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[54] **SINGLE-BUCKET EXCAVATOR**

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[51] **Int. Cl.** **E02f 3/75**

[58] **Field of Search** ... 214/773, 775, 776, 770, 777, 214/138 R

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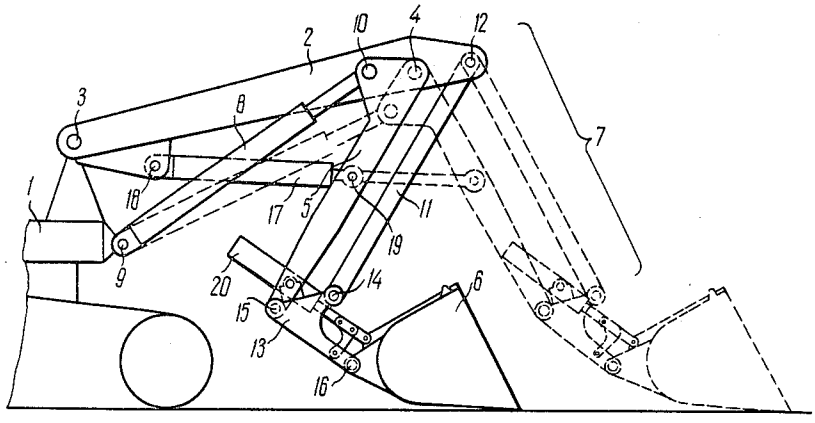
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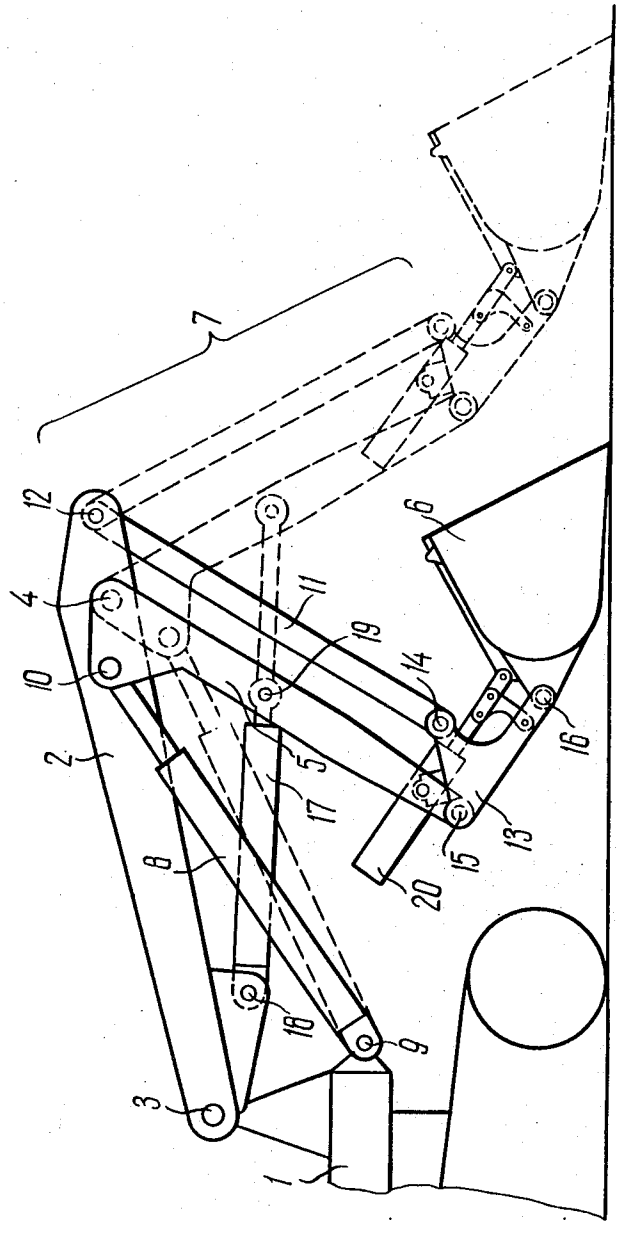
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[57] **ABSTRACT**

A bucket suspension system for an excavator in the form of a six-bar mechanism consisting of two combined four-bar mechanisms whose common links are the boom and the arm. One of the four bar mechanisms is a parallelogram; the other four-bar mechanism, besides the boom and arm, comprises as one of the links a power cylinder which is hingedly connected to the turntable and the arm thus making the turntable a stationary link of this four-bar mechanism. Such suspension eliminates changing of the cutting angle during the working travel of the bucket.

