

Nov. 2, 1948.

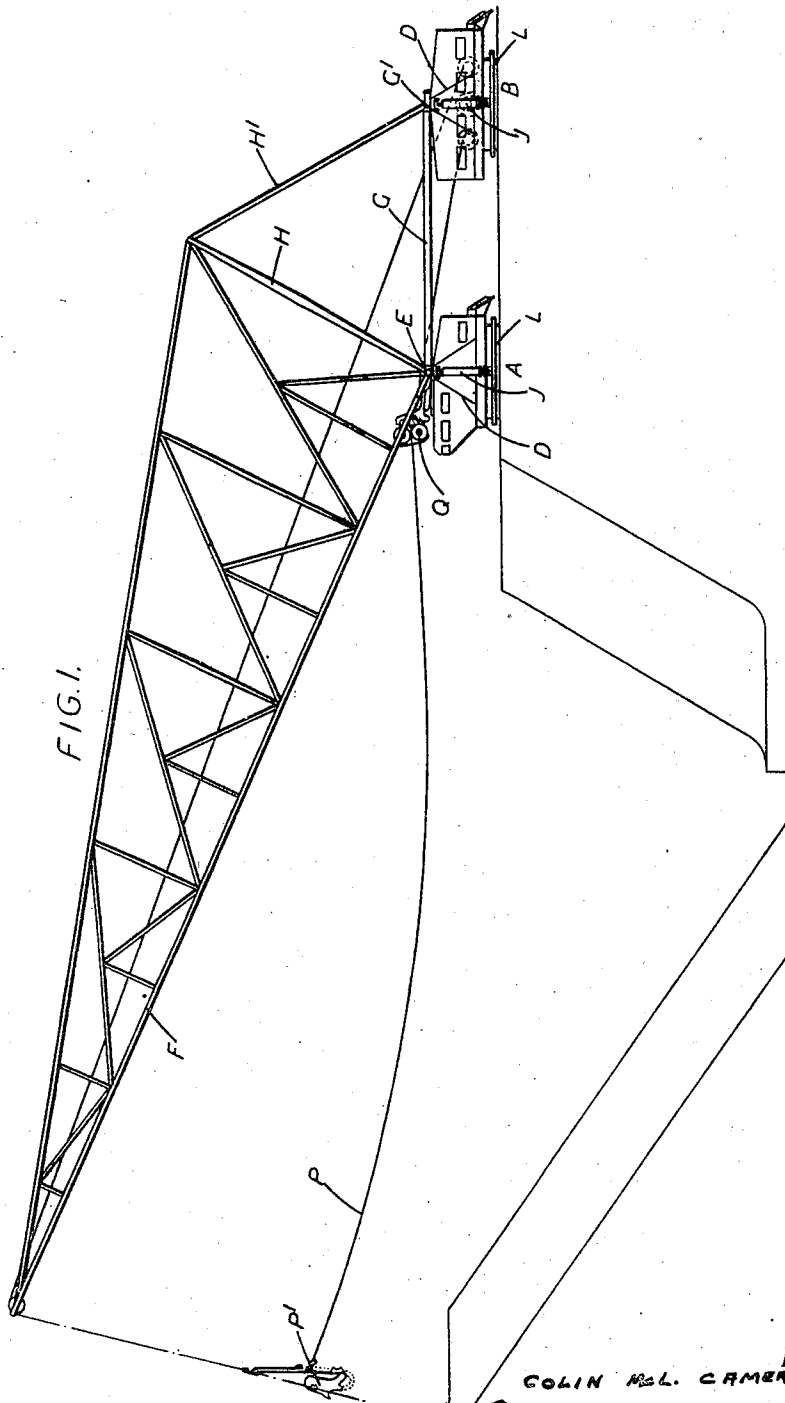
C. M^cL. CAMERON

2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 1



Inventor
COLIN M^cL. CAMERON

By
Querry Holcombe & Bai
Attorney

Nov. 2, 1948.

