Abstract: An excavator combined with a lateral surface cutter is provided. Specially, a tunnel can be excavated in the form of a half moon or arc. The excavator can perform an advancing excavation and a lateral excavation in order to surface-cut a lateral surface at right angle and at horizon. The excavator includes: a boom rotatably combined with a car body by a boom rotating pin; an arm reciprocally combined with the boom by an arm rotating pin; a triangular clamp detachably combined with the arm using connectors; a cylindrical surface cutter which is combined with the corner of the clamp facing the connectors; and a hydraulic cylinder which enables a piston rod is reciprocated using the hydraulic pressure and the surface cutter to move to the left and right around the hinge pins.
EXCAVATOR COMBINED WITH LATERAL SURFACE CUTTER

Technical Field

The present invention relates to an excavator combined with a lateral surface cutter, and more particularly, to an excavator combined with a lateral surface cutter to excavate a tunnel in the form of a half moon or arc, and perform an advancing excavation and a lateral excavation in order to surface-cut a lateral surface at right angle and at horizon.

Background Art

A conventional excavator is designed into a linked structure of a boom rotatably combined with a car body, an arm rotatably combined with the boom, and a bucket rotatably combined with the arm.

The boom, the arm and the bucket are working actuators, respectively and are driven by a boom cylinder, an arm cylinder and a bucket cylinder, respectively.

The boom is combined with the car body by a boom rotating pin, the arm is combined with the boom by an arm rotating pin, and the bucket is combined with the arm by a bucket rotating pin.

The above-described conventional excavator decides a work position of the bucket which performs an excavation work according to a connection correlation position of two link articulations of both the boom and arm.
Meanwhile, in the case of excavating a tunnel, a semicircular excavation is performed using an excavator bucket and a breaker. Then, two curved beams are joined in a semicircular form and the beams are connected with a reinforcing steel ring at a certain interval. Thereafter, a wire mesh is installed and shortstop concrete is sprayed to thus make a tunnel surface.

However, the rear surface of the bucket is not well seen by the reasons such as an obstacle of visibility caused by light in the excavator, the shadow, and a remote operation. An operator is uncomfortable to feel a milling phenomenon, a roughness, or a vibration shock of a breaker intuitively or visibly, when excavating. In addition, it is not accurate to maintain a certain depth or interval. When a vibration shock is applied, a collapse such as falling stone or soil may occur. At the place of a deep river, an amount and a weight of shortstop concrete is not endured but detached.

In addition, a non-connection action of an excavator breaker may cause an inefficient work due to a pecking 'work. In the case that a focus of protruded rock contacts sharp blades of the breaker, a sliding phenomenon may occur.

That is, when a breaker is used, a fixedly installed semicircular beam is not congruent with an angle of an excavator's surface. Accordingly, a breaker striking operation is performed at a low efficiency since the breaker striking is inefficient and is apt to be slid obliquely. In the case of a strong rock, it is
not possible to work an excavation in a narrow tunnel. In the case of excavating the end of the root of a beam (called a beam root seat) using a breaker, it is inefficient to work with a breaker's blade in order to excavate a groove having no free surface. Also, it is difficult to make the area and depth of a groove required by the beam root seat formed of a desired arc because of an inaccuracy of power according to the texture of rocks.

Accordingly, construction safety rules may be violated, since a more extensive area than a predetermined interval may be excavated. That is, there is a problem that construction safety rules cannot but be overlooked irresistibly.

Finally, it is difficult to work with the conventional excavator portions which are excavated in a semicircular form like the end of a tunnel. In particular, in the case of the flimsy ground, a more amount of the ground may be excavated than a portion to be excavated in the process of excavating with a bucket and a breaker. As a result, impacts may be imposed on the portions which need not be excavated, to thereby cause danger of falling stone or soil and collapse to severely increase.

**Disclosure of the Invention**

It is an object of the present invention to provide an excavator combined with a lateral surface cutter, which can excavate a portion necessary for excavating the inner
circumferential surface of a tunnel.

