March 14, 1939. W. L. SHACKLETON 2,150,848

EXCAVATOR

Filed June 22, 1937 4 Sheets-Sheet 1

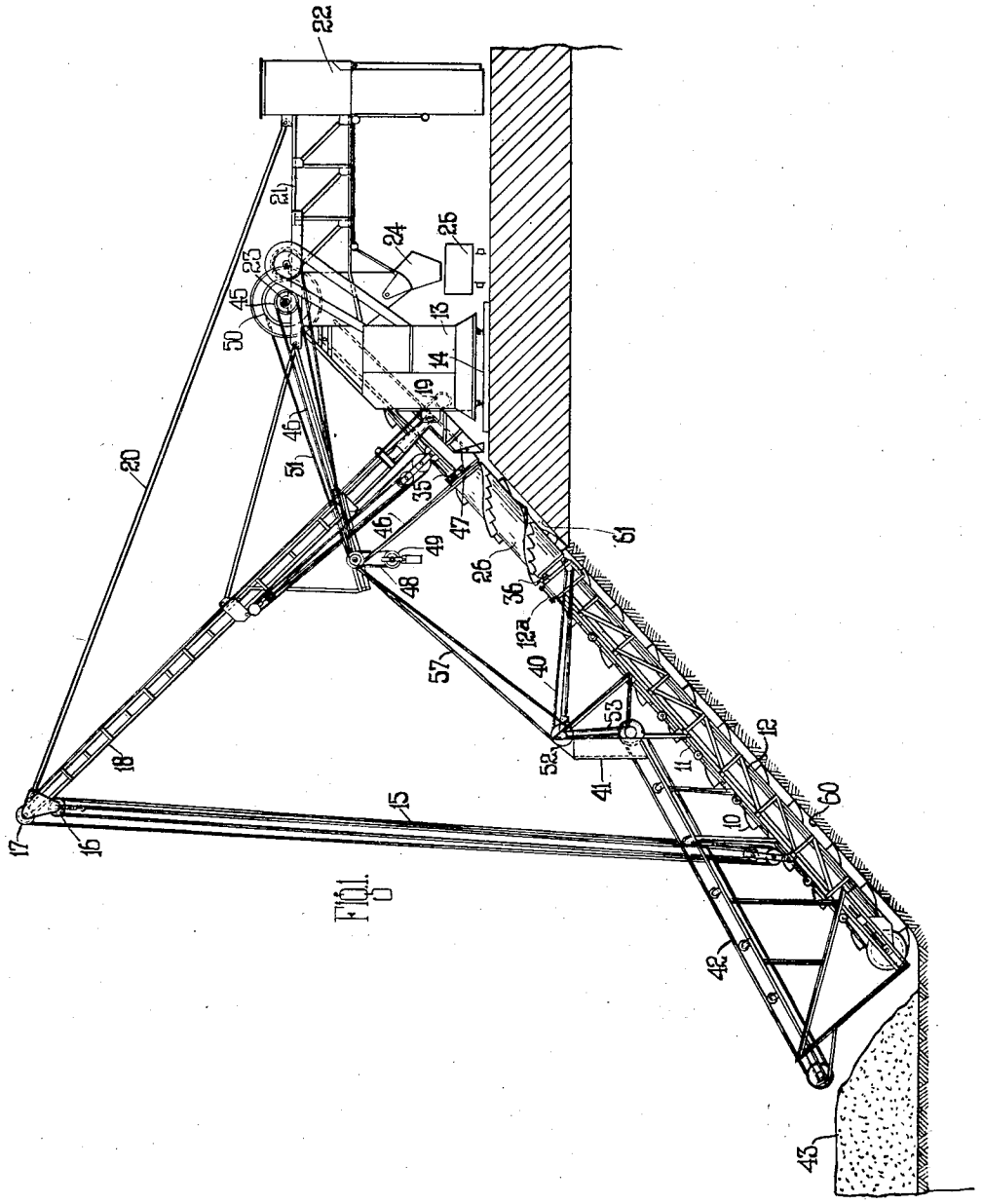


FIG. 1.

Inventor:
Walter L. Shackleton
By: Mason & Porter
Attorneys

March 14, 1939. W. L. SHACKLETON 2,150,848

EXCAVATOR

Filed June 22, 1937 4 Sheets-Sheet 2

FIG. 2.