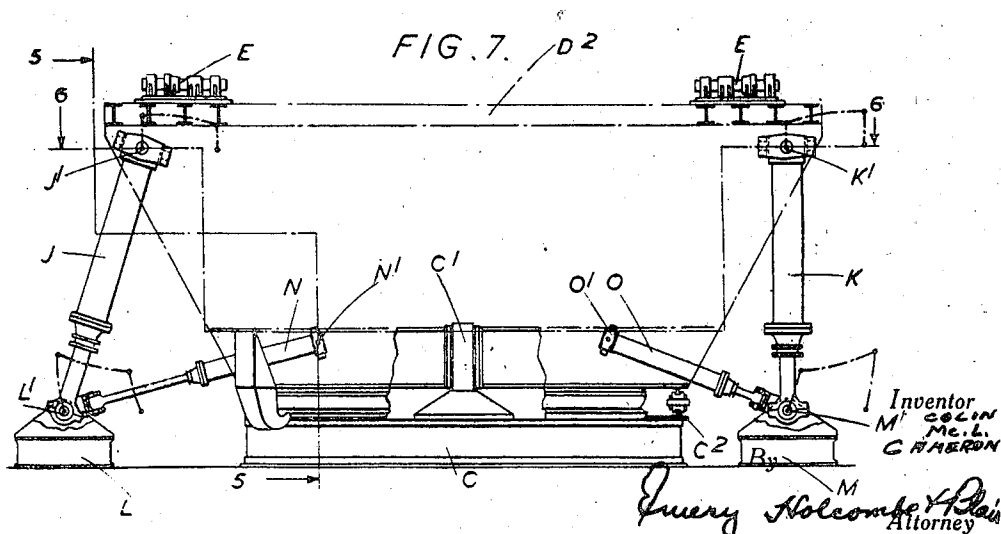
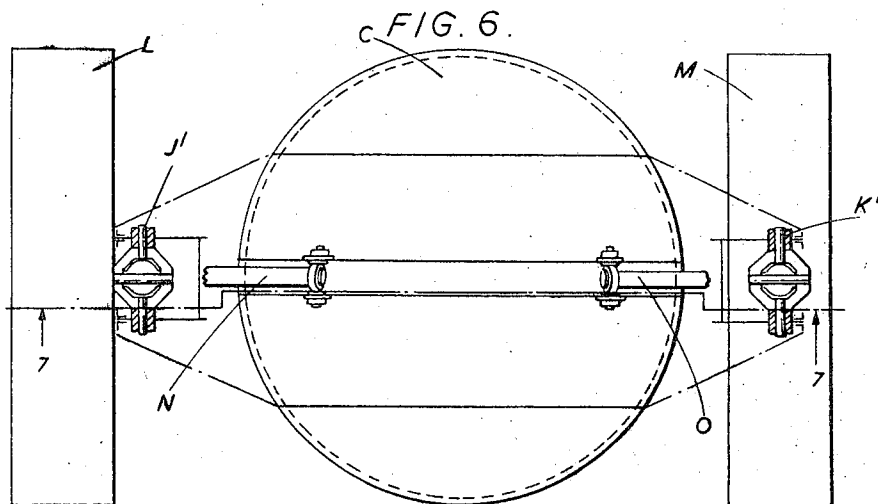
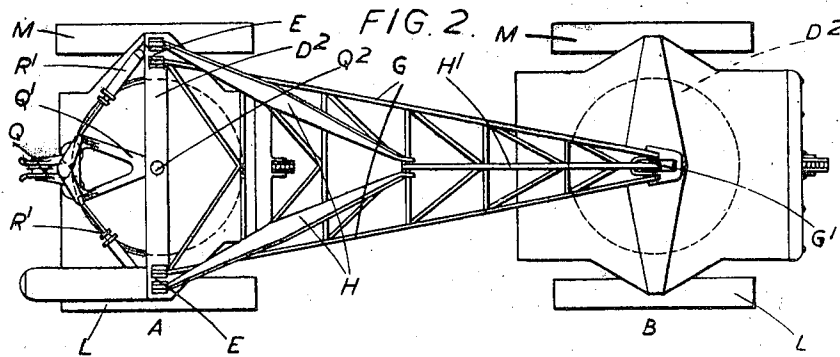
C. McL. CAMERON

2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 2



Nov. 2, 1948.

C. McL. CAMERON
EXCAVATING MACHINE

2,452,632

Filed July 24, 1945

7 Sheets-Sheet 3

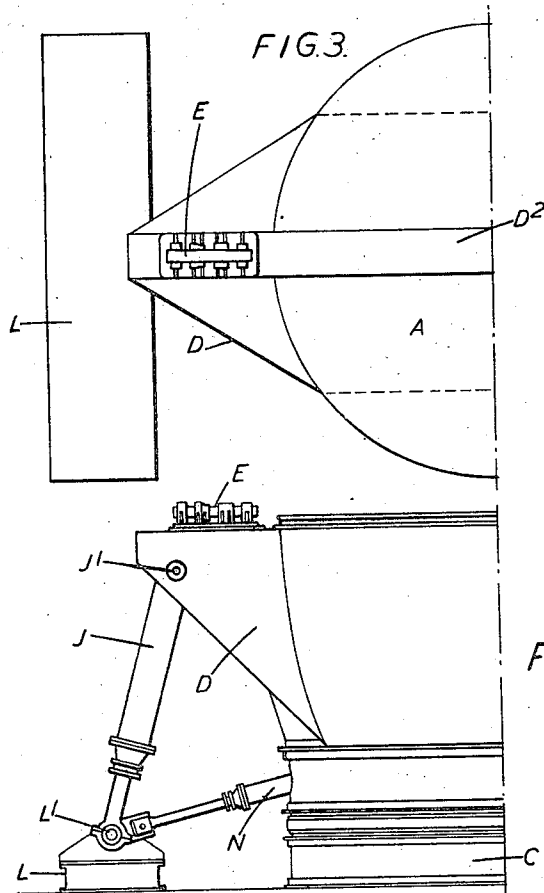
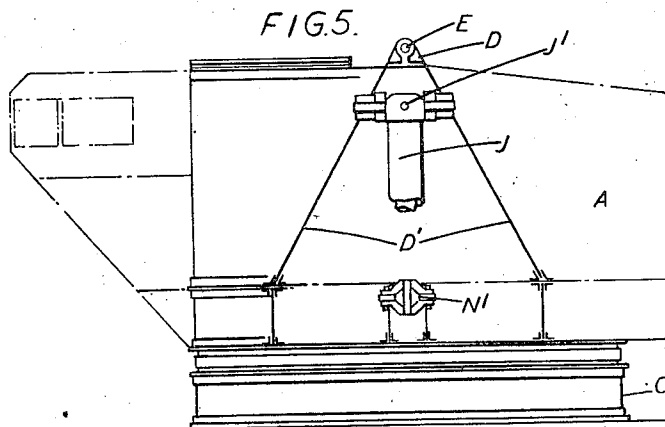


FIG. 4.