To accomplish the above object of the present invention, there is provided an excavator comprising: a boom rotatably combined with a car body by a boom rotating pin; an arm reciprocally combined with the boom by an arm rotating pin; a triangular clamp detachably combined with the arm using connectors; a cylindrical surface cutter which is combined with the corner of the clamp facing the connectors, using hinge pins, and is rotated by a hydraulic pressure, in which a number of hook pins are provided in the outer circumference, to thus enable a tunnel or a space portion to be processed in the form of an arc shape when the cylindrical surface cutter is rotated; and a hydraulic cylinder which enables a piston rod is reciprocated using the hydraulic pressure and the surface cutter to move to the left and right around the hinge pins, in which the surface cutter and the clamp are combined with each other.

Preferably, a conical auxiliary surface cutter or a cylindrical auxiliary surface cutter is further combined with the end of the surface cutter by screw connection.

Preferably, spiral grooves are formed in the outer circumference of the surface cutter and the auxiliary surface cutter, respectively.

Preferably, a stator and a rotor are provided in the surface cutter in which the rotor is connected with a housing of the surface cutter through a bracket, and the housing of the surface cutter is rotated by rotation of the rotor.
Preferably, a stator and a rotor are provided in the surface cutter in which a housing of the surface cutter and the rotor are connected through a plate spring, and in which the rotor and the plate spring are fixed by a first fixing unit, the plate spring and the housing are fixed by a second fixing unit, and the second fixing unit is combined by a spiral plate spring integrally combined with the plate spring.

Preferably, a guide of a circular ring shape is further included in the rear surface of the housing of the surface cutter in order to limit a surface cutting depth.

Preferably, the hook pins are inserted and fitted between coupling protrusions of the hook pins whose both sides are protruded, and are fixed to penetrate fixing pins for fixing the hook pins.

Preferably, the hydraulic cylinder is connected with a surface cutter connecting link which is installed from a surface cutter connecting link fixing piece and an auxiliary support link of a panel form which is projected from a hinge pin, using a coupling pin.

**Brief Description of the Drawings.**

FIG. 1 is a side view showing the whole of an excavator according to the present invention;

FIG. 2 is a perspective view showing a surface cutter according to the present invention;

FIG. 3 is a side view showing a surface cutter according to
the present invention;

FIG. 4 is a side cross-sectional view showing the inner portion of a surface cutter according to the present invention;

FIG. 5 is a side view for explaining an operating state of a surface cutter according to the present invention;

FIG. 6 is a disassembled perspective view showing a surface cutter combined with a first auxiliary surface cutter according to the present invention;

FIG. 7 is a partial cross-sectional view showing a surface cutter combined with a first auxiliary surface cutter according to the present invention;

FIG. 8 is a partial cross-sectional view showing a surface cutter combined with a second auxiliary surface cutter according to the present invention;

FIG. 9 is a front cross-sectional view showing a surface cutter according to another embodiment of the present invention;

FIG. 10 is a horizontal cross-sectional view of FIG. 9; and
FIG. 11 is a diagram for explaining a work state using a surface cutter according to the present invention.

Best Mode for Carrying out the Invention

Hereinbelow, an excavator combined with a surface cutter according to a preferred embodiment of the present invention will be described with reference to the accompanying drawings. Like reference numerals are assigned for like elements in the drawings.
Also, the detailed description of the specific function and the common knowledge is omitted in the case that it is judged that such a description may make the present invention unnecessarily dim.

