting in incapability of realization of full mechanisation of operation. Though some of the conventional excavators are provided with excavating, earth moving and chipping means, yet none of them can do the excavating and the chipping work simultaneously, and moreover, it is necessary first to remove the bucket and then to replace it with a chipper. This is very troublesome. It will be much more troublesome, if on some occasions, it is required that chipping and clearing away the chipped fragments be done simultaneously, as in that case, if only one single machine is to be employed, there are bound to be frequent replacements in turn of bucket and hydraulic chipper. Besides, on some occasions it is necessary to dig up clay which is subject to adhere to the bucket not easily to be cleared away. This is apt to reduce the effective capacity of the bucket and prolong the unloading time. To solve this problem, the conventional way is to employ a bucket carrying a scraper, as shown in Fig. 3. But as a simple device of four-bar linkage mechanism is employed, the scraper can substantially make

translational movements of small range and the movement of the scraper relative to the bucket almost entirely depends on the revolving movement of the bucket. The effective revolving angle of excavation is relatively small, which lowers the adaptability of the excavating process, and prolongs the time for adjusting the position of the excavating arm relative to the main machine during the operation process, the result still being unsatisfactory.

Consequently, the object of the present invention is to provide a multi-functional mini-size universal hydraulic excavator which can perform chipping and digging simultaneously in a narrow site and is able to conveniently and effectively cope with clay and hard objects.

The excavator proposed by this present invention includes those excavators which are equipped simultaneously with earth moving means, backhoe means and hand-held hydraulic chipper, and also those excavators, some parts of which are replaceable with grab bucket, ditch cleaning bucket, hydraulic chipper, V-type bucket and drilling tools, etc., useful for digging and cleaning ditches, crushing concrete or stones and drilling soil, etc. Said excavator is characterised in that it comprises simultaneously three operating attachments for earth moving, digging and chipping and is able to carry on digging and chipping at the same time. The scraping means it employs not only ensures a high efficiency of scraping off the earth, but chiefly makes the bucket have sufficient bucket capacity in a greater range of revolving angle for excavation to carry on the digging process as well. Besides, the specially-set oil line including the quick-change joint for the accessory operating equipments can conveniently drive any other hydraulic operating equipments.

According to the present invention there is provided a hydraulic excavator comprising a chassis assembly including travelling devices and a vehicle frame, earth moving means pivotally connected to the chassis assembly, an upper carriage assembly, which upper carriage assembly is retained on the chassis assembly by means of a supporting means which allows rotation of the carriage assembly with regard to the chassis assembly, said upper carriage assembly comprising a main hydraulic system, a supporting frame for multi-way valves, a power generator, a control mechanism and electrical system and an excavating arm pivotally connected to the carriage assembly, said excavating arm including a joint holder, a boom, a bucket arm and driving oil cylinders, the excavator further comprising implements mounted on said excavating arm such as an excavating bucket or drilling tools wherein the excavator is provided with a further oil line which operates accessory equipment and which communicates with the main hydraulic system, and quick receptacle means comprising a quick change joint and a receptacle communicating with the main hydraulic system for connecting therewith a hand-held hydraulic chipper and wherein digging and chipping processes may be carried out simultaneously.

In a first embodiment of the invention, the hand-held hydraulic chipper is connected with the excavator without removal of the implements or earth moving means.

In a second embodiment of the invention the hand-held hydraulic chipper is connected with the main hydraulic system by means of the receptacle means and the further oil line.

In a third embodiment of the invention the hand-held hydraulic chipper is connected with the main hydraulic system by means of the receptacle means and

preset ports of the main hydraulic system.

In a fourth embodiment of the invention the receptacle means further comprises a pressure controller, a temperature controller or a warning
5 device.

In another embodiment of the invention the bucket comprises a bucket body and an internal scraper means, each driven by the same oil cylinder, which scraper means moves in the same direction as and more slowly
10 than the bucket body.