Inventor
COLIN McL CAMERON

By
Emery Holcombe & Blair
Attorney

Nov. 2, 1948.

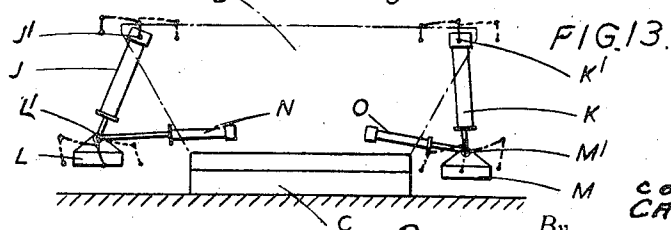
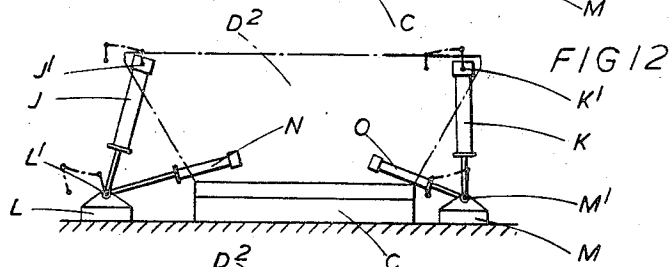
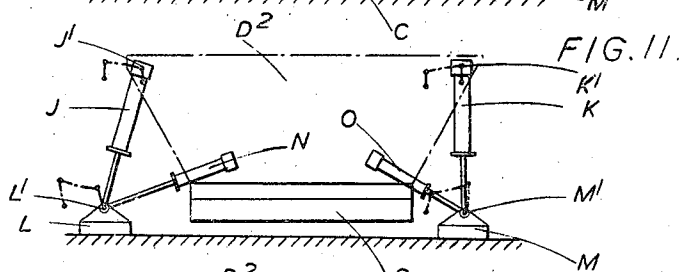
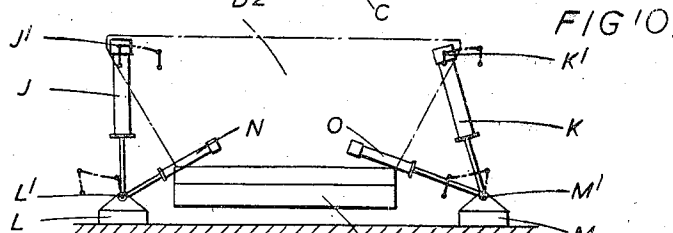
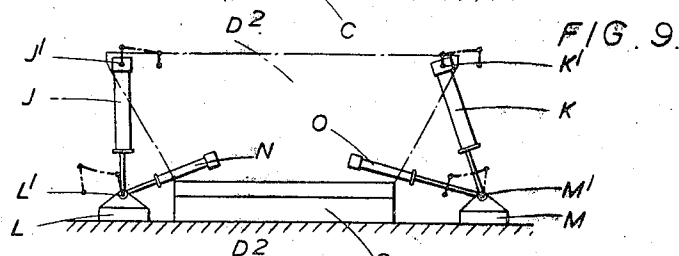
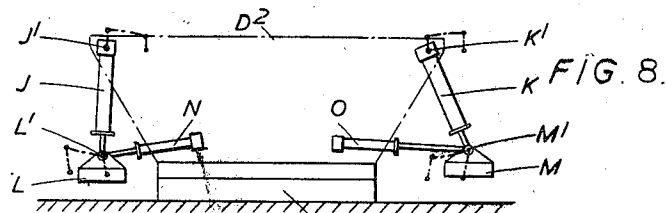
C. McL. CAMERON

2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 4



Inventor
COLIN McL.
CAMERON

By
Ernest Holcombe Blair
Attorney

Nov. 2, 1948.