FIG. 1 is a side view showing the whole of an excavator according to the present invention. FIG. 2 is a perspective view showing a surface cutter according to the present invention. FIG. 3 is a side view showing a surface cutter according to the present invention. FIG. 4 is a side cross-sectional view showing the inner portion of a surface cutter according to the present invention. FIG. 5 is a side view for explaining an operating state of a surface cutter according to the present invention. FIG. 6 is a disassembled perspective view showing a surface cutter combined with a first auxiliary surface cutter according to the present invention. FIG. 7 is a partial cross-sectional view showing a surface cutter combined with a first auxiliary surface cutter according to the present invention. FIG. 8 is a partial cross-sectional view showing a surface cutter combined with a second auxiliary surface cutter according to the present invention.

As illustrated in FIGS. 1 through 8, an excavator according to the present invention largely includes a car body 10, a boom 20, an arm 30, a cylindrical surface cutter 100, an arm connection clamp 200, and a rotatable surface cutter hydraulic cylinder 300.

The boom 10, the arm 20 and the clamp 200 are working actuators, respectively and are driven by a boom cylinder 21, an arm cylinder 31 and a bucket cylinder 41, respectively. The boom 20 is combined
with the car body 10 by a boom rotating pin 22, the arm 30 is combined with the boom 10 by an arm rotating pin 32, and the clamp 200 is combined with the arm 20 by a bucket rotating pin 44, and is combined with the arm 20 through a bucket rotating link 43 and an auxiliary link 42 to allow the clamp 200 to perform a free motion.

In the above-described structure, the car body 10, the boom 20, the arm 30, and the bucket (not shown) have the same structure as those of the conventional art. In the present invention, instead of the bucket, a cylindrical surface cutter 100 is designed to be attached to and detached from the excavator according to need. The excavator according to the present invention includes a clamp 200 for clamping the arm 30, the cylindrical surface cutter 100 which is combined with the clamp 200, and a hydraulic cylinder 300 which can rotate the surface cutter 100 to the left and right.

Now, the structure of the present invention will be described below in more detail.

The clamp 200 is formed of a triangular shape on the whole, and an arm connector 210 is formed at both sides of the housing. A coupling hole 220 is formed in the arm connector 210. The coupling hole 220 is mutually abutted to the coupling hole of the arm 30. Then, the clamp 200 is linked with the excavator car body 10 using coupling pins and coupling screws.

In addition, the surface cutter 100 is connected at the corner portion opposing the arm connector 210 using the hinge pin 230. A hydraulic cylinder fixing piece 240 is installed at either
side of the clamp 200. The hydraulic cylinder 300 is connected with the hydraulic cylinder fixing piece 240. The hydraulic cylinder 300 is connected with a surface cutter connecting link 120 which is installed from a surface cutter connecting link fixing piece 110 together with an auxiliary support link 250 of a panel form which is projected from a hinge pin 230, using a coupling pin 260. Accordingly, the surface cutter 100 can move to the left and right.

The hydraulic cylinder 300 includes a piston rod 310 like a conventional hydraulic cylinder and controls a hydraulic pressure which is imposed in the cylinder to thereby push or pull the piston rod 310 into or out of the cylinder 300. Accordingly, the piston rod 310 can reciprocate. According to the reciprocation of the piston rod 310, the surface cutter 100 is pivoted around the hinge pin 230 left and right. Here, and, the auxiliary support link 250 and the surface cutter connecting link 120 function to make the surface cutter 100 smoothly move to the left and right.

That is, if the piston rod 310 of the hydraulic cylinder 300 proceeds forward, the surface cutter 100 naturally moves left or right while pushing the surface cutter connecting link 120.

Meanwhile, the surface cutter 100 is equipped with a hydraulic motor, and makes the rotor 132 rotate by rotation of the hydraulic motor, to thus pulverize the inner circumference of a tunnel.

The hydraulic pressure provided for the hydraulic motor activates a hydraulic circuit using power generated in the process
of driving an excavator engine.

That is, the engine exists at the rear side of a driver seat, and a hydraulic pump is connected directly with the engine. As the engine rotates, the hydraulic pump rotates to generate a hydraulic pressure. The hydraulic pressure is distributed to the respective units of the excavator through a control valve, according to a driver's manipulation in order to drive the excavator. Here, according to the present invention, the surface cutter rotates by the hydraulic pressure received from the hydraulic pump.