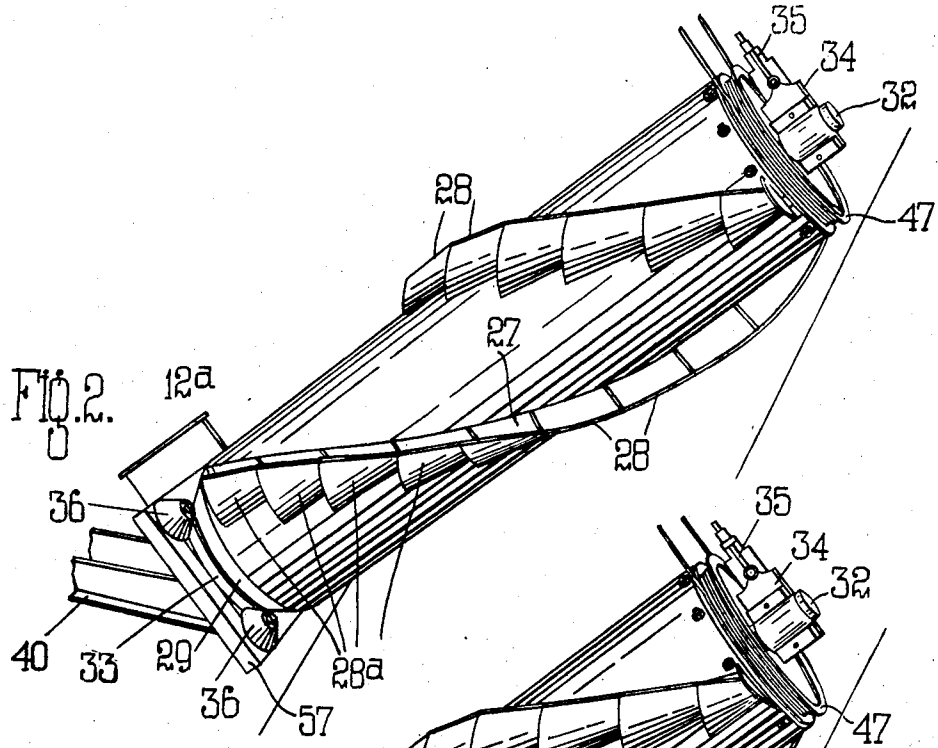
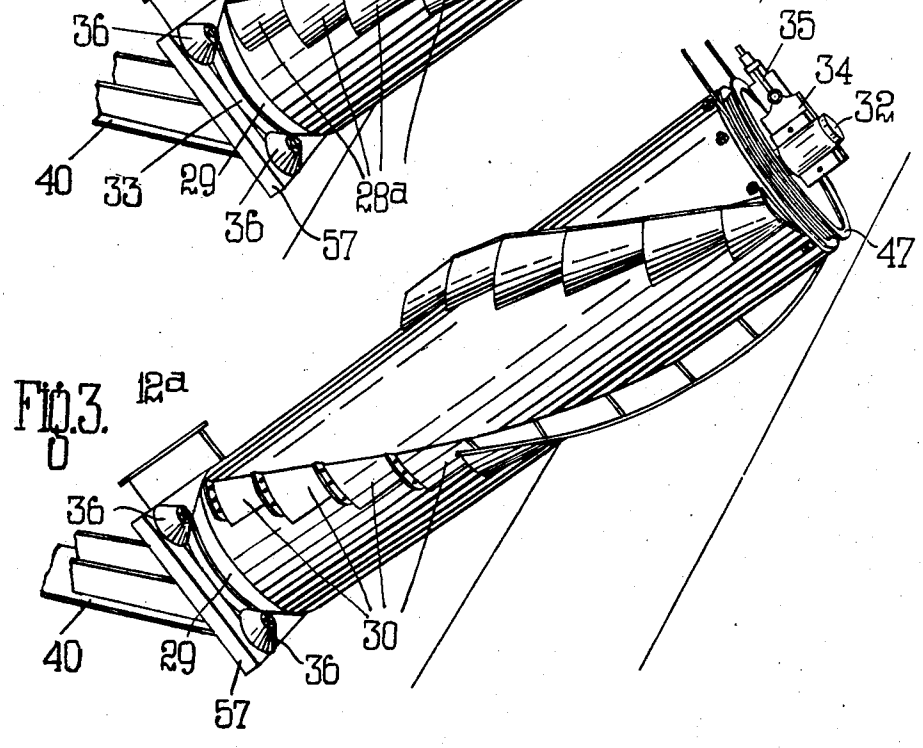


FIG. 3.