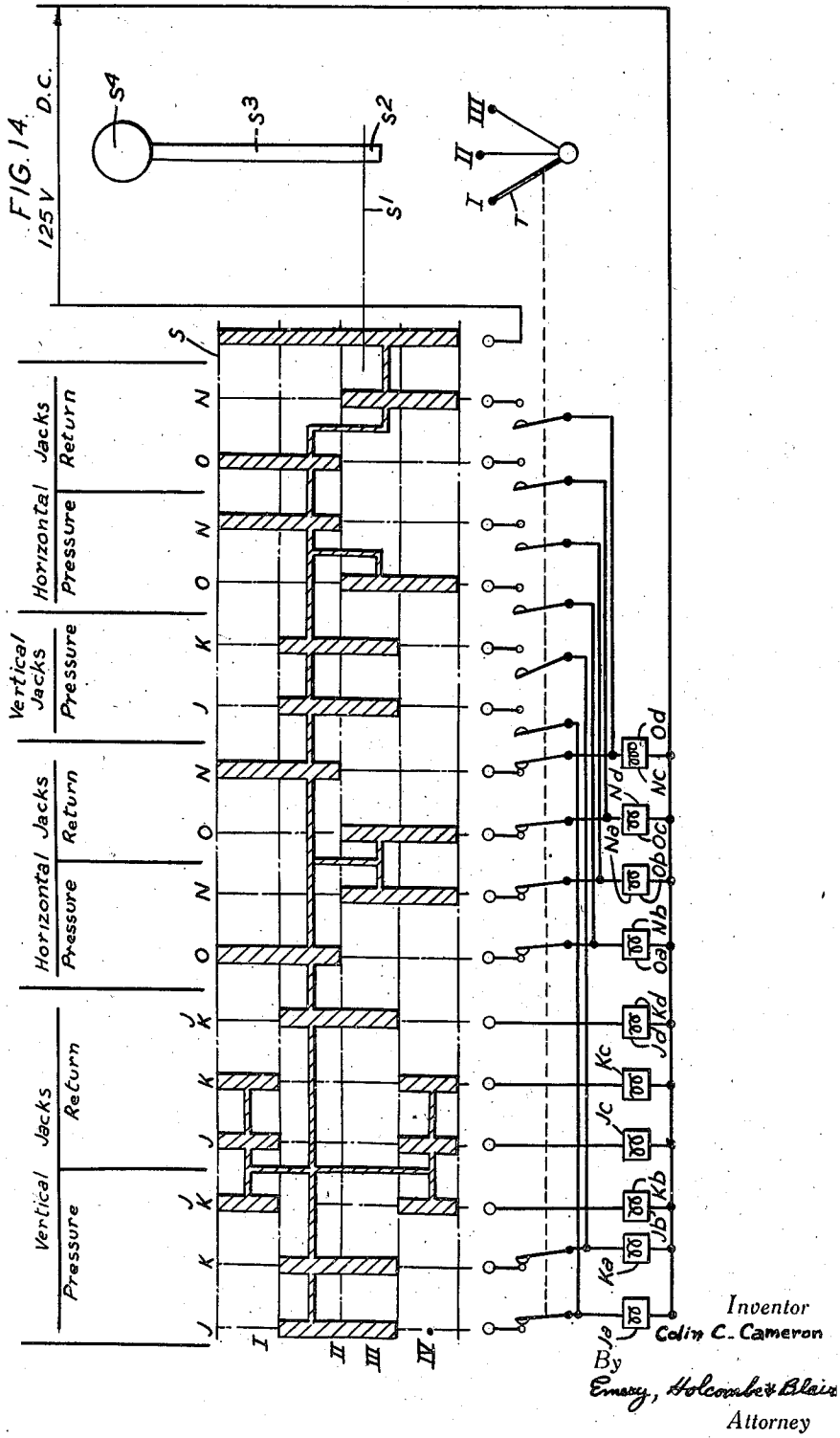
C. McL. CAMERON

2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 5



Nov. 2, 1948.

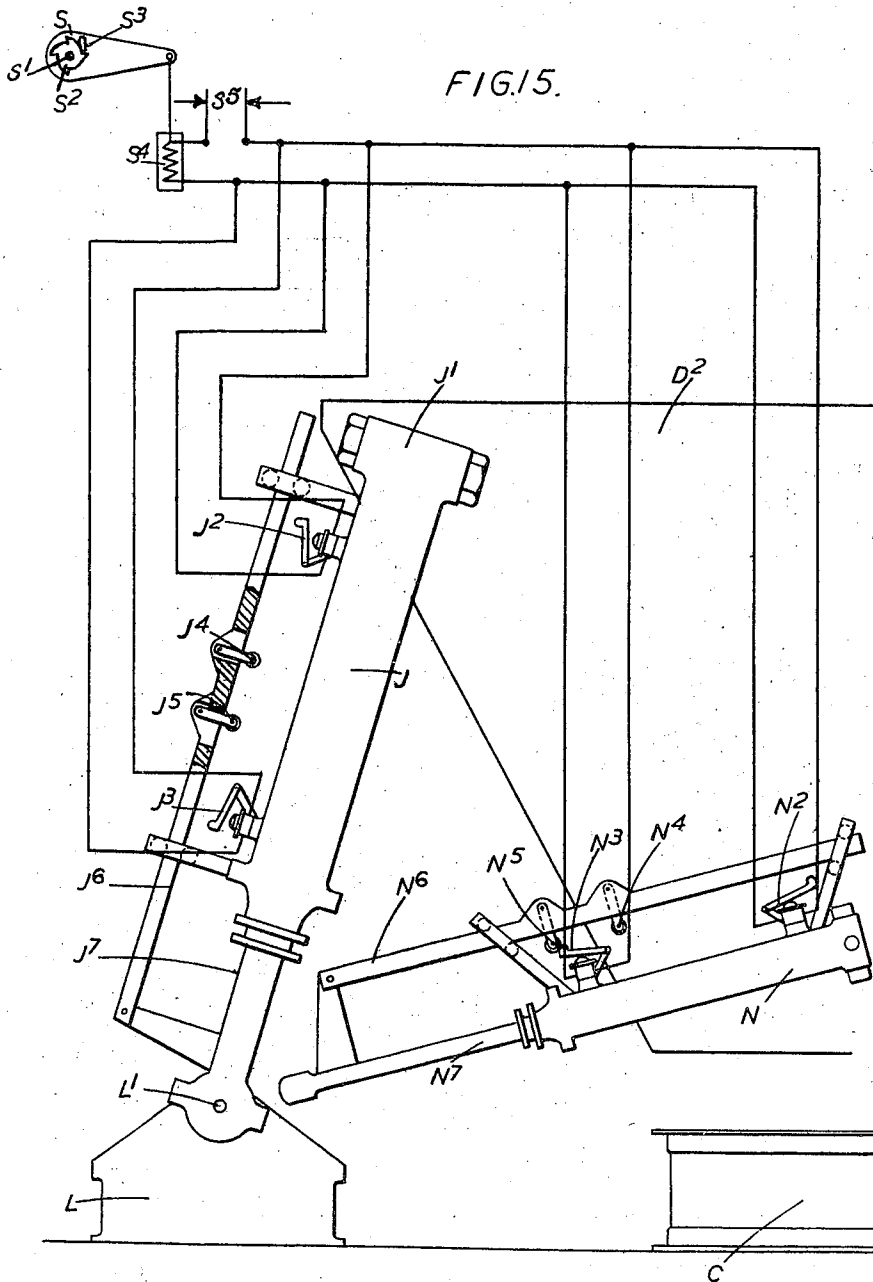
C. McL. CAMERON

2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 6



Inventor
COLIN McL. CAMERON

By
Emery Holcombe & Poirer
Attorney

Nov. 2, 1948.