In yet another embodiment of the invention the bucket body and the internal scraper are connected to the driving oil cylinder by means of a six-bar linkage mechanism, which mechanism comprises a connecting plate
15 attached to the driving oil cylinder and to a swing bar by means of a first pivot, attached to the bucket body by means of a second pivot and attached to a connecting rod by means of a third pivot, the swing bar being
pivotally connected to the bucket arm and the
20 connecting rod being pivotally connected to the internal scraper.

In still another embodiment of the invention the bucket body and the internal scraper are connected to the driving cylinder by means of a five-bar linkage
25 mechanism, which mechanism comprises a connecting plate attached to the driving oil cylinder and to a swing bar by means of a first pivot, attached to the bucket body by means of a second pivot and attached to the internal scraper by means of a third pivot, the swing bar being
30 pivotally connected to the bucket arm, wherein the third pivot also executes translational motion, substantially parallel to the internal scraper and perpendicular to the axes of rotation about the pivots.

In yet a further embodiment of the invention there is also provided a hydraulic excavator comprising a chassis assembly including travelling devices and a vehicle frame, earth moving means pivotally connected to the chassis assembly, an upper carriage assembly, which upper carriage assembly is retained on the chassis assembly by means of a supporting means which allows rotation of the carriage assembly with regard to the chassis assembly, said upper carriage assembly comprising a main hydraulic system, a supporting frame for multi-way valves, a power generator, a control mechanism and electrical system and an excavating arm pivotally connected to the carriage assembly, said excavating arm including a joint holder, a boom, a bucket arm and an excavating bucket which bucket comprises a bucket body, an internal scraper means and a multi-bar linkage mechanism, each driven by the same oil cylinder, which scraper means moves in the same direction as and more slowly than the bucket body.

For the excavator according to the present invention, the hand-held hydraulic chipper can be connected with the oil lines of the main machine by means of the driving oil tube and receptacle means without removal of the bucket or the earth moving means; the connection point might be the accessory operating equipments oil line, or it might also be the pre-set receptacle of the main hydraulic system.

In the excavator according to the present invention, said receptacle means might be at least a quick-change joint and a receptacle or it might be a combination of a quick-change joint and a receptacle, a pressure controller, a temperature controller or a warning device. Said bucket with multi-bar linkage mechanism might be a five-bar or six-bar linkage mechanism including a bucket body, a scraper and a bucket arm.

The following is a description, given purely by way of example, of the preferred embodiment of the present invention with reference to the accompanying drawings, in which:

5 Fig. 1 is a side view of the present invention,

 Fig. 2 is a schematic diagram of the hydraulic system according to the present invention,

 Fig. 3 is a diagrammatic drawing of a conventional backhoe bucket with a scraper,

10 Fig. 4 is a diagrammatic drawing of a backhoe bucket with a scraper according to the present invention,

 Fig. 5 is a diagrammatic drawing of the excavator according to the present invention operating at moving
15 earth for backfill along a wallside,

 Fig. 6 is a diagrammatic drawing of the excavator according to the present invention operating at digging along a wallside and a hand-held hydraulic chipper,

 Fig. 7 is a diagrammatic drawing of an alternative
20 embodiment of a backhoe bucket with a scraper according to the present invention.

 As shown in Fig. 1, and excavator according to the present invention comprises a chassis assembly employing crawler travelling devices and an upper
25 carriage assembly mounted on the chassis by means of a swivel support 14, the upper carriage assembly being swivellable completely or 360 degrees; on the upper carriage are mounted a joint holder 1, a boom 9 and bucket arm 7, forming an excavating arm capable of
30 marking independent horizontally arcuate motion, the joint holder 1 being pivotally connected to the swivel carriage 18 at pivot C, the boom 9 being pivotally connected to the joint holder 1 at pivot B and the bucket arm 7 being pivotally connected to the boom 9 at
35 pivot A. The ends of the hydraulic cylinder 8 are pivotally connected to the boom 9 and the bucket arm 7