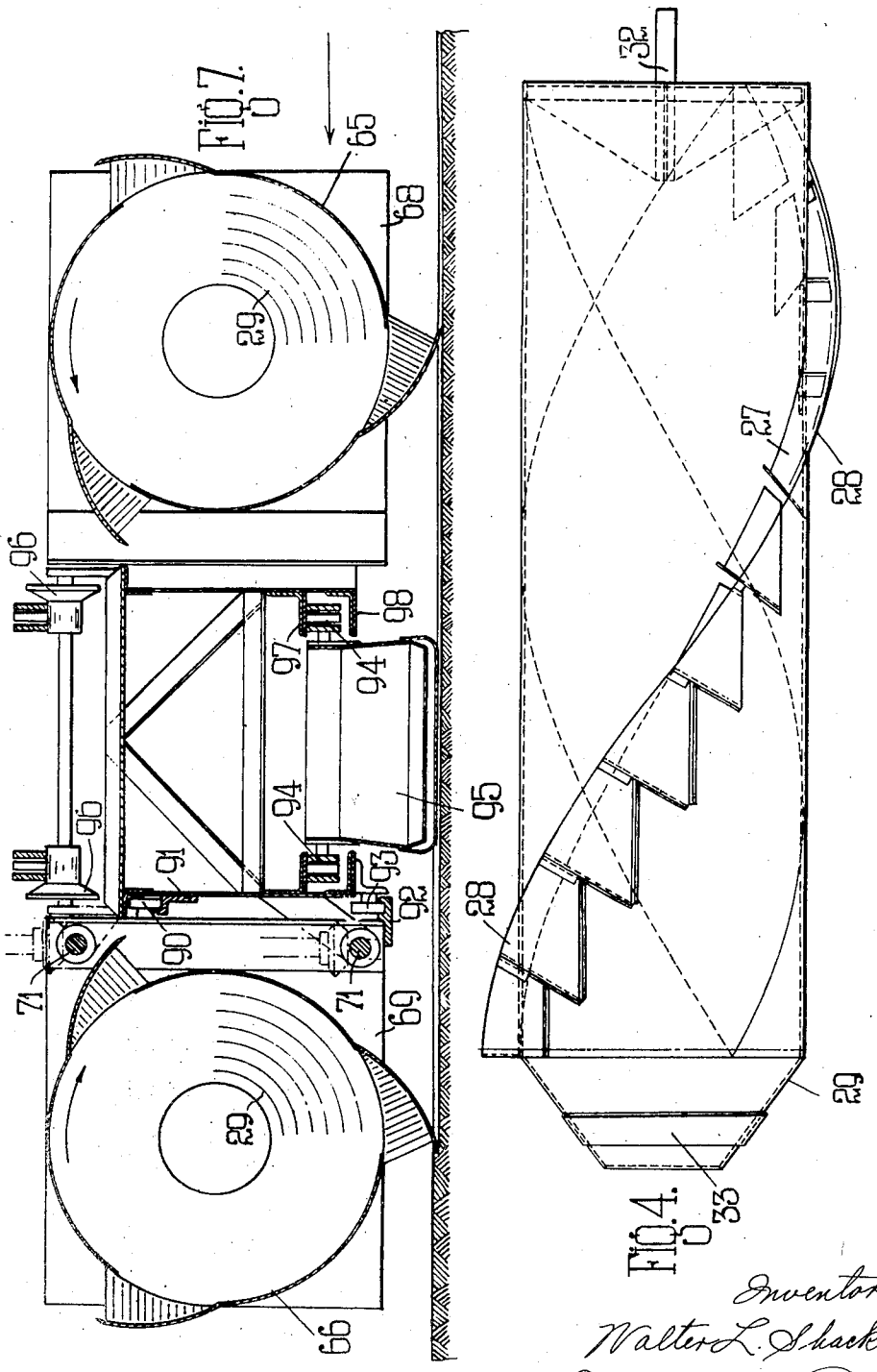


Inventor:
Walter L. Shackleton
By: Mason & Porter
Attorneys

March 14, 1939. W. L. SHACKLETON 2,150,848

EXCAVATOR

Filed June 22, 1937 4 Sheets-Sheet 3



Inventor:
Walter L. Shackleton
By: Mason & Porter
Attorneys

March 14, 1939. W. L. SHACKLETON 2,150,848

EXCAVATOR

Filed June 22, 1937 4 Sheets-Sheet 4

Fig. 5.