C. McL. CAMERON

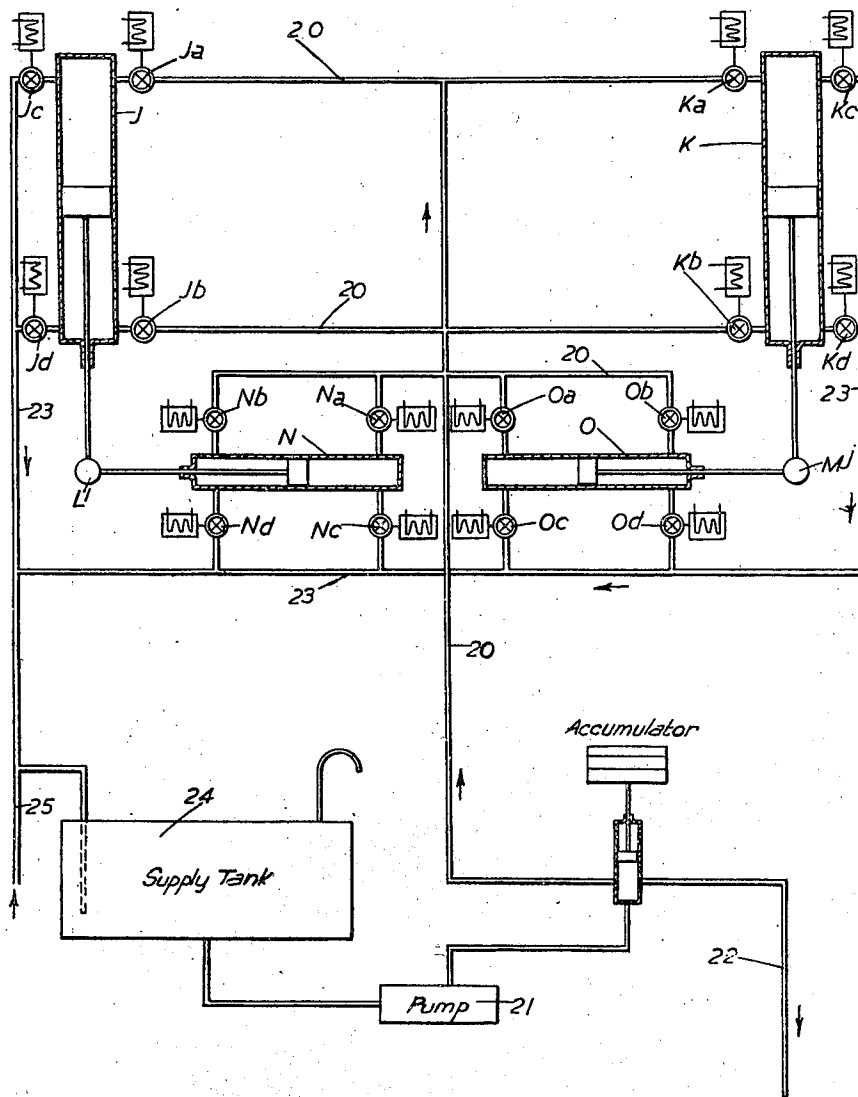
2,452,632

EXCAVATING MACHINE

Filed July 24, 1945

7 Sheets-Sheet 7

FIG. 16.



Inventor
COLIN McL. CAMERON
By
Querry Holcomb & Davis
Attorney

UNITED STATES PATENT OFFICE

2,452,632

EXCAVATING MACHINE

Colin McLeod Cameron, Ipswich, England, assignor to Ransomes & Rapier Limited, Ipswich, England, a company of Great Britain

Application July 24, 1945, Serial No. 606,827
In Great Britain April 13, 1944

5 Claims. (Cl. 37—116)

1

This invention relates to excavating machines of the drag-line type and has for its object to increase the range of operation of such a machine so as to enable it to remove a greater depth of overburden than has previously been economically practicable.

According to this invention the improved machine has in combination two separate base structures situated one in front of the other and spaced apart in the longitudinal direction of the machine, each of these structures comprising a base member preferably circular, a center post, a circular roller path and an upper frame rotatable on the base, a boom pivoted on the upper frame of the forward base structure to which are also connected the forward members of an A frame and the ends of the parts of a horizontal member, connections between the upper frame of the rear base structure and the rear members of the A frame and the rear ends of the parts of the said horizontal member, and means for moving each base and rotating the parts thereon for the purpose of moving the whole machine and slewing the boom. Conveniently the main hoisting and dragging machinery and a main electrical generating set and equipment are mounted on the rear base structure.

To enable each base and the whole machine to be moved each base including the parts erected thereon is provided at its opposite sides with plate-like members which rest on the ground and serve as "feet" structures being connected to the upper frame on the base through hydraulic jacks arranged and operative so as to impart to the whole a lift and a movement in the horizontal direction. By suitably manipulating the jacks a sideways lift-and-step or walking movement can be imparted to either or both base structures for slewing the boom or traversing the whole machine.