respectively, the bucket arm 7 driven by the hydraulic cylinder 8 being made to be pivotable on the horizontal pivot axis A; the ends of the hydraulic cylinder 2 are pivotally connected to the joint holder 1 and the boom 9 respectively, the boom 9 driven by the hydraulic cylinder 2 being made to be pivotable up and down on the horizontal pivot axis B located in the joint holder 1; the ends of the hydraulic cylinder 31 (see Fig. 6) are pivotally connected to the swivel carriage 18 and the joint holder 1 respectively, the joint holder 1 driven by the hydraulic cylinder 31 being made to cause the excavating arm to be pivotable horizontally within a small range, on the pivot axis C located at the front end of the upper carriage; a backhoe bucket 3 with a multi-bar linkage mechanism is mounted on the outer end of the excavating arm to form an excavating assembly; an oil cylinder 6 is pivotally connected at one end to the bucket arm 7 and at the other end to the multi-bar linkage mechanism, the pivotal joint being not on the bucket arm 7 or the bucket 3. Driven by the oil cylinder 6, the bucket 3 is made to revolve relative to the bucket arm 7 within a plane defined by the excavating arm. In consideration of the different requirements of various working operations, the bucket 3 might be a standard backhoe bucket, or it might be replaced with a backhoe carrying a scraper, a ditch cleaning bucket or a V-type bucket, or it might also be replaced by means of connection means with such accessory tools as a grab bucket, a hydraulic chipper and a drill. Through operating the control elements of the hydraulic system and adjusting the excavating arm to a suitable position, it is ready to begin the excavating work. When the excavator is excavating along a wall side and is inconvenient to swivel completely to unload, the operator can conveniently carry on the excavating and unloading by means of the

independent small-range swing motion of the excavating arm, as shown in Fig. 6. The main part of Fig. 6 is a top diagrammatic view of an excavator doing excavating work along a wallside, the part encircled by the wavy line being a front diagrammatic view of hand-held hydraulic chipper in operation and a schematic functional view of the receptacle means.

The material dug out can be directly unloaded into vehicles for removal. If it only needs piling, levelling, backfilling or short-distance transportation, the earth-moving means of the excavator according to the present invention can be used. The earth-moving means comprises essentially an earth-moving spade 16 pivotally connected to the chassis and an earth-moving oil cylinder 30 (Fig. 2) pivotally connected at both ends to the chassis and the earth-moving spade respectively. Driven by the earth-moving oil cylinder 30, the earth-moving spade is made to be raised or lowered relative to the chassis. By operating the control unit of the hydraulic driving system to set the earth moving spade at an appropriate position, the main machine body is moved to carry out earth moving processes when it is required to backfill a trench along a wallside, in order to reach the operating site more closely the carriage 18 can be made to turn 90° (or 270°), to carry on the earth moving process in a state perpendicular to the length of the chassis, as shown in Fig. 5.

In the operation of digging clay, a backhoe bucket carrying a scraper should be used. The backhoe device carrying a scraper according to the present invention is comprised of a multi-bar linkage mechanism not less than five-bars including the bucket itself and the scraper. It ensures not only a satisfactory efficiency of scraping off the earth, but chiefly makes the bucket have sufficient bucket capacity in a greater range of

revolving angle for excavation to carry on the digging process as well. Fig. 4 shows a preferred embodiment of the backhoe bucket carrying a scraper according to the present invention. The bottom surface of the

5 bucket is of circular arcuate shape and the back wall is a movable scraper 42. A bucket body 43, a scraper 42, a connecting rod 41, a swing bar 5, a bucket arm 7 and a connecting plate 40 altogether constitute a six-bar linkage mechanism. In reality, it can be broken

10 down into two four-bar linkage mechanism, in which the bucket body 43 is connected with the excavating arm by means of a pivotally connected four-bar linkage mechanism comprised of the bucket body itself together with the bucket arm 7, the swing bar 5 and the

15 connecting plate 40; the scraper 42 with the bucket body 43, the connecting plate 40 and the connecting rod 41 also form a pivotally connected four-bar linkage mechanism. These two four-bar linkage mechanisms move