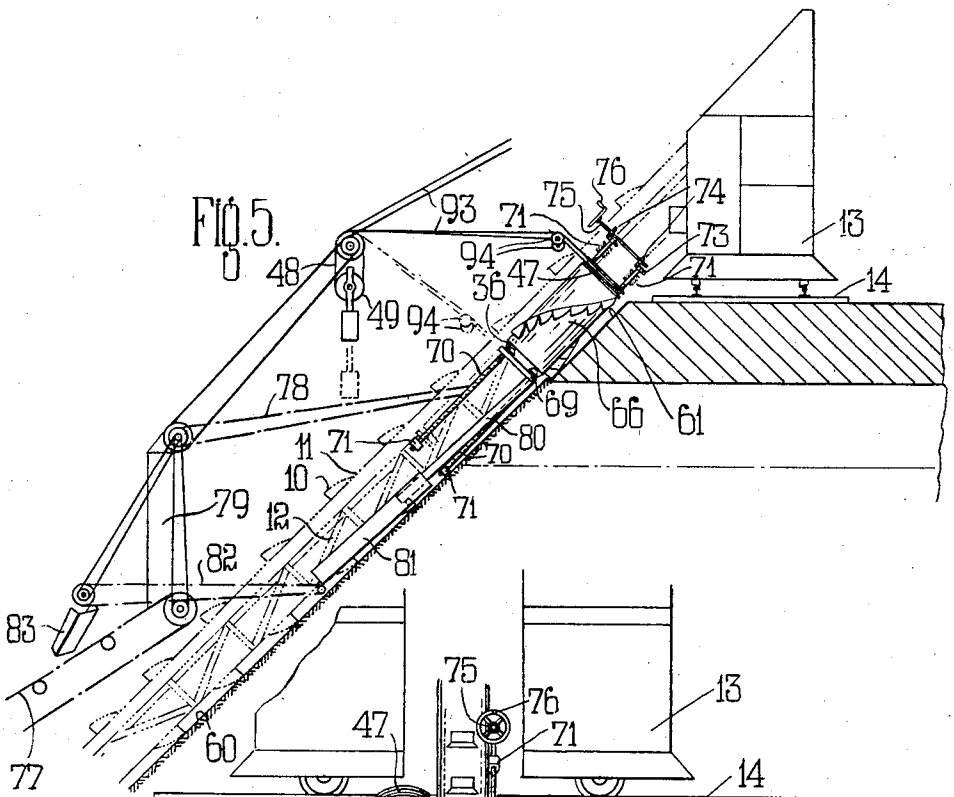
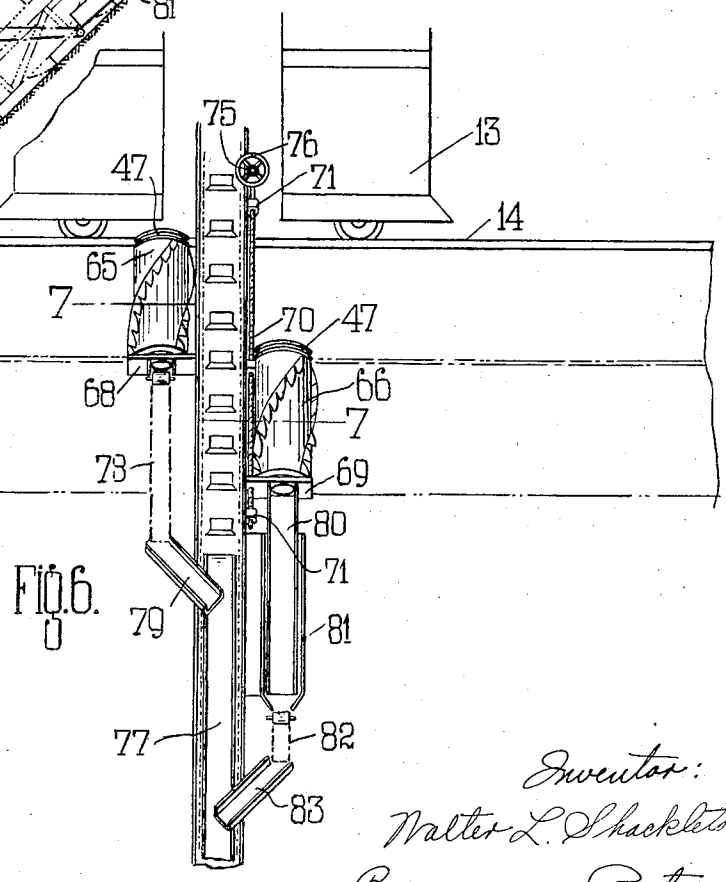