1 Claim, 1 Drawing Figure




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SINGLE-BUCKET EXCAVATOR

The present invention relates to road-building equipment and more particularly it relates to single-bucket excavators intended for load-handling and levelling operations in which the working travel of the bucket along a straight path is either practicable or indispensable.

The experience of load-handling operations shows that the best effect is achieved when the bucket penetrates the pile of free-flowing or lump material in such a manner that its cutting lip moves in a straight line progressively along the border line between the pile and the surface on which it rests.

Known in the art are single-bucket excavators built for the above-mentioned applications wherein the straight path of the bucket working travel is accomplished by using a suspension in the form of a six-bar mechanism. Said mechanism consists of two four-bar mechanisms so combined with each other that the excavator boom and bucket arm serve as as common links for both of them.

One of the four-bar mechanisms is constituted by the consecutively-connected arm-lifting hydraulic cylinder, rod, bucket arm, and boom. The other four-bar mechanism is constituted, in a consecutive order, by the boom, bucket arm, bucket -turning power cylinder and the swinging bracket of the bucket turning drive in which case the opposite links of this four-bar mechanism are not equal to each other (e.g., "Scooper-505" excavators manufactured by Koehring, USA, NCK-Rapier, England, and M150R manufactured by Menck, Federal Republic of Germany, and defined in U.S. Pat. No. 3,120,315 Cl. 214–138).

The main disadvantage of these excavators resides in the impossibility of standardizing the elements of the bucket suspension with those of the other items of equipment. This is attributable to the complex configuration of the boom and arm and to the necessity of providing special points of attachment to the excavator turntable, used exclusively with one type of equipment.

Also known in the art are other single-bucket excavators of the same utility wherein straightness of the bucket travel is accomplished by using a suspension in the form of a four-bar mechanism constituted by the boom, bucket arm, swivelling bracket for fastening the bucket to the arm, and by the rod connecting said bracket to the boom (e.g., excavators "TC-45" and "TY-45" manufactured by Messrs Poclain, France and described in French Pat. No. 1,241,190 Cl. E02f).

A disadvantage of these excavators lies in changing of the cutting angle during the working travel of the bucket. This occurs due to the inevitable rotary motion of the bracket connected to the bucket when the position of the bucket suspension changes in the process of ensuring straight travel of the bucket cutting lip.

The main object of the invention resides in standardizing the elements of the bucket suspension with those of the other items of equipment. Another object of the invention is to stabilize the cutting angle during the working travel of the bucket.

These objects are achieved by providing a single-bucket excavator with the bucket suspension made in the form of a six-bar mechanism consisting of two combined four-bar mechanisms whose common links are the boom and bucket arm in which, according to the invention, one of the four-bar mechanisms comprises a power cylinder one end of which is articulated to the

excavator turntable while the other one is fastened to the bucket arm; the second four-bar mechanism is a parallelogram which includes the upper end of the boom and the bucket arm as unequal links.

The bucket suspension of this type makes it possible to eliminate swivelling of the bracket and bucket secured to said suspension in the course of straight travel of the cutting lip and, in addition, to use the connecting elements of the turntable for installing other kinds of replaceable working tools and also to use the elements of the suspension according to the invention (boom, boom-lifting power cylinders, etc.) for these kinds of replaceable working tools.

Given below is a detailed description of the invention by way of example with reference to the accompanying drawing the sole FIGURE of which illustrates mainly the front-end of the excavator-loader realized according to the present invention in one position in solid lines, the dotted lines showing another working position of the equipment).

The excavator turntable **1** mounts a boom **2** whose lower end is articulated to the turntable **1** by a hinge **3.** The arm **5** of the bucket **6** is articulated to the upper end of the boom **2** by means of a hinge **4.** The boom **2** and arm **5** are included in a six-bar mechanism **7** of the bucket suspension. The mechanism **7** is composed of two four-bar mechanisms combined in such a manner that the boom and arm serve as their common links. One four-bar mechanism (referred to hereafter as the "first") is constituted by hydraulic cylinder **8** one end of which is connected by the hinge **9** with the turntable **1** while the other end is connected to the arm **5** by the hinge **10,** the length fo the arm **5** between the hinges **4** and **10,** the length of the boom **2** between the hinges **4** and **3** and the part of the turntable **1** between the hinges **3** and **9.** The other four-bar mechanism hereinafter called the "second" mechanism is a parallelogram formed by the arm **5,** connected by the rod **11** to the boom **2** by the hinge **12,** by the bracket **13** which is connected by hinges **14** and **15** with the rod **11** and arm **5,** and by length of the boom **2** between the hinges **4** and **12.** The arm **5** and rod **11** as well as the bracket **13** and the length of the boom **2** between the hinges **4** and **12** form the opposite equal sides of the parallelogram of the second four-bar mechanism.