20 in coordination under the driving action of the oil cylinder 6, that is, with the revolving of the bucket body 43 about the pivot axis D, the scraper 42 also revolves in the same direction about the pivot axis E. However, regardless of whether it revolves forward or backward, the revolving speed of the scraper 42 is a

25 fixed amount less than the revolving speed of the bucket body 43. In other words, through the excavating process, with the forward revolvment of the bucket body 43, the scraper 42 would revolve backward relative to the bucket body 43 at a definite speed, enlarging

30 the effective capacity of the bucket and thus achieving the goal of loading more. In the unloading process, with the backward revolvment of the bucket body 43, the scraper 42 would revolve forward relative to the bucket body 43 at a definite speed, gradually reducing

35 the effective capacity of the bucket, thus performing the task of unloading. This makes the bucket have

sufficient bucket capacity in a greater revolving angle range to carry on digging. This enhances the adaptability of the bucket to the excavating position and reduces the operation adjusting time for the bucket so that the working efficiency is improved.

The backhoe bucket carrying a scraper can be brought about not only by means of a six-bar linkage mechanism described in the aforementioned embodiment, but by means of a five bar linkage mechanism as well. Fig. 7 shows another embodiment of the backhoe bucket carrying a scraper according to the present invention. The bottom surface of the bucket presents a circular arcuate shape and its backwall is a movable scraper 42. A bucket body 43, a scraper 42, a swing bar 5, a bucket arm 7 and a connecting plate 40 jointly constitute a five-bar linkage mechanism. This five-bar linkage mechanism can be broken down into a four-bar linkage mechanism and a crank connecting link slide mechanism, in which the pivotally connected four-bar linkage mechanism comprised of the bucket body 43, the bucket arm 7, the swing bar 5 and the connecting plate 40 is connected with the excavating arm, while the scraper 42, the connecting plate 40 and the bucket body 43 form a crank connecting link slide mechanism. The five-bar linkage mechanism comprised of these two mechanisms operates coordinately under the driving action of the oil cylinder 6, that is, with the movement of the bucket about the pivot axis D, the scraper 42 revolves in the same direction also about the pivot axis D. The effectiveness it produced is substantially the same as what the above-mentioned six-bar linkage mechanism produces.

Fig. 6 shows an embodiment of the use of the hand-held chipper according to the present invention. If hard objects such as stones or concrete blocks are encountered during the excavating process, the

excavating operation will be forced to stop. A hand-held hydraulic chipper can be mounted on at this time without the removal of the backhoe bucket. As shown in Fig. 6, the hand-held hydraulic chipper 20a can be quickly connected with the accessory operating equipments oil line 44 of the main machine by means of the quick receptacle means 19 and the driving oil tube 20b. The accessory operating equipments oil line 44 is fixed on the excavating arm and connected with the pre-set ports P and T (Fig. 2) of the multi-way valves of the main hydraulic system, wherein the port P is the outlet for the pressure oil, and the port T the inlet for return oil. By manipulating the foot pedal convergent flow valve 26a of the hydraulic system and the hand-operated valve (not shown) of the hydraulic chipper, the pressure oil of the main machine is transmitted to the hydraulic chipper to drive it to carry on the chipping and crushing process. As the hand-held hydraulic chipper is connected to the main machine by means of the quick receptacle means and the driving oil tube, it can carry on chipping in a certain area at some distance from the main machine or spots the main machine cannot reach. In order to be fit for various different hydraulic chippers, a receptacle means 19 having the functions of controlling the pressure and temperature is provided at the junction of the chipper's driving oil tube 20b and the main machine's hydraulic system, so that the chipper and the main machine's hydraulic system can work under different levels of pressure, and the excessively high temperature produced by the operation of the chipper which may damage the hydraulic equipment can be avoided. The receptacle means 19 essentially is comprised of quick change joint 19a, pressure control valve 19b and temperature controller or a warning device 19c. It should be noted that if the hydraulic

chipper specially designed to fit the main machine of the present invention be employed, the pressure and temperature control devices are not needed for short time operation. This time the receptacle means
5 comprises only the quick change joint.