Fig. 6.



Inventor:
Walter L. Shackleton
By: Mason & Porter
Attorneys

Patented Mar. 14, 1939

2,150,848

UNITED STATES PATENT OFFICE

2,150,848

EXCAVATOR

Walter Lancelot Shackleton, Wallasey, England, assignor to Barker & Jones Limited, Wallasey, England, a British company

Application June 22, 1937, Serial No. 149,774
In Great Britain June 29, 1936

4 Claims. (Cl. 37—191)

The present invention relates to excavators of the type in which excavation is carried out substantially continuously as distinct from excavators in which the excavation is done intermittently.

One example of an excavator in which the excavation is carried out substantially continuously and to which the invention is particularly applicable is the bucket-ladder type of excavator which consists of an endless conveyor having spaced buckets, digging tools or the like mounted thereon, which are traversed over an area to be excavated and supported on a suitable beam or jib which is pivotally connected to a suitable carriage.

According to the present invention an excavator of the continuously excavating type including a supporting structure and driving gear, is provided with an auxiliary excavating apparatus, supported by or from said supporting structure and preferably driven by said driving gear, said auxiliary excavating apparatus being adapted to operate within the field of operation of the main excavator to effect the separate removal of part of the material within said field of operation of the main excavator.

The auxiliary excavating apparatus may be said to operate in advance of the main excavator insofar as material which would otherwise be removed by the main excavator is previously removed by the auxiliary excavating apparatus.

The auxiliary excavating apparatus may be adjustable relatively to the main excavator in order to alter the disposition of the field of operation of the auxiliary excavating apparatus in the field of operation of the main excavator. Where however, the apparatus is required for use in a locality in which the material to be removed lies within a substantially constant region, for instance, in a strata of substantially constant depth, the position of the auxiliary excavating apparatus may be fixed, but if desired, the auxiliary excavating apparatus may be capable of adjustment to vary the extent of its field of operation, for instance, by increasing the effective length of the auxiliary excavating apparatus.

The invention includes a method of mechanically excavating earth or the like in which the earth or like is separately and simultaneously removed from two contiguous strata and the removal of earth from one strata, preferably the upper, at any given time, taking place further into the working face than the other.

The invention is particularly valuable for removing the overburden in clay-pits.

A suitable known type of excavator used in clay-pits is the bucket-ladder type consisting of a beam or jib which is pivotally connected to a supporting carriage adapted to run along the edge of the working face of the pit, the jib being inclined downwardly, when the carriage runs along the upper margin of the working face, or upwardly, when the carriage is disposed at the bottom of the pit, at a suitable angle according to the slope of the working face and the angularity of the jib being adjustable for instance, by suitable rope and pulley tackle operated from a derrick mounted on said carriage. The jib is provided with an endless belt on which spaced buckets or diggers are mounted, the lower run of the belt, when the carriage runs along the upper margin of the working face, being usually moved in the upward direction, and having buckets upwardly directed thereon, whereby as the buckets move over the working face in an upward direction, and as the carriage is traversed along the face, material is brought up to the margin of the pit.

Usually in clay-pits the clay strata commences some distance below the surface of the ground and the material above the clay strata which is called the overburden and which is unsuitable for mixing in with the clay, must be removed, so that the buckets of the excavator do not engage and excavate same at the upper end of their upward movement.