The hydraulic motor applied in the present invention includes a stator 131 and a rotor 132 which are provided in the surface cutter in which the rotor 132 is connected with a housing 140 of the surface cutter through a bracket 133, and the housing 140 of the surface cutter 100 is rotated by rotation of the rotor 132. Accordingly, a surface cutting of an object to be processed is accomplished. The stator 131 is fixed by a support plate 150. A hydraulic hose 134 is connected through the support plate 150. A circular plate shaped guide 160 is further connected at the back of the support plate 150, to thus limit a work area of the surface cutter 100. The guide 160 limits thickness of a work surface digged by the hook pins 170 so that a curved surface is excavated to a fixed thickness at tunnel work.

A number of hook pins 170 are formed on the outer circumference of the surface cutter 100 to perform a surface cutting work of a tunnel. A number of spiral grooves 180 are formed on the outer
circumference of the surface cutter housing 140. Here, the hook pins 170 are inserted and fitted between the hook pin coupling protrusions 171 and fixed by fixing pins 172 which fix the hook pins 170, respectively. Thus, the damaged hook pins 170 can be replaced by new ones.

The hook pins 170 play a role of surface-cutting a tunnel at the process of rotation of the housing 140. The spiral grooves 180 play a role of allowing scraps generated at the process of surface-cutting the tunnel to move along the outer surface of the surface cutter 100 to then be discharged out of the surface cutter 100.

Also, a conical auxiliary surface cutter 100a is detachably combined with the front surface of the surface cutter 100 by screw-coupling. Accordingly, a boring work or a work of various angles can be performed using the conical auxiliary surface cutter 100a.

Also, in addition to the conical auxiliary surface cutter 100a, a cylindrical auxiliary surface cutter 100b is detachably combined with the front surface of the surface cutter 100 by screw-coupling. Accordingly, an effect of extending the housing 140 of the surface cutter 100 can be obtained.

Of course, a majority of hook pins 170 are combined with the conical auxiliary surface cutter 100a and the cylindrical auxiliary surface cutter 100b, and a majority of spiral grooves 180 are formed on the outer circumference thereof. Small fragments generated at
work can move along the spiral grooves 180.

The function and effect of the excavator according to the present invention will be described below.

Similarly to a conventional excavator structure, an excavator according to the present invention includes a boom 20, an arm 30 and a bucket. The excavator also includes a boom cylinder 21, an arm cylinder 31 and a bucket cylinder 41 as working actuators.

In order to perform a surface cutter work according to the present invention, the bucket is taken out, the clamp 200 is connected with arm 30, and the clamp 200 and the surface cutter 100 are connected using the hinge pin 230 and the coupling pin 260, to then be connected with the excavator car body 10.

The clamp 200 and the arm 30 are strongly mutually connected with each other on the clamp connection piece using the coupling pin. In addition, the clamp 200 and the surface cutter 100 are strongly connected with the hydraulic cylinder 300 by the auxiliary support link 250 and the surface cutter connecting link 120.

The surface cutter 100 according to the present invention includes a hydraulic motor which rotates using a hydraulic pressure. Accordingly, the hook pins are rotated by rotation of the rotor. If the bucket cylinder that is a conventional excavator component is used, it is possible to make the surface cutter 100 move up and down. Using the hydraulic cylinder connected with the side surface of the clamp, the surface cutter can be moved left and right.

That is, the surface cutter 100 can be moved left and right
by action of making the piston rod 310 of the hydraulic cylinder 300 move up and down. Also, the angle of the surface cutter 100 can be accurately controlled by interaction of the surface cutter connecting link 120, the auxiliary support link 250, and the hydraulic cylinder 300.