During the operation process, though it is possible to clear up the construction site right with the backhoe means or grab bucket and earth-moving means without removing the driving oil tube 20b and the hand-
10 held hydraulic chipper 20a, yet as dismantling and mounting are very convenient and rapidly to work out when employing the quick-change joint, it is generally better to remove the driving oil tube 20b and the hand-held hydraulic chipper 20a first and then to carry on
15 the digging and earth moving processes. If it is really necessary to chip and to clear or to dig at the same time, to prevent the frequent dismantling and mounting, the receptacle means 19 can be directly connected to the preset ports P and T of the multi-way
20 valve 26, as shown by the double dots-dash line in Fig. 6.

The receptacle means 19 employed by the present invention makes the excavator be characterised in that it contains simultaneously three kinds of operating
25 devices, namely, digging, earth-moving and chipping devices, and is able to carry on digging and chipping processes at the same time, not only making the chipping process easier, but also making it possible to carry on the operations of chipping and clearing away
30 the broken fragments conveniently and efficiently all alone by one single machine.



CLAIMS:

1. A hydraulic excavator comprising a chassis
assembly including travelling devices and a vehicle
frame, earth moving means pivotally connected to the
5 chassis assembly, an upper carriage assembly, which
upper carriage assembly is retained on the chassis
assembly by means of a supporting means which allows
rotation of the carriage assembly with regard to the
chassis assembly, said upper carriage assembly
10 comprising a main hydraulic system, a supporting frame
for multi-way valves, a power generator, a control
mechanism and electrical system and an excavating arm
pivotally connected to the carriage assembly, said
excavating arm including a joint holder, a boom, a
15 bucket arm and driving oil cylinders, the excavator
further comprising implements mounted on said
excavating arm such as an excavating bucket or drilling
tools wherein the excavator is provided with a further
oil line which operates accessory equipment and which
20 communicates with the main hydraulic system, and quick
receptacle means comprising a quick change joint and a
receptacle communicating with the main hydraulic system
for connecting therewith a hand-held hydraulic chipper
and wherein digging and chipping processes may be
25 carried out simultaneously.

2. An excavator as claimed in claim 1 wherein
the hand-held hydraulic chipper is connected with the
excavator without necessitating removal of the
implements or earth moving means.

30 3. An excavator as claimed in claim 1 or 2
wherein the hand-held hydraulic chipper is connectable
with the main hydraulic system by means of the
receptacle means and the further oil line.

4. An excavator as claimed in claim 1 or 2
35 wherein the hand-held hydraulic chipper is connected
with the main hydraulic system by means of the



receptacle means and preset ports of the main hydraulic system.

5. An excavator as claimed in claim 1 wherein the receptacle means further comprises a pressure controller, a temperature controller or a warning device.

6. An excavator as claimed in any preceding claim wherein the bucket comprises a bucket body, an internal scraper means and a multi-bar linkage mechanism, each driven by the same oil cylinder, which scraper means moves in the same direction as and more slowly than the bucket body.

7. An excavator as claimed in claim 6 wherein the multi-bar linkage mechanism consists of a six-bar linkage mechanism comprising the bucket body and the internal scraper, which mechanism comprises a connecting plate attached to the driving oil cylinder and to a swing bar by means of a first pivot, the connecting plate being attached to the bucket body by means of a second pivot, the bucket body being attached to a bucket arm by means of a third pivot, the swing bar being pivotally connected to the bucket arm, the internal scraper being pivotally connected to the bucket body and the ends of the connecting rod being pivotally connected to the connecting plate and the internal scraper respectively.

8. An excavator as claimed in claim 6 wherein the multi-bar linkage mechanism consists of a five-bar linkage mechanism comprising the bucket body and the internal scraper, which mechanism comprises a connecting plate attached to the driving oil cylinder and to a swing bar by means of a first pivot, the connecting plate being attached to the bucket body by means of a second pivot, the bucket body being attached to the internal scraper and the bucket arm by means of a third pivot, the swing bar being pivotally connected



to the bucket arm, and the internal scraper being connected to the connecting plate by means of a sliding means.