The work of removing overburden in the past was usually done at least partially by manual digging and at considerable expense. The present invention enables the overburden to be removed during clay-excavation.

A suitable form of auxiliary excavating apparatus according to the invention consists of a suitable rotary cutter or cutting apparatus adapted to revolve about an axis parallel with the direction of movement of the buckets of the main excavator and the cutting edges of which are so spaced from their axis of rotation that in their position nearest the working surface, they project beyond the cutting surface or plane of the main excavator and preferably by a distance equal to at least one cut of the main excavator so that if the auxiliary excavator is located on one side of the main excavator and the apparatus moves in one direction with the auxiliary excavator leading, the auxiliary excavator will remove sufficient material to preclude the main excavator

from excavating such material on the return traverse. The auxiliary excavator may, for instance, be arranged to cut 2'' in advance, i. e., towards the working face, of the main excavator. When two auxiliary cutters are provided, one on each side of the jib the degree of advance of the auxiliary cutters beyond the cutting surface or plane of the main excavator may be less than one cut of the main excavator.

It will be appreciated that a single auxiliary excavator may be arranged on one side of the jib. Alternatively, however, and particularly in the case of a jib projecting upwardly from a carriage located at the bottom of the pit, two auxiliary cutters may be arranged, one on each side of the jib, for the sake of balance.

An auxiliary excavator or cutter may be constructed as a hollow drum having its axis parallel to the jib of the main excavator, and supported by the jib, the drum having openings in its surface with blades disposed on one side of such openings, whereby material excavated by the blades passes through the openings and into the drum. The blades and openings may be arranged in sets, each set extending helically along and around the drum and three or more such sets of blades and openings are preferably provided. If desired, a number of the lower blades may be adapted for detachable connection to the drum, so as to vary the effective depth of the auxiliary excavator.

The auxiliary excavator is driven from the main driving gear of the excavator by any suitable transmission gear. A suitable form of gear consists of a wire rope drive through pulleys, a substantially constant tension of the wire rope being obtained by the provision of a freely depending loop in the wire which supports a weighted pulley. The lower end of the drum may be provided with a converging conical end which may serve as an end bearing for the drum, and also as a discharge opening for the material excavated. The material excavated by the auxiliary excavator may be returned to the bottom of the pit by a suitable chute or conveyor means which may be supported partly or wholly by the jib or partly by the jib and partly by the derrick and such chute or conveyor means may be adjustable for the suitable direction of the excavated material into the pit bottom.

In a preferred arrangement, the material excavated by the auxiliary excavating apparatus is discharged on to a substantially horizontal or slightly downwardly inclined endless conveyor which discharges into a fairly steep chute and thence to a further downwardly inclined endless conveyor. One or both of said endless conveyors and if desired also the chute, may be adjustable as to slope and may be pivotally supported for instance at the upper end by the jib and may be supported at the lower end through a suitable pulley tackle from the derrick.

An alternative form of auxiliary excavator may consist of an endless belt supported from the jib to run substantially parallel with the main excavator belt and having spaced buckets thereon. The buckets of the auxiliary excavator may, for instance be disposed opposite to those of the main excavator, so as to move over the face of the pit in a downward direction. In this arrangement the cutting edges of the buckets of the auxiliary excavator would project in the direction of the working face beyond the surface or plane of movement of the cutting edges of the buckets of the main excavator.

According to a further feature of the invention a rotary cutting device, for instance of the hollow drum type described above, may be longitudinally displaceable but angularly fixed upon a shaft extending lengthwise of the jib, the cutter operating in advance of the main excavator for the removal of material at any part of the working face prior to excavation at that part by the main excavator. This arrangement may be employed for instance for the removal of gravel from a clay face and may be used either with or without an auxiliary excavator such as described above for the removal of overburden.

The invention is more particularly described with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic general arrangement view of one form of construction.

Figures 2 and 3 are perspective views of the auxiliary excavator.

Figure 4 is a side elevation of the auxiliary excavator.

Figure 5 is a diagrammatic side view of a second form of construction, the bottom end part of the apparatus being omitted.

Figure 6 is a diagrammatic front view corresponding to Figure 5 but with certain of the parts in slightly different positions.