With this improved construction of excavating machine it is possible to employ a boom of much greater length than hitherto with the result that a deeper cut or excavation can be effected since the spoil or overburden can be deposited further away and in greater quantity opposite to the machine.

During digging, the vertical jacks on the front unit may be used to distribute some of the weight to the feet, and the amount of load the jacks should carry under this condition may be controlled through a pre-set pressure breaking switch of usual design in the circuit of a solenoid valve controlling the supply of pressure to the hydraulic jacks.

2

If the longitudinal centre line of the machine is maintained approximately at right angles to the direction of the cut and spoil bank there may be no need to slew the boom or rotate the machine about the centre of either of the base structures. The necessary movement of the whole machine along the side of the cut is then effected by means of "feet" structures and the hydraulic jacks.

The accompanying drawings illustrate by way of example a construction of the improved drag-line excavator. In these drawings,

Figure 1 is a side elevation of the whole machine.

Figure 2 is a plan with the boom omitted.

Figure 3 is a half plan of the front base structure on an enlarged scale and with the boom and associated framing omitted.

Figure 4 is a half front elevation of the same base structure on a similarly enlarged scale.

Figure 5 is a sectional side elevation on a similar scale of the front base structure and on the line 5—5 in Figure 7.

Figure 6 is a sectional plan on the line 6—6 in Figure 7.

Figure 7 is a transverse sectional elevation on the line 7—7 in Figure 6.

Figures 8 to 13 are diagrammatic views illustrating the successive movements which are caused to take place when performing the lifting and walking by which each base structure is moved.

Figure 14 is a diagram showing a development of a drum type master controller such as may be employed and by rotation of which the successive walking movements are caused to take place.

Figure 15 is a diagram illustrating more particularly the arrangement of the limit switches for the electric circuits controlling the valves which determine the operations of the hydraulic jacks.

Figure 16 is another diagram in which is indicated the layout of the hydraulic piping system.

As seen in Figure 1 the whole machine is carried on two structures which may conveniently be referred to as the front base structure A and the rear base structure B. Each of these structures comprises a circular base member C on which is a turntable with centre post C¹ and roller track C², see Figure 7, and on this table is erected a framework D which as seen from the side of the machine has a generally triangular formation with the apex D¹ directed upwardly, see Figure 5. As may be seen in Figure 2 this apex forms a ridge D² when extends diametrically on the turntable and runs in the transverse direction

with respect to the longitudinal centre line of the whole machine. On this ridge on the front base structure A are mounted the horizontal pivots E of the heel of the boom F and to these points are also connected the forward ends of the side members G of a horizontally extending frame which runs rearwardly to the rear base and turntable structure B where these members come together and are connected through a gimbal or like joint G¹ to the centre of the apex ridge D² of the framework on that base. This connection G¹ is necessarily a form of universal joint in order to permit the rear structure B to adjust itself relatively to the front structure A according to the nature of the ground. On the horizontal member G is erected an A frame with its forward members H connected at E to the apex ridge D² of the front structure A and its rear member H¹ attached through the joint G¹ to the ridge D² of the rear structure B. On this rear structure B and in suitable positions there are mounted the mechanisms for hoisting and operating the draw bucket together with an electric generating set or other source of power and necessary accessories. By placing these weights on the rear structure they serve largely as a counterbalance operative about the forward structure A for the boom and bucket operations.

Two hydraulic jacks J and K are respectively connected by universal joints J¹ K¹ to the opposite ends of the apex ridge beam D² of each structure A and B and these jacks extend to two similar foot structures L and M which lie in a fore and aft direction on opposite sides of the bases. Each foot is built up of plates and the jacks are connected to them by joints L¹ M¹ and the feet on each side of a base are substantially parallel. While as seen in the drawings the jacks J and K are directed downwards to the feet L and M and by means of these jacks each base and all that is carried thereon can be lifted, a lateral movement can be imparted by the action of hydraulic jacks N and O. These are respectively connected by joints N¹ and O¹ to the turntable framework and extend laterally in a horizontal direction to the feet L and M to which they are connected at L¹ and M¹.

The successive movements imparted to the feet L and M of each base structure by the actions of the hydraulic jacks J and K, and N and O, are conveniently controlled by electric means and caused to take place in proper sequence, according to the direction in which the machine as a whole or each base is to be moved, but other systems for control may be used. As an instance, by means of a master controller of the drum type adapted to be rotated by the operation through ratchet mechanism of an impulse solenoid controlled and actuated by limit switches, there will be closed in proper sequence a series of switches which will bring about the actuation of solenoid-operated hydraulic valves which separately control the supply of pressure liquid to the several jacks. The switches of these valves can be set by suitable means for bringing about walking to the right or left or so as to place them in neutral.

Some degree of side cutting may be effected by carrying the drag-line P from the bucket P¹ through a fairlead Q on the end of an arm Q¹ pivoted at Q² on the apex or ridge beam D² of the front structure A. By means of two hydraulic jacks R and R¹ this arm Q¹ can be swung to right or left and the direction in which the bucket P¹ is dragged can be altered.