Therefore, the surface cutter according to the present invention uses the units of supplying the hydraulic pressure for the bucket cylinder 41 and the hydraulic cylinder 300. If the surface cutter according to the present invention mixes their motions mutually, the tunnel can be excavated in the form of an arc in the process of cutting the tunnel with the surface cutter.

Also, the surface cutter according to the present invention can work using the guide 160 while forming an arc equally at a desired thickness.

Also, since the hook pins 170 applied in the present invention are detachably formed, the damaged hook pins can be replaced immediately and thus a surface cutting work or an excavation work for a tunneling work can be always perfectly performed.

Also, in the present invention, the surface cutter 100 is formed of a cylindrical structure, and the auxiliary surface cutters 100a and 100b which are formed of a conical shape and a cylindrical shape, respectively are further mounted in the surface cutter 100. As a result, a work of various angles such as an advancing excavation and a lateral excavation can be performed.

FIG. 9 is a front cross-sectional view showing a surface
cutter according to another embodiment of the present invention. FIG. 10 is a horizontal cross-sectional view of FIG. 9. FIG. 11 is a diagram for explaining a work state using a surface cutter according to the present invention.

As shown in FIGS. 9 through 11, the rotor 132 and a housing 140 of the surface cutter 100 are connected through a plate spring 132a, and in which the rotor 132 and the plate spring 132a are fixed by a first fixing unit 132d, the plate spring 132a and the housing 140 are fixed by a second fixing unit 132c.

Here, the second fixing unit 132c is combined by a spiral plate spring 132b integrally combined with the plate spring 132a. That is, the second fixing unit 132c is wound by the spiral plate spring 132b.

In the present invention, the housing 140 rotates as the rotor 132 rotates. Here, since the plate spring 132a and the spiral plate spring 132b perform a buffering action, the motion of the housing 140 can be corrected within a certain interval.

Therefore, even if an error or variation occurs in working with the hook pins 170 placed in the housing 140, the plate spring 132a and the spiral plate spring 132b can correct the error or variation. As a result, a surface cutter work or an excavation work for a tunneling work can be performed without suffering from an extreme shaking of the excavator or the surface cutter. Thus, the excavator or the surface cutter can be protected.

Finally, when an excavation work or a surface cutter work is
performed as shown in FIG. 11, using the excavator combined with a surface cutter according to the present invention, a fixedly installed semi-circular beam 190 becomes a reference point and a guide 160 becomes a guiding surface. Accordingly, the excavation work or surface cutter work can be naturally processed up to a desired surface 191.

As described above, the present invention enables an advancing action of a boom and rock, a rotary drum, a clamp, a guide hydraulic cylinder, various actions of a linkage, etc., of an excavator, to thereby rapidly perform a work of a certain arc shape using a guide, with a small rotational motion and at minimum shock, impact, low noise, etc., in a tunnel or narrow place.

Also, since an excavation work can be done at a certain depth and a certain interval, a concrete amount can be saved at the time of spraying shortstop concrete, and a quality of an excavation work can be enhanced.

Also, if a conical auxiliary surface cutter is attached to the surface cutter, an arc-shaped hole can be excavated with the vertical beam root seat, to thus increase an excavation efficiency and prevent the beam from moving after installation of the beam, as well as to trim a narrow surface or vertical surface.

Also, the present invention is very useful for surface-cutting of a narrow tunnel or a place where an excavator cannot swing (for example communication check holes, electric power check holes, water tunnels).
Also, the cylindrical auxiliary surface cutter can freely control a surface-cutting surface.

As described above, the present invention has been described with respect to particularly preferred embodiments. However, the present invention is not limited to the above embodiments, and it is possible for one who has an ordinary skill in the art to make various modifications and variations, without departing off the spirit of the present invention. Thus, the protective scope of the present invention is not defined within the detailed description thereof but is defined by the claims to be described later and the technical spirit of the present invention.