Figure 7 is a sectional view taken on the line 7—7 of Figure 6.

Both forms of construction shown in the drawings illustrate the application of the invention to excavators of the bucket ladder type in which spaced buckets **10** are mounted on endless chains **11** which are supported by a beam **12** depending from a carrier **13** running along a track **14**. The angle of the beam **12** may be adjusted by means of a wire rope **15** running over pulleys **16**, **17** at the head of a jib **18** and connected at its end to a drum **19** driven through a suitable clutch mechanism by the prime mover of the excavator. The jib **18** is supported by a tie-rod **20** which is anchored to a cantilever structure **21** extending outwardly from the carriage, which cantilever structure **21** also supports a ballast contour **22**.

At their upper ends the chains **11** pass over sprockets (not shown) co-axial with the shaft **23** and the excavated material on leaving the buckets **10** at the upper end of their run is delivered by a chute **24** to trucks **25**.

According to the invention the main excavator is provided with an auxiliary excavator **26** operating within the field of operation of the main excavator.

Referring more particularly to Figures 2, 3 and 4, it will be seen that the auxiliary excavator consists of a drum having helically arranged openings **27** and helically arranged cutting blades or scoops **28** one for each opening. The material excavated by each blade **28** passes through the opening **27** and falls downwards through the drum and is discharged therefrom through the conical end **29**. In the construction illustrated there are three helical rows of openings and blades.

With the object of enabling the field of operation of the auxiliary excavator to be varied in depth a number of the lowermost blades, namely the four blades **28***a* are removable and the openings **27** can be closed by suitable blanks **30** so that only the remaining upper blades are left in operation, (Figure 3).

For the support of the drum by the beam **12** the drum itself is provided at its upper end with

a bearing spindle 32 and at its lower end with a conical bearing rim 33.

The spindle 32 is journalled in a bearing 34 supported from and adjustable relatively to the beam 12 by means of a screw and nut arrangement 35 whilst at its lower end the drum is supported through the conical bearing rim 33 by conical bearing rollers 36 mounted on a plate 37 which is adjustable by means of screws and nuts relatively to the beam 12.

In Figures 2 and 3 the element 12a is diagrammatically shown as representing a portion of extension of the beam 12.

The material excavated by the auxiliary excavator is discharged on to an approximately horizontal conveyor 40 thence into a chute 41 to an inclined conveyor 42 which delivers the excavated material to the bottom of the pit as shown at 43. The auxiliary excavator is driven from a pulley 45 by a wire rope 46 which engages a pulley 47 at the upper end of the drum 26 (see Figures 1 and 2). The pulley 47 is preferably conically surfaced where it receives the rope to assist the tightening of the rope on the pulley. The rope 46 includes a loop 48 in which is supported a weighted pulley 49 whereby the rope is constantly maintained under tension and whereby the effective length of the rope 46 is automatically adjusted for all working positions of the beam 12 and positions of the drum 26 relatively to the beam 12. The conveyor 40 is driven from a pulley 50 through a wire rope 51 which engages a pulley 52 at one end of the conveyor 40. The rope 51 includes a loop supporting a weighted pulley (not shown) as in the case of the rope 46. The conveyor 42 is driven from the shaft of the pulley 52 by means of a chain or wire rope 53.

Means not shown may be provided for adjusting the inclinations of the conveyors 40 and 42 and such means may consist of suitable wire rope and pulley arrangements depending from the jib 13. If desired, suitable means may be provided for adjusting the vertical disposition of the drum 26 for example the bearings 34 and 37 may be adjustable longitudinally of the beam 12.

It will be observed that in the condition of the excavator as illustrated in Figure 1 the buckets 10 of the main excavator are excavating along a line 60 whilst the auxiliary excavator is excavating along a line 61 parallel to the line 60 but disposed further into the face of the pit.

Figures 5, 6 and 7 illustrate a construction in which two auxiliary excavators 65 and 66 are employed, one on each side of the beam 12 and in which the lowermost auxiliary excavator 66 is adjustable longitudinally of the jib to vary the total depth of the field of operation of the auxiliary excavating plant. If desired, of course, the upper auxiliary excavator 65 could be adjustable or again both of the auxiliary excavators could be adjustable.