The successive movements which occur are shown diagrammatically in Figures 8 to 13. In Figure 8 both feet L and M are seen raised off the ground but in positions such that the foot L is nearer to the base C than is the foot M. In Figure 9 both feet have been lowered so that each rests on the ground but the base C still rests also on the ground. The feet have been brought in this position by the downward thrust on them exerted by the vertical jacks J and K. In Figure 10 the base and the structure above has been raised off the ground by the lift exerted by the jacks J and K. Up to this stage the horizontal jacks N and O have not been operative except to maintain the feet L and M at their respective distances from the sides of the base structure in which they were at the start of this operation. Now, as seen in Figure 11 the jacks N and O come into operation and while the jacks J and K hold the base clear of the ground, the jacks N and O impart a horizontal movement to the whole structure this movement being from right to left as seen in the drawings. This brings the foot M in towards the base C and pushes the foot L away from this base. The jacks J and K now lower the base until it rests once more on the ground as shown in Figure 12 and the structure has now completed the taking of one step to the right. Finally the jacks J and K raise the feet L and M off the ground as seen in Figure 13 and the jacks N and O will keep them in the lateral positions in which they then are until it is desired to impart some further movement to the structure. If another step is to be taken in the same direction the feet are moved horizontally by the jacks N and O until they occupy the positions in which they are shown in Figure 8. The sequence of operations as just described and shown in the figures is then repeated and the structure is thereby caused to take another step to the right. If, however, it is desired to move the structure back again and make it take a step to the left, then the procedure described will be reversed. The feet will be first lowered by the jacks J and K until they rest on the ground as seen in Figure 12 and then the jacks J and K will lift the base C as in Figure 11. Next the horizontal jacks N and O will operate and move the structure laterally, but this time from right to left so as to bring it into the position seen in Figure 10. The base C is now lowered on to the ground as in Figure 9 and finally the feet L and M are raised.

It will be appreciated that with this machine the main ground reactions will be evenly distributed about the centre of pressure of the circular or like bases. These base structures may be spaced apart at a distance suited to the duty of the machine and the weights of the various components.

Figures 14, 15 and 16 illustrate by way of example one means for controlling and bringing about the walking operations in proper sequence as set out in Figures 8 to 13.

Referring first to Figure 16, there are there indicated the vertical hydraulic jacks J and K and the horizontal jacks N and O as disposed on one of the structures A or B with the connections of these jacks at L¹ and M¹ to the feet. The jacks J and N are here assumed to be on what may be regarded as the left side of the structure, while the jacks K and O are on the right side. Except for a part specially mentioned hereunder, the present diagram applies equally to each of the

structures A and B and the arrangement now described will bring about similar walking operations in both of these structures.

Each jack is provided with four solenoid-operated hydraulic valves. Thus the jack J has the valves *Ja*, *Jb* controlling the supply of pressure liquid respectively to the top and bottom of the jack cylinder so as to push down or raise the foot L to which this jack is connected at *L*¹. The function of the valves *Jc*, *Jd* is to relieve the pressure respectively from the top and bottom of the jack cylinder. The jack K has similar valves *Ka*, *Kb* for admitting pressure liquid and release valves *Kc*, *Kd*. In the same way the horizontal jack N has valves *Na*, *Nb* for admitting pressure liquid to the ends of the jack cylinder and release valves *Nc*, *Nd*, and the other horizontal jack O has similarly operating valves *Oa*, *Ob*, *Oc* and *Od*. The piping 20 which runs to these several pressure controlling valves is supplied with pressure liquid from a pump 21 and a connection at 22 extends to the second structure and the jacks thereon. All the pressure release valves connect with piping 23 which runs to a supply tank 24 from which the liquid is drawn by the pump 21. There is a return pipe 25 from the jacks on the second structure.

Referring now to Figure 15, this shows one vertical jack J and the horizontal jack N which cooperates with it in moving the foot L. Each of these jacks is provided with limit switches which are actuated automatically to cut off the supply of pressure liquid when the piston of the jack has travelled through the distance necessary to give the required movement to the foot L. The automatically opening jack J has the limit switches *J*², *J*³ which are simple push button switches with a pivoted actuating lever over the top of the push button. The switch actuating levers are operated by striking gear comprising striking levers *J*⁴, *J*⁵ having rollers at their free ends. The striking levers *J*⁴, *J*⁵ are mounted on a rod *J*⁶ which can reciprocate in guides and is connected to and moves with the piston rod *J*⁷ of the jack. Each striking lever *J*⁴, *J*⁵ is pivoted by one end to the rod *J*⁶ so that it can be collapsed in one direction, but is prevented by a stop from being collapsed in the other direction. Thus when the piston rod *J*⁷ is moving outwardly and is about to reach its limiting position the striking lever *J*⁵ bears against its stop and rides over and momentarily closes the limit switch *J*³. On the other hand, when the piston rod *J*⁷ is moving inwardly from its limiting position the striking lever *J*⁵ will be collapsed in a clockwise direction, as shown in the drawing, by the actuating lever of the switch *J*³ and will not operate the switch. The jack N has similar switches *N*², *N*³ actuated by striker gear *N*⁴, *N*⁵ on a rod *N*⁶ connected to the piston rod *N*⁷. In each case the current controlled by these several switches is that running to the solenoids which operate the valves admitting the pressure liquid to the jack cylinders. The arrangement is such that when the piston of the jack has reached the limit point in its movement in one direction no further movement in that direction can take place as the pressure supply which caused the movement is cut off, but when movement in the opposite direction is required this can take place as current is then free to flow to the solenoids by which the necessary pressure admitting valve is operated.