The bracket **13** is connected with the bucket **6** by a hinge **16.**

The hydraulic cylinder **8** is provided for lifting and lowering the boom **2.**

The hydraulic cylinder **17** connected by hinges **18** and **19** with the boom **2** and arm **5,** respectively, serves for turning the bucket arm **5;** the hydraulic cylinder **20** turns the bucket **6** around the hinge **16** with respect to the bracket **13.**

The arrangement described above ensures rectilinear travel of the bucket on the level of the excavator supporting surface which is an imperative prerequisite for the most efficient and power-saving scooping of the material with the bucket.

This straight motion of the bucket is provided for by the hydraulic cylinder **17** alone, the cylinder **8** being locked, which greatly simplifies control of the working equipment in scooping the material.

With the working tools in the initial position, the rod of the hydraulic cylinder **17** is retracted, the boom **2** is set by the hydraulic cylinder **8** to such a position that the cutting lip of the bucket **6** is lowered to the level of

the excavator supporting surface and the bucket is set to a position for scooping with the aid of the hydraulic cylinder **20.**

The material is scooped by extending the rod of the power cylinder **17** so that the arm **5** turns on the hinge **4** and the arm length located between the hinges **4** and **10** changes the position of the first four-bar mechanism relative to the immovable link, i.e. the portion of the turntable **1** between the hinges **3** and **9.** The position of the hinge **10** on the arm **4** is set in such a manner that, due to automatic coordination between the positions of the arm **5** and boom **2,** the cutting lip is constantly at the level of the excavator supporting surface during the movement of the power cylinder **17.** The progressive motion of the bucket **6** is ensured by the second four-bar mechanism. The rectilinear progressive motion of the bucket is completed by turning the cutting lip of the bucket upward by the force of the power cylinder **20.**

Subsequent lifting of the bucket and entire working equipment if effected by the hydraulic cylinders **8.**

Then the turntable **1** is slewed by its own mechanisms and the load in bucket **6** is dumped. For this purpose its cutting lip is turned down by means of the hydraulic cylinder **20.**

After the turntable **1** has been swung back and the bucket brought to the point of scooping, the working equipment is again set to the initial position and the operating cycle is repeated as described above.

Though the excavator disclosed in the application has been described mainly as a loader, it can be employed with equal success for the levelling jobs.

What we claim is:

1. A single bucket excavator comprising a turntable, a boom pivotably connected to the turntable, a bucket arm pivotably connected to the boom, a six-bar bucket

suspension constituted by two combined four-bar mechanisms with the boom and arm being common links thereof, a first power cylinder pivotably connected at one end thereof to the turntable and at the other end thereof to the bucket arm, said power cylinder serving as one of the links of one four-bar mechanism, the second four-bar mechanism including a rod extending parallel to said bucket arm and pivotably connected to said boom, and a bracket to which said bucket, said arm and said rod are pivotably connected individually and directly such that the second four-bar mechanism is a parallelogram linkage with the rod and bucket arm as one pair of links, said rod and arm constituting the sole connection between the boom and bucket, the other pair of links of the second four-bar mechanism being unequal in length to the first pair and constituted by said bracket and the portion of the boom between the pivotal connections thereof to the rod and bucket arm, said first power cylinder and said boom being pivotably connected to said turntable at spaced locations, the length of the turntable between said locations representing another of the links of said one four-bar mechanism, said bucket arm including an integral projection to which said first power cylinder is pivotably connected at a location offset from the pivotable connection of the bucket arm to the boom, the length of the bucket arm between the connection thereof to said first cylinder and said boom representing another of the links of said one four-bar mechanism such that by virtue of said integral projection, said arm forms a respective link in both four-bar mechanisms, and a second power cylinder pivotably connected to said boom and said bucket arm.

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