In the construction illustrated each of the auxiliary excavators is supported from the beam 12 by means of an auxiliary frame 68, 69. The auxiliary frame 69 is slidable longitudinally of the beam under the influence of a pair of longitudinally fixed threaded rods 70, supported in fixed bearings 71 on the beam. The rods 70 pass through screwed openings in the auxiliary frame 69 and are provided at their upper ends with bevel gears 73 which engage with co-operating bevel gears 74 mounted on a shaft 75 which is rotated by a hand wheel 76.

The main conveyor for receiving the material excavated by both auxiliary excavators is indicated at 77.

The auxiliary excavator 65 discharges to an approximately horizontal conveyor 78 which discharges into a chute 79, the end of which is disposed above the main conveyor 77. The auxiliary excavator 66 discharges into a chute formed of two parts 80 and 81 of which the part 81 is fixed and the part 80 longitudinally movable with the auxiliary excavator 66. The lower end of the part 80 lies within the part 81.

In Figure 5 the auxiliary excavator 66 is shown in a raised position with the chute part 80 largely withdrawn from the part 81 whilst in Figure 6 the auxiliary excavator 66 is in a lower position with the chute part 80 largely overlapping the chute part 81.

The chute part 81 discharges to an approximately horizontal conveyor 82 which leads to a chute 83, the lower end of which is disposed above the main conveyor 77. The conveyors are suitably driven by wire ropes and pulleys substantially as illustrated in Figure 1.

The auxiliary frame 69 is provided on one side with rollers 90 secured thereto and guided in a guide 91 secured to the beam 12, whilst at its other side the guide 92 on the auxiliary frame 69 engages rollers 93 mounted on the beam 12.

The driving rope 93 for the auxiliary excavator 66 passes over guide rollers 94 on its way to and from the pulley 47 of the excavator drum. These guide rollers 94 are fixed to the auxiliary frame 69 and thus their position in relation to the pulley 47 and thus the correct guidance of the rope 93 on to the pulley is maintained at all positions of the excavator 66. In Figure 5 the auxiliary excavator 66 is shown in its uppermost position and the rollers 94 and rope 93 are shown in full lines whilst the positions of the rollers 94 and rope 93 corresponding to the lowermost position of the auxiliary excavator as shown in Figure 6, are shown in dotted lines in Figure 5.

In Figure 7 the chains of the main excavator are indicated at 94 and a bucket of the main excavator at 95. The upper runs of the chains are not shown but these are guided on successive pairs of rollers 96. The lower runs of the chains are guided between flanges 97 and 98 on the main frame.

I declare that what I claim is:

1. In an excavator of the continuously excavating type including a supporting structure, the provision of an auxiliary excavating apparatus adapted to operate within the field of operation of the main excavator comprising a rotatable drum supported from said supporting structure and having openings therein, a cutting blade adjacent each opening adapted to discharge excavated material into the drum through the opening at least some of said blades being detachable and the corrsponding openings closable and means for rotating said drum.

2. In an excavator of the bucket ladder type including a supporting structure, the provision of excavating apparatus including at least two excavator drums supported from said supporting structure, said drums having openings therein and being adapted to operate in contiguous fields and at least one of the drums adapted for axial adjustment to enable the drums to operate in overlapping fields whereby the combined field of operation of said drums can be varied in extent, a cutting blade adjacent each opening and adapted to discharge excavated material into the

drums through the openings, and means for rotating said drums.

3. In an excavator of the bucket ladder type including a supporting structure, an auxiliary excavator comprising a rotatable drum supported from said supporting structure with its axis of rotation approximately parallel to the plane of excavation of the main excavator, said drum having openings in its curved wall with a cutting blade adjacent each opening, whereby material is excavated by the blades and passed into the drum through said openings, said drum having a discharge outlet at its lower end for the discharge of excavated material from the drum.

4. In an excavator of the bucket ladder type including a supporting structure, a pair of auxiliary excavator drums arranged in parallel relationship and adapted to operate in contiguous or overlapping fields, each of said excavator drums comprising a rotatable drum supported from said supporting structure with its axis of rotation approximately parallel to the plane of excavation of the main excavator, each of said rotatable drums having openings therein with an external cutting blade adjacent each opening, whereby material excavated is discharged into the drum through the openings.

WALTER LANCELOT SHACKLETON.