Turning now to Figure 14, this shows the dispositions of the contacts on the drum-type con-

troller and the circuits associated with these contacts. The controller S of which this is a development is carried on a spindle *S*¹ on which is a ratchet wheel *S*², and a ratchet *S*³ is actuated by an impulse solenoid *S*⁴ when the controller will be turned step-by-step into four successive positions. The impulse solenoid *S*⁴ is energised whenever a limit switch on one of the jacks is actuated. The electrical connections between the solenoid *S*⁴, the limit switches, and the power supply *S*⁵ are shown in Figure 15. A hand lever T simultaneously operates a series of switches in the controller circuits by means of a common pull-rod, indicated by a dotted line in the drawing, so as to determine, according to the direction in which walking is to be performed, which circuits are to be operative on the solenoids of the valves of the jacks so that the proper sequence of movements may be carried out. In Figure 14 the solenoid-operated valves which are there indicated correspond as marked with those valves as they appear in Figure 16 except that for convenience in Figure 14 in some cases only one solenoid valve is shown when really there are two which are simultaneously actuated and accordingly two reference letters are placed beside such valves. The hatched parts of the developed controller drum S represent the contacts, and the electrical connections between them are indicated by the hatched double lines interconnecting the hatched parts.

The successive rotational positions of the controller are indicated as I, II, III, and IV. When the controller is in position I the solenoids operating the valves *Nb*, *Nc*, *Oa*, *Od*, *Jb*, *Jc*, *Kb* and *Kc* will be connected to the power supply through the respective controller contacts and those switches which are closed when the hand lever T is in its position I. Thus the jacks will be caused to operate so as to perform the movements necessary for the parts to pass from the positions in which they are shown in Figure 13 to the positions in which they are represented in Figure 8. The transition from the positions of the parts as seen in Figure 8 to the positions in which they are shown in Figure 9 and thence to the positions indicated in Figure 10 takes place when the controller has been turned into the position II. When further turned into the position III the parts move into the places shown in Figure 11. The next position IV of the controller brings the mechanisms into and through the positions shown in Figure 12 so that finally the mechanisms assume the positions shown in Figure 13. All these successive movements will take place in the reverse order to effect walking in the opposite direction if the hand lever T is moved from the position I to position III thereby opening those switches that were closed, and closing those that were open when the lever T was in the position I. In this manner certain of the circuits are changed over so that continued rotation of the controller will alter the sequence of operations. The hand lever T may be set in the intermediate position II when the parts will be locked in the positions which they then occupy as when the apparatus is set in the place where drag-line work is to commence.

In place of using hydraulic jacks and "feet" plates as described above for the purpose of moving each base structure and thus the whole machine, there may be provided and used for this purpose walking mechanism such as that covered by United States Patent No. 2,259,199, in the name of the present applicant and another, and described in that patent specification.

What I claim as my invention and desire to secure by Letters Patent is:

1. An excavating machine of the drag-line type provided with a drag-line bucket and comprising in combination two separate base structures each adapted to rest on the ground and situated one in front of the other and spaced apart in the longitudinal direction of the machine each of these structures comprising a base member, a centre post, a circular roller path on the base member and an upper frame rotatable about the centre post on this path on the base, a boom having its heel connected to the upper part of the front base structure, an A frame erected on the said two base structures with the forward end of the horizontal member of this frame connected to the said front base structure, a connection including a universal joint between the rear end of the horizontal member of the said A frame and the top of the upper frame of the said rear base structure, a connection between the boom and the apex of the said A frame, means for individually moving each base structure over the ground, and mechanism disposed on the said rear base structure for controlling the operation of the drag-line bucket.

2. An excavating machine of the drag-line type comprising in combination the parts as set out in claim 1 and wherein the means for individually moving each of the said two base structures comprises "feet" connected by hydraulic jacks to the upper frame of the structure with means for causing the jacks to raise the base structure on its "feet" and impart to it a transverse "walking" movement.

3. An excavating machine of the drag-line type provided with a drag-line bucket and comprising in combination two separate base structures each adapted to rest on the ground and situated one in front of the other and spaced apart in the longitudinal direction of the whole machine each of these structures comprising a base member, a centre post, a circular roller path on the base

member and an upper frame rotatable about the centre post on this path on the base, the upper frame having a generally triangular formation with the apex uppermost and running as a ridge transversely across the base, a boom having its heel connected to the ridge of the said upper frame on the forward base structure, an A frame erected on the said two base structures with the forward end of the horizontal member of this frame connected to the ridge of the said upper frame on the front base structure, a connection including a universal joint between the rear end of the horizontal member of the said A frame and the ridge of the said upper frame on the rear base structure, a connection between the head of the boom and the apex of the said A frame, means for moving each base structure over the ground, and mechanism disposed on the said rear base structure for controlling the operation of the drag-line bucket.

4. An excavating machine of the drag-line type comprising in combination the parts as set out in claim 1 and wherein the means for individually moving each of the said two base structures comprises on each of the opposite sides of said two base structures a "foot" structure which is connected to the upper frame of the base structure and operated by two hydraulic jacks respectively directed downwardly and horizontally.

5. An excavating machine of the drag-line type comprising in combination the parts as set out in claim 1 and wherein a drag-line is carried through a fairlead mounted on one end of an arm whose other end is pivotally connected to the upper frame of the said front base structure, and two hydraulic jacks extending respectively between the free end of the said pivoted arm and the framing of the structure on opposite sides of this arm and operative to swing the arm to one side or the other.

COLIN McLEOD CAMERON.

No references cited.