**Industrial Applicability**

As described above, the present invention provides an excavator combined with a lateral surface cutter to excavate a tunnel in the form of a half moon or arc, and perform an advancing excavation and a lateral excavation in order to surface-cut a lateral surface at right angle and at horizon.
What is claimed is:

1. An excavator comprising:
   a boom rotatably combined with a car body by a boom rotating pin;
   an arm reciprocally combined with the boom by an arm rotating pin;
   a triangular clamp detachably combined with the arm using connectors;
   a cylindrical surface cutter which is combined with the corner of the clamp facing the connectors, using hinge pins, and is rotated by a hydraulic pressure, in which a number of hook pins are provided in the outer circumference, to thus enable a tunnel or a space portion to be processed in the form of an arc shape when the cylindrical surface cutter is rotated; and
   a hydraulic cylinder which enables a piston rod is reciprocated using the hydraulic pressure and the surface cutter to move to the left and right around the hinge pins, in which the surface cutter and the clamp are combined with each other.

2. The excavator combined with a lateral surface cutter according to claim 1, wherein a conical auxiliary surface cutter or a cylindrical auxiliary surface cutter is further combined with the end of the surface cutter by screw connection.

3. The excavator combined with a lateral surface cutter
according to claim 1 or 2, wherein spiral grooves are formed in the outer circumference of the surface cutter and the auxiliary surface cutter, respectively.

4. The excavator combined with a lateral surface cutter according to claim 1, wherein a stator and a rotor are provided in the surface cutter in which the rotor is connected with a housing of the surface cutter through a bracket, and the housing of the surface cutter is rotated by rotation of the rotor.

5. The excavator combined with a lateral surface cutter according to claim 1, wherein a stator and a rotor are provided in the surface cutter in which a housing of the surface cutter and the rotor are connected through a plate spring, and in which the rotor and the plate spring are fixed by a first fixing unit, the plate spring and the housing are fixed by a second fixing unit, and the second fixing unit is combined by a spiral plate spring integrally combined with the plate spring.

6. The excavator combined with a lateral surface cutter according to claim 1, wherein a guide of a circular ring shape is further included in the rear surface of the housing of the surface cutter in order to limit a surface cutting depth.

7. The excavator combined with a lateral surface cutter
according to claim 1, wherein the hook pins are inserted and fitted between coupling protrusions of the hook pins whose both sides are protruded, and are fixed to penetrate fixing pins for fixing the hook pins.

8. The excavator combined with a lateral surface cutter according to claim 1, wherein the hydraulic cylinder is connected with a surface cutter connecting link which is installed from a surface cutter connecting link fixing piece and an auxiliary support link of a panel form which is projected from a hinge pin, using a coupling pin.
INTERNATIONAL SEARCH REPORT

INTERNATIONAL APPLICATION N o
PCT/KR2007/001774

A. CLASSIFICATION OF SUBJECT MATTER

E02F 5/00(2006.01), E02F 3/36(2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 E02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) & keywords "cutter", "grinder", "rotation", "excavator", "boom", "arm", "construction"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Relevant to claim No</th>
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<tr>
<td>A</td>
<td>US 6,438,874 B1 (LABOUNTY, K R et al) 27 AUGUST 2002 See column 2, line 55 - column 3, line 50, Figures 1A-1E, and 2</td>
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<td>JP 11-303419 A (MITSUI MIKE MACH CO., LTD) 2 NOVEMBER 1999 See paragraphs 16-39, Figures 1, 2, and 7</td>
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☐ Further documents are listed in the continuation of Box C ☐ See patent family annex

* Special categories of cited documents
  "A" document defining the general state of the art which is not considered to be of particular relevance
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"Z" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"S" document member of the same patent family

Date of the actual completion of the international search
09 AUGUST 2007 (09 08 2007)

Date of mailing of the international search report
10 AUGUST 2007 (10.08.2007)

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No 82-42-472-7140

Authorized officer
KIM Sung Ho
Telephone No 82-42-481-8548
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Form PCT/ISA/210 (patent family annex) (April 2007)